HC 199W .

In memory
of
Dr. Michael J. Gavin
and
Mrs. Ellen T. Gavin

Hilda T. Gavin

Case 76.
Shelf D.
Book 14-

Digitized by the Internet Archive
in 2025

https://archive.org/details/dictionaryofprac0000chri

DICTIONARY

OF

PRACTICAL SURGERY

A—L

DICTIONARY

OF

PRACTICAL SURGERY

BY

VARIOUS BRITISH HOSPITAL SURGEONS

EDITED BY

CHRISTOPHER HEATH, F.R.C.S.

HOLME PROFESSOR OF CLINICAL SURGERY IN UNIVERSITY COLLEGE, LONDON
SURGEON TO UNIVERSITY COLLEGE HOSPITAL; MEMBER OF THE
COUNCIL AND COURT OF EXAMINERS OF THE ROYAL
COLLEGE OF SURGEONS OF ENGLAND

VOL. I.

ABDOMEN—LYMPH-SCROTUM

BOSTON MEDICAL LIBRARY
IN THE
FRANCIS A. COUNTWAY
LIBRARY OF MEDICINE

PHILADELPHIA:
J. B. LIPPINCOTT COMPANY.
1886.

PREFACE

The Dictionary of Practical Surgery will, it is hoped, supply a want in the library of the busy practitioner, who necessarily often meets with cases of surgical disease or injury on which he desires to have immediate information as to diagnosis and treatment. With the view of assisting him, as far as is possible for a book to do so, in arriving at a correct diagnosis (on which suitable treatment must of course depend), a series of articles on the diagnosis of the injuries and diseases of the several regions of the body has been introduced, as well as general articles on Deafness, the Eye, Skin Diseases, &c. The surgical affections will be found fully described under their proper names, in alphabetical order; or when it has been found more convenient to group together a series of diseases of one organ—as, *e.g.*, of the Breast—cross-references have been given, the name of the separate article referred to being printed in small capitals.

The subjects are treated of, so far as is practicable, in the following order:—1, Cause; 2, Pathology; 3, Symptoms and Diagnosis; 4, Treatment; 5, Prognosis. Each writer has signed his articles, and is responsible for the statements contained in them; but the Editor has, of course, exercised a general supervision, and has endeavoured to prevent the promulgation of crude theories, or the inculcation of doubtful practices. At the same time, he has not attempted to reconcile the views of surgeons who may happen to differ on points of practice; nor does he endorse every statement put forth by the various writers. It was impossible to illustrate the Dictionary, both on account of the extra space which would have been occupied, and also on account of the time necessary for the production of original woodcuts. The aim of the Editor has been to produce a com-

pendium of the practice of British Surgery of the present day, and, as only two years will have elapsed between the first planning of the Dictionary and its publication, that object will have been fairly attained.

At the end of the second volume will be found a General Index of Subjects, which will, it is hoped, greatly facilitate reference to the several articles bearing on any special subject, and also an Index of Authors, giving the contributions of each. The Editor has to thank these gentlemen for their valuable contributions and for the promptitude with which they have completed their labours.

The Editor has also to offer his best thanks to Mr. W. Johnson Smith, who has acted as Sub-editor of the whole work; and to Dr. Robert Liveing and Mr. John Tweedy, who have respectively supervised the articles on Diseases of the Skin and Affections of the Eye, for their valuable co-operation.

Cavendish Square: *January* 1886

DICTIONARY

OF

PRACTICAL SURGERY

ABDOMEN, Injuries of the.—All abdominal injuries are attended by more or less shock; if this be of a persistent or relapsing nature, grave internal mischief is denoted, although authenticated cases are on record in which a blow on the epigastric region has resulted in death, due solely to shock. Continuous pain, which becomes most intense at one point, and radiates over the abdomen from this, is an unfavourable sign. Persistent vomiting should be regarded as a symptom pointing to visceral injury. In all cases the abdomen must be very carefully examined, and it is specially desirable to ascertain if the bladder be intact. Purgative medicine should always be avoided until the exact injury has been diagnosed.

Contusion of the Abdominal Parietes. This injury occurs both without and with rupture of some abdominal textures and underlying viscera.

Simple contusions may be either cutaneous or musculo-cutaneous.

The *cutaneous* ones are caused by slight blows, falls, kicks, or wheels of heavy vehicles.

The *symptoms* depend on the extent of the injury. Generally there will exist feelings of faintness and sickness, anxious face, and diminution in the warmth of the extremities; pain in the region of the injury, increased by movement; more or less pain during respiration, followed by ecchymosis of the skin over the affected area.

Treatment.—Rest in the horizontal position. Stimulants in small doses to counteract the shock; anodynes to relieve pain. Locally, warm poultices or ice. If blood has been extravasated in small quantity it is apt to give a peculiar crepitant feeling to the hand of the surgeon, if in large quantity it may be necessary to aspirate the fluid portion.

Contusion with Muscular Rupture. This may exist as a small tear of one muscle, most frequently the rectus, or the whole thickness of the muscular wall of the abdomen may be rent.

Causes.—Passage of wheels over the surface of the abdomen, and buffer-accidents.

Symptoms.—Those of shock; some pain in affected region, increased by movement: if the patient be seen directly after the receipt of the injury, separation of the muscular fibres may be detected; but this is often difficult to discern, as the lesion is quickly followed by extravasation of blood and tumefaction. If the whole thickness of the muscular wall of the abdomen is involved, the symptoms will be more marked, and even resemble those of internal hæmorrhage, viz. pale and anxious face, extreme prostration, general restlessness, pulse small and feeble, skin cold and clammy.

Prognosis.—This depends upon the degree of rupture. If the whole muscular wall be torn, death may take place from shock. If recovery ensues, the formation of a ventral hernia must be looked for.

Treatment.—Rest in the horizonal position. Stimulants at first in small doses. Locally, hot fomentations, ice, or Leiter's coil; opium, or some of its preparations, by the mouth, rectum, or subcutaneously to relieve pain. The abdomen should be supported by a flannel bandage, a suitable belt, or by strapping if the rupture be small. Any intestinal protrusion must be returned, and a firm dry compress applied over it. Should symptoms of strangulation ensue, the opening must be exposed by incision, the bowel returned, all blood-clot removed,

and the parietal wound closed by silk sutures.

Rupture of the Stomach without External Wound.—*Causes.*—Direct violence applied to the epigastric region.

Symptoms.—Marked collapse, pallid skin, clammy sweats, pulse small and weak, tenderness over the whole abdomen, most marked in the epigastric region; vomiting of blood and matter resembling coffee-grounds may or may not be present.

Prognosis.—Unfavourable: death always taking place within twelve hours of the receipt of the injury.

Situation.—Any portion of the stomach may be affected, but in the cases recorded the majority were ruptured near the pyloric extremity, and on the great curvature. All the coats of the viscus may be torn, or the mucous and peritoneal may suffer, and the muscular be left intact.

Treatment.—Rest in bed, warmth, ether subcutaneously for shock, and morphia administered in the same manner to allay pain. Stimulant and nutrient peptonised enemata should be given, and nothing by the mouth.

Rupture of the Intestine from External Violence without Wound of the Parietes.—*Causes.*—Force applied suddenly to the front and sides of the abdomen, such as that caused by the wheels of a vehicle, blows or kicks of a man or animal.

Symptoms.—Those of shock: the face pale and anxious-looking; restlessness; tympanites following almost immediately the receipt of the injury. The pain in the abdomen is great, and rapidly diffuses itself all over the belly. As peritonitis is developed, the muscles of the abdominal wall become tense and unyielding. Vomiting is constant and distressing, and usually commences immediately after the injury has been inflicted. Any food in the stomach is first ejected, then grumous-looking fluid, finally stercoraceous matter. The tongue varies, being generally dry, coated and red at the edges. Intense thirst is present. The respiration is thoracic, rapid and shallow. The pulse varies—at first feeble and somewhat slow, then rapid and thready.

Parts affected.—Any portion of the intestinal tract, from the stomach to the rectum, may be injured; but the small intestines, jejunum and ileum, are most frequently lacerated. The size of the wound varies greatly.

Prognosis.—Unfavourable, as death generally ensues in forty-eight hours, the later symptoms being those of extreme prostration. A chronic circumscribed peritonitis may result, ending in absorption or abscess, and recovery. Such cases, however, are the exception, and not the rule.

Treatment.—Rest in bed, and the application of artificial heat to the extremities. Morphia should be administered subcutaneously every two hours, if needed, until the acuteness of the pain is lulled. Anodyne suppositories may also be used, but are not so efficacious in relieving the pain. For the intense thirst, ice may be given to suck, or iced water in teaspoonful doses. If this be ejected by the stomach, warm water in the same quantities may be tried.

Locally.—Hot fomentations, or light linseed poultices, alone or with laudanum, may be applied. A cradle should be employed to keep off the weight of the bedclothes.

When the diagnosis has been made as certain as possible, and the symptoms are hourly becoming more urgent, some surgeons might feel justified in opening the abdomen to seek the injured intestine. *See* Laparotomy.

Emphysema of the Abdominal Wall. This condition, as the result of injury, is a sign of rupture of the underlying intestine, and an escape of flatus into the sub-peritoneal tissues. A puffy, doughy, crepitant swelling, usually commencing in the flank, slowly creeps up the abdominal wall, which may even become resonant on percussion. The air is generally re-absorbed without requiring any puncture.

Wounds of the Abdominal Walls.—The various kinds of wounds of the walls of the abdomen may be: 1. incised; 2. punctured; 3. lacerated and contused.

1. *Incised wounds* are produced by sharp cutting instruments, glass, and china, and may extend to any depth, down to the peritoneum. When the direction of the wound is transverse, the consequent gaping is apt to be more marked than when the direction is vertical. Unless some branch of the internal mammary or epigastric arteries is severed, the hæmorrhage caused is not great, but there is most risk of bleeding when the injury is in the iliac region.

2. *Punctured wounds* are of a more dangerous nature, as their exact extent is not always evident, and probing and other manipulations should be avoided, or at any rate but very gently employed. Suppuration is apt to follow the infliction of this type of wound, which, spreading in the cellular planes between the muscles, may ultimately set up peritonitis.

3. *Lacerated and Contused Wounds.*—These, clinically, may be classified together; they are caused by blunt instruments, the horns and teeth of animals, and firearms. The injured textures are prone to slough, and the severity of the symptoms will depend upon the depth of the injury. Gunshot wounds, which are the result of spent balls, generally suppurate extensively; healing takes place slowly.

Treatment.—The immediate treatment of all varieties of wounds of the walls of the abdomen consists in the cleansing of the wound and the staunching of the hæmorrhage. The former should be accomplished with clean warm water, or an antiseptic solution, such as carbolic acid (1 to 40) or corrosive sublimate (1 to 1,000). If the bleeding be only slight, it may be controlled by a pad of lint or a piece of sponge; if more profuse, and a spurting artery is visible, the vessel divided must be secured, either with a catgut ligature or by torsion. Should the precise bleeding point be obscured, the wound must be cautiously enlarged until it can be brought into view, and then secured.

If the wound be an incised one, the edges should be approximated by sutures passing deeply through all the divided tissues, and a suitable drainage-tube be inserted at the lower angle of the wound. In punctured and the other variety of wounds of the abdominal parietes, no attempt at closure should be made.

The subsequent dressing may be Listerian, or of lint steeped in carbolic or terebene oil (1 in 10), boracic glycerine (1 in 4), or an aqueous solution of carbolic or boracic acid, or corrosive sublimate (1 in 2,000); and either wood-wool pads or those composed of an antiseptic absorbent cotton-wool should be placed over and secured by a broad bandage firmly applied, to counteract the tendency to ventral hernia. As far as possible, perfect rest should be enjoined, and all tension taken off the abdominal muscles by bending the trunk in a forward direction.

Wounds of the Abdomen with Protrusion of Uninjured Viscera.—The escape of the contents of the abdominal cavity is relatively much greater than the size of the wound, and a larger protrusion results from incised and lacerated wounds than from punctured ones. Omentum, intestines, stomach, bladder, and liver may all protrude, but the omentum and small intestines do so most frequently.

Prognosis.—In all cases of wounds of the abdomen with visceral protrusion, the outlook is serious, as the consequent shock is severe, and peritonitis and septicæmia are very frequent complications, causing a fatal termination.

Treatment.—Before entering into details of the treatment of the various viscera when projecting through an opening in the abdominal walls, a few preliminary points with reference to the treatment of all injuries of the abdomen should be stated. A very important matter to be attended to is, as far as possible to enjoin absolute rest for the viscera; for this purpose, but little nourishment should be given for the first three days except in the form of a little milk and water. Pain should be allayed by morphia given subcutaneously or by suppository. Efforts at coughing, straining, or vomiting, should be avoided; if the last-named symptom be present, the patient should be fed by pancreatised enemata, and nothing but small quantities of warm water given by the mouth.

Locally.—All hæmorrhage should be stopped, and care taken that at the first dressing the peritoneum be left clean and dry. No irritating antiseptic should be applied to the peritoneum, or this end may be defeated. Especial care should be taken that all sponges and fingers are aseptic and are used warm. The protruding viscera should be handled as little as possible, and while exposed should be covered with a flat warm sponge.

Protrusion of the Omentum.—A careful examination must be made as soon after the injury as possible, to see that no coil of the intestines is concealed. This having been demonstrated, the exact treatment will depend upon the existing condition of the hernia. The injury being recent and the omentum sound and reducible, the protruding mass is to be cleaned with an aseptic sponge and warm water and returned gently into the abdomen. The wound is to be closed with an interrupted or continuous suture, including the entire thickness of the abdominal wall.

Should the omentum be irreducible, congested or strangulated, it must be left in position, plugging the wound. A compress of antiseptic gauze, absorbent wool, wood wool, or lint soaked in boracic glycerine, terebene oil, or warm water, should be applied and kept in position by means of a broad bandage. If no urgent symptoms supervene, the dressings should be left *in situ* for several days, and when adhesions have been formed, a double ligature should be passed through the protruding fatty mass, just above the level of the skin, and

it should be firmly tied in two halves. The portion of omentum projecting above the ligature should be gently removed with the knife or scissors. That part left plugging the wound will subsequently granulate, and the opening close.

If, when first seen by the surgeon, the omentum be inflamed, adherent, suppurating, or gangrenous, the mass should be ligatured and removed at once.

Protrusion of Intestine.—The protrusion being recent, an anæsthetic should be at once given, and the projecting coil protected by a sponge wrung out in hot water. The gut having been gently and carefully cleaned, it should be returned into the abdominal cavity by means of the thumb and forefinger of one hand and the pressure of the warm sponge with the other. The intestine should be followed into the peritoneal cavity, in order that perfect reduction may be effected, and that it may not be merely pressed back between the peritoneum and the abdominal wall.

Reduction having been accomplished, a piece of warm flat sponge should be passed in at the opening, and left overlying the returned gut, until the closure of the external wound is all but completed: it should then be withdrawn. The silk sutures for closing the abdomen may be either interrupted or continuous, and should include the peritoneum and all textures composing the abdominal wall. Some surgeons prefer to close the peritoneum first, by means of a continuous catgut suture, and afterwards the wound in the parietes. Pads of dry lint, cotton wool, or wood wool should then be applied, and maintained in position by strapping and a broad flannel bandage.

Should, however, the protruding mass of intestine be large and irreducible through the original wound, either this must be sufficiently enlarged in an upward or downward direction, the surgeon's forefinger being introduced into the abdominal cavity to act as a guide, until the necessary reduction can be accomplished; or the protruding coil may be aspirated or punctured with a small needle, and emptied of its distending flatus. Reduction in a collapsed state may then be attempted.

If the protruded mass be already inflamed or deeply congested, it should still be returned into the abdomen, but the external opening must not be quite closed at its lower angle, to allow of the insertion of a glass drainage-tube for at least twenty-four hours. Should the intestine be strangulated and gangrenous, or very doubtful-looking, the opening in the abdominal walls should be enlarged to relieve the constriction, and no attempt should be made at reduction, but the affected coil be left *in situ* and watched. In such cases, the formation of an artificial anus offers the most hopeful prognosis. If the jejunum be the injured part, and a false anus supervenes, death will eventually take place from inanition. The gangrenous mass may either be incised or left to slough. The dressing should be warm charcoal and linseed poultices, or antiseptics such as boracic acid, carbolic and terebene oils, and iodoform in powder.

Wounds of Hollow Viscera.—These are very grave injuries, and the prognosis is unfavourable on account of the extreme shock which is occasioned, the extravasation of the contents of the intestine, and the subsequent peritonitis. The hollow viscera may be injured by incised, punctured, lacerated, or gunshot wounds, and the coiling of the intestines renders them liable to be the seat of multiple wounds. The relative frequency of the seat of injury is as follows:—1. Small intestine. 2. Transverse colon. 3. Stomach. 4. Ascending and descending colon.

Wounds of the intestines may occur (1) with or (2) without protrusion, and the extent of the injury will vary from a mere prick or wound a few lines long, to complete severance of the tube. When a mere puncture occurs, the mucous coat will often prolapse, and plug the wound in the muscular and peritoneal coats. When the small intestine is the portion of the tube injured, the prognosis is more unfavourable than when the colon is so affected, owing to its contents being more liquid, the covering of the peritoneum more complete, and the tube less fixed in position.

Symptoms.—Severe and prolonged collapse, pale and anxious countenance, feeble quick pulse, cold and clammy extremities, vomiting, thirst, great local pain, and the escape of flatus and fæces through the wound. Peritonitis speedily sets in.

Treatment.—The first step in all varieties of wounds of the hollow viscera is to stop hæmorrhage, and to ensure rest in the horizontal position. Morphia or opium should be administered for the pain, and all solid nourishment should be abstained from for three days, the patient merely sucking ice, or taking teaspoonfuls of warm or cold water at intervals. If possible, the bowels should be confined for ten days. If the large gut be intact, pancreatised enemata may be administered for purposes of nourishment.

Wound with Protrusion.—When the wound is a mere prick, the peritoneal cavity should be carefully sponged out, the bowel returned, and the wound closed.

If the wound be a few lines long, the intestinal tube should be held on each side of the opening with forceps, and a catgut ligature applied. The intestine should then be returned into the abdomen, and the wound closed. The wound being large, and the coats of the intestine cleanly incised, a continuous carbolised or catgut suture should be applied, as far as possible avoiding the mucous coat, and replacement effected, with closure of the wound.

Should the wound of the gut be lacerated, the intestine should be sewn to the skin of the parietal wound, and an artificial anus constituted. When the intestine is cut right across, an endeavour may be made to close the wound by a continuous silk ligature, applied with great care, to bring similar textures into apposition, or an artificial anus may be made. In our present state of knowledge, the latter procedure seems to offer the best prognosis.

Without Protrusion.—The wound in the wall of the abdomen must be carefully enlarged, and the opening in the viscera looked for. If found, it must be treated according to its dimensions. (*See* above.) Should the wound not be discovered, the peritoneal cavity must be thoroughly washed out, and a large glass drainage-tube passed down into the pelvis, the parietal opening being closed, except at the lower end. THOMAS F. CHAVASSE.

ABDOMINAL ANEURISM. — The abdominal aorta is subject to degenerative changes which rob the vessel of its elasticity, and render it liable to rupture of its coats and the formation of a false aneurism; or the elastic coat may alone be at fault, and a permanent dilatation of all the coats of the vessel may result, constituting a true aneurism in the affected part of the vessel. The existence of true aneurism of the abdominal aorta is, however, a very rare occurrence.

In this vessel another factor comes into play in producing aneurism, viz. sudden or violent exertion of the trunk of the body. This often leads to the formation of an aneurism in a tolerably healthy vessel, a fact of importance in considering the treatment of the disease, as it is in these cases, resulting from violent straining of the vessel, that we may look for the best results in adopting treatment by pressure.

Most of the aneurisms in this vessel are sacculated (60 per cent.), and vary in size, from the smallest pouch-like depression, to sacs of a size as large as the vessel and the surrounding parts will permit. In these large aneurisms the internal and middle coats of the vessel almost disappear, or exist as mere calcareous or atheromatous patches, while the external coat is often much increased in thickness, and supported by adherent organs. On the other hand, the external coat may become attenuated by the pressure of surrounding parts. Thus, either absorption of the coats of the vessel, and erosion of the surrounding parts, or adhesion and thickening of its walls, may be going on in an aneurism; and its duration will be largely determined by the prevalence of the one or the other of these processes. The sac of the aneurism may be almost filled by coagula of blood and fibrin, or it may be almost empty. This difference, to a large extent, depends on the size of the orifice of communication between the sac and the vessel, by which the volume of the current of blood in the sac is regulated. This is a matter of some importance in enabling us to form an opinion of the treatment to be used. A globular aneurism, forming a distinct and somewhat movable tumour, is likely to have a small orifice, and is favourable for the deposition of blood-clot or fibrin; and in it the current can be most effectually cut off by pressure when an aneurism enlarges.

While in most cases aneurisms of the abdominal aorta tend to increase in size, and eventually to burst, there are not a few cases on record in which spontaneous cure has occurred. Hodgson related the case of a small aneurism which had hollowed out the body of a vertebra by pressure, and had then become completely filled up by the layers of fibrin. Again, a sacculated aneurism has been found doubled over on its aperture of communication with the aorta, and thus cured by its own pressure. Holmes quotes a case of spontaneous cure of an aneurism of the cœliac axis, which he discovered in the body of a man who had never complained of any symptoms of aneurism. The sac was obliterated, except a channel in the centre filled with soft clot, through which the circulation must have been maintained in the large branches of the cœliac axis. He refers, also, to the curious preparation in the Hunterian Museum of the abdominal aorta of a jaguar with an aneurism nearly consolidated.

Seat of the Disease.—The disease may occur at any point in the circumference of

the vessel, and the late Dr. Sibson has shown that it springs just as often from the front of the vessel as from its posterior aspect. It may be as high as the pillars of the diaphragm, or it may occupy the origin of the cœliac axis, or, more frequently, it lies on a level with, or below, the renal arteries. It occurs less frequently in the lower third of the vessel, generally involving the inferior mesenteric artery, if the sac is large. The arteries involved in the aneurismal pouch are either dilated or obliterated, the former by the expansion of the walls of the vessel, the latter by pressure of the tumour as the vessel passes over it, or by plugging with fibrin from within. Pressure on the surrounding organs often results as the aneurism enlarges, leading to jaundice, from pressure on the liver or bile-ducts, or to nausea from pressure on the stomach and duodenum; or to dysphagia from pressure on the œsophagus, or to uræmia, in rare cases, from pressure on the kidneys or renal vessels. Sometimes organs are pushed out of their natural position by abdominal aneurisms, e.g. the liver may be pushed forward, or the left kidney pushed to the opposite side.

The vena cava is seldom compressed, and on this account dropsy of the extremities and enlargement of the superficial veins are rare in abdominal aneurism. The colon may be compressed, so as to lead to obstruction of the bowels.

An aneurism which springs from the front of the aorta presses on the ganglia and plexuses of the sympathetic system, leading to pain in the epigastric region, for the most part. An aneurism which springs from the posterior aspect of the aorta presses on the spinal nerves, leading to pain (chiefly paroxysmal and radiating) in the back and loins. These posterior aneurisms produce erosion of the vertebræ, but statistics show that the characteristic pain may be present without erosion, and erosion without the characteristic pain, so that no relation exists between pain and erosion. The pains doubtless arise from pressure on the spinal nerves.

Abdominal aneurisms are liable to rupture; and the formation of a diffuse aneurism, when bleeding occurs into the areolar tissue, is the result. Rupture may also occur on the surface of the skin or mucous membrane, or into the peritoneal cavity.

The Causation of the Disease.—The predisposing cause is degeneration of the coats of the vessel. The chief exciting cause is strain produced by over-exertion. Advanced age, syphilis, intemperance, and all other influences which impair the constitution, lead to these degenerative changes of the tissues which favour aneurism. In the writer's opinion, syphilis is most often the principal factor in this disease. The occupations which seem to predispose to the disease are all of a laborious nature—smiths, strikers, excavators, navvies, porters, paviours, being its victims. Where the disease occurs apart from great bodily exertion, we may infer the existence of considerable degeneration of the vessel.

Symptoms.—Pain is the earliest and most prominent symptom—sometimes continuous, with occasional paroxysms of increased severity; at other times, almost entirely paroxysmal or intermittent. It occurs in the epigastrium or hypogastrium, and in the back or loins; in the former cases it indicates aneurism of the front of the aorta, in the latter it indicates a posterior aneurism. The pain radiates around the trunk, down the extremities, and into the testicle. It varies in character, as indicated by the words turning, catching, twisting, lancinating, or boring. Often a dull pain when continuous, it becomes sharp and severe when paroxysmal. A pulsating tumour is also a very prominent symptom. The pulsation is generally felt equally in all directions, and the tumour is felt to expand under the hand with each pulsation of the aorta. A double shock is sometimes felt when the tumour is so near the heart as to receive an impulse from it.

The tumour is generally fixed, its non-mobility with the diaphragm being highly characteristic. The pulsation may be felt in the epigastrium, a little to the left of the middle line, or it may be covered by the margins of the left ribs. More rarely it inclines to the right, pushing forward the liver with each impulse. It sometimes lies so deeply in this region as to be barely perceptible on deep pressure.

The *diagnosis* in these cases is rendered extremely difficult, especially when we remember how vividly a nervous pulsation of the aorta will simulate an aneurism. In the latter case, we have an aneurism with scarcely perceptible pulsation, and in the former we have violent pulsation of the aorta without an aneurism. The tumour may appear in the loin or in the groin, and may simulate a lumbar abscess in the one case, or a psoas abscess in the other. It may also be mistaken for disease of the spleen and kidney. Let it be specially noted that an aneurism may exist where no tumour at all can be felt.

The pulsating tumour may vary in size, shape, and consistency to almost any extent, so that no valuable indication can be derived from these points, but it possesses a special characteristic in the *bellows-murmur*, which occurs in a large number of cases. If this murmur be systolic in time, and be distinct from any cardiac murmur which may exist, it becomes a very reliable sign of the disease. In all doubtful cases the stethoscope should be applied to the left vertebral groove, as well as in front, since a murmur audible in the back is strong evidence of the disease.

Dyspnœa from pressure on the diaphragm, cough from the same cause, dysphagia from pressure on the œsophagus, nausea, spasmodic flatulent pain and constipation from pressure, are secondary symptoms; as also are numbness or coldness of the legs, formication, pricking pain and loss of power in the lower extremities. On the other hand, ascites and anasarca are exceedingly rare in this disease. It must not be forgotten that all these symptoms may subside for a time, and apparent recovery may take place, until sudden death reveals the secret existence of the disease. In most cases, if not cured by treatment, the patient passes through a period of increasing pain, restlessness, insomnia, emaciation and exhaustion, until rupture puts an end to his sufferings.

Let it be noted that the following symptoms are rare in aneurism, and contra-indicate the presence of the disease:—Rapidity of pulse, œdema of the lower extremities, ascites, enlargement of the superficial abdominal veins; the presence of pus, mucus, blood, or albumen in the urine, jaundice, mobility of tumour without murmur, the malignant cachexia of cancer, and the deposits of cancer or tubercle.

The duration of the disease varies from a few months to many years. After the first appearance of prominent symptoms, the patient rarely lives more than eighteen months, and generally dies within three months, unless he is rescued by surgical or medical treatment.

Death may occur from exhaustion, pressure on vital parts, or hæmorrhage. The hæmorrhage may be suddenly fatal, or it may let life ebb out in a gentle stream, and the patient may get relief of all his symptoms before he dies. When the bleeding occurs into the peritoneum death is sudden, and when into the stomach, lungs, or bowels, blood will often be discharged from these cavities before death. The occurrence of bleeding is often followed by the formation of a soft, semi-fluctuating tumour in one of the abdominal regions, indicating the formation of a diffuse aneurism.

Treatment.—The treatment of abdominal aneurisms has come within the range of practical surgery during the last twenty years. Previously, these diseases were regarded as beyond the pale of surgical treatment, and the efforts to cure them consisted mainly in a system of resting the parts; while the circulation of blood was reduced by medicines and diet to a level which was supposed to be conducive to the formation of layers of fibrin, by which the aneurismal sac might be filled up.

Since the year 1864 a considerable number of cases have been cured by the application of the rapid-pressure treatment—i.e. by applying pressure to the aorta, above the seat of the aneurism, so as to stop the circulation of blood in the vessel. This method of rapid and complete pressure in the case of aneurisms of the abdominal cavity has established the following points:—

1. That aneurisms of the abdominal aorta (or its branches) are curable by pressure.

2. That pressure is not necessarily a long process, as had been previously supposed, but when efficiently applied its action may be *rapid*—so rapid as to reduce its application from *many hours* to *as many minutes* in some cases.

3. That occlusion of the aorta may occur suddenly, without much risk to the patient, and that a very rapid opening up of new channels by the anastomoses of vessels is the means by which circulation is re-established in the lower parts of the body.

4. That the administration of chloroform is necessary in the application of this rapid method, inasmuch, as, without it, currents of blood are liable to pass through the sac of the aneurism, and disturb the coagulation going on there.

5. It is probable, from the rapidity with which the cure of a large aneurism may take place, that the process depends on coagulation of blood to a large extent, and not on the deposition of layers of fibrin only.

Before adopting any surgical measure for the cure of aneurism of the abdominal aorta, it is advisable to try the effect of absolute rest in the recumbent position for two or three weeks, and during this period of rest the treatment by iodide of potassium in large doses should also be adopted. The success attending Tuffnell's treatment by diet and rest alone would justify this preliminary process, and the still greater success following the use of large doses (30 grains three times daily) of iodide of

potassium, gives this treatment a fair prospect of success.

Should the trial of rest, spare diet, and iodide of potassium have produced no change for the better, either in the disease or in the condition of the patient, we are justified in resorting to the use of pressure.

Two things are now to be considered:

1. The state of the patient as to general health, as to the state of the heart and arteries, and as to the state of the kidneys.

2. The site and anatomical relations of the aneurism.

First, as to the general condition of the patient, it is most essential to examine the important viscera, and the existence of organic disease of any of them is to be regarded as an obstacle to the success of the pressure treatment. Cachexia, either general or specific, also negatives the hope of success. Secondary and tertiary syphilis may yield to the iodide of potassium, which should be fully tried in such cases. The cachexia of cancer is of course decisive. Ordinary anæmia is unfavourable. Ascites renders pressure impossible, and œdema of any kind should be traced to its source. Should it indicate renal disease, with the slightest trace of albumen, blood, or casts in the urine, the pressure treatment is thereby contra-indicated. In all cases the urine should be carefully and repeatedly examined for albumen and sugar. Above all it is necessary to determine the state of the arterial system. Extensive degeneration, heart-disease, the existence of another aneurism in the chest or elsewhere, all contra-indicate a favourable result. Should there be an absence of these unfavourable conditions, the next step will be to inquire if the site of the aneurism permits of pressure being applied.

In considering the question of site in relation to the application of pressure, two methods may be pursued:—1. The ready method of trying the application of a tourniquet under chloroform, to ascertain if there is space enough above the aneurism to permit of the vessel being fully compressed by the instrument. 2. It will be found that pressure can rarely, if ever, be brought to bear on the vessel above the renal arteries.

If, however, in a very tall patient with a short chest and a wide epigastrium, pressure were contemplated, it would be unwise to venture on it without duly considering the site of the renal arteries in such a subject. In ordinary subjects there is no need to insist on the rule, 'that pressure should never be applied on or above the renals,' as this is simply impossible. So that we may safely say that we may press as high up as we can apply the pad of the tourniquet. In most cases this point will be found to coincide with the left triangle of the epigastrium. Although aneurisms above the renal arteries are never cured or treated by *proximal* pressure, they admit of treatment by *distal* pressure. Mr. Bryant's case shows that curative changes do occur in the aneurism, even as high as the cœliac axis, when subjected to distal pressure. Where other conditions are favourable we should continuously try distal pressure when other means fail to relieve the patient.

Below the origin of the renal arteries there is nothing to prevent the use of pressure. It is here both a practicable and tolerably safe procedure.

Let us now proceed to state what is to be done in a case where the trial of the rapid-pressure treatment for abdominal aneurism has been decided on. The patient needs to have the abdominal viscera unloaded, as far as possible, by a gentle aperient which removes flatus while acting. One aloe and assafœtida pill, followed by magnesia and rhubarb with ginger and other carminatives, will probably do this. If necessary an enema of assafœtida and turpentine may be given. The bladder is to be emptied. Nothing of a solid nature is to be eaten for three or four hours before the operation. The next step is to administer chloroform, and to put the patient fully under its influence before attempting pressure. Sometimes a preliminary administration of chloroform may be tried, to see how far and how easily the pressure may be applied without injury to the patient. As the patient may become exhausted by the long-continued anæsthesia, the administration of strong peptonised beef-tea enemata, during the operation, is necessary, and in some cases brandy in the enemata is needed.

The tourniquet may be that of Lister, or Carte, or the ordinary horse-shoe tourniquet may suffice. In the hands of an experienced surgeon the horse-shoe tourniquet is best, as he will, by skilfully guiding it, be able to keep it on the vessel during any accidental movement of the patient. The most important point in applying pressure is to secure that amount of it which will stop the flow into the aneurism, without injuring adjacent or intervening parts. Experience, tactile skill, manual dexterity, and sound judgment will best aid the operator here, and it will be seen that no mere tyro or student can be trusted in such a delicate operation. The surgeon must make up his mind to give up a day to the work and to

take the immediate supervision of every detail, if he is to succeed. Apart from the consideration of internal injury which may be inflicted by the pressure, there is the all-important point of fully and completely arresting all flow of blood through the aneurism, which is essential to a rapid result.

If a rapid cure is aimed at, the shorter the period of pressure in this region the better. The operator must bear in mind that, every time he allows a current of blood to slip past the tourniquet, the chance of a rapid cure is reduced. If these rushes of blood are allowed to take place, the cure cannot be rapid, for each current breaks in on the coagulating process and carries the stationary blood onward, so that the process has to be recommenced. Granted that each time a volume of blood is held stationary a layer of fibrin may be deposited, that does not lead to a rapid result. It may lead to a cure by alternated layers of fibrin and blood, but this means the prolonged and probably the repeated application of the tourniquet. To succeed in a first attempt of two, three, four or more hours, we must have full command of the aorta, and aim at holding the blood in the aneurism undisturbed. In all cases slight currents will pass through the sac, and thus, instead of one mass of coagulated blood filling the vessel, we are sure to have successive deposits of coagula.

The writer has again and again succeeded in stopping the pulsations in an aneurism by holding the vessel with a firm and careful hand for half an hour, after unsuccessful pressure had been tried for a good many hours. When the pressure does not succeed in reducing the size or pulsation of an aneurism in four or five hours, we must carefully look to the state of the patient, and the slightest indication of failure of the pulse or shock must warn us to remove the pressure and chloroform, and ascertain how the patient has borne the treatment. Unless there is an entire absence of any evidence of shock or injury to the ganglionic nerve-centres, of failure of the heart's action, or injury to the stomach or duodenum from pressure, we must postpone our efforts. By trying the pressure too long or too severely our object will be defeated. When the pressure is removed, it is not infrequently noticed that, although the aneurism still pulsates, its pulsations are much reduced in force and extent. In these cases it is well to watch the patient, and to keep him at rest, free from the slightest excitement, as it is probable the pulsations will gradually disappear, and the aneurism may thus be cured.

Where proximal pressure fails, or is inadmissible, the application of distal pressure is advisable, and some authorities urge the application of distal as well as proximal pressure in all cases. After the consolidation of an aneurism, it is necessary to apply warmth to the extremities and flannel to the abdomen, and to feed the patient cautiously.

New vessels will appear in the abdominal wall in a few days, and after a lengthened period pulsation may be felt in the iliac and femoral arteries. WILLIAM MURRAY.

ABDOMINAL HERNIA.—This term is applied to protrusions through the antero-lateral parts of the abdominal parietes below the umbilicus, exclusive of those through the inguinal canal. The hernia is usually in the middle line, and most commonly follows operation wounds, as that for ovariotomy. The rupture may appear within a few weeks of the healing of the ovariotomy wound; but, as a rule, it does not present itself until many months have elapsed. It may not be noticed until after an interval of years. It may follow upon accidental wounds, upon abscess, contusions, rupture of the abdominal muscles, destructive burns, and may be apparently the consequence of pregnancy, ascites, &c.

It is usually met with in female adults. The tumours formed are, as a rule, large. The sac often has no neck. In some ruptures of old standing the tumour may become pendulous. These herniæ are seldom the seat of acute change. The more pendulous may become incarcerated when they contain colon, some of the smaller and more circumscribed protrusions may be the seat of inflammation, but the strangulation of a ventral hernia is an occurrence of great rarity.

The rupture should be supported by a suitable abdominal belt.

FREDERICK TREVES.

ABDOMINAL SECTION. *See* LAPAROTOMY; CÆSAREAN SECTION; OVARIOTOMY; OÖPHORECTOMY; UTERUS, Extirpation of.

ABDOMINAL SURGERY.—No department of surgery has made more rapid progress during the last quarter of a century than that of the abdomen. The fear of peritonitis which prevailed so strongly in the early part of the century deterred surgeons from opening the cavity of the abdomen, except under the most desperate circumstances, and the delay thus encouraged was of itself in great measure the cause of the fatal result so frequently

witnessed. The first ovariotomists had to encounter not merely the ordinary difficulties inherent to all novel procedures, but had to withstand the violent prejudices of those whose knowledge was limited to the bad teaching of former years, and whose experience was *nil*.

Probably the experimental teaching of Spencer Wells, that the edges of the cut peritoneum, when brought together, would unite in a few hours, was the greatest step towards the success of modern abdominal surgery; and next must be put the practice of perfect cleanliness, so little thought of in former years, both as regards the body of the patient and his surroundings, and the hands and instruments of the surgeon. Whether the strictly antiseptic practice of Lister has done much for abdominal surgery must still be considered *sub judice*. Ovariotomy had become a success before the days of carbolic spray, and it is yet an open question whether more is not lost than gained by exposing the interior of the peritoneum and the contents of the abdomen to a carbolic or other antiseptic spray for one or two hours at a time.

The treatment of certain Injuries of the Abdomen, notably of rupture of the bladder, has been greatly influenced by modern views, and the question of opening the abdomen with the view of stitching up the bladder may now be fairly entertained. In the treatment of Intestinal Obstruction, the operation of laparotomy for the division of a band or the unfolding of an intussusception has yielded excellent results, and has emboldened surgeons to remove gall-stones, and even to excise portions of the intestinal canal (Enterectomy). Gastrostomy, for the relief of stricture of the œsophagus, has become a success, at least in cases of traumatic stricture; and forcible dilatation of the pylorus has yielded better results than excision of that sphincter.

Early Colotomy has been proved greatly to prolong life, in comparative comfort, when the large intestine is the seat of cancer, and in a few instances an attempt has been made to excise the diseased structure (Colectomy). Removal of the lower end of the rectum is an operation which must be said to be still on its trial, since the cases suitable for its performance are few and far between, whilst the risks of the proceeding are great, and its after-results are not, so far, very encouraging.

The whole surgery of the Female Pelvic Organs has undergone a change. Ovariotomy is no longer confined to enormous tumours, the bulk of which is estimated by the gallons of fluid contained, but ovarian tumours are diagnosed and removed when small, and diseased and painful ovaries with no special enlargement are extracted (Oöphorectomy), whilst the Fallopian tubes are also dealt with if necessary. Uterine tumours are removed when necessary by abdominal incision, with little more risk than those of the ovary, and Excision of the Uterus for malignant disease is now a recognised surgical proceeding.

The surgery of the Kidney has grown up with a rapidity almost marvellous. Incision for the relief of renal abscess (Nephrotomy) has been followed by the successful removal of calculi from the kidney or its pelvis (Nephro-lithotomy); and even removal of the entire kidney, for malignant disease (Nephrectomy), has been crowned with success.

The surgery of the Urinary Organs has received a notable extension by the successful removal of Tumours of the Bladder in many cases till lately deemed irremediable; and the revival of the supra-pubic method of Lithotomy, rendered at once easy and safe by the distension of the rectum, offers a prospect of increased success in the treatment of large calculi.

Christopher Heath.

ABDOMINAL TUMOURS, Diagnosis of.—The pathological conditions which produce recognisable swellings or tumours of the abdominal walls, or of the organs contained in the cavity, are very numerous, and though each will be found in its proper place in the special articles, some general notice of these diseases is necessary. It is obviously impossible to deal with the causes, pathology, diagnosis, symptoms and treatment of each, but the following is the method which should be employed in their general diagnosis.

The patient should be laid on the back with the head and shoulders well supported by an inclined plane of pillows, and the knees should be raised, and if necessary also supported by a firm pillow placed under them, so that the abdominal muscles are relaxed. The whole surface of the abdomen should be thoroughly exposed to view, and the relaxation will be aided by keeping the patient in conversation, or causing a succession of deep respirations to be made, while the mouth is held open. Careful inspection, palpation, percussion, and auscultation should then be employed. If the parts which appear to be healthy are first syste-

matically examined by the above methods, a diagnosis by exclusion is made, which can then be confirmed, or corrected, by varying the position of the patient, and repeating the examination. It is always better to pass from healthy to diseased structures, than to examine the tumour first.

The systematic examination will be easier if the tumours are considered in three groups: 1. Tumours of the abdominal parietes; 2. Tumours of the peritoneum, and of the organs contained in its cavity; 3. Tumours of the tissues and organs which lie behind the peritoneum.

1. *Tumours of the Abdominal Parietes.* The only growths in the parietes which will be found difficult to differentiate from tumours contained in the peritoneum, are those which are prone to cause inflammation of the peritoneal surfaces, and thus to contract adhesions to the organs contained in the cavity, especially to the omentum and intestines. These are inflammation (cellulitis), abscess, hydatid cysts, carcinoma and sarcoma.

Inflammation.—Considerable swellings of a diffused nature may arise, from some part of the areolar or fibrous tissues of the abdominal wall.

Abscess.—A later stage of inflammation, but one not necessarily reached, if rest and appropriate soothing treatment be used in time. It is most common in the sheaths of the muscles, as the result of strain or other injury.

Cysts.—The most common are hydatids and sebaceous cysts.

Fatty Tumours are not at all rare.

Fibrous Tumours.—These are of frequent occurrence, and usually arise from the sheaths of the muscles.

Carcinoma is rare, but is occasionally met with, especially in the neighbourhood of the umbilicus.

Sarcoma, in some of its many forms, though not so common as the simple fibrous tumour, is much more often met with than carcinoma.

Obesity, Œdema, and Elephantiasis must also be noted as affections of the parietes not infrequently mistaken for intra-peritoneal tumours.

Hernia.—The ventral and umbilical forms of hernia may contain either serum, omentum, or intestine. The ovary and a portion of a fibro-myoma of the uterus have also been found in ventral herniæ. This disease is placed in this group because, though really intra-peritoneal, it is from its earliest formation a projection into or through the tissues forming the parietes.

Contraction of Abdominal Muscles.—A single muscle or a group may suffer from spasmodic contraction, and simulate a solid growth (phantom tumour).

2. *Intra-peritoneal Tumours* may arise from—

Peritoneum.—Any part of the peritoneal membrane may be itself the seat of a solid or cystic growth. The former are usually malignant, and though occasionally primary are more often secondary.

Liver.—The diseases of the liver which give rise to abdominal tumour are degenerations causing enlargement of the whole organ, such as the early stage of cirrhosis, amyloid degeneration, and carcinoma; simple serous cysts, abscess, hydatids, and carcinoma affecting one lobe rather than the whole organ.

Gall-bladder.—Gall-stones are the most common cause of enlargement of this organ, but it is also liable to distension from catarrhal occlusion of the duct, and it is occasionally the seat of malignant tumour. One very remarkable case of solid tumour has come under the notice of the writer. Its seat was verified by exploratory incision, and it entirely disappeared, apparently from changes induced by free puncture with the aspirating needle.

Pancreas.—This organ is occasionally the seat of malignant disease, and may form an abdominal tumour of very considerable size.

Spleen.—Abscess of the spleen, simple cystic disease, hydatids, simple hypertrophy, and enlargement as a part of the general disease leukæmia, are all met with as abdominal tumours, and with the exception of the last are of great importance to the practical surgeon.

Stomach.—Cancer is the disease which most often affects this organ, so as to cause a definite tumour. Unusual distension with food or gas may also have to be considered, and in females large collections of hair, cotton, &c., may be occasionally met with, and are exceedingly difficult to differentiate from fæcal impaction in the large intestine.

Intestine.—Fæcal impactions, volvulus, intussusception, carcinoma, and sarcoma all form abdominal tumours of a kind requiring great care for correct diagnosis.

Omentum.—Cancer, hydatids, and simple cysts are, in the order in which they are given, the tumours most common in the omentum.

The *Mesentery* is liable to the same diseases as the omentum, and has been known to be the seat of very large sarco-

mata and cystosarcomata. It occupies a position between the intra-peritoneal and retro-peritoneal groups, and its cystic growths are very difficult to diagnose from renal tumours.

Bladder.—Distension.

Uterus.—Pregnancy, hydramnios, hydatidiform degeneration of the chorion, moles, fibro-cystic tumour, fibro-myoma, sarcoma, carcinoma, metritis, hæmatometra, physometra, and abscess of the uterine wall, all cause enlargements of this organ, which have to be considered in examining an abdominal tumour.

Round Ligaments.—Fibrous tumours of these ligaments sometimes attain a very considerable size, but they are usually more in the groin than in the abdomen.

Broad Ligament.—Simple cysts, parovarian cysts, papilloma-bearing cysts, hydatids, cellulitis, abscess, fibroma and sarcoma, all have their seat in this ligament, and are often extremely difficult to diagnose from like affections of the ovary.

Fallopian Tubes.—Hydro-salpinx (accumulation of serum in the tube), pyosalpinx (accumulation of pus in the tube), hæmato-salpinx (accumulation of blood in the tube), papillomatous disease of the lining membrane, and tubal pregnancy, are all conditions which may present themselves as abdominal tumours, though they are more often confined to the pelvis.

Ovaries.—Unilocular and multilocular cysts, dermoid cysts, fibroma, sarcoma, carcinoma, abscess and ovarian pregnancy, are all of great importance, and the cysts especially so from their very common occurrence.

Subperitoneal Cyst.—This may arise in any portion of the subendothelial connective tissue. It is placed in this class for the same reason that hernia is placed in the previous class.

Encysted Peritoneal Effusion or *Dropsy* is occasionally met with, along with malignant disease of omentum, &c., or independently, as a result of some localised inflammatory process.

Peritoneal Hæmatocele arises when a vessel ruptures into the peritoneal cavity, or when a retro-peritoneal hæmatocele does so, and the blood only becomes encysted by the agglutination of intestines, or other organs, whose peritoneal coats have become irritated by the presence of the blood.

Besides this long array of diseases of organs contained in the peritoneum, we have also to mention the following more general affections.

Tympanites.—The gas usually accumulates in the intestines, but occasionally in the peritoneal cavity. The percussion sound is hyper-resonant all over the abdomen.

Ascites or *Hydroperitoneum* may arise from diseases affecting organs outside the cavity, such as the heart and kidneys, or it may arise from tubercle, or from papillary disease or peritoneal cancer of the peritoneum, or from the irritation set up by almost any of the many tumours named above.

Phantom.—This is a curious disease chiefly met with in women who believe themselves to be pregnant when they are not so, but also occasionally associated with some derangement of the female sexual organs. It may affect the whole abdomen or a portion only, and appears to be due to an arched and rigid condition of the abdominal muscles. It is sometimes extremely difficult to distinguish from a real tumour, but it may be suspected when an enormously distended abdomen is resonant all over, or when a localised swelling is so; and the diagnosis may be made certain by the use of an anæsthetic, for with complete anæsthesia the tumour will disappear, to rise again as the patient returns to consciousness. It may simulate a tumour of almost any abdominal organ.

Extra-uterine Pregnancy.—Two varieties of this disease have already been named as occurring in the Fallopian tubes and ovaries, and it only remains to mention the abdominal form, in which the ovum gets altogether away from the uterus, tubes, and ovaries, and becomes implanted on some other peritoneal surface.

3. *Retro-peritoneal Tumours.*—*Aneurisms* of the abdominal aorta or of its main branches.

Abscesses of various kinds. These more often appear at some point outside the abdomen. Iliac and pelvic abscesses, however, often encroach on the abdominal cavity.

Cysts may have their origin in the retro-peritoneal cellular tissue.

Solid Tumours.—Either fibroma, sarcoma, or carcinoma may also arise in the retro-peritoneal cellular tissue, but the two latter usually affect the lumbar glands and are secondary in their origin.

Kidneys.—The distensions and neoplasms of the kidneys or ureters are the most important of the retro-peritoneal tumours and are hydronephrosis, pyonephrosis, calculous pyelitis, hydatids, sarcoma, and carcinoma.

Hæmatocele.—Retro-peritoneal hæmatocele is usually pelvic in its origin, but may

become abdominal and form a tumour of great size.

The above recapitulation of the tumours which may be met with in the abdomen, will serve to refresh the memory of those who are not frequently called upon to diagnose tumours in this situation, but it will be necessary to refer to the special articles for detailed information.

J. Knowsley Thornton.

ABSCESS.—*Definition.*—An abscess is a localised collection of matter in any organ or tissue, and the term is often extended to include suppuration in certain of the already existing cavities of the body. It may result from any inflammatory process which reaches a sufficient degree of intensity. Thus there may be an abscess of the subcutaneous tissue, or in the substance of a bone, in the brain or the liver, in a bursa, a joint, or the sheath of a tendon; and we also speak of a peritoneal or a pleural abscess, if the suppuration in these situations be circumscribed.

Given the inflammatory process, complex and highly differentiated tissues become crowded with small round cells (whether by a proliferation of previously existing cells, or by the escape of white blood-corpuscles from the blood, or both, it would be out of place here to discuss), and the special structure of the part disappears, to be replaced by a tissue made up of these small round cells loosely held together and permeated by vessels—in other words, by granulation-tissue. A slight increase of the inflammatory process causes this lowly-organised tissue to generate a still less highly organised material—namely, pus—and an abscess is the result. The process is somewhat different in the case of an abscess developed in a previously existing cavity—for example, in the knee-joint; here we must assume that the lining wall of the space is converted by the inflammatory action into a condition, pathologically if not to the naked eye, resembling granulation-tissue, from which, in its turn, the pus of the abscess is developed. It is thus possible that the effusion may be purulent from the first, as is most likely the case in the suppuration of joints during the course of pyæmia; or it may be serous at first, and become purulent at a later stage, when the inflammation of the enclosing surface is further advanced, as is illustrated in the case of acute synovitis of a joint going on to suppuration, or in the abscess which results from inflammation of the bursa patellæ.

Causes.—The causation of abscess is at the present time one of great uncertainty, and one that is exciting considerable controversy. Thus, while it is not improbable that we may some day be able to classify all the causes under the heads mechanical and chemical, it is obvious that there are at present many which do not belong apparently to either category. Under the head *mechanical* are such abscesses as arise from pressure—for example, subcutaneous decubitus—or from the presence of clean, though mechanically irritating, foreign bodies, as when suppuration occurs round a silk ligature long after the wound has healed, or round a piece of a needle which may have entered some time previously. To this class, also, belong the numerous abscesses caused by simple tension, as when a wound is imperfectly drained and becomes distended by the effused serum; or when the duct of a secreting gland is obstructed and the gland is distended by its own secretion. Under the head *chemical* we may, though with some reservation, include that most important class of abscesses which depend upon septic agencies, embracing, at all events, the abscesses of phlegmonous erysipelas and its allied diseases, those of septicæmia and pyæmia; though it must be remarked that micro-organisms are always present in these cases, and that we are totally unable to say how far and in what way they may be irritating in themselves, independently of the acrid fluids which accompany their growth. This class also includes such cases as the suppuration which accompanies the subcutaneous injection of an aseptic or an antiseptic material, say corrosive sublimate, and perhaps the suppuration of lymphatic glands drawing their supply of lymph from inflamed regions.

We have not, however, at present sufficient knowledge to determine the cause of many abscesses, such, for example, as the chronic suppuration of glands, bones, and other parts in strumous subjects, the suppuration of joints in rheumatic people, or the apparently spontaneous development of an abscess in the interior of a deep viscus, such as the brain; nor can we say whether or not an abscess may originate by what is commonly called sympathy, or by irritation transmitted through the nervous system, though this is a convenient method of expressing, without explaining, certain obscure conditions.

Whatever may have been the original cause of an abscess, its enlargement is determined partly by the persistence of this

cause if unremoved, partly by the existence of tension, which, as was stated above, is a potent cause of inflammation. It thus happens that, almost without exception, the collection of matter continues to increase, and the abscess spreads in the direction of least resistance, the opposing substances being either displaced, as is common in the more chronic form of abscesses, or actually involved in the inflammatory changes. We say, almost without exception, because cases occur now and then, in which the contents of an abscess, which have been proved to be actual pus by the withdrawal of an infinitesimal quantity, have subsequently been, without further interference, absorbed, and have completely disappeared. The matter then makes its way ultimately, though often by a long and circuitous route, to a free surface, either that of the skin or that of some internal cavity or hollow organ. When it has reached the surface, *pointing* is said to occur, and when rupture takes place the contents are evacuated. By this means tension is more or less relieved; but, in the majority of cases, a new element of irritation, viz. putrefaction, is introduced. Nature's opening is usually too small, but supposing that the tension is completely relieved, and the original source of irritation is no longer present, and the putrefactive element be not productive of serious mischief, the sides of the cavity fall together, and the granulations lining its wall, to which the name of *pyogenic membrane* is applied, being no longer irritated, cease to develop, or do so to a less extent than before. The discharge, which is then either serous or purulent, escapes from the opening, and the constant growth of the granulations gradually fills up the abscess-cavity, healing taking place, as is said, from below.

But if the original source of mischief be still present, as, e.g., in the case of an abscess caused by diseased bone or foreign body, the cavity contracts, but continues to discharge, and a narrow suppurating track or *sinus* remains, communicating at the one end with the source of irritation, and at the other with the point of rupture. If the putrefactive element be productive of mischief, and especially—as is often the case when an abscess has burst spontaneously—if the opening be insufficient, *burrowing* takes place; that, is matter finds its way amongst the cellular planes, or through the least resisting structures, and thus other secondary tracks may be developed from the original abscess. In many cases a second or a third, or even multiple openings, may occur; and if one of such openings be into an internal hollow viscus or cavity, whilst another is on the surface of the body, what is known as a *fistula* is the result. A fistula may also follow a simultaneous wound of such an internal surface and the skin, or may originate on such a surface and make its second opening by bursting externally. The best example of this condition is the *fistula in ano*, which, commencing in many cases as a submucous abscess, bursts both into the skin of the buttock and also into the rectum, leaving a fistulous track communicating both with the bowel and with the surface of the body. These fistulæ have usually no tendency to heal spontaneously. The term fistula is also applied to sinuses communicating between two internal hollow organs, as between the rectum or bladder and the vagina; or to similar tracks that have resulted from wound or rupture of an internal organ such as the gall-bladder, the lacrymal duct, or the intestine. Lastly, a fistula may result from a congenital defect, as when a urinary or fæcal fistula exists at the umbilicus, or an œsophageal fistula in the neck, depending on a nonclosure of one of the branchial arches.

Acute Abscess.—A good illustration is the acute abscess of the breast which occurs during the active condition of the gland. Here the source of irritation is, probably, a mechanical one, viz. the plugging of one of the ducts, with retention of the secretion in one of the acini, and consequent tension; though the frequency of the association of this abscess with eczema of the nipple suggests the possibility of another explanation. The resulting inflammation involves the surrounding parts to a greater or lesser degree, and at last, in the centre of the inflamed area, suppuration takes place, no doubt accompanied by the death of a larger or smaller portion of tissue. The occurrence of suppuration increases the amount of tension, and, as it continues, the cavity rapidly increases in size, principally by the formation of more pus, but partly by the breaking down of the inflamed tissue. This process advances until the matter reaches the surface, or until the abscess is opened by the surgeon; but the necrosis bears so small a proportion to the suppuration that, on evacuating the contents, the sloughs are not perceptible, and only pus is seen to escape.

Chronic Abscess, on the other hand, is very slow of development, and unless, in the course of its enlargement, it involves some sensitive structures, is unaccompanied by the signs of acute inflammation. It

gradually makes its way to the surface without causing heat or pain or redness, for the most part displacing the structures that it meets with, and following the cellular planes and the course of vessels; and at last, like an acute abscess, it involves the skin, which turns of a purplish red colour over a comparatively small area. A piece of this reddened skin then sloughs, and the contents of the abscess escape. Good examples of this form are to be found in the ordinary *cold* or *lymphatic* abscess of the soft parts, or in a psoas abscess starting from caries of the vertebræ. A cold abscess begins, we know not why (though it may be plausibly held to be a tubercular inflammation), in an almost imperceptible manner. The patient is probably unaware of its existence until the presence of a distinct swelling attracts his attention, and its growth is not accompanied by any other inconvenience. Abscesses of this kind sometimes occur in considerable numbers in persons predisposed to their development by ill-health or the strumous diathesis.

Abscesses, in their course, are usually guided by the strong fasciæ of the body; they may cause absorption of the soft or firmer structures, and occasionally open into vessels; but, as a rule, vessels and nerves are simply denuded by them, and remain as bands stretching across the track of suppuration. If ulceration of an artery or vein occur, the cavity becomes distended with blood, and, in the case of an artery, a pulsating tumour is formed, which may easily be, and has often been, mistaken for an aneurism.

The *contents* of an acute abscess are usually thick, yellow pus, mixed sometimes with small clots of altered blood and shreddy particles of slough; those of a chronic abscess are sometimes thick, but often thin, and indeed occasionally quite serous, and mixed at times with larger or smaller flakes of coagulated lymph. If the contents are actually serous, the abscess will have been accompanied by an exceptionally mild and chronic inflammation, and to this form the term *serous abscess* has been applied. It must be understood that this statement is in very general terms, and that the contents of both acute and chronic abscesses are liable to every form of variation; thus in an abscess of the breast the pus may be mixed with milk; in a cæcal abscess it may contain fæces; in a hepatic abscess, bile or broken-down liver tissue; in a psoas abscess, particles of bone; in a pulmonary abscess, mucus; in a renal abscess, urine, and so on: but it is impossible in this article to enter on this part of the subject with anything approaching to detail. The pus of an unopened abscess is not always sweet, and not always free from micro-organisms; a perineal or an ischio-rectal abscess has often a marked fæcal odour, even though there be no communication with the bowel, and abscesses in the axilla and in some other situations often contain pus with a remarkably offensive smell. Almost all acute abscesses again, whether sweet or not, have been shown to contain micrococci, and this observation applies even to abscesses which have been caused by the injection of irritating, but aseptic, materials; but it does not follow that these will not follow an aseptic course if treated properly. In other words, it does not follow that the organisms contained in the unopened abscess are those which accompany or produce putrefaction.

Treatment.—The treatment of abscess will vary in accordance with the different conditions which have been described, the only essentials that can be laid down for all cases being that the surgeon should secure—1st, a free opening, in a dependent position if possible; 2ndly, efficient drainage; and, 3rdly, antiseptic management of the case, if he can.

The treatment of acute abscesses may be divided into that suitable for the pre-suppurating stage, and that which is required when the abscess is ripe. In the former, our efforts should be directed to the alleviation of pain, and, if possible, to the prevention of suppuration, which is best attained by the application of heat, either by means of hot fomentations, or some form of poultice. This may be supplemented by frequent bathing of the part in hot water, or by the inunction of the region with a preparation of belladonna (Ext. belladonnæ ʒij., Glycerini ɪʒj.).

The part, when practicable, should be elevated, and all undue pressure should be avoided. Occasionally, local blood-letting may be practised with advantage. In the second stage, when suppuration has occurred, it is in most cases best to make a free incision, which affords the most satisfactory exit for the pus, and reduces the inflammation by relieving the tension. But in cases where the matter is deep, and where a long scar is objectionable from its unsightliness, as, e.g., in acute abscesses of the breast or neck, an excellent result may be obtained by making an opening in a suitable position just large enough to admit a drainage-tube of good size; provided, as should always be the case if practicable, the

opening be made with efficient antiseptic precautions. In the after-treatment, if the pus be putrid, a hot and moist application should be used. Boracic fomentations, viz. boracic lint wrung out of hot water, and covered with guttapercha tissue; or an antiseptic poultice, made by mixing boracic acid or iodoform with linseed meal, will be found excellent applications. Iodoform may be applied when practicable to the interior of a putrid abscess, or it may be mopped out with some antiseptic lotion —chloride of zinc, gr. 40 ad fʒj., carbolic acid 1–20, or whatever is found convenient.

Similar, though milder, lotions may be employed on subsequent occasions if it be found necessary. In many examples of putrid abscess, whether acute or chronic, if it be thought practicable to render the cavity pure, this end may be most easily attained by removing the granulations lining it by means of Volkmann's sharp spoon, or other suitable scraping instruments, before applying the potent germicides mentioned above; these sharp spoons are made long and short, so that they may serve for superficial or deep abscesses, and they are strong enough for the treatment of sinuses in the interior of a bone.

The treatment of a chronic abscess is essentially the same as that of an acute abscess, but may in some respects be modified; thus it is not necessary to anticipate the period of incision by use of fomentation or poulticing; it is not a matter of importance that the incision should be a long one, provided that it be sufficient to admit a tube of sufficient calibre. On the other hand, it is perhaps of more importance that the opening should be made in a position which will favour drainage, and thus prevent the retention of matter in a diverticulum or pocket, and it is often a matter of great importance to scrape away the thick and very lowly organised pyogenic membrane, which is, in many cases, but little prone to take on a healthy reparative action. The reader is referred to the article on Antiseptic Surgery for the methods of managing both an acute and a chronic abscess. It may be pointed out, however, that it is not essential that elaborate machinery or complicated dressings should be employed in order to conduct the antiseptic treatment of an abscess rigidly from beginning to end; though, if they are at hand, it is no doubt better—especially in cases such as that of psoas abscess, where the life of the patient probably depends upon the maintenance of the aseptic state—that every possible known precaution should be employed.

The following plan is one which the writer can recommend for simple cases. Before making the incision, the skin, the instruments, and the operator's hands, are to be thoroughly purified with carbolic acid solution (1–20). A dressing has been previously prepared consisting of a piece of lint soaked through and through with an ointment consisting of Iodoform gr. lx., Ol. eucalypti fʒj., Paraffine fʒijss., Vaseline ʒijss. After making the incision, pressure is maintained over the abscess by the left hand of the surgeon, in order to prevent the regurgitation of air into it; and, if a drainage-tube be required, it is inserted, and the dressing is applied before this pressure is relaxed. Outside the piece of lint is placed a large pad of salicylic wool, iodoform wool, or carbolised tow, and the whole is secured with a bandage. The whole proceeding should be accomplished as expeditiously as possible, and when the dressing is changed, similar precautions should be employed, viz. a piece of rag is soaked in the carbolic acid solution, and as soon as the dressing is removed, it is placed over the incision. If the tube is to be removed, a few drops of the lotion should be allowed to fall on the wound whilst it is being taken out or returned. The piece of rag (guard) is applied while any necessary cleaning in the neighbourhood of the wound is taking place, and is then replaced by the deep dressing. After this the outlying parts are purified by the lotion, and lastly the absorbent outer dressing is reapplied as before. This simple process has been described in detail because there is a prevalent belief that there is no halfway-house between rigid Listerism and the most primitive form of poulticing; whereas, as was mentioned above, even a poultice may be rendered, in the strictest sense of the term, antiseptic. Many other and equally good plans will, no doubt, suggest themselves to the practical surgeon, in which, by the employment of iodine, benzoin, carbolized oil, or other materials, and by the exercise of a little common sense, he may keep even the largest abscesses free from putrefaction.

If the matter show a disposition to 'pocket' in an outlying part of the abscess, or if burrowing occur, it may be necessary to make a *counter-opening*, by which is meant a second opening in a position suitable for drainage, and at a distance from the first incision. This may often be accomplished by passing a probe from the original incision to the required point, and

cutting upon its extremity, which is made to project under the skin. If the pocket is a deep one, it may be advisable to force the probe, or better a stout metal bougie, through the superjacent soft parts, and, after cutting on its point, to follow back the track it has made either with the finger or a pair of dressing-forceps, by expanding the blades of which the second opening may be dilated. A tube is then inserted into the counter-opening. It is often convenient to pass a tube through from one opening to the other, and, after the track has contracted to a mere sinus, to cut the tube in the middle, and afterwards gradually shorten the two remaining portions. Several counter-openings may sometimes be required.

The *treatment of a sinus* depends upon its cause. If there be a source of permanent irritation at the bottom, it is obvious that the sinus cannot heal till this has been removed. If it depend upon insufficient drainage, this must be secured by enlarging the opening and inserting a drainage-tube, or by making a counter-opening. If it be merely the result of a sluggish action of the parts, this may be rectified by scraping the sinus with a sharp spoon; or by applying some irritating or stimulating material, such as a piece of lint impregnated with red oxide of mercury ointment, or by the injection with a solution of sulphate of zinc 2 grains to the ounce, or sulphate of copper 2 grains to the ounce, or some similar substance; or the application of the solid nitrate of silver, by coating a probe with this caustic. The healing of a sinus may often be promoted by the application of a blister over the orifice, and sometimes by the judicious use of pressure over the deeper parts.

RICKMAN JOHN GODLEE.

ABSCESS-KNIFE.—For the purpose of incising abscesses near the surface of the body, various forms of cutting instrument have been used. In a case of a purulent collection of slight extent, as a boil or a minute abscess, an ordinary bleeding lancet will be found a suitable instrument; whilst in large abscesses many surgeons make use either of a straight or curved bistoury, or of a stout scalpel with a broad and double-edged blade. The term abscess-knife, however, is restricted to two forms of instrument, of which one, known as Syme's knife, has a thin, slightly curved, and double-edged blade, whilst the other, known as Paget's knife, consists of a narrow, straight blade, attached to its handle by a thin metal stalk.

ABSCESS OF BONE, Chronic.—This is a disease of great practical and clinical importance, for complete relief can, as a rule, only be obtained by operation. It almost always occurs in the cancellous tissue at either end of a long bone, especially in the head or lower end of the tibia.

Causes.—Very little can be said definitely as to its causation. There is very frequently a history of an injury or accident, occurring some little time before the first symptom of the disease. The patients are oftentimes strumous subjects, and there is a suspicion in many that the disease is tubercular, although this has not yet been proved to be so in any considerable number of cases.

Pathology.—Chronic abscess of bone commences by rarefying ostitis of a localised portion of the cancellous tissue, the central part of which becomes fluid pus, with possibly a very small sequestrum. The changes by which this is effected will be found described under OSTITIS, NECROSIS, and OSTEOMYELITIS. The peripheral portion of the inflamed area frequently becomes very dense and hard, as in condensing ostitis, and tends to prevent the pus from coming to the surface. It may, however, gradually, in the course of years, work its way through the bone or from the first be more superficial, making itself evident as a fluctuating tumour beneath the skin. The part affected is almost always one of the ends of a long bone, the disease occurring with much greater frequency at either end of the tibia than in any other bone. It is also found in the lower end of the femur, and in the articular extremities of the humerus, ulna, or radius. Specimens are preserved in our museums of chronic abscesses in other bones, and a few instances are recorded in which the diaphysis of a long bone has been so affected. When it occurs, as it does most frequently, in the articular extremity of a long bone, there is a danger of its opening into the joint.

Symptoms.—More or less dull aching pain, which is much worse at night and in wet weather, is the prominent symptom of which the patient complains. On examination, a swelling will commonly be found at one or other extremity of a long bone. This swelling will be seen and felt to be due to an enlargement of the bone, unless the pus has already made its way through the cortical layer and formed a small area of fluctuation on the surface. Still, even in that case, the peripheral part of the swelling will be found to be produced by the enlargement of the bone beneath. Generally, how-

ever, the swelling is uniform, dense, hard, and resistant to the touch, and on firm pressure at one spot the patient will be found, almost without exception, to complain of extreme pain. This spot is generally not larger than a sixpence or a shilling, and is in about the centre of the swelling and on its most superficial aspect, as, for example, on the inner surface in the case of the tibia.

This tenderness on pressure is probably the most characteristic symptom of such a chronic abscess, especially when taken in conjunction with the increased size of the bone and the persistent pain at night. There may also be slight œdema of the soft parts over this tender area, so as to leave a mark of 'pitting on pressure.' The pain at night has generally existed a long time—for months as a rule—before an examination has led to the discovery of enlargement of bone and tenderness on pressure, and occasionally one or more years have elapsed before the diagnosis has been made.

Treatment.—If the pus has found its way to the surface so as to be superficial, an incision must be made, and the opening in the bone searched for. The osseous sinus is then enlarged, and the cavity in the articular extremity of the bone examined for a sequestrum. Fluctuation is not, however, often detected, and the trephine has to be applied to the most tender spot, and a circle of bone removed. The abscess will in this way generally be opened and a free vent given to the pus. Should this not be the case, the cavity may have been missed by the opening being made a little on one side. Esmarch's bandage will be found of great assistance in this operation, and should always be used, as the amount of pus may be very small and quite obscured by the blood, which otherwise freely flows from the highly vascular bone to which the trephine is applied.

If, notwithstanding this precaution, no pus has been seen during the operation, the sides of the aperture made by the trephine should be perforated by a drill, in the hope that the supposed cavity may in this way be discovered. Pus having been found, a free opening must be made into the cavity in which it is contained. If, however, these measures fail to discover any pus, the surgeon need not be disappointed, as the operation will almost certainly give relief by the removal of tension and abstraction of blood from the engorged bone.

As regards the method of dressing, antiseptics should, if possible, be employed. The cavity should be sponged out with chloride of zinc (40 grs. to f℥j.), and some absorbent dry dressing applied. Wood wool and corrosive sublimate gauze, or iodoform gauze with salicylic wool, are probably the best. If the above method has been properly carried out, there need be no fear of decomposition, and the dressing may not require changing for a week, or even longer. The cavity in the bone becomes in this way much more quickly filled up with rapidly organizing tissue than under the older method of dressing.

When the cavity in the bone has thus become filled with inflammatory new formation, fresh bone is rapidly reproduced, and the patient restored to perfect health.

H. H. Clutton.

ABSORBENT SYSTEM. *See* Lymphadenitis; Lymphadenoma; Lymphangitis.

ACARUS. Acarus Folliculorum.—A minute, wormlike grub which is found in healthy or diseased sebaceous follicles. In man it is harmless, but a variety exists in certain of the lower animals which causes boils. It varies in length from $\frac{1}{12}$th to $\frac{1}{8}$th of a line, and is eight or ten times as long as it is broad. It has a head, thorax, long abdomen, and four small legs on each side of the thorax. For microscopic purposes, it can be obtained by mixing sebaceous matter, collected from some of the larger follicles of the face or back, with an equal quantity of oil.

The parasite is not the cause of comedones, acne, or seborrhœa.

Acarus Scabiei.—This is the name given to the mite which is the essential cause of the disease known as the *Itch* or *Scabies*. *See* Scabies.

It belongs to the class Arachnoidea. There are both female and male acari, but the former is the one most easily found, as it can be dug out from the little cuniculus or tunnel in the epidermis into which it has burrowed, whereas the male can only, with difficulty, be discovered on the surface of the skin.

The full-sized female is visible to the naked eye as a white, semi-transparent speck. Under the microscope, it is seen to be oval in shape, slightly indented on either side, and about $\frac{1}{80}$th of an inch long by $\frac{1}{160}$th of an inch broad. Its convex dorsal surface is covered with little spines, while its flat ventral surface is characterised by wavy furrows running from side to side. The head is small and oval, and on it are minute hairlike processes. The legs, which are clearly seen on the ventral surface, are eight in number, four being situated an-

teriorly, near the head, the remaining four on the posterior half of the body. The front legs are short and broad, and provided with suckers; the posterior ones being slightly longer and narrower. Bristles are seen both on the body and on the legs. The male is much smaller than the female, has suckers on the hindermost pair of legs, between which are the organs of generation. Inside the cuniculus or burrow, the female acarus lays from twelve to twenty eggs, from which are hatched the young acari. At first they have but six legs, and only become fully developed after shedding their skins three times.

MALCOLM MORRIS.

ACCOMMODATION OF THE EYE.

When the eye is completely at rest it is focussed for one definite distance only; that distance is called the *far point* (F). But it is well known that, during the greater part of life, we have the power of seeing distinctly, and therefore of focussing objects, at different and nearer distances. This is called the *Power of Accommodation*. The nearest point to our eyes for which we possess the power of accommodating is called the *near point* (N). It is evident that, other things being equal, it requires a stronger lens, or a stronger system of refractive media, to bend the rays proceeding from a point near the eye, sufficiently to bring them to a focus on the retina than is required to focus those coming from a more distant point. The *range of accommodation*, then, is given by the difference between the refractive power when the eye is accommodated for the near point, and when it is at rest or adapted for the far point. It is clear, therefore, that the range of accommodation is equivalent to, and may be expressed by, a lens the optical strength of which is equal to that difference. Such a lens, if placed in front of the eye *at rest*, would evidently give to rays proceeding from a point at a distance from the eye, equal to the distance of the near point (N), a direction similar to those proceeding from the far point (F). The eye being at rest, the rays would be focussed on the retina, so that the lens would take the place of accommodation.

The actual position of the near point will depend upon: 1. The range of accommodation; 2. The position of the far point. The first is evident from what has been said, and it need only be added that in all individuals the range of accommodation is approximately the same at the same age, though it varies very much with age; thus whilst at ten years of age it is equal to a lens of 14 dioptres; at forty it is only equal to one of 4·5 D, and at seventy-five is = 0. The far point, or the point for which the eye, when at rest, is focussed, cannot always be represented by an actual point in space; this can evidently only be the case when the far point lies at a *finite* distance *in front* of the eye, and is therefore one from which the rays are divergent as they enter the pupil, as in Myopia (*see* REFRACTION, Errors of). The ideal or emmetropic eye is focussed for a point the rays from which enter the pupil parallel to each other; such a point must be at an *infinite* distance, and has therefore no reality in existence, although the divergence in the case of rays whose base is the pupil and whose apex is a point at the distance of 20 feet, is so slight as to make them *practically* parallel. We have so far, then, two forms of eye, in one of which the rays from the far point are more or less appreciably divergent (myopic eyes), and in the other parallel (emmetropic eyes). But this does not exhaust the possibilities: one other form is met with, in which the rays, in order to be focussed by the eye at rest, must enter the pupil converging to each other, and therefore converging towards a point which lies at a finite distance *behind* the eye. In such eyes (hypermetropic eyes) the far point lies behind the eye, and is evidently not an actual, but only an imaginary, point.

From what has been said, it is evident that we may represent the *breadth* or *amplitude* of accommodation by the lens which brings the focus from the far point to infinity (∞), *plus* the lens which represents the difference between the refractive power for focussing an object at ∞ and that necessary for focussing one at the near point. The lens which brings the focus from F to ∞ is *practically* determined by the lens which, when the eye is at rest, gives the fullest possible acuity of vision at twenty feet (*see* VISUAL ACUITY). In emmetropic eyes no lens is required; in myopic, a concave or *minus* lens; in hypermetropic, a convex or *plus* lens. As an example, take the lens bringing the focus from F to ∞ in three cases of Emmetropia, Myopia, and Hypermetropia, viz., 0. − 2·0 and + 2·0 (dioptres) respectively, and the lens giving the difference between ∞ and N in each case as 10·0, 12·0, and 8·0; we have for the breadth of accommodation (A)—

$$A = 10{\cdot}0 + 0 = 10 \text{ E.}$$
$$A = 12{\cdot}0 + (-2{\cdot}0) = 10 \text{ M.}$$
$$A = 8{\cdot}0 + 2{\cdot}0 = 10 \text{ H.}$$

i.e., the *breadth of accommodation* is the same in all these cases, although the *near point* is different in each case, nearer than normal in myopia, and farther off in hypermetropia.

Mechanism.—The change produced in the refractive power of the eye, which brings about accommodation, is effected by the contraction of the ciliary muscle and the elasticity of the lens. On contraction of the muscle, the lens, more particularly in its anterior surface, assumes, owing to its elasticity, which comes into play when the tension on its capsule is reduced, a greater curvature, thereby increasing its refractive power. G. A. Berry.

ACCOMMODATION, Disorders of.—The change in the refracting power of the eye, produced by accommodation, may be looked upon as the result of the simultaneous action of two factors, the one a contraction of the ciliary muscle, and the other an alteration in the shape of the crystalline lens. This latter, which takes place in response to the diminished tension of the lens-capsule, a result of the contraction of the ciliary muscle, is the expression of the elasticity of the lens. The degree of perfection of the lenticular elasticity depends upon its structure and chemical constitution. The functional activity of either factor, in the production of accommodation, may be altered. The power of contraction in the ciliary muscle may be lost or impaired by atrophic or inflammatory changes, such as glaucoma, cyclitis, &c. Or, again, it may cease to be brought into play, owing to some interrupted function in the nervous mechanism with which it is supplied. On the other hand, a diseased state of the lens may diminish its elasticity; or disease of, or accident to, the zonule, alter or destroy the conditions by which, under normal circumstances, that elasticity responds to changes in the shape and position of the ciliary muscle when contracted. The lesion, giving rise to such an interruption, may be at a considerable distance from the muscle, and produce the functional disorders by interfering with the normal reflex mechanism giving rise to accommodation. Or it may exist at the centre, in the trunk of the third nerve, in the ciliary ganglion, or in the peripheral terminations of the ciliary nerves.

Paralysis.—All the conditions mentioned tend to diminish the amplitude of accommodation, or deprive the patient of the power of accommodating altogether. But the term *paresis* or *paralysis of accommodation* can only properly be applied to such cases as owe their origin to more or less impeded innervation. Some acute diseases are apt to be followed by more or less complete paralysis of accommodation, more especially diphtheria, and enteric and typhus fevers. Chronic diseases may also exhibit this symptom, such as syphilis, diabetes, various central and reflex nervous disorders, &c. Further, this form of paralysis is produced by some poisons, putrid fish or meat, and mydriatics (those principally employed in ophthalmic practice being atropine, homatropine, duboisine, daturine, and hyoscyamine).

The *diagnosis* of paresis of accommodation, if slight, is not always easy; but it is always to be suspected when there is pronounced diminution in the amplitude of accommodation, which should correspond to the age of the patient, provided, of course, the diminution is due to a recession of the near point, while the far point remains unaltered. Whenever distant vision remains unchanged, or, if improved at all, improved only by convex glasses, whilst distinct vision for near objects has suddenly become impossible, or rendered more difficult, then we may conclude there is more or less paresis of accommodation. Often, too, there is more or less mydriasis, which assists the diagnosis. Not infrequently children suddenly lose distinct vision for distant as well as near objects, owing to the paralysis of accommodation rendering an existing hypermetropia absolute.

The *treatment* should be general and tonic (according to the cause), and we may sometimes hasten a cure by the careful use of myotics; some believe, too, in faradisation and strychnia.

Spasm.—The amplitude of accommodation may also be diminished owing to *spasm of the ciliary muscle.* The spasm is either constant (a very rare condition), or occasional, and occurring during efforts of fixation. It generally occurs simultaneously in both eyes, rarely unilaterally. Spasm of the ciliary muscle occurs reflexly along with congestion myosis, and is excited by irritable states of the conjunctiva, cornea, and iris, and often associated with retinal hyperæsthesia. It is met with as a rare concurrence in some cases of errors of refraction and disturbances of the cervical sympathetic. Various toxic agents also bring about spasm of accommodation, principally the so-called myotics (those used for this purpose are eserine, pilocarpine, and

muscarine). There is not much difficulty in diagnosing the condition. The diagnostic points are—abnormally small amplitude of accommodation, along with more or less myosis, and marked recession of the far point under the influence of mydriatics.

The treatment consists in keeping the eyes at rest: the removal of all sources of irritation, whether direct, indirect, or reflex; the use of mydriatics, and, if necessary, the accurate correction of errors of refraction.

It has been shown that in both paresis and spasm of accommodation therefore, there is to be found a diminution in the amplitude of accommodation. In paresis this is due to the recession of the near point, the far point remaining stationary; whilst in spasm the opposite takes place, the far point being brought closer to the near point, which here remains stationary (sometimes indeed approximating to the eyes slightly).

The effect of a weak myotic is often to increase the amplitude of accommodation, by increasing the contractile power of the muscle, allowing thereby the near point to approach more to the eye whilst, there being no actual spasm, the far point remains stationary.

The diminution of elasticity, as well as the change in the total refractive index of the lens, which begin at about the age of ten, and continue throughout life, both give rise to a gradual decrease in the amplitude of accommodation. When the amplitude has been reduced to an amount leaving a residue equivalent to a lens of less than 4·50 dioptres, the condition known as presbyopia or old vision is said to exist, a condition which, although in one sense a disorder of accommodation, is one which is in no respect pathological. *See* PRESBYOPIA.

G. A. BERRY.

ACEPHALO-CYST. *See* HYDATIDS.

ACHORION SCHÖNLEINII is the name given to the vegetable fungus which constitutes the greater part of the yellow crusts of favus. A small piece of the crust, treated with liquor potassæ, and examined under the microscope (magnified 500 diam.), shows the parasitic fungus to consist of spores and mycelium threads in great abundance. The spores consist of minute rounded bodies, the mycelium of long, narrow, thread-like tubes, which curve and branch in various directions. Some of the mycelium filaments appear to contain spores, while others are empty; free spores are also met with in abundance.

ROBERT LIVEING.

ACHROMATOPSIA. *See* COLOUR-BLINDNESS.

ACIDS, Swallowing of.—The only acids which, when swallowed, produce effects that are of surgical importance are the corrosive acids. The strong mineral acids (*sulphuric*, *nitric*, and *hydrochloric*) cause the most serious results. *Hydrofluoric acid*, which has been very rarely swallowed, also has a corrosive action, as have likewise *carbolic* and *oxalic* acids, but these latter are of more interest from their toxic, than from their traumatic, effects. Strong sulphuric acid, or oil of vitriol, is the acid which is most commonly taken. It may be deliberately swallowed with suicidal intent, or may be administered with murderous intent, or it may be swallowed accidentally in mistake for castor oil, or some other medicine or a liqueur. The result which follows on the swallowing of oil of vitriol, or other strong acid, depends more upon the concentration of the acid than the actual quantity taken. A teaspoonful of strong acid will produce results more serious than three or four times the quantity if previously diluted.

Symptoms.—Marks of the corrosive liquid are often seen at the angles of the mouth, and dirty white stains may be observable on the tongue and throat. There is at once a sharp burning taste in the mouth and throat, quickly followed by excruciating pain in the abdomen. The strong acid has a great affinity for water, and as it enters into combination with the water of the tissues, the heat evolved is intolerable. Vomiting is common in the early stages. The vomit is acid, and may cause effervescence if it fall on a limestone pavement. The patient is soon reduced to a state of collapse, which is extreme if perforation of the stomach takes place (*see* COLLAPSE). There is usually constipation, but, exceptionally, there may be some tenesmus and passing of shreds of mucus, and small quantities of altered blood and similar matters, as well as the contents of the stomach, may also be vomited. The urine is usually diminished in quantity, and is loaded with sulphates when sulphuric acid has been taken.

The *prognosis* is always grave. It depends upon the amount and strength of the acid taken, and on the state of the stomach (whether full or empty) at the time. A small quantity of strong acid in an empty stomach is necessarily very likely to lead

to perforation. When perforation occurs, death takes place within a few hours. If the air-passages are affected by the acid—if, for example, some finds its way to the glottic aperture—suffocation may soon follow the inflammatory swelling of the mucous membrane. If the stomach be not perforated, and if the air-passages escape, the patient lives longer. Death from collapse may occur, even though no perforation takes place. Death may result at a more remote period from inanition, resulting either from the destruction of the glandular structure of the stomach, or the occlusion of the œsophagus by the contraction of a cicatrix, the result of the corrosive action of the acid. *See* Œsophagus.

Treatment.—In treating these cases, it is very essential to bear in mind that the patient is necessarily in danger of perforation. The stomach-pump must *not* be used, nor any emetics be administered; but no time should be lost in endeavouring to neutralise the acid by the administration of alkalies. The carbonates of the alkalies should not be employed, lest the stomach, already in danger of perforation, be burst by the disengagement of carbonic acid gas. Calcined magnesia, stirred up with water or lime-water, or liquor potassæ, freely diluted, are the best antidotes. If these be not at hand, the plaster off the walls or ceiling may be given, powdered and suspended in water. If none of the alkalies are at hand, it is probably advisable to give the carbonates (e.g. washing soda), as the danger of keeping the acid undiluted is certainly greater than that arising from the disengagement of carbonic acid in the stomach. If neither the alkalies nor their carbonates be obtainable, the mere dilution of the acid may be aimed at. Copious draughts of milk, or milk and water, or even water alone, may be given; and oily or mucilaginous drinks are recommended as a protection to the coats of the stomach. If the patient be collapsed, it may be necessary, after the severe corrosive symptoms have subsided, to administer stimulants by the rectum.

The symptoms arising from taking the other corrosive acids are in the main so similar to those of sulphuric acid that it is hardly necessary to enter into the details again. Nitric acid, owing to the fact that it evolves irritating fumes, is very prone to attack the air-passages, and, after the corrosive symptoms as affecting the alimentary tract have subsided, the patient may succumb in the course of a few days to bronchopneumonia. Perforation does not occur quite so readily with nitric as with sulphuric acid. The nitric acid forms a tough yellow slough by its action on the mucous membrane. This separates after a few days, and the patient may vomit a cast of the œsophagus and stomach. This involves destruction of the glandular structure and ultimate death from inanition, if, indeed, perforation do not follow on the separation of the slough. G. V. Poore.

ACNE.—*Synonyms:* Acne vulgaris; Acne disseminata.

Definition.—Acne is a chronic disease of the skin, confined to the face, back, and shoulders. It is met with chiefly in young adults. The eruption consists of pimples, which are produced by an inflammation of the sebaceous glands and hair-follicles. The disease leaves small depressed scars.

Symptoms and Pathology. — Many qualifying names have been applied to common acne, such as 'simplex,' 'punctata,' 'indurata.' These names indicate the varying appearance of the eruption, and its different degrees of severity, rather than varieties of the disease.

Common acne is so constantly associated with comedones that it is almost impossible to deal with the two eruptions separately. A comedo consists of a hair-follicle, distended by a small mass of inspissated sebum mixed with *minute hairs*; these minute hairs are shed within the follicle, and in course of time accumulate in considerable numbers; they become matted together with sebum, and thus the natural escape of the sebaceous matter is prevented; a little black spot marks the orifice of the distended follicle. Subsequently inflammation occurs, and the comedo becomes converted into an acne pimple, which ultimately suppurates, discharges its contents, and heals with the formation of a small depressed scar. All acne pimples are not formed in this way, as inflammation may arise in the follicles without the previous formation of comedones; and, in very severe cases a more deep-seated inflammation occurs, producing a kind of blind boil which is very slow in suppurating. In theory, acne may appear on the skin of any part of the body, except the soles and palms, which are free from sebaceous glands and hairs; it is, however, rarely met with except on the face, neck, shoulders, back, and chest. Acne develops in successive crops which follow each other in quick succession, so that we see in any given case pimples in all stages of development and decay, from the early comedo to

the final process of scarring; thus the *disease*, taken as a whole, is *chronic*, though the course of any one spot may be acute.

Etiology.—Acne, which is equally common in males and females, usually appears at the age of puberty, and arrives at its full development at about the age of eighteen or twenty; a few years later it has generally disappeared. In severe cases, however, it may continue to a much later period of life. It is met with, for the most part, in young people who have what is called a sluggish circulation, and who suffer from cold hands and feet, and sometimes chilblains. Acne is, moreover, much less troublesome in summer than in winter —indeed, it often disappears altogether during the height of summer, to return with the ensuing winter.

Varieties of Acne.—One variety of acne requires a brief notice. It apparently consists of groups of comedones, and is unattended with any *visible* inflammation; it is followed, however, by a very superficial kind of ulceration and scarring, giving to the skin an appearance which can best be described as a worm-eaten look. The scars are very shallow, clean cut, and different in appearance from those of ordinary acne.

Diagnosis.—The differential diagnosis of acne is usually very easy when the age of the patient and the history and distribution of the eruption are taken into consideration. The only eruptions with which it is at all likely to be confounded are (1) certain forms of dermato-syphilis, and (2) acne rosacea. The presence of comedones, and the absence of any symptoms of syphilis, will serve to separate it from the former, while the age of the patient and the absence of burning sensations and itching, will assist in distinguishing it from the latter.

Allied Diseases. — Certain eruptions allied to acne are usually classed with it — (1) acne artificialis, (2) acne varioliformis. The former of these is simply a convenient, though inexact, term for certain medical rashes resembling acne, such as those sometimes produced by bromide or iodide of potassium, or the local application of tar to the skin. Acne varioliformis is a rare, but well-defined, affection resembling acne; it is confined, for the most part, to the forehead and hairy scalp; the pustules, which are of uniform and rather large size, form scabs and deep scars like those of smallpox. This eruption is generally regarded as of syphilitic origin, and, without doubt, there is a form of dermato-syphilis which closely resembles it. But the eruption referred to is not a syphilitic one, as is shown by its occurrence in those who have never had syphilis, and also by the fact that it does not generally yield to anti-syphilitic remedies, but rather to large doses of arsenic. It is, however, a very obstinate affection.

Treatment.—An ordinary case of acne is best treated in the following manner :— A sulphur ointment (ʒj. to ʒj.) should be well rubbed on the skin affected every night; it should then be lightly wiped off, so as to allow only a small quantity of the ointment to remain on all night. In the morning the ointment should be washed off with a soft flesh-brush, soap, and warm water; if the skin is tender, a little starch powder may be applied to the face during the day. This plan of treatment must be continued for months or years according to circumstances. Instead of using an ointment, a drying sulphur lotion, containing a little ether and spirit, may be used, but very little of the sulphur in the form of powder should be allowed to remain on the face, otherwise it is apt to get into the eyes and produce irritation. When sulphur does not suit the skin, a weak soap lotion (soft soap ʒiij., proof spirit fʒviij.) may be applied every night, and a little allowed to dry on; this should be washed off in the morning with warm water in the usual way. In very severe cases of acne, the larger acne pimples should be lightly touched with a small blunt-pointed piece of wood, dipped in pure carbolic acid; this must be done carefully, so as not to allow the acid to run down the face; a few spots should be touched daily; this process causes the pimples to dry up, and thus tends to diminish the formation of deep scars. In most cases of acne, the administration of cod-liver oil during cold weather will be found beneficial. Small doses of arsenic are also sometimes useful.

ROBERT LIVEING.

ACNE ROSACEA. — *Definition.* — Acne rosacea is a chronic disease of the skin of the face, a characteristic feature of which is a passive congestion of the vessels, associated with sensations of burning and itching and the formation of pimples.

Symptoms and Pathology. — Acne rosacea has little relation to acne vulgaris, except in name and appearance. The eruption, which is confined to the face, is met with chiefly in women of middle age. It has one feature in common with acne vulgaris, namely, its great tendency to appear in those whose cutaneous circulation is

sluggish, that is, who suffer from cold hands and feet and passive venous congestion. Hence it is that those who have had acne vulgaris in early youth are very liable to acne rosacea in middle life.

It is usual to describe two forms of acne rosacea: (1) the *hypertrophic form*, which is comparatively rare and chiefly met with in men; and (2) the *non-hypertrophic form*, which is very common and almost confined to women. The former consists in an increased growth of the fibro-vascular tissue of the nose and adjacent skin of the face; in severe cases the nose is much enlarged, nodulated and red. This hypertrophy is generally associated with the development of acne-like pimples. The disease is often, but by no means always, the result of over-indulgence in alcohol. Long and frequent exposure to cold winds in those whose cutaneous circulation is feeble, is very apt to produce a similar result, though in a less degree.

The *non-hypertrophic* variety of acne rosacea is very common. In its mildest form it consists simply of a passive over-distension of the vessels of the skin of the nose and cheeks, forming a pretty well-defined symmetrical red patch; the congestion may vary much at different periods of the day, but is generally aggravated after a meal and during the evening. Besides the nose and cheeks, the chin and forehead are often affected. In a more advanced stage, the congestion becomes more persistent and small red pimples appear, resembling those of acne vulgaris. The eruption is almost always accompanied with sensations of burning and itching, especially the former.

Etiology.—One cause of acne rosacea has already been referred to. A much more common cause is chronic indigestion associated with a feeble circulation. It is not uncommon to find all the symptoms of the disease aggravated every month at the period of menstruation, and the age at which that function altogether ceases is especially liable to its attacks.

Diagnosis.—Acne rosacea is hardly likely to be mistaken for any other disease except acne vulgaris. The age of the patient, the congestion of the skin, and the subjective sensations which are almost always present, serve to distinguish it from the latter disease.

Treatment.—The treatment of the hypertrophic form of the disease consists in the free division of the vessels; this relieves the congestion, and at the same time gradually gets rid of the new vascular tissue; at the same time, complete abstinence from alcohol must be enjoined. The non-hypertrophic variety of the disease arises so often from indigestion, that the greatest attention should be given to diet, rest, and those medicines which are generally useful for improving the digestive powers. Mild saline purgatives are sometimes very beneficial, especially when the bowels are naturally constipated. The most generally useful local application is the ordinary calamine and oxide of zinc lotion, to which a small quantity of sulphur has been added. (Oxide of zinc, ʒij.; calamine, ʒij.; precipitated sulphur, ʒss.; rectified spirit, fʒss.; glycerine, fʒij.; lime water, fʒij., rose water to fʒviij.). Robert Liveing.

ACROCHORDON is a small outgrowth of the skin, consisting of a minute thread or cylinder of fine fibrous tissue, containing small vessels. When cut across, these vessels sometimes bleed freely. Acrochordon is met with chiefly on the loose skin of the neck. The treatment consists in snipping it off with a pair of scissors, and then lightly touching with caustic.

Robert Liveing.

ACROMION PROCESS, Fracture of the. *See* Scapula, Fracture of the.

ACUPUNCTURE may be performed, according to circumstances, with a round-pointed or sewing, or with a cutting-edged or surgical needle. Its uses are various: as a stimulant; as a counter-irritant; for the purpose of evacuating or dispersing fluids from various parts of the body; and the term may also be applied to the use of needles in the operation of tattooing, which is almost confined to ophthalmic practice. With regard to the use of acupuncture for the purpose of evacuating fluid in cases of anasarca, the practice is so well known as hardly to call for any remarks; and the same may be said with respect to its use in dispersing the contents of certain encysted collections of fluid, such as hydrocele and ganglia. In the latter case, however, a cutting-edged needle must be used to ensure a successful result; whereas in dropsy a round-pointed needle is sufficient, and in fact preferable, as being less likely to inflict injury upon the skin. But the term acupuncture is more generally applied to the use of needles for the relief of various painful affections, such as neuralgia, and muscular pain and stiffness consequent upon injury or chronic rheumatism. For this purpose the needles should be flexible, with handles or heads made of bone, glass,

sealing-wax, or twisted wire; they should be introduced with a slight rotatory movement, or by a succession of light taps. This practice has for ages been popular amongst the Orientals, more especially the Chinese and Japanese, in whose hands the effects are said to be marvellous; but the records of English surgery do not throw much light upon the subject. It is true that its use in the treatment of obstinate sciatica is well recognised, but its success has been by no means constant. For this purpose the directions usually given are, that the tender part of the nerve having been ascertained by pressure, the needle is to be thrust in until it is felt by the patient to have entered the nerve, and there left for a few minutes. Erichsen says that five or six needles may be introduced at one operation. The mode of action is uncertain, but one explanation is that tension is relieved by the puncture of the nerve-sheath. In the recent edition of Agnew's *Surgery* (vol. ii. p. 265) is shown an instrument for producing superficial acupuncture in the treatment of local pains; but here the effect may be clearly defined as counter-irritant.

Regarding the use of acupuncture for the relief of chronic muscular pain and stiffness, more especially where arising from injury, probably the best account will be found in the *Lancet* for April 29, 1871, in a paper by Mr. Pridgin Teale, 'On the Relief of Pain and Muscular Disability by Acupuncture,' in which he relates several cases where the thrusting in of a needle in two or three places until the bone was touched, and leaving it there for a minute or two, was followed by complete cure in one instance, and relief in three or four more out of ten cases, and explains his view of the mode of action. Also Mr. Simeon Snell, of Sheffield, in the *Medical Times and Gazette* (June 9, 1880), relates several cases of loss of power of the deltoid, which he treated successfully in the same manner. Acupuncture has been used in the treatment of ununited fractures. Here the object is to set up irritation and increased vascularity, and the needles should be left in for several days. In a case related by Wiesel (mentioned in Holmes' *System of Surgery*), they were left in for six days, until they caused pain and swelling, and the result was successful. Malgaigne tried this plan, but unsuccessfully. The difficulty is to get the needles between the ends of the bone.

Lastly, acupuncture has been tried in the treatment of aneurism. Originally suggested by Velpeau, it was practised with a successful result by Benjamin Phillips, of London, in 1831, in a case of carotid aneurism. In more recent times (January 1879), it was tried by Mr. Christopher Heath, in a case of traumatic aneurism of the subclavian, where amputation at the shoulder-joint had failed. He 'introduced three pairs of sewing needles into the tumour, making each pair cross within the sac; they were not withdrawn until the fifth day, by which time considerable clotting had taken place.' The aneurism gradually became solid; but bronchitis supervened, and the patient sank seventeen days after the insertion of the needles. The post-mortem examination showed that the aneurism was cured, the sac being full of dense fibrin. Encouraged by the result in this case, the writer of this article tried the same plan in a case of aneurism at the root of the neck, occurring in a man thirty-three years of age, who was under his care in the Liverpool Northern Hospital, in the early part of 1880. Mr. Heath's plan was as nearly as possible carried out accurately; but as there was no apparent effect at the end of four or five days, other needles were inserted, as the first were withdrawn, but at different parts of the swelling. As each needle was withdrawn, a few drops of blood escaped from the puncture, which was at once covered with styptic colloid. This procedure was carried out for several weeks, with the result that the tumour became firmer and the pulsation feebler; then the aneurism became smaller, and finally almost disappeared behind the sternal end of the clavicle. Unfortunately, some chronic cellulitis had been set up by the needles, and just at the time when success seemed to have been attained, a slight sanio-purulent discharge occurred from one of the needle-holes which reopened. The same evening the temperature rose, vomiting occurred (evidently due to septicæmia), and as a result of the vomiting the sac must have given way, for the swelling suddenly became diffuse, and several of the needle-punctures reopened, giving vent to broken-down clot and fresh arterial blood, and, in the course of less than forty-eight hours after, the patient died. A post-mortem examination revealed an aneurism of the innominate artery, the collapsed sac of which would have contained a small hen's egg; this sac had evidently recently given way, and the aneurism had become diffuse, forming a large cavity in the lower part of the neck containing fluid blood, fresh clots, and one

large mass of old and thoroughly organised hard clot which had obviously filled the true aneurism, and escaped when the rupture of the sac occurred. This case, together with Mr. Heath's, may be taken as evidence that acupuncture is worthy of consideration in suitable cases of aneurism; but the writer feels that his own case is furthermore a warning against pushing this treatment too far. It would be better to wait patiently the result of the first introduction of the needles before proceeding to insert others.

Acupuncture has also been used in the treatment of cirsoid aneurism, but as in most instances it has been tried in combination with the galvanic current, its use in such cases can hardly be considered here, although Professor Billroth, its principal advocate, attributes the success in his three cases of galvano-puncture to the acupuncture only. CHAUNCY PUZEY.

ADAMS'S OPERATION.—An operation for the subcutaneous division of the neck of the femur in cases of angular osseous ankylosis of the hip-joint. *See* HIP-DISEASE.

ADENIA. *See* LYMPHADENOMA.

ADENITIS. *See* LYMPHADENITIS.

ADENOMA.—An adenoma is an encapsuled tumour, containing in its structure the textures found in glands, and commonly those of a racemose gland, and it generally occupies a position on the periphery of one of the complex secreting glands, the mammary region being by far the most frequent site of adenomatous growths. Some of the prostatic enlargements are tumours of this kind, and occasionally they are found in the lips and cheeks. The parotid is a common position, but here adenomata not infrequently contain cartilage, as also do those which less frequently occur in the sub-maxillary region.

Cause.—No cause capable of demonstration can be assigned for the occurrence of adenomata. It has been suggested, from the circumstance of such tumours appearing, or rather taking on growth, during the period of functional activity in the adjacent gland, that they are congenital, having remained dormant during early life. Some force is lent to this suggestion by the fact that some of the mammary adenomata shrink and seem to disappear with the occurrence of atrophic changes in the mammary gland itself.

Pathology.—For a tumour growing in proximity to a gland to be regarded as an adenoma, it must possess the histological characters of gland-structure, and usually, as has been noticed, that of a racemose gland, with its grouping of acini, tubules, and lobules. *See* BREAST, Diseases of the.

Symptoms and Diagnosis.—These vary so entirely with the situation of the adenoma, that it is an impossibility to give any general description of the external characters of this class of tumour which should hold good for chronic mammary tumours, for an adenoma of the lip, or of the encysted tumours of the prostate. As the mammary region supplies the greater number of gland-tumours, a description of one of these will indicate the clinical features of adenoma sufficiently.

In size adenomata vary from a hazel-nut to a walnut, and are usually found in young unmarried women; they are rare after the age of forty. They are usually firm and irregularly ovoid; they do not adhere to the skin, or cause dimpling of it. They are very freely movable, but nevertheless are seemingly attached to the adjacent mammary gland. Sometimes they are contained within the substance of the gland, or cause a depression on its surface, and they rarely afford any feeling of fluid. When pain is complained of, it is usually paroxysmal or neuralgic, and there is frequently complaint of some increased fulness and tenderness at the menstrual periods. Often they remain stationary for years, and then enlarge, or with disappearance of the menstrual flux they may shrivel.

As a rule, the *diagnosis* is easy. A limited isolated tumour, not very hard and without lymphatic affection, can scarcely be taker for a carcinoma. Rarely is the sense of fluctuation obtained, but a quickly-growing adenoma in the substance of the breast may be mistaken for some one of the cyst-formations found in this organ. So, again, it may not be possible to tell before removal whether a tumour is a quickly-growing adenoma or a sarcoma.

In later life, however, it is not always easy by examination alone to say whether a firm swelling is an adenoma or a small circumscribed scirrhus-growth of a portion of the margin of the gland. Due attention to the duration, the age, and the history, will generally enable a correct diagnosis to be made.

Treatment.—If decidedly increasing in size, if disfiguring, if the pain is so great as to cause distress to the patient, or if the

mental anxiety at discovering a tumour in the breast affects the health, it will be well to advise the removal of an adenoma. On the other hand, in the absence of any of these circumstances, the patient may be told that the growth is quite innocent in its nature, and that, so long as it is not a source of annoyance, there is no object to be gained by an operation. In these cases, and in others where the patient shrinks from an operation which the surgeon can seldom truthfully say is imperatively demanded, much relief may be obtained by insisting on the abandonment of all such dresses or other garments as press upon the tumour, and by protecting the part from ever-repeated self-examinations of the swelling, which only irritate the part and disquiet the mind; nothing answers this purpose better than a belladonna plaster, kept on for two or three weeks. Temporary restraint of the use of the arm by the adoption of a sling may be advised when there is shooting pain, referred, it is to be presumed, to the inner side of the arm. The patient should be strongly urged to dismiss all thoughts of the swelling from her mind. Of course, many points in the patient's general health may need attention, and signs of indigestion, habitual constipation, irregular, scanty, and painful menstruation, should be at once attended to. A. Willett.

ADHESION.—The growing together of living tissues, healthy or diseased. Physiological adhesion is the basis of reparative surgery; pathological adhesion is one of the most fertile and potent factors in the development of surgical complications.

Healthy adhesion of divided tissues is the continuous work of normal nutrition, commencing so soon as divided surfaces or parts are restored to, and maintained in, accurate contact. As divided parts approach most nearly to the state of health, their reunion is proportionately rapid, painless, and firm. Foreign bodies and impurities, tension and unrest, are causes of nervous and vascular irritation; and, to an equal extent, impediments to direct adhesion. This is illustrated in all the operations of plastic surgery, and generally in the healing of wounds, whether of the soft or hard parts. *See* Fractures; Wounds.

When the physiological standard is departed from, and excess of vascular and nutritive activity reaches the inflammatory stage, adhesion may still occur; and often does so, under those circumstances, to a very great extent. But adhesive inflammation is strictly a pathological process, and a cause of diseased conditions. Cicatrices, when adherent to subjacent parts, and especially to bone after amputation, are often causes of lifelong trouble. Injuries into, and in the neighbourhood of, joints, are followed by impairment of motion, in proportion as synovial membranes and tendinous sheaths become adherent. Bands and layers of lymph deposited within the abdomen are frequent causes of internal strangulation, and serious complications of ovarian and uterine disease. The ophthalmic surgeon also has abundant evidence of the mischief worked within the eye by pathological adhesion.

Nevertheless, the process of adhesion surpassing the physiological limits often has a preservative tendency, which the surgeon may utilise with the best results. Bullets and other foreign bodies which sometimes remain painlessly within the body for years, do so in virtue of the inflammatory process which they excite, and the adhesive products therefrom resulting. Internal abscess, aneurism, phlebitis, and ulceration may be rendered comparatively harmless by inflammatory adhesions. In arresting hæmorrhage from divided arteries, in treating intestinal wounds, in the radical cure of hernia, hydrocele, nævus, and varix, the surgeon relies on his power to produce inflammation, within the limits of adhesion. So directed and restricted, inflammatory adhesion is a therapeutic resource, often as beneficent and enduring as is painless and physiological adhesion.

Sampson Gamgee.

AINHUM.—This disease occurs in negroes, especially those of Brazil and Bahia. It affects the little toes chiefly, and appears to consist in a fatty degeneration of all the tissues, commencing without pain, and not affecting the general health. A groove gradually extends round the root of the toe; the parts beyond this are much increased in size, become looser and looser, and interfere with walking.

Treatment.—Amputation.

W. H. A. Jacobson.

AIR IN CELLULAR TISSUE. *See* Emphysema.

AIR IN VEINS.—*Pathology.*—The entrance of air into veins through a wound in their parietes is an exceedingly grave accident. The occurrence may give rise to a train of the most serious symptoms, or may lead to an almost sudden death. The air is drawn into the thorax through the wound in the vein by the inspiratory move-

ment of the chest, just as it is drawn into the lung through the trachea. It enters the right auricle of the heart, and that cavity, after death, will be found to be quite distended by a frothy mixture of blood and air. The same froth will be found in the superior vena cava and the innominate veins. The air may make its way into the right ventricle, and a small quantity may even penetrate as far as the pulmonary artery and its branches. Death in these cases appears to be due to arrest of the pulmonary circulation and to interference with the heart's mechanism. For the proper working of the tricuspid and pulmonary valves it is necessary that the heart should be occupied by fluid blood. The valves cannot act in a mixture of air and blood, and with the cessation of their action the proper movement of the heart ceases. The circulation of blood through the lungs must be suddenly interrupted when this accident occurs, and as but little blood can reach the left ventricle, anæmia of the brain and of other parts must be produced.

The aspiratory effect of the thorax upon the venous circulation does not appear to extend beyond the vessels of the neck and axilla. The isolated cases, in which air is said to have been drawn into the thorax through wounds in such veins as the median basilic and the long saphenous, are open to considerabl doubt. The cervical veins have been much more frequently the seat of this accident than the veins of the axilla.

That air may enter it is necessary that the vein be only partly divided, or, if entirely divided, that its lumen be kept open by the adhesion of the vein-walls to the adjacent parts. If a normal vein in the regions in question be entirely cut across, its limp walls are drawn together during an inspiratory movement and its lumen is more or less entirely closed. This closure is really effected by atmospheric pressure, and can be well seen in drawing air along a thin india-rubber tube, a part of whose wall has been divided. Veins whose walls are thickened are apt to favour the entrance of air, as are also such vessels as are bound up in inflammatory material or in the substance of a new growth. The external jugular vein, moreover, is so related to the cervical fascia, and the axillary vein to the costo-coracoid membrane, that these vessels remain patent when cut across. Often the dragging upon the parts, as in removing a tumour, is such as to make some of the veins that have been divided gape and remain open. The accident has occurred most frequently during the removal of tumours from the neck or axilla. It has happened also during amputation at the shoulder, resection of the scapula, ligature of the carotid and subclavian arteries, tracheotomy, venesection of the external jugular vein, and, in one recorded instance, during the introduction of a seton in the neck.

Symptoms.—The entrance of the air is marked by a very distinct hissing noise, precisely like that heard when air and water are being drawn up by a syringe. It must be especially noted that if any bubbles are seen about the wound they are caused, not by the air that is entering, but by the air that has escaped from the vein during the expiratory movement of the thorax. The patient, if not anæsthetised, is seized with a sudden terror; there is severe dyspnœa with hurried and violent inspirations; the action of the heart becomes irregular and often tumultuous; the pulse sinks, is most irregular, and often becomes rapidly imperceptible; the face is, as a rule, bluish at first and then becomes pale; there is more or less profound syncope, and in some cases there may be convulsions of a tetanic character or a violent cough. The dyspnœa is probably entirely due to the sudden interruption in the pulmonary circulation, while the faintness depends mainly upon the anæmia of the brain consequent upon the lack of blood in the left ventricle. About two-thirds of the patients thus affected die, the majority within a few minutes, the remainder after an interval of hours or even days. On the other hand, recovery has taken place, even after the symptoms have been very severe, and in a few instances no visible ill-effects have followed the accident, although the hissing noise was distinctly heard. Clinical experience, as well as vivisection experiment, appears to show that the fatal result depends rather upon the rapidity with which the air is introduced than upon the actual amount that enters, other things being equal.

Treatment.—It cannot be too constantly borne in mind that this accident can only occur in what may be termed dry wounds. The injured vein must be either exposed to the air or separated from the air by only a thin layer of blood; if the wound be full of blood the accident is impossible. As may be supposed, it occurs most usually when a tumour is being dragged from its attachments, or just after a deep incision has been well sponged out.

The moment the hissing sound is heard the wound should be filled with water squeezed from a sponge. This at once

prevents the entrance of more air, and at the most the patient merely draws into the vein a little blood and water. It is useless at the first to attempt to tie the vein. The damaged vessel is not easy to find, and to apply a ligature takes time. Moreover, if the ligature be applied during an inspiration, it would certainly prevent the entrance of more air, but if applied during an expiration it would merely prevent the escape of such air as had already entered. To place the finger upon the divided vein during inspiration and remove it during expiration would not be bad practice. But here again comes the difficulty of recognising the damaged vein. The hissing sound is the only guide. There is nothing to be seen as the air enters. Any bubbles that are seen in the wound indicate the escape of air, and to place the finger over the spot where the bubbles are seen—as some advise—would be obviously bad practice. The filling of the wound with water is a ready and safe expedient, and, in all deep operations about the neck and axilla, the writer always has a sponge filled with water held ready, so that in a moment its contents can be squeezed into the wound.

The second step in the treatment of the accident is to endeavour to remove the air that has already entered the chest. This can be best effected by waiting until the next expiratory movement, and then bringing forcible pressure to bear upon the front of the thorax. The air so expressed bubbles up through the water or blood that still fills the wound, and is obviously unable to re-enter so long as the wound is protected in the way indicated. The ease with which a large quantity of air can be expressed from the chest during an expiration is remarkable, and especially in children. The relief given to even the most alarming symptoms is immediate and striking. When all the air has been expressed, the wounded vein should be seized—most conveniently with a pair of Spencer Wells' forceps—and either entirely divided or ligatured. The writer has recorded two cases (*Brit. Med. Journ.* June 30, 1883) where the treatment just detailed was carried out with complete success. The suggestion that the air should be sucked out of the auricle through a catheter passed down one of the main veins cannot be too strongly condemned. An almost equally objectionable practice is that of resorting to artificial respiration. There is no lack of air in the thorax, but indeed too much, and this mode of treatment could only have the effect of hastening a fatal issue.

FREDERICK TREVES.

ALBINISM.—The absence of pigment from those parts of the body ordinarily coloured, e.g. the skin, hairs, and iris. The subject of this congenital defect is ordinarily termed an ALBINO.

ALBUGO.—A dense white opacity of the cornea, generally resulting from injury, especially burns with caustic lime.

ALBUMINOID DEGENERATION is a variety of retrogressive metamorphosis of the albuminous constituents of animal protoplasm, almost invariably consequent upon the cachectic condition produced by some wasting disease. It most frequently attacks the arterioles and small blood-vessels, then the spleen, liver, lymph-glands, intestine, kidney, heart, and muscles, while very rarely only one organ may be notably affected.

Etiology and Causation.—This change which, when once begun, is almost invariably fatally progressive, attacks individuals usually between the ages of 10–30 years, and more frequently those of the second decade, namely, 20–30 years. Further, males suffer much more frequently than females, a striking difference which may possibly be accounted for by the greater prevalence of syphilis among the male sex.

It is usually preceded by, if not always caused by, one of the following diseases:—Prolonged suppuration, chronic lung-disease, accompanied by suppuration (namely phthisis, bronchiectasis, chronic bronchitis), leukæmia, rickets, gout, simple new-growths (e.g. myxofibroma, &c.), and the following cachectic states. Syphilis (not only with osteitis, but also in cases of syphiloderma, and in the congenital as well as the acquired form of the disease), intermittent fever, and mercurial poisoning.

The most favourably received explanation of the mode in which this change in the tissues may be brought about, is that of Dr. Dickinson, namely, that the albuminoid condition is the result of a constant drain from the body (by the suppurative discharge) of the alkaline salts, notably the compounds of potassium. This theory is supported by many histo-chemical facts and analogies, and therefore is given here in the absence of fuller knowledge on the point. The development of the change, usually supposed to be slow, was shown by Cohnheim to be occasionally very rapid; thus he found it very extensively marked within three months of the infliction of the lesion which started the degenerative process.

Symptoms. — The symptoms directly due to interference with the functions of the various organs affected, are fairly marked, so as to enable us to distinguish them from those due to concurrent affections.

From the fact of the disease attacking the organs and tissues in the order given above, the following are the most marked symptoms:—*anæmia*, affecting the red corpuscles mainly, is rather rapidly developed, and then remains almost at an equilibrium, but increases slightly towards death; *hydræmia*, causing œdema of many parts, more especially the connective tissues of the lower limbs, sometimes invades the whole body in advanced cases, when albuminuria reveals the fact that the afferent arterioles and malpighian glomeruli in the kidney are practically *hors de combat*. Occasionally *ascites* is present, the serous effusion being increased by pressure of the enlarged liver upon the portal vein. *Hæmorrhages* may occur, and death has followed directly from hæmatemesis. *Pseudo-leukæmia* is commonly noted as a combination of the foregoing symptoms. *Tumours* of the organs most frequently affected—viz. the liver and spleen—are easily discovered and recognised by their even surface and outline; *pain* is produced in the abdomen by a little local peritonitis around the affected organs, which are commonly found covered with adhesions. The *appetite* fails, and sometimes *vomiting* is noted; the *excreta* are pale from the absence of *bile*, stinking, covered with mucus, and followed by much flatulent discharge of gases. This change does not give rise to any pyrexia.

Diagnosis is rendered easy by observing the concurrence of the above symptoms with one of the diseases noted as leading to the degenerative change in the tissues.

Prognosis is probably always hopeless.

Pathological Anatomy.—The degeneration in an early stage is found to cause the intima or internal coat of the arterioles to become thickened, structureless, hyaline, and brightly refracting, while in addition Kyber noticed the arterioles to be frequently varicose. In other vessels the middle muscular coat becomes similarly affected; in the capillaries, as may be well seen in the malpighian glomeruli, the whole bunch of vessels becomes gradually fused into a bright amorphous mass. The veins almost escape the change altogether. This distribution of the degeneration is well illustrated by the disease as it occurs in the liver, where the middle zone of each hepatic lobule (namely, that part of it which is supplied by the hepatic artery more especially), is found to be first the seat of the change.

In consequence of the above changes in the blood-vessels, an organ which is thus degenerated appears on section to be bloodless, the surface being dry and pale; owing to the physical properties of the degeneration product, the whole organ is, as a rule, enlarged, has a bright shining surface on section, and while frequently hard, is yet tough and resistant to reagents, the mass not being soluble in either acid or alkaline solutions, and not readily decomposed.

The proper gland-cells of an organ thus diseased are said by some to be unaffected by the change directly, but to undergo fatty degeneration and atrophy as a result of the ischæmia produced by the disease of the blood-vessels; but in many instances they can be seen to be involved in the general metamorphosis which eventually converts the whole tissue into an amorphous refractive mass. Chemically this product has been isolated as lardacein, which is not amyloid or starchy as supposed by Virchow and others, but is an albuminous substance recognised most easily by its physical properties and its reaction to iodine and methyl anilin violet. Thus, if the cut surfaces of an affected organ be washed with water, and then (for some minutes), with a solution in water containing ·5 per cent. of iodine, and 1·5 per cent. of iodide of potassium, the diseased portions will be coloured of a mahogany red colour quite different to the general yellow stain of the surrounding parts; and if, moreover, a 10 per cent. solution of sulphuric acid be added, the red staining of the diseased tissues will change to a dirty purple or violet tinge. When the affected tissue is stained with methyl violet, the diseased portion becomes red and the healthy part blue.

Treatment. — This must of course be first directed to the removal of the cause if possible, and in the mean time to endeavour to relieve the organs chiefly attacked, while the general strength is being maintained. Thus constipation and diarrhœa, &c., must be treated by appropriate drugs; the skin, often harsh and dry, must be excited by hot air baths and pilocarpine, in order to relieve the kidneys; in fact, vicarious action must be encouraged as far as possible. At the same time free oxygenation of the tissues must be provided for by proper change of air, and the drain of potassium salts met by the administration of the same in combination with peptonised albumen, or some

similar vehicle, which will admit of their being rapidly and easily assimilated. Iodide of iron and carbonate of ammonia have been much recommended, and can do no harm.

The diet must be chosen so that as far as possible the alimentary canal, the submucous coat of which is attacked early in the disease, may be relieved. This will best be effected by the food being of a light nature, and in addition being partly peptonised or pancreatised beforehand. The former is less disagreeable often to the patient, who of course is subject at any moment to attacks of vomiting and dyspepsia. VICTOR HORSLEY.

ALBUMINURIA.—The form of albumin which appears in the urine is nearly always serum albumin; egg albumin, and a peculiar variety described by Bence Jones from a case of osteomalacia, have also been found, but only under very exceptional conditions, and are of little surgical importance.

The albumin may be derived (1) from the mucous membrane lining the urethra in front of the compressor urethræ muscle; (2) from the prostatic portion of the urethra, the neck of the bladder, and the bladder itself; and (3) from the ureters and the pelves of the kidneys, and the kidneys themselves. Further, in the female, a very considerable quantity may find its way into the urine from the neighbouring genital organs, especially in cases of leucorrhœa; and even in the male it is probable that from time to time small quantities of spermatic secretion containing albumin may be discharged with the urine.

Albumin present in the urine, and derived from the anterior portion of the urethra, points to some inflammation of the mucous membrane, either gonorrhœal or else catarrhal, due to stricture, the presence of papillary granulations, some neighbouring inflammation, or even a constitutional affection—syphilis, struma, tubercle, or gout—roused into activity by some accidental cause. This may be distinguished by its always being small in quantity, and by the fact that it is only present in the first portion of the urine passed; the urethra is washed clear by the stream flowing through, and if care is taken to keep the first ounce separate, the rest will be found free. Not infrequently, under these conditions, there are found in the urine long, semi-transparent, rolled-up threads, the so-called gonorrhœal casts.

The portion of the urethra lying behind the compressor urethræ muscle, belongs, surgically speaking, to the neck of the bladder; if a large amount of secretion collects anteriorly to this point, it flows out of the meatus urinarius, and is known as a gleet; if posteriorly, it flows back into the bladder, and becomes mixed with the urine. Under these circumstances, though the first portion of the urine passed contains the largest amount of albumin, and, perhaps, casts of the prostatic ducts and spermatozoa, the rest is not quite free; and, in addition, there are the ordinary symptoms of inflammation about the neck of the bladder—frequent micturition, strangury, especially at the end of micturition, pain in the perinæum, and, perhaps, just at the close, when the bladder is contracting, a few drops of blood.

If the source of the albumin is the mucous lining of the bladder itself, it is very rare for the urine not to show other changes in reaction, deposit, and microscopic characters. There may only be a slight cloud floating about, with a few mucous corpuscles and detached epithelial cells visible under the microscope; or the urine may be foul and offensive, alkaline, partly from the amount of alkaline mucus added, partly from the decomposition of urea, with a thick, dense, gelatinous deposit of muco-pus mixed with triple phosphate crystals forming slowly at the bottom of the vessel, and, when this is inverted, falling out in a tenacious slimy mass.

It occasionally happens that this deposit of muco-purulent matter occurs in acid urine, of course unmixed then with crystals; no casts can be found; the urine remains acid, in spite of the large amount of alkaline mucus added; frequent micturition may be present, because the urine is no longer in normal relation with the bladder, but there is no strangury, showing that the neck of the bladder is not inflamed. Under these conditions it is to be suspected that the pus may come from the pelvis of the kidney, and that not improbably the whole of that organ may be disorganised, and consist of nothing but a greasy, yellowish-white, tenacious mass, enclosed by the capsule, on the inner side of which some shreds of cortex may still persist—strumous pyelitis.

Calculous pyelitis, and surgical kidney causing albuminuria, may be, in general, distinguished by the other changes that take place in the urine simultaneously, the occasional presence of blood, the altered reaction, the amount of albumin, and the presence of tube-casts, showing that the

secreting structure of the kidney itself is involved.

Albuminuria, further, is nearly always present, and is of very great surgical importance, in organic disease of the kidneys—amyloid, large, white, or the small contracted granular form—and the diagnosis must be made from a consideration of the cause, from the amount of urine passed, the specific gravity, the evidence of amyloid disease elsewhere, the condition of the organs of circulation, and the presence and character of the tube-casts.

Besides these causes, albumin may make its appearance in the urine from disturbance of the circulation through the kidney, not merely from passive congestion, as in heart-disease, but probably through interference with the vaso-motor nerves. At least, it seems most easy in this way to explain the occasional occurrence of albuminuria and even hæmaturia after injuries to the head or the spine, and after the administration of certain drugs. Whether there can be any connection between these facts and the frequency of renal degeneration in patients suffering from abdominal tumours, is uncertain.

Albuminuria, then, is to be regarded as a symptom indicative either of some abnormal condition of the genito-urinary tract, or of some alteration in the composition of the blood, and a diagnosis must be made of the cause of its appearance from its character and quantity, and from the other features presented by the urine. When it has gone on for any length of time, no matter what the cause, it is always of very serious import in prognosis; the general nutrition suffers in direct proportion to the amount of the loss, and anæmia, emaciation, weakness, and inability to resist depressing agencies, increase *pari passu*. This is to be regarded as of no less importance in renal disease than the defective elimination of effete material; in genuine contracting disease of the kidney, with little loss of albumin, the normal colour and plumpness are long retained.

Albuminuria is of such importance with regard to surgical operations, that it should be held as a rule from which no deviation is to be allowed, that the patient's urine should always be tested on the morning of an operation, and, if possible, several times before. Nor should the urine passed on rising only be made use of—the urina sanguinis—but that also which is passed at intervals throughout the twenty-four hours. If the albumin is a mere accidental admixture from the neighbouring genital organs, or if it comes from the urethra or neck of the bladder, and the operation is one devised for the purpose of removing the cause, of course it has little to do with the question of prognosis. But if it points to the presence of cystitis, or, even worse, disease of the kidneys, at once it becomes an exceedingly serious element. This is true, not only of the presence of albumin in the urine, but also if the specific gravity is low and the urea percentage habitually below normal. The writer has more than once seen patients whose urine presented these two conditions without albumin being present, suddenly, after an operation, excrete a large quantity, probably owing to a certain amount of fever.

Operations, in general, are affected, as regards prognosis, in two ways. In the first place, there is a very considerable loss of strength represented by the loss of so much albumin; and, secondly, if of any severity, a great amount of strain is thrown on organs already partly incapacitated by the extra quantity of waste developed in the system. But besides these two conditions, both of which are sufficiently serious, the genito-urinary tracts are so closely bound up with the kidneys by means of the nervous system, that if the latter are diseased it is highly probable that any operation on the former, even the passing of a catheter, will cause partial, or even complete, suppression of urine. This, in all probability, arises from congestion being set up in inflamed organs which are only just able to do their work under normal conditions, and is effected in some reflex manner through the nervous system.

Albuminuria, arising from amyloid disease of the kidneys, is, in some respects, peculiar. It may usually be diagnosed by the early occurrence of polyuria, and by the presence of waxy degeneration of other organs; and there can be no question that there is a possibility, if not of complete recovery, at least of cessation of progress of the disease, if the exciting cause of the amyloid change be removed sufficiently early. *See* Urine; Urea.

C. Mansell Moullin.

ALKALIES, Swallowing of.—The caustic alkalies are not so frequently swallowed as are the acids. Potash, soda, and ammonia have each proved fatal. Like the acids, the danger depends more upon the concentration than the actual amount taken. The symptoms are those of a corrosive poison—abdominal pain, vomiting, thirst, followed by collapse. The vomit is

alkaline, and is often soapy in character, with much ropy mucus. Perforation of the stomach is not so common as with the corrosive acids, but, nevertheless, may occur. The liquor potassæ of the Pharmacopœia has been taken by mistake, but the most common accident has been the swallowing of soap-lees by those employed in soap-works.

The *treatment* consists in the neutralisation of the alkali by the administration of dilute acids, vinegar, very dilute mineral acids, or citric or tartaric if these be not at hand. The juice of acid fruits, such as lemons, or even oranges, if given in large quantities, may be of service. The employment of the stomach-pump is not advisable, owing to the danger of perforating the softened mucous membrane. It may be advisable to give stimulants per rectum. Death may result at a more remote period from inanition, owing to the destruction of the glandular surface of the stomach, or by the occurrence of stricture of the œsophagus from contraction of the cicatrix, which is the result of the corrosion.

If the alkaline corrosives enter the air-passages, death may result (as with the acids) from suffocation.

The volatile alkali (ammonia), like the volatile acid, is very apt to affect the air-passages, owing to the inhalation of the caustic vapour, and in this case the patient dies from capillary bronchitis, with some patches of pneumonia. Ammonia sometimes has the effect of producing a false membrane on the trachea and bronchial tubes, which to the naked eye is indistinguishable from a diphtheritic membrane. Cases are on record of death being caused (in persons already much enfeebled) by the mere inhalation of ammoniacal vapour, owing to the incautious use of the strong ammoniacal solution as a 'smelling-salt' for restorative purposes.

G. V. Poore.

ALLARTON'S OPERATION. — A modern form of median lithotomy. *See* Lithotomy.

ALOPECIA AREATA.—*Definition.*—Alopecia areata is a non-contagious atrophic disease of the hair, a chief feature of which is the rapid formation of smooth bald patches on the scalp or other hairy parts of the body.

Symptoms.—Although alopecia areata is chiefly met with on the scalp, yet it is not uncommon on the eyebrows and beard. In extreme cases the whole body is affected, and becomes completely denuded of hair. The disease is sometimes unilateral, but more frequently it is roughly symmetrical. The regions of the scalp most often affected are the lower occipital, where the scalp joins the skin of the neck, and the part behind the ears. The eyebrows are often shed, and when this is the case, the outer part generally goes first. The parts attacked are usually quite denuded of hair, with the exception perhaps of the margin, where a few stumps may sometimes be found. This abrupt contrast between the smooth white bald patch and surrounding luxuriant hair, gives to the disease its peculiar and characteristic appearance. In an early stage of the malady, the bald patch is sometimes pinker than the surrounding skin, but much more commonly it is of the same colour or paler. A loss of sensibility over the patch is rare, yet sufficiently common to have been noted by many observers. In most cases there is a complete absence of subjective sensations; in some, however, there is neuralgic pain, and in others a tenderness on pressure. One of the most remarkable features of the disease is its almost sudden onset without any very apparent cause. It is very chronic, often lasting for years, and is also very apt to recur, so that it is not uncommon to find adult patients suffering from their second, third, or even fourth attack.

Etiology and Pathology.—The causes of area are at present unknown. It is more common in the young than in the old, and is probably equally common in males and females. It is met with more frequently in England than on the continent of Europe. The belief in the parasitic origin of the disease has been completely abandoned by all competent observers, partly because the clinical features of the disease cannot be explained on this supposition, but still more from the fact that no one has been able to demonstrate the parasite under the microscope. The origin of the disease is probably due to nerve-disturbance, causing impaired nutrition and subsequent atrophy of the roots of the hairs, and sometimes also of the skin itself.

Diagnosis.—The only disease with which alopecia areata is confounded is tinea tonsurans. In doubtful cases the examination of the stumpy hairs under the microscope, will generally determine the point. There are, however, some instances of tinea tonsurans in which the diseased patches rapidly become bald and assume the appearance of alopecia areata; this change sometimes occurs naturally, and at other times is the result of treatment; in either

case the differential diagnosis may be difficult, unless the history of the case is carefully investigated.

Treatment. — The treatment of this disease is not very satisfactory. Tonics, good food, and change of air are beneficial. Local remedies consist in stimulating lotions, the best of which are the various preparations of cantharides, especially the acetum cantharidis diluted with spirits of wine. It is, on the whole, better to use a preparation not quite strong enough to blister, so that it may be applied daily.

ROBERT LIVEING.

ALTERNATING CALCULUS. *See* CALCULUS, Urinary.

ALVEOLAR ABSCESS occurs in both jaws, as the result of inflammation connected with the teeth and originating in the socket. The earliest symptom is pain, with slight protrusion of the tooth, due to the inflamed condition of the membranes covering the tooth and lining the alveolus. If not relieved by judicious leeching or incision, matter forms in the socket, and either finds its way out by the side of the tooth, which is necessarily loosened, or, after causing great pain for a day or two, perforates the alveolus, and finds its way beneath the gum. This is the ordinary form of 'gum-boil,' which breaks spontaneously and after causing much suffering, unless previously relieved by a timely incision or extraction of the tooth.

The propriety of an early and free incision through the gum on to the alveolus is to be strongly insisted on, since necrosis and consequent exfoliation of large portions of the jaw not unfrequently follow neglect or postponement of the operation. Extraction of the tooth alone is not sufficient where the alveolus has been perforated, and in many cases the incision will serve to preserve a useful, though dead, tooth for many years. A wound of the facial artery has been met with from the edge of the knife being turned towards the soft tissues instead of against the alveolus.

But alveolar abscess does not always point within the mouth. The perforation of the alveolus may take place beyond the line of reflection of the buccal mucous membrane, and then the matter has to find its way to the nearest skin. In this way abscesses, with their resulting fistulæ, may be seen on any part of the face or neck, and occasionally grave errors of diagnosis are made from non-recognition of the fact that alveolar abscesses may burrow for long distances. The writer has known one instance of fatal suppuration between the muscles of the neck, leading eventually to suffocation, due entirely to mischief around a molar tooth in a patient whose health was undermined by drink.

In the case of the upper jaw, abscess connected with the incisor teeth not unfrequently finds its way backwards along the hard palate, and occasionally, but more rarely, into the nostril, being then liable to be mistaken for discharge from the nose itself or from the antrum.

CHRISTOPHER HEATH.

ALVEOLAR CANCER.—A term applied to colloid cancer. *See* CARCINOMA.

ALVEOLAR SARCOMA. *See* SARCOMA.

ALVEOLUS, Fracture of the.—This is a frequent accompaniment of tooth-extraction even in the most skilful hands, and depends for the most part upon the divergence of the fangs of the teeth, by which extraction is rendered difficult. The operator may or may not be conscious that the alveolus is yielding to the pressure of the forceps, but upon the extraction of the tooth finds a portion of the outer plate of the alveolus loose beneath the gum. This need give rise to no uneasiness unless very extensive, since reunion of the fragment often takes place readily, or, at the worst, the portion detached becomes necrosed and exfoliates in the ordinary way. It is well to press together the margins of the alveolus in all cases of extraction, but when a distinct fracture has occurred caution must be used lest the fragment should be forced through the gum.

CHRISTOPHER HEATH.

AMAUROSIS.—The term amaurosis was formerly applied to all those cases in which the patient complained of complete loss of vision, whilst there was no apparent disease of the eye except that the pupil was dilated and remained motionless under the stimulus of light. It was synonymous therefore, in a large number of cases, with what is now called white atrophy of the optic nerve with cupping of the disk, which is most frequently the sequel of glaucoma; but other conditions were included in it, so that upwards of thirty varieties, distinguished by their real or supposed origin, or by some associated symptoms, were admitted and described by the older authors. Yet in some modern works upon the eye the term amaurosis is hardly so much as mentioned;

no chapter is devoted to its consideration, and most of the diseases once included in it, being easily recognised and discriminated from each other by the practised eye, are now discussed under separate headings. The uncertainty attached to its meaning has frequently led to its employment with the addition of some qualifying epithet, such as 'complete' or 'partial,' or 'unilateral' or 'hemianopic,' but it is properly restricted at the present time to those cases of total blindness which are associated with atrophy of the optic nerve without cupping of the disk, and to those cases of loss of vision in which the most careful examination, with all the advantages resulting from improved methods of research, fail to reveal any physical changes in the media or tunics of the eye. In all instances the function of the retina and optic nerve must be entirely abolished, or the case becomes one of mere dulness of vision, the causes and varieties of which will be considered under the head of Amblyopia.

Etiology.—If a typical case of amaurosis be placed before the ophthalmic surgeon—one, that is to say, in which there is total loss of vision whilst the optic disk is of a dead white colour—and he is asked what may have led to this condition, many causes present themselves to his mind. Amongst these are surgical injuries, such as contusions of the eyes from blows with balls, champagne or soda-water corks; lesions of the globe or of the optic nerves, tracts, and centres from the entrance of foreign bodies, as in gunshot wounds; compression of the nerve in the optic foramen, owing to fracture of the bone or to periostitis; or similar pressure exerted by effusions of lymph, blood, or pus, as in the atrophy that occurs after capsulitis and inflammation of the cellular tissue of the orbit, which may be either primary or an extension of erysipelas of the face. Pressure on the nerve may also be exerted by thrombosis and by aneurism of some branch of the ophthalmic artery, or the nerve may receive an insufficient supply of nourishment owing to embolism of the arteria centralis retinæ; or there may be disease of the central nervous apparatus affecting the corpora quadrigemina, optic thalamus, cortex cerebri, or spinal cord. Again, meningitis, congenital malformation of the skull and hyperostosis, or imperfect development of the brain may be present.

Amaurosis may also be the result of causes affecting the metabolism of the system generally and of the nervous system in particular, as in the cases which follow typhus, scarlet fever, diphtheria, or other exanthem. It may be a symptom of Bright's disease, or proceed from the administration of large doses of quinine, or from the abuse of alcohol or tobacco, or from exposure to the injurious action of lead; from sexual excesses, or—which is perhaps of most common occurrence—proceed from syphilis. It has been known to follow the suppression of habitual discharges and the sudden arrest of the catamenia, and many instances have been recorded of its occurrence as a symptom of hysteria and of epilepsy. It has occasionally been observed to arise from reflex irritation, as in dental disease, especially when inducing suppuration in the antrum of Highmore, from worms in the alimentary canal, and from comparatively slight blows causing lesion of the branches of the fifth pair of nerves distributed to the brow, face, and temple.

In regard to this last point, without denying that a contusion of the supraorbital nerves, or their division and subsequent implication in the cicatrix, might lead to reflex amaurosis, it may safely be stated that some of the recorded cases, if they had been examined by means of the ophthalmoscope, would have exhibited visible lesions sufficient to account for the sudden accession of blindness, such, for example, as hæmorrhage into the vitreous, or detachment of the retina; or in cases where the onset of the disease was slower, progressive white atrophy with or without optic neuritis.

Lastly, amaurosis sometimes only temporary but at other times persistent, has been noted as a result of severe hæmorrhages.

The conditions which may lead to amaurosis are thus seen to be sufficiently numerous and diverse, and there are still other cases, of the cause of which no satisfactory explanation can be afforded. It is probable, however, that the history of the case, with a careful consideration of the collateral symptoms, especially of those presented by the nervo-muscular apparatus, will, in most instances, enable the locality, if not the precise nature, of the primary affection to be determined with some approach to precision, even in cases where the exterior of the eye appears to be normal.

Some of the forms of amaurosis mentioned above are very slow in their progress, and, as in the case of alcoholic and tobacco amaurosis, rarely proceed to complete loss of vision, so that their description is relegated to the article Amblyopia.

Symptoms.—The symptoms in a typical case of amaurosis may be divided into the

objective and the subjective. The objective symptoms are the dilatation, not generally extreme, of the pupil, with immobility of the iris when light falls suddenly and directly upon the eye. It is well to note, however, that if the amaurosis be unilateral, associated movements of contraction and dilatation may sometimes be observed in the affected eye when the sound one is exposed to the alternate play of light and shade, aud that contraction may also occur as an associated movement when the eyes are made to converge in accommodation—a condition, sometimes termed the Argyll-Robertson symptom, from that surgeon having first noticed its occurrence. The eyes are often otherwise natural in brightness, in size, in form, in colour, and even in their tension, though this is generally and sometimes considerably increased; and in the earlier periods of the disease, whatever may be its origin, they may move symmetrically.

The gait of the patient, and the expression, or rather absence of expression, in the face, are characteristic. The head is carried erect, and the elevated eyes seem as it were to search for light, in marked contrast to the lowered head, shaded eyes, and cautious step of the cataractous patient. The eyes gazing into vacancy, with their visual axes parallel, present a persistent unmeaning stare, which is well known and cannot be easily imitated. Oblique illumination reveals nothing except the immobility of the pupil and the absence of any reflex movements of the lids when a strong light is thrown upon the eye. Ophthalmoscopic examination demonstrates, in the great majority of cases, that the media are clear, and that the choroid and retina present little or no indication of disease. The only part which has undergone conspicuous change is the optic papilla, though in some cases even this is unaltered. Usually, however, it is seen to be well-defined at the margins, and, of various degrees of whiteness, from a pallor that is within physiological limits to an intense porcelanous or bluish whiteness. The retinal vessels are sometimes small, straight, attenuated, and greatly reduced in number, whilst at others they preserve almost their natural size and characters. In some instances, indications of optic neuritis and retinal and choroidal changes may be seen in the immediate vicinity of the disk.

The subjective symptoms are—loss of vision, freedom from pain, and an incapacity of the retina to respond to any stimulus—luminous, mechanical, or electrical. Hence the brightest illumination, such as exposure to the sun, fails to awaken any sensation of light; and none of those luminous rings can be perceived, which are produced in the healthy eye by pressure on the globe, and which have received the name of phosphenes.

Treatment.—In regard to the treatment of amaurosis, much must depend upon the sagacity of the surgeon in discovering its cause. The numerous remedies which were formerly recommended as a consequence of the ignorance which prevailed in regard to the etiology of the disease and the physical conditions that were present, have successively fallen into disrepute, and their ill-directed use in pre-ophthalmoscopic times has given place to an apathy which neglects all means of cure. Yet it is possible that in some cases, especially in those which occur after fevers, the administration of appropriate remedies might be attended with improvement if not with perfect restoration of vision. It is certain that the most complete white atrophy does not preclude the possession of a very considerable amount of vision, and no forecast can therefore be founded upon this symptom alone. As a rule the employment of strychnia may be recommended, which may be administered in doses of ten minims of the solution, or it may be subcutaneously injected in quantities commencing with one-twenty-fifth of a grain daily or three times a week, rising gradually to one-tenth of a grain, repeated with equal or greater frequency. Larger doses are not in general well borne, the patients complaining of giddiness and twitchings of the muscles. Iron may with advantage be conjoined with the strychnia, and when these remedies fail, sulphate of zinc or of copper in doses of from one-quarter to one grain. Arsenic in ordinary doses, and gold cyanide in doses of one-eighteenth grain, may be given. As a rule iodide of potassium and mercury, in any mode of administration, are without effect, and indeed, when vision is not wholly abolished, appear, by depressing the patient, to do more harm than good. When white atrophy is fully established, the time for their employment is past. The same may be said of all local depletory measures, such as leeches, blisters, setons, and issues. The general health should be attended to, good diet prescribed, and attention to the bowels enjoined, and the respiratory and circulatory functions promoted by baths, exercise, and change of air. Without going so far as to state that electricity, whether employed in the form of the constant or of the

interrupted current, is never successful, it may fairly be said that it has been often tried and has often failed. If employed it will be found that the constant current is more effective than the interrupted.

For Simulated Amaurosis *see* Vision, Feigned Disorders of. Henry Power.

AMAZIA, or Complete Absence of the Mamma, is very rare. It has usually been associated with absence or imperfect development of the pectoralis major, and sometimes of some of the ribs on the side on which the gland was wanting. A rudimentary condition of the breast in the female, resembling that of the male, has been met with in conjunction with congenital absence of the ovaries.

Marcus Beck.

AMBLYOPIA.—The term amblyopia signifies dimness, dulness, or indistinctness of vision, a condition that may arise from many causes. In the first place the media may be cloudy, preventing more or less completely the access of light to the retina. Secondly, although the media may be clear, their refractive power may be at fault; parallel rays of light when the eye is at rest being brought to a focus in front of the retina, as in myopia; behind it, as in hypermetropia; or meeting in different foci in different meridians, as in astigmatism; in each case causing the image formed on the retina to be blurred and indistinct. Thirdly, although the image is perfectly well defined on the retina, this organ may, as the result of some structural defect proceeding from imperfect development, inflammation, non-use, or other cause, be unable to convert luminous waves into nervous impulses, and even if such conversion occur, the optic nerves and tracts may be incapable of transmitting the impulses generated to the brain. Lastly, although all conditions requisite for clear vision may, so far as the eye is concerned, exist, the central nervous apparatus may be the seat of some lesion that renders it incapable of appreciating and responding to the impressions transmitted to it by the optic nerves. Each of these forms of amblyopia requires brief consideration.

In England there do not appear to be any precise instructions issued to guide the examiners in determining what degree of impairment of vision should exist to cause rejection for the naval and military services; but in France, M. Barthélemy states that for admission into the army a recruit must see $\frac{25}{100}$, or $\frac{1}{4}$th the normal, with the right eye, and $\frac{8 \cdot 5}{100}$, or $\frac{1}{12}$th, with the left eye, whilst for the inscription or for the marines it must be $\frac{50}{100}$ at least.

This is not altogether an arbitrary limit, but is in relation with the ordinary conditions of military life; for it is clearly essential that, as M. Barthélemy observes, a soldier should be able to distinguish a sentinel, a man on horseback, a group of men, count the files of a squadron, judge of their state of repose or movement, their line of march, and the like, at a distance of at least 250 to 300 yards. He must be able to take effective aim at about the same distance, but the body of a man having a height of 5 feet, and a breadth of 12 to 15 inches, is easily distinguished at a distance of from 1,200 to 1,400 yards by a normal eye, and would therefore be still seen at 300 yards by an eye that had lost three-fourths of its visual power, at a distance at which the fire of a rifleman is highly effective.

For amblyopia due to cloudy media and diseases of the optic nerve and retina, see articles Cornea; Crystalline Lens; Vitreous, Diseases of the; Optic Nerve; Retina, Affections of the; Choroid, Diseases of the.

Amblyopia ex Anopsia is a term that has been applied to those cases where the dimness of vision is simply the result of disuse. This condition is familiar to ophthalmic surgeons in cases of squint, but is also observed in cases of congenital cataract, of leucoma, and of other affections in which the access of light is prevented or interfered with. In those cases of squint where the only defect is some error of refraction, the images of external objects, when the affected eye is at rest, are dim and indistinct, and little attention is paid to them, and if, as in hypermetropia, clear vision can only be obtained by a strong effort of the accommodative power for a short time, the internal recti soon become fatigued, the convergence of the eyes can no longer be maintained, and one eye wanders from the point of fixation. In some instances the patient uses the eyes alternately, and then good vision may be preserved in both; but in many cases a preference is given to one eye; the impressions made upon the other are then less and less attended to, and finally, in a few rare cases, the torpor or inactivity of the receptive apparatus in the eye, or of the percipient cells in the brain, becomes so marked that the largest objects can scarcely be discerned, and vision is reduced to little more than the mere perception of light. In such cases the most careful ophthalmoscopic examination fails

to reveal any definite change in the optic disk, retina, or retinal vessels, and the proof that no serious organic alteration of structure has been produced is derived from the fact that by practice, when appropriate glasses are supplied, or the cataract removed, or when—as in cases of leucoma—an iridectomy has been performed, and clear images are once more thrown upon the retina, it resumes its former functions, and in course of time the vision may become perfect, the recovery being, in general, earlier and more complete the shorter the time that has elapsed since the eye has been disused. Hence, cases of strabismus should be placed under treatment as soon as the defect is observed, and the operation for congenital cataract should not be postponed, on this as well as on other accounts, providing there is no contraindication, for more than the second or third year, a time of life when it is generally successful.

Amblyopia seems to arise occasionally from masturbation in both sexes, and scattered notices of its occurrence may be met with in books and occur in practice. It is most common between the ages of fifteen and twenty-five, but may, of course, occur at a later period.

Amblyopia from Exposure to Bright Light.—Impairment of vision has been observed in those who have incautiously gazed at the sun, especially through a telescope, in those who have looked intently at the electric light, and in those who have been long exposed to the bright reflection of light from snow. Newton is well known to have suffered from scotomata through life, after a momentary glimpse of the sun through his telescope; and Deutschmann has shown that, when the rays of the sun are concentrated on the eye of a rabbit, serious and persistent lesions are produced, the retinal albumen becoming coagulated, and great vascular disturbance—indicated by congestion, diapedesis of blood-corpuscles, and dislocation of the pigment—being set up. A case of temporary amblyopia, after long inspection of the electric light, in a young telegraph engineer, was seen by the writer. There was some peripapillary œdema; rest effected a cure. In snow-blindness the impairment of vision usually soon disappears with removal of the cause.

Various cases of reflex amblyopia have been published, as after a vaginal injection which caused severe pain (Priestley Smith, *Ophth. Rev.*, Jan. 1884), apparently from thrombosis of the retinal artery.

Nyctalopia.—Amblyopia, in the form of night-blindness, is often associated with physical changes in the retina, and especially with pigmentary deposits in the form of patches, fine striæ, plexuses and stellæ, which in many cases run parallel to, or are in close contiguity with, the retinal vessels. This form of amblyopia has been frequently noticed as a result of scurvy, and several instances have been recorded by Dr. Alexander Bryson in the second volume of the Ophthalmic Hospital Reports. As a rule, the prognosis in nyctalopia, unless *retinitis pigmentosa* is present, is favourable, and recovery usually follows rest of the eyes, good food, and the administration of tonics.

1. Cerebral Amblyopia.—In a certain number of cases impairment of vision results from some lesion of the cerebral extremity of the nerves. In some instances the lesion is congenital, and consists in an imperfect development of the visual centres—whether optic thalami, corpora quadrigemina, or occipital lobes depends upon circumstances. It is then often associated with nystagmus. The same symptoms are observed in children who are suffering from hydrocephalus. It is sometimes seen as the result of uræmic poisoning, unattended with notable physical change in the retina or disk. It has been surmised that in these cases effusion into the corpora quadrigemina has taken place, and the blindness has, in some fortunate instances, proved transitory. It may result from simple anæmia of the centres, and the darkness that is felt just before swooning is of this nature. It may be a consequence of the growth of tumours or other coarse disease of the brain, as has been well shown by Hughlings Jackson, optic neuritis making its appearance at an early period, and white atrophy being the final result.

It must not be forgotten, however, that various cases have been recorded in which large tumours and extensive lesions of the brain have existed without any impairment of vision. According to Zehender, organic lesion of the cerebellum is insufficient to cause amaurosis.

A special form of amblyopia, passing sometimes into complete amaurosis, has been described recently by M. Dianoux under the title of anæsthesia of the optic nerves, characterised by more or less complete blindness without visible ophthalmoscopic lesion. It supervenes upon a central scotoma, first perceived after sleep, lasting for many months, and usually coexisting with cutaneous anæsthesia. Recovery may

take place after appropriate treatment by potassium iodide, strychnia, and electricity, but it may also pass into white atrophy.

2. Crossed Amblyopia and Hemianopsia.—The phenomena of crossed amblyopia cannot be understood without a knowledge of the origin and course of the fibres entering into the composition of the optic nerves. On tracing the optic nerves backwards from the eye, they are seen to form a remarkable junction, named the chiasma, and to be continued beyond this, as the optic tracts, to the brain.

The course of the fibres of the optic tracts, on reaching the optic chiasma, has been the subject of much controversy, and is still open to further research. Some consider that there is here a complete decussation of the fibres of the optic tracts, others that there is mere juxtaposition without any decussation, whilst a third set of observers, who are constantly becoming more numerous, hold that there is a partial decussation. The chief arguments against this are, that occasionally the chiasma is absent and then complete decussation is observed, and, secondly, a median section of the chiasma has, in the hands both of Magendie and of Brown Séquard, been observed to produce total loss of vision. This result, however, does not appear to be constant. The evidence derived from the microscopic examination of the chiasma, from the effects of section in various parts of the optic nerve, chiasma, and tract, and lastly, from pathology, all point to the partial decussation, the non-decussating fibres chiefly supplying the outer side of the retina of the same side, and the decussating fibres, which are by far the most important, supplying the rest of the retina of the eye of the opposite side.

The view proposed by Charcot, and which has met with general acceptation, is that, admitting the fibres of the optic nerve to arise from one or more centres on each side of the cortex cerebri, some of these fibres course down through the optic tract of the same side, decussate in the chiasma, and are distributed to the inner, or nasal, side of the opposite eye. Other fibres arising from the same centre or centres, decussate in the corpora quadrigemina, and, descending in the opposite optic tract, pass to the outer or temporal side of the eye of the opposite side. Thus the whole of the fibres decussate, but some decussate in the chiasma and some in the corpora quadrigemina. Lesion of the cerebral centre of one side causes complete blindness of the opposite eye, because both sets of decussating fibres are destroyed. Lesion of the left optic tract would cause loss of the right half of each visual field, Lesion of the right optic tract would cause loss of the left half of each visual field. Lesion of the central portion of the chiasma causes temporal hemianopia; and lastly, lesion of the lateral portions of the chiasma would cause nasal hemiopia.

Neither the physiologist nor the pathologist can as yet localise an intracranial lesion occasioning blindness, and this is owing, not only to the wide connections of the optic nerves, but to the curious power of compensation that apparently exists between the opposite hemispheres; for it has been shown by Ferrier that sudden destruction of a very definite and limited portion of the brain, named the angular gyrus, on one side, causes complete blindness in the opposite eye; but if the opposite angular gyrus have remained intact, owing to this process or power of compensation, after a little while vision again returns in the previously blind eye, and, so far as can be ascertained, the animal sees as well with it as before. E. Munk, Crouineau, and others have found in their experiments that destruction of the angular gyrus is alone insufficient to cause blindness, though it may occasion amblyopia, but that destruction of the cortex of the whole occipital lobe invariably abolishes vision.

Amblyopia, proceeding to amaurosis, from cerebral disease, is usually accompanied with great dilatation of the pupil (mydriasis), but when resulting from spinal disease is associated with great contraction of the pupil (myosis).

In many of these cases other symptoms are present which point to the cerebro-spinal origin of the disease. Amongst them are loss of tactile sensibility of one side of the body or of the face, hyperæsthesia, hemichorea, contraction of certain muscles, motor paralysis, and impairment of speech. The prominent eye-symptoms which have been fairly determined are, that there is amblyopia with contraction of the field of vision. Féré, who has put together the principal facts in regard to cerebral hemianopsia and amblyopia, distinguishes three groups: those which are post-apoplectic and transitory, those which are permanent, and those which are for the most part quite transient and accompany the affection known as 'la migraine ophthalmique.' The cases belonging to the first group result from the pressure produced by the effusion being propagated to,

and acting upon, the optic tracts, which recover their function as soon as they have accommodated themselves to it, or as soon as absorption takes place. In the second group of cases the symptoms may be due to hæmorrhages or to the development of tumours, and the hemianopsia is most commonly associated with complete or incomplete motor hemiplegia; it is rare to meet with it in monoplegia; when, however, these are present, the face and upper limb are the parts chiefly affected. In cases of hemianopsia and motor hemiplegia aphasia may be present, and, in that case, the hemianopsia and hemiplegia are always on the right side. Hemichorea is occasionally present and is usually associated with hemianæsthesia. Hemianæsthesia not unfrequently occurs with hemianopsia, but the combination of hemianæsthesia, aphasia, and hemianopsia has only been observed in one case. The third group is characterised by various disturbances of vision, such as photopsia, often presenting the appearance of fortifications, and scotomata. There is also intense pain in the brow or temple, the attack culminating in nausea and vomiting. No very well-marked physical signs are present in this form, but the patients often suffer from dyspepsia, gout, rheumatism, or epilepsy. Between the attacks the vision may be normal.

Bellouard, who has closely studied the subject of hemianopsia, maintains that typical lateral hemianopsia is due to some lesion of the posterior extremity of the hemisphere near the posterior cornu of the third ventricle. Hemianopsia complicated with hemianæsthesia, with or without hemiplegia, is referable to participation of the direct sensory fibres of the pes pedunculi. Lastly, the co-existence of hemiplegia with hemianopsia renders it probable, he thinks, that the lesion is situated in the interior of the hemisphere, above and to the outer side of the optic radiation, that is to say, near the lenticular nucleus or external capsule. The lesion may, indeed, be in the paracentral lobe or centre for the movement of the limbs, but it is then distinct from that producing the hemianopsia.

3. Spinal Amblyopia. — (*a*) Tabetic Amblyopia—Amblyopia occurs as a symptom of progressive locomotor ataxy, and then constitutes the tabetic amblyopia of Charcot. The symptoms of this form of amblyopia, which is often syphilitic in its origin, are progressive deterioration of vision, the field of vision becoming gradually and concentrically limited. In some instances only one eye is affected, and complaint is made of a central scotoma, or dark spot, or several such spots, distributed over the field of vision. A greater or lesser degree of colour-blindness is usually present, red appearing of a very dark or almost black hue, and green appearing grey or dirty brown; whilst the secondary, or mixed, colours can no longer be distinguished. This defect of colour-vision does not necessarily proceed *pari passu* with the general failure of vision. Photopsiæ, or luminous phenomena of various kinds, are often observed. In the early stages of the disease, the fundus of the eye may appear almost natural. As the disease advances, however, the disk becomes gradually whiter, owing to atrophy of the capillaries. Microscopical examination shows that the axis-cylinders of the optic nerve fibres first undergo atrophy, and then the medullary substance, those nearest the arteria centralis retinæ, according to Leber, long retaining their normal characters. The connective tissue becomes greatly hypertrophied.

(*b*) Amblyopia is apt to occur in cases of grey degeneration of the posterior columns of the spinal cord; the disease in the nerves being of a similar nature, and affecting the whole, or a part only, of the optic nerves and tracts. It rarely occasions complete blindness.

The treatment to be recommended in this class of cases must vary, of course, with the special conditions of the case; but, speaking generally, it must be directed to the improvement of the general health. Fresh air, such exercise as can be taken, baths, friction of the skin, the administration of iron and strychnia; and silver nitrate, iodide of potassium, and perchloride of mercury may be prescribed, the effects of each being watched, and symptoms treated as they arise.

4. Toxic Amblyopia.—Amblyopia may be the effect of causes operating generally on the nervous system, the symptoms expressing themselves more strongly in the eyes, and these may now be briefly mentioned.

(*a*) *Amblyopia from Tobacco.* — This form of amblyopia has been made a subject of special study by Mr. Jonathan Hutchinson, who points out that since many men smoke, and, indeed, smoke inordinately, whilst few are affected in their powers of vision, it is probable that when tobacco produces amaurosis or amblyopia it does so in virtue of an idiosyncrasy, whilst the effects of the poison are undoubtedly augmented by the abuse of alcohol and other excesses. It occurs, as might be ex-

pected, almost exclusively in men, in some cases the actual quantity consumed not being large, though the effects are well-marked. In the great majority of instances both eyes are affected, and to nearly an equal degree, the vision becoming lowered to one-half of its normal sharpness. The progress of the disease is slow but continuous, though rarely proceeding to total blindness. It is usually accompanied by a state of general debility and defective tone of the nervous system. The patient complains of seeing everything as if in a fog, and the sight is impaired both for form and colour. The impairment affects chiefly the central part of the field, the defect being most perceived in bright lights.

The ophthalmoscopic symptoms in well-marked cases are that the disks are paler than natural, especially on the outer part, the surface swollen, and the margins blurred and indistinct, though without presenting the aspect characteristic of optic neuritis, peripapillary œdema being absent. The retinal vessels are smaller and less numerous than in the healthy eye.

In young persons, and in those in whom the attack has been induced by recent and excessive addiction to smoking, perfect recovery may, in general, be obtained by giving up the habit entirely; but in old smokers, in whom the progress of the affection has been steady and prolonged, and in whom, also, the atrophy of the disk is clearly perceptible, smaller improvement, or the arrest of the disease, is all that can be expected. Tonics, such as strychnia, iron, quinine, and sulphate of zinc, have appeared to be of service in aiding the nervous system to regain its tone.

(*b*) *Amblyopia from Alcohol.*—The symptoms here are similar to those observed in tobacco amblyopia. The patient complains of more or less sudden failure of vision, and this may be so great as to incapacitate him from all close work. The central part of the field is most affected. There is great loss of vision for colours, especially for green and red, which are described as appearing of a muddy tint. In the early stages there is probably some congestion of the optic disk, but it subsequently becomes pale, with woolly aspect, and finally white. In some cases of alcoholic amblyopia changes, perceptible under the microscope, have been observed. Thus, Uhthoff has given the results of section of the optic nerves in two alcoholists, who during life presented pallor of the temporal half of the optic papillæ. In one of these there was a central scotoma, or defect of vision, whilst the other presented at one time typical alcoholic amblyopia, which, however, had in great measure passed off before death. In both cases the anatomical lesions were nearly identical, differing only in their intensity. In both there was hypertrophy of the interstitial connective tissue, with considerable proliferation of nuclei, new formation of vessels, and atrophy of nerve-fibres. The degenerated nerve-fibres occupied the region between the central retinal vessels and the periphery of the optic nerve. In one case the chiasma and optic tracts were examined, and it was found that the degenerated fasciculi gradually left the peripheric region, and, in the optic foramen, formed a cylindrical mass near the centre of the optic nerves. In the chiasma itself a group of degenerated fibres could be distinguished in each half, which extended along the upper and inner part of the tractus. The treatment must consist in the absolute interdiction of alcohol in every form, the administration of tonics, change of air and scene, and general restorative measures. Remarkable cases of recovery may, under the altered conditions of life, be sometimes observed.

(*c*) *Saturnine Amblyopia.*—Amblyopia from the toxic influence of lead, or saturnine amblyopia, has been noticed by many writers. The symptoms are those of acute, subacute, or chronic lead-poisoning generally: headache, local paralysis, and blue line on the gums, with gradual deterioration of vision.

The ophthalmoscopic signs are not strongly marked, but there is probably a stage of hyperæmia of the disk, if not of actual neuritis, and this is succeeded by a period during which the disk becomes pale, ill-defined at the margin, and ultimately white.

(*d*) *Quinine Amblyopia.*—Besides alcohol, tobacco, and lead, some other drugs have been known to cause amblyopia; thus cases are reported where it has resulted from excessive doses of quinine, the amblyopia amounting, in some instances, to almost complete amaurosis. It usually passes off as soon as the use of the remedy is discontinued, though it may, in some instances, leave persistent dulness of vision and contraction of the field behind it. The ophthalmoscopic symptoms are few and slight, consisting chiefly of pallor of the disk, with some diminution in the size and number of the retinal vessels. Belladonna again, with several other solanaceous plants, has been known to produce, when

taken in poisonous doses, temporary amblyopia.

(*e*) *Amblyopia from Malarial Poisoning.*—Occasional or exceptional conditions of amblyopia have been noticed in intermittent fever. Peounow, for example, reports four cases of slight diminution of the sharpness of vision during the attack, together with impairment in the perception of colours, or even a chromatic scotoma in the centre of the field of vision, which disappeared quickly under the influence of quinine.

In consequence of the general failure of power in the constitution and bodily powers in diabetes, it is not surprising that failure of accommodation should occur; and Trousseau has drawn attention to this as one of the most common as well as one of the most remarkable of the symptoms of saccharine diabetes. But, apart from this, there is probably a form of amblyopia in diabetes which owes its origin to changes in the optic nerve, and there is still another in which the amblyopia is essentially due to retinal hæmorrhages.

5. Diabetic Amblyopia.—In diabetic as in tobacco amblyopia, there is sometimes an area of red blindness near the centre of the field of vision.

But few observations have been made upon the microscopical aspect of the optic nerve in cases of diabetic amblyopia. Drs. Edmunds and Lawford, however, had the opportunity of making sections of the optic nerve in a case of diabetic amblyopia, in which during life the appearances presented by the fundus of both eyes were normal. It should be stated that the patient had at one time indulged immoderately in the use of tobacco. No macroscopic changes were perceptible in the nerve, but, under the microscope, marked changes were found in a group of the nerve-bundles throughout the whole length of the orbital part of the nerve, the trabeculæ and the walls of the nutrient vessels were found to be greatly thickened, the fasciculi of nerve-fibres seemed to have the fibres in them destroyed, their place being taken by an irregularly granular structure, containing a large number of nuclei which stained with colouring agents.

6. Renal Disease.—Impairment of vision is sometimes the first symptom that leads to the discovery of albuminuria, and it is a very common concomitant of the later stages of that affection. *See* Optic Nerve; Retina, Affections of the.

7. Amblyopia in Pregnancy.—Amblyopia not unfrequently occurs in the course of pregnancy, and it may range through all degrees, from slight impairment to almost complete loss of vision. In the slighter cases the defective vision is probably due to loss of accommodation from mere weakness and exhaustion of the nervous system in general, and of the ciliary muscle in particular, and is consequently most marked in those who are the subjects of hypermetropia, though this may previously have passed unnoticed. In the more severe forms, well-marked ophthalmoscopic symptoms may exist, which bear a close resemblance to those of albuminuric retinitis, the optic disk presenting the aspect of optic neuritis, its margins being ill-defined, its surface swollen and woolly, the veins full and dark, tortuous and varicose, the arteries small, and seen with difficulty. Here and there large areas of effusion of whitish colour are to be seen on the surface of the retina, with irregular patches of hæmorrhage. These conditions are commonly associated with the presence of albumen in the urine, and it is highly probable that they proceed from pressure exerted by the uterus on the renal vessels, and especially on the renal veins, since the affection usually commences about the seventh month of pregnancy, and the symptoms continue to increase in intensity to the full term. After delivery is effected, they gradually decline, and in some instances perfect recovery may take place, though in others the vision of one or both eyes may be permanently impaired, and, under the ophthalmoscope, more or less advanced white atrophy, with discoloured areas, indicating the former presence of retino-choroiditis, may readily be seen.

The treatment of this form of amblyopia should, unquestionably, be the induction of premature labour, which probably acts by relieving the renal vessels from the pressure to which they have been subjected, and by effecting a restoration of the normal conditions of circulation in the capillaries of the kidney. The writer has seen several cases where the adoption of this plan of treatment has lead to immediate, great, and persistent improvement in the vision of eyes which appeared to be almost hopelessly blind, in which, indeed, there was little more than quantitative perception of light. On the other hand, he has known cases in which, when pregnancy was allowed to progress to its natural termination, the visual troubles were only premonitory of death by convulsions, or to blindness of an incurable nature.

8. Amblyopia from Cardiac Disease.—An intermittent form has been described by Nettleship, associated with valvular disease of the heart, the characteristic symptoms of which are, that the impairment of vision supervenes suddenly, lasts for a short time only, varying from a minute or two to an hour or more, and quickly disappears. The attack is not limited to one eye, but most frequently affects only one, and not always the same. It is probably connected with vascular constriction of an irregularly periodic character, and primarily dependent on some lesion or disturbance of the nervous system. The treatment should be directed to the heart, and to improvement in the general health of the patient.

9. Hysterical Amblyopia. — Impairment of vision not unfrequently occurs in hysteria. In hemianæsthetic hysteria, amblyopia, with concentric contraction of the field of vision, is apt to occur on the same side as that on which the anæsthesia exists. In the cases of hysterical amblyopia, examined by Landolt at the Salpêtrière, it was found that there was concentric contraction of the visual field for white light and for colours. The cause of this condition is not known, but it may, with much probability, be referred to alterations in the calibre of the blood-vessels leading to irregular, imperfect, or perverted nutrition of particular regions. Ophthalmoscopic examination, in some instances, demonstrates the presence of optic neuritis.

Diagnosis.—To determine the nature and degree of amblyopia, where no reason for suspecting simulation exists (*see* Vision, Feigned Disorders of), a methodical examination of the eyes should be undertaken, and special attention should be paid to the sharpness of vision for form and colour, the field of vision, the physical condition of the eye, including the appearances seen with the naked eye and with the aid of lenses, by direct and oblique illumination, the refraction of the eye, and, lastly, the appearances presented on examination with the ophthalmoscope. *See* also Visual Acuity; Ophthalmoscopy; Perimetry.

Henry Power.

AMBULANCE.—The term ambulance is so elastic in its acceptation, that it is difficult to know how to limit its scope. In the widest sense it signifies a movable, in contradistinction to a fixed or stationary, means of affording relief. The patients are sought for by the doctor and his assistants, instead of the patient coming to the doctor. First aid to the injured cannot be dealt with in this short article, but only the means of carrying or transporting the sick or injured.

In all times such means have been used, but the modern stretcher has supplanted the historic buckler, the waggon the war chariot, the litter and cacolet the haphazard throwing across a horse or camel's back.

To follow the different plans now in use in peace and war, it will be profitable to divide the means employed into carriage by hand, by stretcher, by waggon, by cacolet, by litter, and by railway carriage.

I. Carriage by Hand.—1. *When only one bearer is available.—a.* If the patient can stand, the bearer places himself at the uninjured side, say the right. The bearer then places the patient's right arm around his (the bearer's) neck and grasps the wrist with his right hand. The bearer's left hand now grasps the patient's left hip. By this manœuvre the patient's weight is thrown on to the bearer, who can thus help him along or even carry him.

b. By the fireman's lift. Standing in front, the bearer seizes the patient's right wrist in his left hand, then bending down until his right shoulder is below the patient's right hip-joint, he throws the patient across his shoulders and back, and grasps the legs with his right arm.

2. *When two bearers are available.—a.* Two-handed seat. The bearers face each other, the right-hand bearer presents his right hand for the left bearer to grasp with his left hand, or *vice versâ*; the free hand of either bearer then grasps the clothing over the hip, loin, or shoulder of the other, to form a back or support for the patient. The clasped hands are brought firmly together, and on these the patient sits; the patient's arms should encircle the bearers' necks.

b. Three-handed seat with support for the back. The bearers face each other; the right-hand bearer grasps his own left forearm; the left-hand bearer with his left hand grasps the right bearer's right forearm, who with his free hand grasps the left bearer's right forearm. A triangular seat is thus formed. The left bearer's free arm is placed on the right bearer's shoulder, to form a support for the back.

c. Four-handed seat. The bearers face each other; each grasps his own left forearm, and approaching hands, each man seizes the right forearm of the other with the disengaged hand, a sedan-chair being thus formed. By any one of these methods patients may be carried some distance, or placed on the tail seat of a waggon or on a

cacolet. If the patient cannot stand, others might lift him on to the seats thus formed.

II. Carriage by Stretcher.—Stretchers consist essentially of a couple of poles with canvas or other material stretched between them, and must be long enough and broad enough to carry a patient.

a. Stretchers for use in hospitals. The best form is a piece of canvas 6 feet 6 inches long, 1 foot 10 inches wide, with a couple of pole-sheaths at the sides. This piece of canvas can be passed below a patient as is an undersheet, and the poles, 8 feet long, slipped into the sheaths when it is wanted to move the patient, say from the bed to the operating table, or *vice versâ*. A couple of iron traverses to keep the poles apart can be adjusted after the poles are in place.

b. Stretchers used in the field or in the streets must have supports in the form of legs or wheels. The army pattern stretcher has wooden wheels, whereby it can be rolled into an ambulance waggon. The canvas is 6 feet long, 1 foot 11 inches wide, the poles are 7 feet 9½ inches long, and the traverses made to bend in the centre with an easily opened and easily closed joint.

Methods of placing a patient on a stretcher:—

1. Four bearers are assigned to each stretcher according to the army regulations. The stretcher is placed parallel with the patient, close to, say, his right side. Three bearers take post on the left side of the patient, one opposite the shoulder, a second opposite the hip, and a third opposite the knee. The fourth bearer places himself on the opposite side of the stretcher to the patient. The three first-named now raise the patient by placing their hands below the patient, whilst the fourth bearer pushes the stretcher beneath the patient when he is raised, and then helps to gently lower him on the canvas.

2. Another method, that practised by the St. John's Ambulance Association, requires three bearers only. The stretcher is placed in line with the patient, either at his head or feet; one bearer takes stand on either side of the patient opposite the middle of his body, and each passes his hands beneath the patient's shoulders and hips until the fingers of the bearers meet, when they grasp each other's hands; the third bearer passes his hands beneath the legs, and all rising together advance by a side step over the stretcher.

3. A still better method is as follows. Place the stretcher in a line with the patient's body at the head or feet. Two bearers now stride across the patient, one opposite the body, the other opposite the knees. Both, bending down and seizing the patient, raise him a sufficient height from the ground to allow the third bearer to push the stretcher between their legs, i.e. beneath the patient.

4. When two bearers only are available, the stretcher is laid in a line with the patient's body at the head or feet. The two bearers then stride across the patient, and raising him a sufficient distance, straddle forwards with their burden until over the stretcher.

To *carry* a stretcher two bearers are sufficient, but a third or fourth are useful to look after the patient and to relieve the others in carrying. A patient should always be carried feet first, except when going up a steep hill. If the patient is suffering from a broken thigh, he ought to be carried head first even coming down hill, and feet first going up, to prevent jostling of the fragments one on another. The bearers walk in broken step to prevent the stretcher swinging. The steps taken must be short—twenty inches; the knees are to be kept bent, and the feet lifted high off the ground. Leather or canvas belts over the bearers' shoulders and around the handles of the poles, are efficient aids in carrying. In going up a hill the shorter bearer, if there is a difference in height, should go in front, and *vice versâ* coming down. On going up or down a slope, the aim is to keep the patient as nearly as possible on a level, and this may be done to some extent by either bearer raising or lowering his end of the stretcher as occasion arises.

Improvised Stretchers.—**1.** A blanket and broom-handles.—The blanket, rug, horse-cloth, plaid, &c., is laid flat on the floor or ground, and a couple of broom-handles, pitch-forks, goal poles, rifles, &c., wrapped up in it one from either side until within a foot of the centre of the blanket; the patient is then laid thereon, and four bearers are at each corner to grasp the poles where they are wrapped in the blanket with one or both hands. This will do for short distance carriage, but for longer distances, say half a mile, use the following.

2. Secure a stout loop at the four corners of a blanket, then double it over so that the two loops at either end are brought together, then slip one pole through the loops on one side, and another within the doubling of the blanket on the other side.

3. A ship's hammock may be arranged to be carried on a single pole, and borne on the shoulders, or two poles may be utilised by a little management.

4. A couple of poles may be kept apart by cross poles tied or nailed at either end, and then the bottom can be made up of straw, ropes, belts, knapsacks, &c.

5. Coats are utilised thus:—Two long poles or four rifles are required, the pairs of rifles being lashed together at the muzzle-ends; the sleeves of the coat or coats are then turned outside-in. The coat is laid on the ground, the back of the coat next the ground; the two coats being in line, the rifles or poles are pushed through the sleeves, and the coats buttoned down the front in the usual way.

III. Carriage by Waggon.—An ambulance waggon is a four-wheeled vehicle, set on easy springs and drawn by two horses. It is capable of accommodating two patients lying on stretchers in the body of the vehicle, three more sitting on the front seat, and three, two patients and an attendant on the hind seat—eight in all. Over all is a canvas covering, and on the waggon are fitted a small water-tank and various boxes, ready to convey stores on an emergency. The rifles of the men lying down are placed beneath their stretchers, and their kits in the box beneath the drivers' seat. Waggon-stretchers are now essentially the same as the field stretchers, both being provided with wheels. To place the stretchers in the waggon the bearers halt a few paces off the tail of the waggon. The four bearers then seize the poles at the sides, as with the blanket-stretcher, and advance with a side step until the front wheels rest on the floor of the waggon. Then the stretcher is gently rolled onwards along the waggon floor.

On the hind seat are placed those patients who are unable to walk; on the front seat only such patients as are able to walk, since it is necessary to go up a ladder to reach it.

IV. Cacolets are folding chairs, hooked one on each side of a pack saddle, carried by a mule or pony. The patients are necessarily in the sitting posture, their faces towards the animal's head. Patients suffering from fractures or severe injuries to the lower extremities, or who are very weak, must not be put on a cacolet. The cacolet is loaded by two bearers carrying the patient by a hand-seat, back first, towards the chair, on to which he is raised. The feet are placed on the foot-board and the waist-straps buckled to keep the patient on.

V. A Litter is a light iron framework couch, capable of being placed on the side of a mule or pony for the purpose of transporting sick or wounded. A mule can carry two litters. As the mule stands higher in front than behind, the patient lies with his head towards the animal's head. Foot-rails and side-rails are placed to prevent the patient slipping backwards, or rolling over the edge. To load a litter it is laid on the ground, the patient laid thereon by one or other of the methods of placing a patient on a stretcher. The litter is then raised to the animal's sides, and the apparatus hooked, buckled, and belted thereon. Litters and cacolets can be folded into very small bulk when not in use.

VI. Carriage by Railway is effected in:—

1. Invalid carriages. These are simply travelling hospitals, in which the patients are placed on stretchers in bunks instead of on beds. They have all lavatory conveniences and medical and surgical necessaries. Each carriage can accommodate eight patients in two tiers on either side.

2. Second-class carriage seats, being cushioned but not partitioned, are available for a couple of stretchers. Two cross-pieces of wood are laid from seat to seat, each about a foot from the door. The stretcher has to be slightly tilted to get it through the door (1 foot 10 inches wide). A couple of stretchers can be laid along the seats, one on either side, and space left between for the attendant.

3. Goods-waggons and cattle-trucks can be utilised, but each stretcher requires four steel springs on which the handles of the stretcher can be placed. Three stretchers only can be placed on each waggon. The stretchers should not touch the sides of the waggon.

Surgical assistance in the field is regulated thus:—

I. Position of the 'first help station.'—This is immediately in rear of the fighting line, and moves with the combatants. Here only first dressings are applied, when the patient is carried on a stretcher to—

II. The second help or 'collecting station,' 1,000 yards in rear, or just out of rifle range. Here the wounded are placed in waggons, and the bearers are left free to return. Only first aid or hasty re-adjustment is to be here applied, as the patient is hurried off to—

III. The third help, or 'dressing station.' This is again 1,000 yards behind the collecting station, or out of the range of artillery fire. Here the wounded are sorted, ticketed, examined as regards the nature of their injuries, and such operations as are evidently imperative are to be done, but this is not the operating station. From hence the wounded are sent to—

IV. The fourth help, or 'field hospital station.' This should be about four miles to the rear of the combatants, and here the wounded are treated, amputations performed, &c. as is usual in an ordinary civil hospital. Those who can be are sent as soon as possible to—

V. The 'base hospital,' at the seaside, it may be, or in some town the base of the military operations. JAMES CANTLIE.

AMETROPIA.—Any optical condition of the eye, in which, accommodation being suspended, entering parallel rays are not accurately focussed on the retina. The term includes MYOPIA, HYPERMETROPIA, and ASTIGMATISM. *See* REFRACTION, Errors of.

AMPUTATIONS. — GENERAL CONSIDERATIONS. — Amputations, having for their object the removal of a limb or portion of it, are performed, as a rule, in cases of severe external injury, gangrene, morbid growths, many forms of bone and joint disease, intractable ulcers, malformation, aneurism, &c. Re-amputations are recognised and performed on account of certain affections of the stump, such as the conical or 'sugar loaf' stump; necrosis, neuromata, persistent pain, large adventitious bursæ, aneurismal dilatation of vessels, &c. *See* STUMPS, Affections of.

Amputations have been classified with special reference—(1) to the form of flap; (2) the situation where the bone is divided; (3) in traumatic cases, the time after the receipt of the injury that the operation is undertaken; and (4) there are *partial* and *complete* amputations, as of the foot. Then we speak of amputations by *circular* or *flap* methods, and of amputations in the *continuity* or *contiguity*, i.e. where the division of the tissues includes that of the bone at a point more or less removed from its extremity, or passes through an articulation. Another classification (Alcock's) is into *primary*, *intermediary*, and *secondary*. In the primary, the operation is performed immediately after the receipt of the injury and before there is evidence of any febrile disturbance. Secondary amputations are those undertaken at a time more or less remote from the date of the injury, and when suppuration as well as other unfavourable sequelæ, such as bone or joint disease, have supervened. Intermediary amputations are those undertaken subsequent to febrile excitement, but before the occurrence of the other results just mentioned.

In the history of amputation three distinct eras are recognised. In the first of these, operating surgeons made no attempt to form any kind of flaps, the limbs being removed at times by the knife; the 'Cauterium cultellare' (Hildanus); the chisel and mallet (Scultetus, Heister); the pincers (Guillemeau); and the guillotine (Père Botallus). The main object surgeons had in view was, apparently, not so much to obtain a shapely and useful stump as to take precautions that the patient did not succumb to hæmorrhage during the operation. To prevent death from this cause many and various were the devices had recourse to; such as division of the tissues with red-hot irons, plunging the stump into boiling pitch or oil, and the application of variously shaped cautery-irons to the bleeding vessels. It is not surprising, therefore, to learn, as we do, from the writings of Thomas Gale (1563), of the dread people had of this method of checking hæmorrhage by the 'terrible fire, by means whereof many people perished,' and these operations were not unnaturally stigmatised as the 'opprobria of surgery.'

In the second era, commencing towards the end of the sixteenth century, the circular method was advocated and practised. There is evidence that the merits of it were appreciated in 1560 by Ambrose Paré, to whom we are indebted for the introduction of the ligature as a means of arresting hæmorrhage. Although the circular method is mentioned in the writings of Celsus, as is also the ligature, it was not until 1560 that the ligature obtained recognition. The introduction of the ligature, and the invention, a century later, of the tourniquet by Morel (1674), which instrument was advocated by Petit (1708), were doubtless main factors in enabling surgeons to devise better methods of amputating than those previously adopted.

Several modes of performing a 'circular' amputation are recognised—for example, those of Louis, Petit, Mynors, Alanson, O'Halloran, Bell, and others. In the first of these the skin was retracted and two bandages were applied—one above and the other below the line of incision, in order to steady the soft parts, which were divided by a circular incision down to the bone. Then, in order to allow the superficial muscles to retract, the operator removed the upper bandage, and the deeper muscles were divided by a second incision, and the bone was divided on a line with the retracted superficial layer at that point. This Malgaigne states is 'very nearly the method described by Celsus, as Louis himself allows.' The

practice of dividing the skin down to the fascia in the first instance, at a point below where the bone is to be divided, retracting the skin and subsequently dividing the muscular tissues down to the bone on a level with the retracted skin, was introduced by J. L. Petit (1708). Mynors, of Birmingham, went a step farther, and dissected back and reflected the skin to a point on a level with the bone-section. These methods were improved on by Alanson (1782), who introduced oblique division of the muscles, the wound eventually resembling 'a conical cavity, the apex of which is the extremity of the bone.' The parts thus divided he states are 'obviously the best calculated to prevent a sugar-loaf stump.'

The 'triple incision' of B. Bell, of Edinburgh, consisted in the primary division of skin and fascia; secondly, the muscles; and finally, the bone. Mr. Hey, of Leeds, and Desault, have also advocated amputations by 'triple' incision. Mr. Hey advised division of the posterior muscles at a somewhat lower level than the anterior, having regard to the greater tendency of the former to retract and contract.

Other modifications of the 'circular' method have also been proposed, such as that in which two semilunar incisions (Syme and Liston) are made, one on the anterior and the other on the posterior aspect of the limb, the alleged advantages of which are the greater facility afforded for the reflection backwards of the flaps. Another modification is that of Lenoir, having also for its object the facilitating a dissection backwards of the integumental flaps. Having made a circular incision, not passing deeper than the fascia, an inch and a half below where the bone is to be divided, a vertical incision from this point is made, and the two angular flaps can then be easily dissected back, the incision assuming a somewhat oval form. The method appears mainly applicable to amputations of the leg below the place of election, and to the lower third of the forearm.

The credit of priority in the introduction of flap amputations is due to Mr. James Young of Plymouth (1678), who, in amputations of the leg, recommended 'a flap of the membranous flesh covering the muscles of the calf.' Subsequently Verduin recommended a similar flap, but, instead of cutting it from below upwards, he made it by transfixion. Many have been the forms, varieties, and modifications of the amputation originally suggested by Mr. Young: single and double flaps, unilateral, bilateral, antero-posterior, oval, and rectangular. In thigh amputations, O'Halloran first recommended the long anterior and short posterior flap. This method, with slight modifications, has been practised and advocated by B. Bell, Liston, Sédillot, Fergusson, and Spence.

Among the more recent developments of flap amputation are those of Carden and Teale, together with the operation at the knee of Gritti, and the modification of it to which the writer has given the name of supra-condyloid. The advantages of the single flap method are thus epitomised by Carden:—'The facility afforded for amputating either through the knee or through any part of the lower end of the femur, thus proportionately avoiding the shock of higher amputation, and the risks of exfoliation, pyæmia, &c., attendant on sawing through the cylinder of the bone; the simplicity of the whole proceeding, and small extent of the wound; the favourable position of the flap for dressing, and for the escape of discharge; painlessness and quietude of the stump, the principal nerves being divided high up and drawn out of reach of pressure or exposure; the fitness of the stump to stand and walk upon, the bearing being broad, and the skin employed being accustomed to bear the weight of the body in kneeling; the cicatrix being drawn clear of the point of the bone, out of the reach of pressure.'

Notwithstanding these alleged advantages, and the fact that the operation was approved of by Professor Syme, the writer has known the 'surgical calamity' of sloughing of the flap to occur after this operation, and that in more than one case. This is most likely to happen in weakly, delicate, anæmic subjects, and the operation therefore, in such cases, should not be lightly undertaken. When there is reason to apprehend this accident supervening, the flap should be made wider than is recommended by Carden. Thus the risk of sloughing is diminished. It is also to a great extent obviated by the modifications of Sir J. Lister and Professor Spence, in which procedures the anterior flap consists, not merely of integument, but also of muscular tissue. The chances of the accident occurring are, however, more effectually avoided in the percondyloid amputation of Gritti, or in the supra-condyloid modification of it, in both of which operations the patella is included in the anterior flap.

The flap amputation which best fulfils all the requirements needed is the rectangular method of the late Mr. Teale, the special advantages of which are apparent

not merely in thigh amputations, but also in those of the leg, fingers, arm, and forearm. These advantages are: the remote danger of sloughing of the flaps, the abundant covering for the bone and consequent diminished risk of the formation of a conical stump; the cicatrix not being on the face of the stump, but placed posteriorly and above it; the facilities for the escape of fluids from the wound, rendering drainage almost unnecessary; the principal nerves and vessels, being in the posterior flap, are not liable to the injurious effects of pressure; and the main vessels being in the posterior flap, the operator can find and secure them with the minimum amount of disturbance to the wound. It has also been claimed for this operation that the stumps can bear the weight of the body better than after the ordinary circular or flap operations. This opinion, however, though the probabilities of its accuracy are great, is one which the writer is not disposed to endorse.

Two main objections have been made to Teale's operation: one is the length of time that its performance occupies, and the other that the great length of the anterior flap requires a high division of the bone. Although previously to the discovery of anæsthetics (1846), the objection to a surgical operation because of the length of time it occupied would not have been groundless, that objection cannot now be urged. Besides the advantages to the patient obtained by anæsthetics, viz. the prevention of suffering, diminution of shock, and subsequent oblivion of the details of the operation, must be added those enjoyed by the operator—namely, power to act with deliberation, calmness, and freedom from anxiety, care, and hurry; and these advantages are as great to the operator as those already mentioned are to the patient.

The second objection to Teale's amputation is based on the alleged necessity for a higher bone division than in other amputations. There can be little doubt that by following accurately Mr. Teale's directions, in very many instances, both of leg and thigh amputations, a low division of the osseous structures would be impracticable. This is not of so much consequence in amputations of the leg, since the lower third of that limb is not, as a rule, a situation selected by surgeons for the performance of amputation; but in the thigh, the case is different. Here it is all-important to save as much as possible of the bone, not only with the view of subsequent adaptation of mechanical appliances, but also because in thigh amputations, as Dieffenbach has expressed it, 'the danger increases inch by inch.' To avoid a high section of bone, two modifications of Teale's amputation have been proposed by Sir J. Lister and Mr. Wharton. Having regard to the forward position of the bone among the muscles, the posterior surface of it being anterior to the longitudinal axis of the limb, Sir J. Lister makes the following proposal:—An anterior flap, two-thirds of the diameter of the limb, 'after being marked out by carrying the knife through the skin and fat, should be raised so as to contain a good deal of muscle,' and a posterior one, rather more than half its length, of rounded shape, is then made, the integuments of which should be dissected up before the posterior muscles are divided, 'in this way preventing the effects of undue contraction.'

The high division of bone, and extensive division of muscular tissue—the two alleged defects in the rectangular method—are also got rid of by the modification proposed by Mr. Wharton:—'Let the measurements for Teale's amputation be accurately taken and mapped out; but, instead of dividing the bone at the site directed by him, let it be sawn at the situation corresponding to the inferior termination of his posterior flap, and let the superior boundary of his anterior flap be limited by the same plane. The saving of bone thus effected will be considerable, and therefore tend directly to diminish the mortality of thigh amputations. According to this method the anterior flap will be shorter by a fourth than Teale's, and there will be no posterior flap.'

But against this modification it is objected that the cicatrix is too near the surface of the stump; that there is tension of the soft parts on the face of the stump; that the covering is insufficient; that, owing to retraction of the tissues, the posterior surface of the bone projects, and is denuded of soft tissues; that there is a liability of the cicatrix becoming adherent to the immediately subjacent bone; and that the risk of pyæmia is increased. The writer's experience would, however, undoubtedly tend to establish the groundlessness of most of these objections; but, though willing to acknowledge and bear testimony to the excellence of the results obtained by Wharton's modification, he fails to recognise the alleged defects of the rectangular method as originally recommended by Mr. Teale.

For the circular and flap methods, special advantages are claimed. Among those said to belong to the circular method is diminution of shock, the area of the

wound being less in extent than in 'flap' operations. It has also been claimed for circular amputations that, owing to the vessels being divided at right angles to their continuity, the risk of secondary hæmorrhage is diminished, no fenestrated openings in them being possible, a result which may occur in flap amputations, especially when done by transfixion. Again, it is claimed that the risks of phlebitic inflammation are diminished, the wounds in them being less in extent than when divided obliquely, as in flap amputations. And lastly, it is alleged that the mortality is less; but the foregoing advantages appear to be highly problematical. On the other hand the advocates for flap amputations claim greater shapeliness of stump, possibility of operating with greater speed, diminished risk of conical stumps resulting, better covering for the bone, and the stumps being better adapted for the subsequent adjustment of prothetic mechanical appliances.

Previously to the introduction of anæsthetics and Listerian antiseptic practice, the main objections urged against flap amputations may not have been altogether groundless, but that they are so now appears to be beyond question, and there is moreover a general consensus of opinion among operating surgeons that, in the majority of cases, 'flap' amputations are to be preferred, as giving the most satisfactory results.

The Performance of an Amputation.—Before performing an amputation the precautionary measures to be adopted may be considered. The day previous to the operation the patient's bowels should, if confined, be acted on either by an enema or by some mild but efficient aperient. On the morning of the operation the food given should be small in quantity, and of the lightest and most easily digested quality. In some of the more important amputations, such as those of the thigh, at the hip, knee, or shoulder joints, the writer is in the habit of giving the patient an antiseptic (eucalyptol) bath, it being desirable to render the part to be operated on as completely aseptic as possible by diligent washing, and getting rid of all superfluous epidermic accretions by rubbing with soap and pumice. The application of turpentine or ether to the part, to get rid of greasy matters on the skin, is strongly to be commended, and then swathing the limb in moistened carbolised or eucalyptol gauze. The next point is the prevention of hæmorrhage. The tourniquet of Petit and the various modifications of that instrument have been so entirely superseded by the introduction and employment of the so-called Bloodless Method of Esmarch, that any detailed description of the former instruments and their mode of application is unnecessary. But Esmarch's method is not applicable in all cases—for example, in cases of gangrene, or when there is any purulent deposit or infiltration. In such cases it would be preferable to adopt the plan of elevation of the limb for some time previous to the amputation. There are, it has been stated, certain alleged defects connected with Esmarch's method. These are the pain it causes and the liability to produce sloughing and paralysis, especially the latter, when applied to the arm. The writer, after an experience of ten years' constant use of this 'bloodless' method, can bear testimony to having never on any occasion seen those accidents which, in the practice of others, are said to have occurred. On the other hand, he is not prepared to endorse the views of M. Marduel, who in his exhaustive paper, states that the artificial production of a local anæmia not only is unattended with the risks already alluded to, but promotes rapidity of union and diminishes the risk of traumatic fever.

As regards paralysis of the arm following the application of the elastic tubing or tourniquet, Von Langenbeck suggests that for the tubing a flat elastic bandage be substituted. The effect of this would be to diffuse the pressure, and in that way diminish the chances of any mishap occurring from an undue amount of pressure at one point where there was the minimum amount of covering and protection to the nerves. With the same object Sir J. Lister advocates preliminary elevation of the limb, or the 'method of position,' as being one in which an equal amount of local anæmia is produced, with, at the same time, an immunity from the danger of other accidents.

In certain amputations, such as those at the hip and shoulder-joints, other means for the prevention of hæmorrhage than these are employed: in hip amputations, the abdominal clamp of Sir J. Lister and Mr. Davy's rectal lever; and in disarticulations at the shoulder, the method of compression of the subclavian artery on the first rib. These, however, will be better discussed in connection with a detailed description of those procedures. The various forms of forceps for seizing the vessels for the purpose of applying a ligature are the so-called 'bull-dog,' Nunneley's, Liston's, and Von Langenbeck's catch-forceps, and, lastly, Kœberle's, which is, in the writer's opinion, superior to all others hitherto de-

vised. In cases where the vessel to be secured retracts greatly, it often happens that the tenaculum will succeed when the above-mentioned instruments fail. For example, in amputations of the leg, the inter-osseous vessels are especially likely to give trouble from this cause. In such a case the tenaculum will be found most useful. With the object of preventing this difficulty arising Sir G. Porter makes a practical suggestion —namely, that the inter-osseous structures should be divided with the catlin at a situation a little below the point where the bones are divided.

In what may be termed the pre-antiseptic era surgeons had, and with reason, a great dread of phlebitis being induced by the ligature of veins, and the practice, consequently, was universally condemned. The introduction, however, of Listerian antiseptic practice has effected a complete and signal revolution. The writer is unable to recall a single instance in which the ligature of a large or small vein—efficient antiseptic precautions being taken—was attended with any secondary trouble whatever. The sailor's 'reef-knot' is the best to employ, and both ends should then be cut short. For the larger vessels chromicised catgut of medium thickness is to be preferred, as its absorption takes a longer time, but in vessels of smaller calibre ordinary carbolised catgut may be used.

The instruments—amputation knives and scalpels—for the division of the soft structures may here be alluded to. The first-named instruments may be divided into two classes—those rounded at the ends and with strong thick straight backs. These are, as a rule, used in 'circular' amputations. The other class consists of long comparatively slender blades, and pointed at the extremity. These 'catlin' knives, as they are usually called, are employed generally in transfixion flap methods. In certain amputations, such as Carden's, Teale's, and the supra-condyloid method, the use of a full-sized scalpel for making the anterior flap may be employed conveniently, the ordinary amputation-knife being used for making the posterior flaps. Some surgeons prefer, in order to add a certain amount of brilliancy to the operation and save a few unimportant seconds, using one instrument throughout; but there is no special advantage to be gained by doing so. In forming a skin flap, as in Carden's operation, care should be taken not to keep the cutting edge of the knife towards the skin, as in an anatomical dissection. The danger of doing so is the liability of the flap to slough, arising from the nutrient vessels in the subcutaneous tissues being divided during the operation. Another important practical point to bear in mind is the necessity for holding the knife so that the edges of the skin shall not be bevelled, but divided perpendicularly. The dangers of sloughing will in this way be also diminished. On reaching the bone care should be taken to divide the periosteum with the knife, and not, as is so often done, with the saw. Neglect of this is apt to be followed by periostitis from the tearing or laceration of the membrane, an accident which in its turn is followed by necrosis at the extremity of the divided bone.

According to Von Langenbeck, Trélat, and others, the formation of periosteal flaps to cover the cut surface of the bone is believed to be attended with advantages. These are held to be that the periosteal curtain covering the medullary canal acts as a barrier against the introduction of septic agencies, and diminishes, consequently, the chances of the occurrence of osteo-myelitis. It can be done either by making a somewhat quadrilateral-shaped flap and letting it fall over the cut surface of the bone, or by the method of M. Trélat, which is to detach the membrane all round the bone for fully an inch below the point where the bone has to be divided, making thus a sleeve-shaped flap. The writer fails to recognise the advantages of either method.

The division of the bone should be made by a broad-bladed saw with finely-set teeth. The advantage of the broad blade is that it is much easier to make a plane, even section, and, in commencing it, by placing the left thumb-nail against the side of the blade, the operator can steady the instrument and prevent it getting out of the groove it makes in the first instance, in a manner hardly possible when any narrow-bladed instrument is employed. The operator should commence by laying the heel of the instrument on the bone, drawing it towards him to its full length, and complete the division, taking care to avoid too rapid an action of the instrument, as from the friction an amount of heat is generated which, it is alleged, may injuriously affect the bone. If the edges of the bone be sharp, and likely to exercise an injurious effect on the flap, bone-forceps can be employed to round them, and thus diminish the chances of ulceration from pressure.

All bleeding vessels having been secured by carbolised catgut, or other equally aseptic

sutures, the wound should then be dressed. *See* Antiseptic Surgery. The writer, notwithstanding what has been said and written to the contrary, ventures to express his conviction and belief that rendering the atmosphere in which the operation is performed thoroughly aseptic, whether it be done by carbolised spray or other means, is of the first importance.

Another point in connection with the treatment of an amputation wound, which the writer would emphasize is the desirability of a free application of a zinc chloride solution (30 to 40 grs. ad aquæ f℥j.) to the wound, drainage, and taking care not to close the wound until all oozing has ceased; the use of deep, as well as superficial, sutures, and externally the dressings of gauze treated with carbolic acid, eucalyptol, or corrosive sublimate; or, again, wood wool or turf, similarly treated, the latter of which dressings, so much employed of late in Germany, give the best results.

In the performance of an amputation, the operator should have at least four assistants: one to anæsthetize the patient; a second to command the hæmorrhage by tourniquet, digital pressure, or elastic bandage; a third to retract the flaps and ligature vessels; and a fourth to hand the instruments and other appliances.

The principles which should guide the surgeon in the treatment of amputations, and of all wounds, have been clearly and forcibly indicated by Esmarch in his paper 'Der Antiseptische Dauerverband,' read at the last meeting of the International Medical Congress at Copenhagen.

These may be briefly summarised as follows:—

I. Making the wound as thoroughly dry as possible by a complete arrest of all hæmorrhage.

II. By the introduction of deep sutures and elastic pressure externally, preventing cavities or open spaces existing within the flaps.

III. Giving free exit to all wound-secretion.

IV. Maintaining, by the most careful precautions, a thoroughly aseptic condition of the wound, and of everything in close proximity directly or indirectly connected with it.

V. Employing a dressing by which moderate pressure on the flaps can be made, and which can readily absorb all wound-secretion.

VI. Giving rest and fixation (*Immobilisirung*) to the part operated on.

William Stokes.

AMUSSAT'S OPERATION. *See* Colotomy.

AMYGDALITIS. *See* Tonsils.

AMYLOID DISEASE. *See* Albuminoid Degeneration.

ANÆSTHESIA.—The loss of sensation or of the sense of touch, whether from disease or injury: hence *local anæsthesia*. The term 'general anæsthesia' is usually applied to the state of unconsciousness produced by the administration of certain drugs known as anæsthetics.

ANÆSTHETICS.—Agents used for the suspension of sensation, and thus for the prevention of pain.

The chief use of anæsthetics in surgery is for the abolition of pain during operations; but some anæsthetics are also used for preventing reflex movements and for producing muscular relaxation, and are thus valuable aids to diagnosis and treatment.

Anæsthetics are either *local*—i.e. acting only upon the part to which they are applied; or *general*—i.e. rendering the person subjected to their influence entirely insensible.

Local anæsthesia is usually produced by the application of cold to the surface, whereby the part is sufficiently benumbed to admit of superficial operations of short duration being endured without pain. The most convenient method of freezing a part for operation is to direct upon it a finely divided spray of anhydrous ether. A portable spray-producer, which can be easily worked by the hand, is sold by the instrument-makers, and this being fitted to a small bottle containing the ether, a fine spray should be projected upon the part from a distance of about six inches, and with just sufficient rapidity to keep up a constant evaporation. The surface to be frozen should be dry, and the spray should be applied until the skin assumes a dead white colour, when it may be incised without pain.

It must be remembered that the vapour of ether is highly inflammable, so that the spray must not be used in conjunction with the actual cautery or in the neighbourhood of unprotected lights.

A similar degree of local anæsthesia may be produced by the use of a mixture of equal parts of pounded ice and common salt, which should be enclosed in a muslin bag, and kept upon the skin until the characteristic pallor is observed, which is usually in about five minutes.

This method can be applied to a somewhat larger surface than the ether-spray, but in either case the insensibility is but skin-deep, and lasts only a minute or two. This, however, is sufficient for a variety of small operations, such as opening an abscess, slitting up a sinus, or cutting off a pile; and, seeing that the chief pain of many more serious operations depends upon the incision through the skin, much suffering may be prevented by inducing local anæsthesia in cases in which, for any reason, the induction of general anæsthesia is undesirable. No harm results from such freezing, and the only inconvenience of the process is the toughness of the frozen tissues, which renders them more resistant to incision or dissection.

For producing anæsthesia of mucous surfaces, e.g. that of the eye or throat, the local application of a solution of muriate of cocaine has recently been used. A watery solution of 2 to 4 per cent. is suitable for use in operations upon the eye. A drop or two is applied to the inner surface of the lids three times at intervals of two minutes; in six or seven minutes the conjunctiva is sufficiently insensitive to allow of operations, such as that for squint or extraction of cataract, to be performed with little or no pain. Stronger solutions, as e.g. 20 per cent., may be used for painting over the laryngeal or other mucous surfaces, very decided temporary anæsthesia being thus produced.

General anæsthesia is obtained by the inhalation of certain vapours, which have the effect of producing insensibility without interfering with the essential vital functions.

The anæsthetics in common use are ether, chloroform, and nitrous oxide gas.

These differ materially both in their effects and in the mode of administration, so that it will be necessary to describe them separately, but there are some general principles which should be borne in mind in the administration of all anæsthetics.

In the first place there should be no impediment to free respiration, so that all tight clothing should be avoided, and the stomach should be empty. Whenever possible, the patient should be recumbent, and in an unrestrained and easy posture. Artificial teeth should be removed from the mouth, lest they become loose or displaced during insensibility. It is well also for the bladder to be emptied, since involuntary micturition is apt to occur.

The early morning, before breakfast, is as a rule the best time for taking anæsthetics, because abstinence from food is borne during sleep without inconvenience; and the rest of the night conduces to equanimity and calmness. The amount of an anæsthetic required to produce insensibility is in proportion to the quantity of blood in the person to whom it is administered. So that young children and anæmic persons require a proportionately smaller quantity than the full-grown and plethoric. Those addicted to alcohol or to much smoking take, as a rule, a large quantity of ether or chloroform; they usually struggle much, and are not good subjects for anæsthetics.

It is very desirable that the anæsthetic should be given by some one not concerned with the operation to be performed, so that his whole attention may be devoted to the maintenance of the proper degree of insensibility, and to the careful observation of the condition of the patient.

Ether.—This is at the present time the most generally used anæsthetic for operations of any considerable duration. It was the first anæsthetic systematically used for surgical purposes. But soon after the discovery of the method of so using it, and when the whole subject of artificially producing anæsthesia was in its infancy, chloroform was introduced and recommended by Sir James Simpson, as a more potent and convenient agent, and so, in Europe, ether for a time fell into disuse. In America, however, where it was first used, ether continued to be generally employed, and during the last ten years it has, in England, to a great extent taken the place of chloroform, on account of the general belief entertained of its greater safety. The greater safety of ether as compared with chloroform depends upon its stimulant effect upon the action of the heart.

The chief danger of chloroform is the possibility of its producing a sudden failure of the heart's action, and this danger does not pertain to ether. Ether, on the contrary, is a stimulant to the heart, and during inhalation of its vapour the pressure in the vessels is maintained, until there has been a manifest failure of the breathing.

This difference between the two drugs is of very great importance, because the failure of respiration, whilst the circulation is maintained, is a danger from which the patient may usually be recovered; but any considerable failure of the circulation involves the gravest peril.

Moreover, cardiac syncope is apt to occur with great suddenness, so that the absence of warning allows but little opportunity for averting the danger; whereas respiratory failure almost always takes place

gradually, so that careful observation will generally lead to its recognition while it is still remediable.

Nevertheless, death has been known to result from the sudden failure of respiration, owing to the occurrence of an epileptiform spasm of the respiratory muscles, whereby the chest is fixed in the position of expiration. This is the only death from ether which the writer has witnessed during a large experience of its administration, both by himself and others; and unhappily nothing that was discovered, either at the time or at the post-mortem examination, gave any clue as to how the fatality could have been avoided.

Such cases are no doubt extremely rare, but they teach us that it cannot be rightly said that any anæsthetic is entirely free from danger. We can scarcely expect to render a person profoundly insensible without incurring some risk. This risk is certainly very small in the case of ether; but it is sufficient to point to the necessity of carefully watching the condition of everyone placed under the influence of an anæsthetic, and to deter the wise from the use of even the safest of these potent agents without due consideration and necessity.

In the administration of ether vapour for producing anæsthesia the chief precautions necessary to be observed are these:—

1. That kind of ether should be used which is fittest for the purpose of inhalation; and this is the pure anhydrous washed ether, of specific gravity ·720, free from alcohol and water. Methylated ether of sp. gr. ·735 answers perfectly well, however, and it is much cheaper and less volatile. The compounds sold as 'ether for local anæsthesia' are not suitable for inhalation.

2. The ether should be given in such a manner that the inhalation may be commenced with a very weak vapour, which, after a few inspirations, can be rapidly increased in strength. If we begin with too powerful a vapour the air-passages are intolerant of it, and the patient resists the inhalation; but, after a few moments' inhalation of a diluted vapour, its strength can be increased without inconvenience, and the patient rapidly brought under its influence.

3. Stimulants should not be administered before the inhalation. Ether is itself a stimulant, and can be safely given in cases where there is great depression or shock, but it is undesirable to have alcohol in the stomach when ether is being inhaled.

4. Whatever danger may belong to ether has relation to the respiratory function; the breathing should, therefore, be watched, and, should any embarrassment of this function arise, the inhalation should be stopped until the breathing is properly re-established. It is desirable so to place the head of the patient that the saliva (the secretion of which, as well as of the other glands of the mouth, is increased by the ether) may run out of the corner of the mouth rather than into the trachea.

Let it, above all, be remembered that, if any serious impediment to respiration occurs, the remedy which is, beyond all comparison with others, the most potent, is artificial respiration. The greatest care should of course be taken to ensure the absence of any mechanical obstruction to the free ingress of air to the lungs. The tongue should be pulled forcibly forwards and the finger passed to the back of the mouth, to ascertain that the passage is clear. But no time should be wasted in setting batteries to work, administering stimulants, or endeavouring to excite reflex movements. The important thing to be done is to at once commence artificial respiration, and, should air not then pass through the glottis, the windpipe should be opened without delay. Slighter disturbances of respiration may often be overcome by simply throwing back the head into the position of extension, and tilting forwards the chin. In other cases a little sticky mucus requires to be swept out of the back of the mouth with a sponge or towel. More serious obstruction may arise from vomited food lodging in the pharynx. It is always well, therefore, to have at hand a strong pair of flat-bladed forceps, with which the jaws can be opened and the tongue drawn forward, or any obstructing material seized.

In the absence of any special apparatus, ether may be easily administered by folding a towel into the form of a cone, into the apex of which is thrust a small sponge wrung out of hot water; about half-an-ounce of ether is poured on to the sponge and inner surface of the towel, which is then held over the patient's nose and mouth in such a way that (after the first minute, during which air is freely admitted) he breathes an atmosphere heavily charged with ether vapour, no more air being allowed to enter than can be drawn in through the apex of the cone or beneath the edge of the towel held firmly over the face. A fresh supply of ether must be frequently poured on to the sponge, for it evaporates quickly, but in this way insensibility can be produced in four or five minutes.

This, however, though an easily available method, is wasteful and disagreeable,

for the ether is apt to run on to the patient's face, and much also escapes into the room. It is convenient, therefore, to use some one of the special forms of apparatus invented for the purpose.

A very simple one, introduced by the writer when he first advocated the use of ether, is a cone of thick felt covered with silk, between which and the felt is a layer of mackintosh cloth. The lower border of the felt is turned in to the extent of an inch, so as to make a thick soft edge to fit over the face, and to prevent the ether running on to the skin. The cone should be about eight inches high and its base four inches in diameter, and in its upper end should be placed a small soft sponge. Such cones can be made by anyone, are easily washed, and are very portable.

Improvements on these can, however, be obtained of the instrument-makers, of which the best are those invented by Mr. J. H. Morgan and the late Mr. Clover. Mr. Morgan's consists of a double cone, with valves so arranged that the expired air passes between the cones, and is carried to the floor by a tube. Mr. Clover's inhaler has an india-rubber bag communicating with the face-piece, and so connected with a vessel containing ether that the patient can be made to breathe, first the air in the bag, and then, gradually, air passed through the ether vessel, the strength of the vapour being modified by the amount of air passed through the ether.

The pleasantest and most rapid plan is to give first nitrous oxide gas to the stage of insensibility, and then to keep up the anæsthesia by ether. Mr. Clover invented an apparatus in which, by the turn of a valve, the vapour inhaled could be changed from laughing-gas to ether. The disadvantage of this method is the greater venous congestion which is thus produced.

The first effect of the inhalation of ether is a sensation of tingling and warmth throughout the body; the vapour is at first disagreeably pungent, and may excite cough; the air-passages, however, soon become accustomed to it, and the patient then breathes more deeply; after about two minutes sensation is much diminished and consciousness becomes clouded; then there often ensues a short period of struggling, which is succeeded by a gradual relaxation of the muscles and a condition of complete insensibility. When this is reached the eyelid may be raised and the conjunctiva touched with the finger without producing any movement of the lid. This, therefore, is a convenient test of the proper degree of anæsthesia having been attained.

Recovery from ether is sometimes characterised by a somewhat noisy or talkative stage of intoxication. It is well, therefore, to cover the eyes and encourage sleep. The taste of the ether is best got rid of by washing the mouth with warm water, in a tumbler of which a teaspoonful of eau de Cologne has been mixed.

Chloroform is doubtless a most convenient anæsthetic, and, in careful hands and with due precautions, may be given with very little danger. But it has the very great disadvantage that if given in too concentrated a vapour it is capable of producing a dangerous depression, or even a sudden arrest of the heart's action; a condition from which recovery is seldom possible, and which is responsible for the majority of the deaths that have occurred from chloroform inhalation. It would seem, moreover, that some persons are peculiarly susceptible to the action of chloroform upon the heart, so that to these even a small dose of the vapour may be dangerous. It is the opinion of the writer, therefore, that chloroform should only be used in cases to which, for some reason, ether is inapplicable.

For instance, the operation for cleft palate is much more conveniently performed under the influence of chloroform than of ether, because of the increased secretion of saliva and mucus which ether gives rise to, and the greater facility with which chloroform can be re-administered during the progress of the operation. Again the inflammable nature of ether vapour renders it under some circumstances inadmissible.

The chief care, then, in administering chloroform should be the avoidance of too concentrated a vapour, that is to say, of more than four per cent.; and this is to be attained either by using a vapour of measured strength, or by insuring the free access of air with the evaporated chloroform. By Clover's apparatus a mixture of chloroform and air is inhaled from a bag containing thirty-three minims of chloroform to each thousand cubic inches of air, so that a vapour of known and uniform strength is administered. A simpler, though of course less exact, method is to pour a drachm of chloroform upon a folded towel or handkerchief which is held over the patient's face loosely enough to allow air freely to mix with the evaporated chloroform. The patient should be brought gradually under the influence of the drug, by holding the cloth three or four inches from the face to begin with, and after a dozen inspirations,

bringing it more closely over the mouth and nose. Twenty or thirty drops of chloroform are to be added from time to time as it evaporates.

Insensibility is produced in about five minutes, the same stages being passed through as with ether. The pulse and respiration should be watched, and on any failure of the pulse or obstruction of the respiration occurring, the chin should be thrown back and the tongue pulled forcibly forwards. Should this not suffice for recovery, artificial respiration should be at once resorted to. Especial care should be taken when the patient is struggling, lest, by a very deep inspiration and subsequent closure of the glottis, too much chloroform is suddenly absorbed into the blood.

Troublesome nausea and vomiting occasionally occur after taking chloroform, and less frequently, after ether. The best remedies are free ventilation of the room, maintenance of the recumbent posture, abstinence from food, iced water in teaspoonful doses.

Nitrous Oxide Gas.—This is an admirable anæsthetic for operations not lasting more than two or three minutes. It is very safe, not disagreeable, and is seldom followed by any discomfort.

It requires for its administration a special apparatus. This consists of an iron bottle containing the gas condensed into a liquid. An india-rubber tube is connected with the bottle, and by opening the communication, the gas escapes from the bottle into an elastic bag, from whence another tube conveys it to a face-piece through which it is inhaled. It is essential that the gas should be given pure and without the admixture of air, for such a mixture produces the exciting and intoxicating effects which gave it the name of 'laughing gas.' The margin of the face-piece must therefore be enclosed by an air-cushion, to ensure its fitting so accurately to the face that no air can enter.

The bag being filled with gas, the face-piece must be applied and pressed firmly to the sides of the nose and round the mouth; the patient is then directed to close the eyes and to take slow deep inspirations, the communication with the gas-bag being at first closed. Immediately after the first complete expiration the gas should be turned on to the face-piece, and thus, the lungs being emptied, a full dose of gas is at once inhaled, a gentle stream of gas being allowed to flow into the bag, so that respiration is carried on without effort. In about a minute the patient is insensible; the blood is darkened, the surface becomes extremely livid, the breathing stertorous, and slight convulsive movements occur; the eyelids are insensitive and the pupils dilated. The gas must now be removed and the operation at once proceeded with.

As soon as the gas is withdrawn, recovery begins, and at the end of two or three minutes the patient is quite himself again. If necessary, however, insensibility may be prolonged by removing the face-piece, admitting air for two inspirations and then again giving the gas, repeating such intermission from time to time when the breathing becomes stertorous. This should only be done, however, on emergency, for if longer anæsthesia is required it is better to supplement the gas with ether. Moreover the gas cannot be depended upon for producing perfect quietude; there are almost always slight jerky movements, and young people often pass into a condition of complete opisthotonos when deeply under its influence.

For operations upon the mouth, such as the extraction of teeth, it is necessary to prop open the jaws by a wedge fixed between the upper and lower teeth, before the inhalation of gas is commenced; otherwise the jaws would become tightly closed and access to the back of the mouth be prevented. Ordinarily, no disagreeable effects follow the inhalation, although vomiting is occasionally produced in pregnant women. Abstinence from food is of less consequence before inhaling gas than when other anæsthetics are to be taken, yet it is preferable that the stomach be empty, so that respiration may be as deep as possible. To take alcohol before inhaling the gas is dangerous.

Should faintness ensue, or any delay in recovery occur, the patient should be placed recumbent, and artificial respiration performed.

Other anæsthetic compounds have occasionally been used, which are mostly of unstable composition and less reliable than those above mentioned.

Bichloride of Methylene is a compound of chloroform which has been a good deal used in ophthalmic surgery, and by Sir Spencer Wells for ovariotomy and other abdominal operations. Very similar to this is a mixture of one part of alcohol, two of chloroform, and three of ether, which has been by some recommended. The instability of these compounds is objectionable, and they appear to possess no advantage over the other anæsthetics described in this article. J. Warrington Haward.

ANALGESIA.—The loss of the sensation of local pain.

ANAPHRODISIA. *See* Impotence.

ANCHYLOSIS. *See* Ankylosis.

ANEURISM may be defined as a pulsating tumour in direct communication with an artery, since that is its condition when it comes before the surgeon for treatment, although under certain conditions an aneurism does not pulsate. The existence of an aneurism, apart from a wound of the vessel with which it is connected, presupposes disease of the arterial coats (*see* Arteries, Diseases of); for a healthy artery would not admit of dilatation sufficient to form a sac, nor would it give way under any reasonable exertion on the part of the patient. Given a diseased condition of the arterial coats, they may yield spontaneously to the pressure of the blood impelled forcibly against them, as in the transverse portion of the arch of the aorta; or may be stretched and weakened by the constant movement of a neighbouring joint, as in the case of the popliteal artery. In the great majority of aneurisms, however, there is a distinct starting-point of the disease connected with some strain or over-exertion, during which the patient is conscious of a crack or giving way of tissue, in the region where an aneurism subsequently shows itself.

The division of aneurisms into 'true' and 'false' is somewhat complicated by the different views held as to the use of those terms. The existence of any aneurism, in the walls of which all the coats of the artery are to be found is very doubtful, and for all practical purposes a 'true' aneurism may be defined as one in which the blood is contained within the arterial walls, however thin they may be; while a 'false' aneurism has its walls formed by condensation of the tissues surrounding the artery, and is therefore for the most part traumatic.

Aneurisms are rarely *fusiform* or formed by dilatation of the whole circumference of an artery, but are in the great majority of instances *sacculated*, there being a distinct pouch arising from one side of the artery having an aperture of communication with the interior of the vessel. It is by the gradual formation of this sac that the characteristic symptoms of aneurism are produced; and a fatal result is commonly due to rupture of the sac, either externally or internally, or to pressure upon vital parts by the increasing size of the tumour. Occasionally, in the case of the aorta, the coats of which are especially liable to atheroma, the blood finds its way between the middle and external coats of the vessel, splitting them asunder for some distance, and forming an elongated pouch or *dissecting* aneurism, which may or may not have a second communication with the interior of the artery.

As the result of a wound, or more rarely spontaneously, an aneurismal sac may form between an artery and a vein, forming an Arterio-Venous Aneurism.

Causes.—From what has been said it is obvious that the causes of aneurism are divisible into predisposing and active. Conditions of the system tending to arterial disease must conduce to aneurism, and foremost amongst these may be placed intemperance and syphilis. The undoubtedly greater liability of men over women to suffer from aneurism is partly to be explained by the greater prevalence of chronic intemperance and of constitutional syphilis among the former; and partly by the greater physical exertion which the male sex is liable to in various employments. This is especially seen in the case of soldiers, who, besides being the subjects of intemperance and syphilis, are often called upon to make violent exertions, suddenly, under very unfavourable circumstances as regards their clothing. The tight uniforms and rigid stocks of former years had much to answer for in the production of thoracic aneurism, and the lightly clad sailor, though probably equally diseased, has been found to be much less liable to that disorder than the soldier. Obstruction of an artery by its being plugged with an *embolon* or some vegetation loosened from one of the valves of the heart is undoubtedly a cause of aneurism of the smaller arteries, particularly in the brain or the branches of the external carotid. This may occur in young persons, but as a rule true aneurism is a disease of middle life, when the atheromatous changes in the arterial walls are progressive; whilst false aneurism is more likely to occur spontaneously in more advanced years, when the walls of the arteries have become calcareous and brittle, and are therefore liable to rupture on sudden exertion.

Symptoms.—The symptoms of an aneurism in a limb are fairly obvious, the pulsating swelling usually first attracting the patient's notice; but this may come on so insidiously that popliteal aneurisms have often been found, accidentally, in a patient previously unaware of the existence of any swelling. The distinct *pulsation* of a swelling in the position of a main artery at once raising the question of aneurism, its direct

communication with the vessel should be ascertained by making pressure upon the artery nearer the heart, when all pulsation in the tumour should abruptly cease. Now, gently grasping the tumour with his hand the surgeon slightly compresses it, and on relaxing his hold of the artery above is at once conscious of the *distensile expansion* characteristic of aneurism; for although in rare cases of cancer a tumour may, after compression, become distended with blood and eventually pulsate, the time thus occupied is much longer than in true aneurism. The ear or a stethoscope applied to the tumour will now, in the great majority of aneurisms, detect a distinct *bruit*, synchronous with the pulse in a healthy limb, and it is hardly possible to confuse this with the much feebler sound produced by mere pressure on a superficial artery with the edge of a stethoscope.

In internal aneurisms the effects of the pressure of the sac upon important structures must often precede the appearance of any tumour externally. Hence *pain*, which is often by no means marked in aneurisms of the limbs, is a constant and early symptom in internal aneurisms, whether of the chest or abdomen. The pain being due to pressure upon the trunks of nerves is reflected to their peripheries; thus, intercostal pain may be caused by an aneurism of the thoracic aorta, and pain down the thigh by iliac aneurism. In the case of aneurism of the arch of the aorta or of its primary branches, pressure-effects upon the function of important nerves are often well-marked; thus aphonia, from pressure on one recurrent laryngeal nerve with corresponding paralysis of the laryngeal muscles, is frequently met with; or dyspnœa from spasm of the laryngeal muscles due to irritation of the pneumogastric trunk. The mechanical effects of the pressure of an aneurism upon the blood-vessels and other structures is also commonly seen in enlargement of the superficial veins of the thorax and abdomen or in œdema of the limbs, and in the dyspnœa and dysphagia caused by pressure upon the trachea or bronchus and upon the œsophagus.

The effect of dilatation of an artery is to diminish the force of the pulse beyond. Hence the pulse in an aneurismal artery is smaller than in the healthy limb, and this is usually perceptible to the finger, but may be more thoroughly appreciated by the use of the sphygmograph, the tracing of the aneurismal artery having for the most part lost the abrupt rise and fall of l ealth, a id being rounded in form.

Diagnosis.—In the majority of external aneurisms the diagnosis is easy, whilst in internal aneurisms it is always more or less obscure, both as to the nature of the tumour and the vessel involved. There are, however, certain fallacies in external aneurisms to be guarded against, and these are to be avoided mainly by attention to the symptoms detailed above. (1) An abscess or any cyst, in close relation with an artery, may have pulsation so transmitted to it as to cause it to resemble an aneurism; but the pulsation is not expansile, there is no *bruit*, and the history is not that of aneurism. (2) An artery may be so raised by any tumour beneath it as to resemble an aneurism, and the pressure may produce a spurious *bruit*; but the pulsation will be found to exist only in the line of the vessel, to be non-expansile, and to diminish rather than to increase with the growth of the swelling. (3) A soft malignant tumour, usually connected with bone, may pulsate and even have a *bruit*; but its size can be in no way influenced by pressure on the main trunk, although it may cease to pulsate, and when emptied by manipulation it refills more slowly and with a gradually increasing force of impulse, quite unlike that of an aneurism.

Aneurisms may have *ceased to pulsate* from having become consolidated, i.e. cured; or from having given way and become diffused. The first condition is obviously one of no urgency, and time will show that the tumour is decreasing rather than increasing in size. The second is usually accompanied by such marked symptoms as to be unmistakable.

The giving way of an aneurism externally or into an internal cavity is a necessarily fatal event, marked by sudden faintness and death-pallor; but an aneurism giving way into the tissues of a limb, though sufficiently serious, is amenable to treatment. The symptoms of shock, the sensation of something giving way, and the swollen condition of the limb, which is cold and in which no pulsation is to be detected, sufficiently mark the occurrence. If the extravasation of blood is small it may so compress the aneurism as to induce spontaneous cure, but if large it will almost certainly induce gangrene of the limb, with probably septicæmia and death. The treatment must necessarily at first be expectant, the limb being elevated to favour the return of venous blood, and its temperature being maintained without being unduly raised. Should no symptoms of gangrene supervene, the careful support

of the tissues by bandaging, and the observance of complete rest until all the extravasated blood is absorbed, will alone be required to complete the cure, which must necessarily be a tedious one. When, however, gangrene shows itself, there should be no hesitation in amputating promptly above the aneurism, as the best means of saving the patient's life. There is a certain small number of recorded cases in which ligature of the main artery above a ruptured aneurism has been followed by recovery, with or without amputation; but these are more than counterbalanced by the very large number of cases in which a fatal event has followed the operation. The probability is, that the cases which survive ligature of the main artery without amputation would have recovered equally without any operation at all.

Prognosis.—The tendency of all aneurisms is to increase in size with thinning of the wall at some point where resistance is weakened. Hence, internal aneurisms tend to burst into serous cavities or into mucous canals, whilst external aneurisms cause absorption of overlying structures by their pressure, and eventually burst by ulceration of the skin, or become diffused beneath the integuments. Occasionally, no doubt, under favourable circumstances, an aneurism may become cured spontaneously, or, at least, may cease to increase in size and become solidified by deposit of laminated fibrine upon the wall of the sac. Such a result cannot be counted upon, and a patient the subject of aneurism must be made to appreciate the extreme gravity of his condition and the necessity for submission to appropriate treatment.

Cure.—The mode of cure of aneurism was until recently believed to be, in all cases, the slow deposit of laminated fibrine, which is known to occur spontaneously in the sacs of aortic aneurisms. But it has of late been shown that coagulation of the contents of an aneurism may occur both accidentally and as the result of treatment, and that it probably occurs to some extent in all cases, whether a previous deposit of laminated fibrine has taken place or not. In the great majority of cases this mode of cure causes an obstruction of the calibre of the artery, which thereupon ceases to pulsate, but there are a few examples of cured aneurisms in which pulsation of the main artery has continued unimpeded. This can, of course, only occur in well-marked sacculated aneurisms.

Treatment.—(1) *General.* — The most important element in the treatment of all aneurisms is Rest. It is not only that rest will give the best opportunity for the deposit of fibrine and the coagulation of the diminished contents of the sac, but that rest is essential to diminish the force of the circulation and prevent the washing away of coagulum already formed. A patient suffering only from an external aneurism should be kept in bed for a day or two before active surgical treatment is begun. Diet is the next most important element, and should be limited in quantity and carefully regulated as to quality, the object being to favour the coagulation of the blood without stimulating the heart. About ten ounces of solid food, composed of well-cooked meat and biscuit, with half a pint of milk and no stimulants, may be taken as a standard dietary, but many patients cannot bear so low a scale. As regards medicines all that can be said is, that there are many drugs that have a reputation which they do not appear to deserve, as adjuvants in the treatment of aneurism. First, and probably oldest, is Digitalis, by which undoubtedly the action of the heart may be depressed, but with increase of arterial tension. Iron has been held to improve the quality of the blood and favour coagulation. Iodide of potassium and Acetate of lead have been thought to be beneficial, but with doubtful effect; and Ergotine has been injected subcutaneously on the theoretical view of contracting the muscular coat of the aneurism, which has little or no existence. Sedative medicines, such as Morphia, Indian hemp, and Bromide of potassium, are undoubtedly of service in calming the nervous system, relieving pain, and favouring that equable condition of the circulation which is most likely to induce coagulation of the contents of an aneurismal sac.

(2) *Local.*—*Pressure* is the treatment most immediately indicated in the case of aneurisms of the limbs, where the main artery can be controlled on the proximal side of the sac. With the older view of the method of cure before them, and with the successful practice of the Dublin hospitals to support it, surgeons were until recently in the habit of resorting to mechanical means of modifying, rather than of arresting, the flow of blood through the main artery of a limb. Two of Signoroni's tourniquets, or the more elaborate apparatus of Carte, were applied over the femoral artery, and were regulated so as to allow of a flow of blood through a popliteal aneurism sufficient to give slight pulsation in the sac. Applied in this way for twelve or fourteen hours, a cure is sometimes, no doubt,

promptly effected; but in the majority of cases it is necessary to remove the instruments in order to allow of the patient sleeping, and to resume the treatment on the following and perhaps for several consecutive days, before a cure is effected, if at all.

Digital pressure by the fingers of assistants, aided by the use of a heavy weight to relieve their muscular strain, is a more efficient method, and may be adopted either after the employment of instrumental pressure or alone. In this case the circulation through the main artery is completely stopped, and presumably the blood in the aneurism is at rest and in a condition favourable for coagulation. Certainly many cases are now on record, in which complete cure of popliteal aneurism has been effected by digital compression in from seven to ten hours.

Local pressure upon the sac of an aneurism must be of very limited application, from the risk of bursting the sac. Mr. Holmes has recorded a case of subclavian aneurism in which benefit was derived from the pressure of an india-rubber air-ball bandaged into the posterior triangle of the neck; and the method of *flexion* of the knee, recommended for the treatment of popliteal aneurism by Mr. Hart, necessitates some pressure of the sac and through it of the artery. *See* Popliteal Aneurism.

Rapid pressure—i.e. the complete arrest of the circulation through the sac of an aneurism for a limited time under the influence of an anæsthetic—was first successfully employed by Dr. Murray, of Newcastle, in a case of abdominal aneurism. *See* Abdominal Aneurism. The more modern method adopted in the case of the limbs, is Dr. John Reid's application of Esmarch's elastic band and tourniquet to secure complete stagnation of the blood, in both the arteries and veins of a limb, whilst coagulation of the contents of the sac of the aneurism is going on. In employing the method with Esmarch's bandage the writer thinks it essential that the sac should be full of blood; and he therefore recommends that the elastic bandage should be applied from below upwards and also from above down to the sac, in addition to the application of the elastic cord. By this plan the sac is rendered tense, the best proof of which is the production of slight subcutaneous ecchymoses, and coagulation of the contents is materially assisted. There is undoubtedly a risk of gangrene in this method which ordinary digital and instrumental pressure do not involve, and its use should be confined to the cases of small aneurisms in young subjects. *See* Popliteal Aneurism.

The time during which stagnation of the blood in a limb may be safely kept up cannot be accurately ascertained, but the writer has maintained it for three and three and a-half hours respectively, without bad result and with complete cure of popliteal aneurisms. Less than two hours cannot be expected to cure the aneurism, and in any case it is advisable to moderate the flow of blood through the artery by means of a screw tourniquet, for some hours after removal of Esmarch's apparatus, lest the soft and recent coagulum should be displaced and the cure be undone.

The Ligature, applied to the main artery of the limb in which an aneurism is situate, is the most efficient way of applying pressure to the vessel and of producing coagulation of the contents of the sac.

The Hunterian operation, in which a ligature is applied on the proximal side of the sac, but at some distance from it, and with one or more branches intervening to carry on the collateral circulation, is of universal application in the case of the limbs. The distance from the aneurism secures, in the great majority of cases, a healthy vessel, and the application of a ligature, whether of hemp, silk, or catgut (*see* Ligatures), leads, as a rule, to permanent obliteration of the artery at that spot. The immediate effect of tying the main artery is to lower the temperature of the limb and to arrest pulsation in the aneurism, which becomes less tense than before. The sac is not emptied, however, and care should be taken that it is not overmanipulated at the time of the operation, lest the sac should be burst if thin, or be irritated so as to become inflamed. In all cases in which, after ligature, blood is left in the sac, it no doubt coagulates; and these are the cases in which pulsation does not recur, and in which a cure is rapidly and easily produced. In other cases, especially where the aneurism partakes of the fusiform rather than the saccular form, there is little if any coagulum, and cure is brought about later on by deposit of fibrine from the collateral circulation, aided, probably, at the last moment, by coagulation of the small central channel of blood. In these cases a pulsation may be detected in the sac in from twelve to thirty-six hours, at first very feeble, then becoming more forcible, and finally dying away again with permanent consolidation of the sac. But occasionally, and particularly in patients who

have been submitted to prolonged compression-treatment unsuccessfully, the collateral circulation is so enlarged that pulsation returns very shortly after ligature, and persists until the aneurism is found to pulsate as forcibly as before the operation. Under these untoward circumstances recourse must be had to pressure both on the sac and below the seat of ligature, and probably the careful application of Esmarch's bandage offers as good a prospect of cure as any plan of treatment. Failing thus to effect consolidation, should the sac begin to increase and threaten to burst, the surgeon had better resort to amputation between the aneurism and the seat of ligature.

Giving way of the sac of an aneurism may follow immediately upon the operation of applying a ligature to the main artery, and is then due to the over-manipulation of an already attenuated sac; or may occur at a later date from inflammation of the sac with suppuration of its contents. In these cases all will depend upon the condition of the contents of the aneurism. If the extravasation occurs immediately after the application of the ligature, gangrene is almost certain to supervene and necessitate amputation; but if the contents of the sac have already become consolidated, suppuration may occur and matter may be evacuated, with complete recovery, although with considerable risk of the occurrence of secondary hæmorrhage.

Gangrene of the limb may follow the application of a ligature for the treatment of aneurism, and may be moist or dry. *See* Gangrene. The latter form, depending simply upon insufficient supply of arterial blood, shows itself first in the toes, which become dark and shrivelled, and may eventually be removed, leaving a very useful limb. The moist variety, depending upon obstruction of the venous circulation due either to pressure of the aneurism or some interference with the main vein at the seat of the operation, is a much more serious affection, involving the whole limb, and exposing the patient to great risk of the occurrence of septicæmia. Early amputation above the aneurism offers the best chance of saving the patient's life.

Temporary ligature.—Attempts have been made from time to time to apply ligatures temporarily to a main artery, and various contrivances have been invented with this object in view, but have all fallen into disuse. The catgut ligature of Lister and the flat ox-aorta ligature of Barwell are to a certain extent temporary ligatures, and the former has on more than one occasion disappeared too rapidly for a cure of the aneurism to be effected. *See* Ligatures.

Distal Ligature.—In the case of aneurism of the arch of the aorta and its primary branches, the practice of applying a distal ligature to one or more of the great vessels has met with a fair amount of success. The original proposal of Brasdor was, to place a ligature beyond an aneurism in cases in which deligation on the proximal side was impossible; but it was left to Wardrop to bring the method to the test of practice, by tying the common carotid for carotid aneurism low down (1825). Subsequently Wardrop extended the practice to the subclavian artery, which he tied successfully for innominate aneurism (1827), thus showing that the presence of large branches between the aneurism and the seat of ligature was no bar to the proceeding. Consecutive ligation of the carotid and subclavian for innominate aneurism was undertaken by Fearn, of Derby (1836–38), with success; and simultaneous deligation of the two vessels, for aneurism which proved to be aortic, by Hobart (1839), unsuccessfully, and for innominate aneurism, also unsuccessfully, by Rossi (1843). In 1865 the writer revived the practice by successfully tying the carotid and subclavian in a case of aneurism, supposed to be innominate, but which proved to be aortic upon the death of the patient four years later; and his example has been followed by other surgeons, and notably by Mr. Barwell, who also, in 1879, first employed the double distal ligature in a case of aneurism, diagnosed as aortic. In 1872, upon the suggestion of Dr. Cockle, the writer tied the left carotid in a case of pure aortic aneurism, with great relief to the patient, who survived four years and a half, and the operation has been repeated a few times with encouraging results. *See* Aortic Aneurism; Innominate Aneurism.

There has thus, within the last twenty years, been accumulated a good deal of experience as to the applicability of the distal ligature under various conditions, and on the whole the experience is encouraging. At the same time it is not easy to explain the *rationale* of the treatment. Brasdor's original view, that, by obstructing the vessels, coagulation of the contents of the sac might be induced, can only apply to the case where no branches intervene, and Mr. Holmes' suggestion that coagulation spreads backwards from the seat of ligature is not supported by facts. Wardrop's idea also, that cutting off from the aneurism the exit of two-thirds of the blood passing into it tends to cause coagulation of the other third

is hardly tenable, since the full quantity finds its way into the sac as before. It appears to the writer that the most reasonable explanation is that the *direction* of the current of the blood in the sac being probably modified by the application of a distal ligature, there is a greater tendency for it to deposit fibrine than before, and thus to fill up the cavity. It must be admitted, however, that this theory is purely speculative.

Allied to distal ligature are two methods of treatment of aneurism suggested by Sir W. Fergusson. By *manipulation*, or handling of an aneurismal sac, that surgeon proposed to produce an artificial embolism of the artery beyond, and succeeded to a certain extent, in two cases of innominate aneurism, but with the drawback of producing head-symptoms, from embolism of the cerebral arteries. The other proposal was, in desperate cases of subclavian aneurism, to amputate it at the shoulder-joint, and thus perform distal ligature. The writer, having witnessed Sir W. Fergusson's original operations of manipulation, and having, on one occasion, employed the method by amputation, cannot recommend either for adoption.

The treatment hitherto considered has dealt mainly with the artery in which the aneurism is situated; but in cases which have resisted that form of treatment, attempts have been made from time to time to attack the contents of the sac itself. The *injection* of coagulating fluids, and especially of a solution of perchloride of iron, has been tried in a few cases with negative or disastrous results from embolism. The *introduction* of fine needles, in order to entangle fibrine has been tried with some benefit (*see* Acupuncture), and the same may be said of the addition of a *galvanic current*. *See* Electrolysis. The introduction of iron wire and of horsehair into an aneurism, with the view of entangling clot, need only be mentioned as having been tried unsuccessfully.

Traumatic Aneurism is the result of a puncture or rupture of an artery occurring some time before, the blood being enclosed in a cavity formed by the surrounding structures, and the external wound, if any, being generally healed. Pulsation will be present both in the tumour and in the artery below it, and a very loud *bruit* is generally to be heard over the swelling. If small, traumatic aneurisms are no doubt amenable to treatment by perfect rest and carefully adapted pressure over the tumour; but if of large size when first seen, or rapidly increasing in size, prompt surgical interference will be required. The *treatment* is the same as for a wounded artery, viz., to tie the artery above and below the injured spot; but this operation is rendered much more difficult than in the case of a recently wounded artery by the presence of a distinct sac containing clot and overlying the artery involved. The main danger is hæmorrhage, and in the case of the limbs this can be best guarded against by employing Esmarch's bandage (*see* Esmarch's Bloodless Method), and a good screw-tourniquet, so as to render the parts bloodless whilst the operation is being performed. If this is impossible, as in the case of the iliac or axillary artery, digital pressure on the main artery must be made, and the operator must be prepared to thrust his finger into the opening in the wounded artery and to plug it whilst operating with the other hand.

The sac being laid open by a free incision, the clot is to be rapidly turned out, and if there is hæmorrhage it must be at once arrested. The operator has now to dissect or scratch through the wall of the sac immediately above and below the aperture of communication with the artery, in order to pass two ligatures around the vessel and thus secure it. If there is no hæmorrhage it will greatly facilitate this part of the proceeding to introduce a good-sized bougie or catheter into the artery, so as to gain an idea of its position and depth. A very cautious dissection being then made through the sac of the aneurism half-an-inch above the opening, an aneurism-needle is carried round the artery distended by the bougie, which is then withdrawn, and the ligature is tied. The same steps are repeated below the opening. If, on relaxing the tourniquet, there is no bleeding, the operation is completed; but if there is, search must be made for the bleeding spot and the vessel must be secured.

The term *diffuse traumatic aneurism* is sometimes erroneously applied to cases of recent wound or rupture of a large artery, in which a large quantity of clotted blood is extravasated into the tissues of the limb. There will be found no pulsation in the swelling or in the arteries below the seat of the injury, and the whole limb is cold and congested. The treatment is the same as that described above, but the operation will be easier because the wounded or ruptured artery will be more readily found. At the same time the damage done to the soft structures is so great that the propriety of amputation must always be considered,

particularly if there is reason to suspect that a ruptured artery has communicated with the cavity of a large joint, or if the main vein is found also to be torn. *See* Arteries, Rupture and Wounds of.

Christopher Heath.

ANGEIECTASIS. *See* Lymphangitis.

ANGEIOLEUCITIS. *See* Lymphangitis.

ANGEIOMA. *See* Nævus.

ANGULAR CURVATURE. *See* Caries of the Spine.

ANIMAL POISONS. *See* Glanders; Hydrophobia; Malignant Pustule, &c.

ANKLE, Dislocations at the.—Dislocations at the ankle-joint are five in number, viz. outwards, inwards, backwards, forwards, and upwards. These directions apply to the position of the foot, which, being farther from the centre of the body than the tibia, is regarded as the part dislocated. Astley Cooper, Malgaigne, and some others have spoken of the tibia as the bone displaced, and with some reason, inasmuch as the foot is usually fixed on the ground before the ligaments yield and allow the tibia to be displaced from its position. But it is more convenient to regard the foot as the part dislocated.

Dislocations at the ankle are more frequently partial than complete, it being comparatively seldom that the articular surface of the tibia is completely separated from that of the astragalus. When this does happen, the dislocation is usually compound. The partial lateral dislocations result from rotations of the foot upon an antero-posterior axis. The ligaments on one side are thus torn through, and the joint-surfaces gape on the same side. Further, dislocations of the ankle-joint are peculiar, in that they are usually associated with fracture, the fibula frequently, and the tibia sometimes, giving way under the force producing the displacement.

Dislocation Outwards.—Partial dislocation of the foot outwards, with fracture through the lower third of the fibula, is by far the most common dislocation of the ankle-joint, and is often spoken of as Pott's fracture. It is occasioned by forcible abduction of the foot, and often results from simple falls in the street, such as may happen in slipping from the kerbstone. The weight of the body is suddenly directed through the inner ankle, and, as a consequence, the internal lateral ligament gives way, or the tip of the inner malleolus is broken off; the outer surface of the astragalus then bears heavily upon the outer malleolus, and the fibula is fractured from two to three inches above the articular surface of that process. After fracture of the fibula, the fractured end falls in towards the tibia, and the malleolus becomes everted. Thus is produced, to use Pott's own words, 'a perfect fracture and a partial dislocation.' The clinical signs are, eversion of the foot, prominence of the internal malleolus, and a depression on the outer side of the leg corresponding to the fracture of the fibula, at which point crepitus may be elicited on manipulation. Blood-extravasation and swelling from intra-articular effusion rapidly follow.

Rupture of the internal lateral ligament, or fracture of the internal malleolus, and fracture of the fibula, are the only pathological lesions usually admitted to occur in Pott's fracture; but the increased width between the malleoli, often noticeable, suggests something more, either rupture of some of the ligamentous connections between the outer malleolus and tibia, or a splitting off of a portion of tibia with the outer malleolus. This almost vertical fracture of the tibia was found to have occurred in two cases which the writer has had the opportunity of dissecting. It commences at the outer part of the articular surface of the tibia, and appears on the outer surface of that bone above the interosseous tibio-fibular ligaments. One of the cases alluded to was a recent case, the patient having died of more serious injuries; the other was a case in which the deformity had remained permanent, and had necessitated the wearing of an iron support. The latter case was examined fourteen years after the injury, and the line of fracture could still be traced. Moreover, the fibula below was found firmly ankylosed to the tibia by bony outgrowths, showing that nothing short of osteotomy could have corrected the deformity after reparation had taken place. It is probable that this fracture of the tibia may occasionally give rise to difficulty in reducing the dislocation, and the prolonged convalescence often noticed after Pott's fracture may be due to the fracture into the joint.

When the dislocation of the foot is complete, the lower end of the tibia usually bursts through the skin on the inner side of the ankle, and the dislocation thus becomes compound; but the writer has himself seen

the foot thrust out at right angles to the leg without this accident occurring; and it is even said that complete simple dislocation outwards has occurred without fracture of the fibula.

The *reduction* is usually easy. The leg is placed at right angles to the thigh, to relax the gastrocnemius muscle; one hand then presses the tibia outwards, whilst the other is used to draw the foot inwards. It is unusual to find any obstacle to reduction. The deformity having been overcome, the limb may be put up in three splints as in ordinary fractures of the leg, but the outer splint should have its foot-piece thickly padded to press the foot inwards, and the inner splint should be so padded as to press the tibia out.

Dislocation Inwards, though next in frequency to dislocation outwards, is nevertheless a rare accident, and, since greater violence is required to produce it, is more serious. This dislocation is caused by a fall on the outer side of the foot, or by a cart-wheel passing over the ankle. The foot is thrown inwards, whilst the outer malleolus projects prominently beneath the skin, and the foot and toes point downwards. The inner malleolus, against which the astragalus is driven, is split off from the shaft of the tibia in an upward and inward direction, and the astragalus itself may sometimes be fractured. The outer malleolus may also be fractured, or its ligaments torn through.

Reduction is made by first flexing the leg on the thigh, then making extension on the heel and instep whilst pressing the foot outwards. After reduction, Astley Cooper recommends that the leg be laid upon an outside splint, which is padded so as to press on the fibula above the malleolus, and relieve the skin over that process from injurious contact. It may be more conveniently swung in three splints, taking care to prevent recurrence of the deformity by arranging the pads in such a way as to keep the foot straight and at right angles to the leg. The limb should be taken down and passive movement be commenced about six weeks after the injury.

Dislocation Backwards gives rise to an appearance of shortening of the foot, whilst the heel is unduly prominent behind, and the hollow spaces in front of the tendo Achillis are exaggerated. The tibia forms a firm projection beneath the anterior tendons, which are tense, and the toes are pointed downwards. It may be caused, like sub-astragaloid luxations and dislocation of the astragalus forwards, by over-extension of the foot on the leg, or by stepping from a vehicle in rapid motion. The dislocation backwards may be partial or complete. In the former case, the tibia rests partly on the articular surface and partly over the head of the astragalus and the scaphoid. When complete, the tibia passes forward and rests over the navicular and cuneiform bones. According to Hamilton, a partial dislocation may be consecutive to severe sprain and fracture of fibula, being brought about by the action of the muscles of the calf, but such cases should be regarded with some suspicion, as the great swelling present after these severe injuries may readily obscure, at first, a partial displacement. Whilst the tibia passes forward over the scaphoid, the fibula gives way above the malleolus, and this process is retained in its normal relation to the tarsus by its three strong ligaments. In a case dissected by the writer the extreme posterior edge of the articular surface of the tibia was found chipped off. The malleolus of the tibia may also be found broken.

To *reduce* this dislocation the leg should be flexed, and the heel being drawn forward by one hand, the other is used to press the tibia back into position. Should difficulty be experienced, the tendo Achillis may be divided. Though little difficulty has been met with in reducing the dislocation, there is in this form a tendency to reluxation, which must be guarded against. Pressure, directed so as to push the os calcis forward and the tibia backward, at once suggests itself, but, if attempted, must be carried out with the greatest caution, as both these bones are subcutaneous, and sloughing of the skin is likely to follow any but the gentlest pressure. It might be done with hollowed layers of thick felt plaster.

Dislocation Forwards causes lengthening of the foot and diminished prominence of the heel. At the same time, the leg is somewhat shortened, and the malleoli will be found lower than normal. The depressions in front of the tendo Achillis are filled by the displaced tibia, and in front of the joint the trochlear surface of the astragalus may be felt. It is a very rare injury, there being only six cases on record. Extreme flexion of the foot on the leg appears to be the primary cause, which is usually aided by some additional force applied over the tibia. Great difficulty has been experienced in attempts to reduce this dislocation, but a case recorded by Poland, in the Guy's Hospital Reports for 1855, seems to indicate that division of the tendo Achillis is what is required in order to effect reduction.

Before this was done, all attempts, even under chloroform, had failed. After reduction, the limb should be secured on a back splint with a footpiece, and there should be a hole in the splint large enough to receive the heel, so that it nowhere rests on the wood.

Dislocation Upwards, which is sometimes called 'Nélaton's dislocation,' is usually caused by a fall from a height on to the sole of the foot. Two cases have been described by Fergusson, and one by De Morgan; two, also, are mentioned by Bryant, one of which was double. In this injury the fibula is forcibly detached from its connections with the tibia, and the astragalus is driven up like a wedge between them. The inner malleolus and articular end of the tibia form a very prominent swelling, tightly stretching the skin on the inner side. The foot is usually everted, and the malleoli approach the ground, so that the limb is shortened. Reduction has generally been effected by extension, but in some cases all attempts to restore the parts to their normal positions have failed. The leg being flexed on the thigh, and held by an assistant, the surgeon should seize the instep and heel and attempt, by extension and to-and-fro movements, to disengage the astragalus. When reduced no tendency to reluxation has been noticed. Should the means described fail to reduce the dislocation, it may be justifiable to place a loop over the heel and instep, and make gradual extension by means of pulleys. But great care should be taken not to damage the soft parts and so occasion sloughing. When reduced, the limb should be secured between two side splints, and be thus retained for three weeks or a month, when passive movements may be commenced.

Compound Dislocation of the Ankle-Joint is a very serious injury, but not one by any means of necessity requiring amputation. Amputation is indicated when the dislocation is accompanied by much crushing or laceration of the soft parts, and distinct splitting of bone. It is required especially in cases caused by heavy wheels passing over the joint, and, less often, in those resulting from violent strains. The age and constitution of the patient should also be taken into consideration; for delicate and aged persons may succumb under the suppuration an attempt to save the foot may subject them to. Excision of the joint is suggested when there is a large opening freely exposing the articular surfaces, and when the bone protrudes through an opening too small to allow of its being reduced. In the latter case, many surgeons would be content to saw off only such an amount of bone as would allow of reduction. At the ankle the malleoli are apt to interfere with drainage, and the removal of the protruding process provides for this important aid to recovery; but it should be remembered that after removal of the external malleolus there is a tendency to abduction of the foot. In the simplest cases, where the wound is small, the dislocation may often be converted into a simple one by closing the wound at once with a pad soaked in compound tincture of benzoin, which forms, with the blood oozing from the wound, a firm antiseptic covering. The limb may then be fixed on a back splint with a footpiece, and an ice-bag be applied over the joint. Should suppuration follow, the pad must be removed, free exit allowed for pus, and drainage be maintained till the discharge lessens or ceases. In more severe cases the surfaces of the wound should be carefully cleansed with carbolic lotion, any bleeding vessel should be secured by torsion or catgut ligature, tendons drawn out and ruptured should be cut short, and any loose pieces of bone be removed from the joint.

The wound having been placed in the most favourable conditions for recovery, and the dislocation reduced, the foot must be maintained upon a splint at a right angle to the leg; for should ankylosis take place with the foot in an extended position, the limb will be of little service. The splints usually employed are a wooden back splint and two side splints, interrupted opposite the ankle to allow the dressings to be applied. But, in the writer's opinion, a better splint is a simple iron one, such as he is in the habit of using for excision of the ankle. It consists of a thin iron plate, hollowed to receive the leg, and its continuation is looped under the heel (at such a distance as to allow the antiseptic dressings to be wrapped all round), and then carried up as a footpiece to support the sole. It is covered with wax lint, and, the limb being secured in it by means of waxed bandages, no change in position need be made for months, or until ankylosis is complete. The judgment of the surgeon having been given in the first instance in favour of an attempt to save the limb, subsequent sloughing, extensive suppuration followed by exhaustion, or secondary hæmorrhage may compel him to reconsider his opinion, and induce him to perform a secondary amputation in order to save his patient's life. R. Clement Lucas.

ANKLE, Excision of the.—*See* Joints, Excision of.

ANKLE-JOINT, Amputation at the. Various methods have been proposed for the performance of this operation—the circular incision; the long dorsal flap method (Baudens); lateral flaps; and the single internal lateral flap operation (Roux, Sédillot, Mackenzie). Owing, however, mainly to the delicacy and thinness of the flaps, and as a rule the unfavourable situation of the cicatrix, these procedures have failed to bear the test of experience, and have been altogether superseded by the mode suggested by Professor Syme in 1843. This operation is undoubtedly one of the most important of the many surgical procedures associated with the name of that surgeon. The results, as shown by statistics, leave no doubt as to its merit and comparative freedom from risk; and the writer is of opinion that the so-called improvements and modifications which have been proposed should be rejected.

Syme's Operation — one indicated, in the great majority of instances, in cases of tarsal caries—may be thus performed. Provision being made for the prevention of hæmorrhage, which can best be accomplished by Esmarch's elastic bandage, the patient should be placed on a table, with the condemned foot overhanging it. An assistant should then forcibly flex the foot upon the leg, and the operator, fixing the foot with his left hand, which he places behind the heel, and with his index finger and thumb on the points between which the incision should be made—viz., the tip of the outer malleolus and a point half an inch below and a little behind the inner malleolus—makes an incision with a small catlin, straight across the sole of the foot and down to the bone. Some surgeons recommend the incision to be sloped towards the heel, which diminishes the size of the plantar flap, and renders the operation easier, as there is not then so much tissue to dissect off the bone. In cases where there is much prominence of the heel, this modification may, in the writer's opinion, be adopted. Having made the incision across the sole of the foot, the flap is dissected off the inferior and lateral surfaces of the bone, great care being taken to keep as close to the bone as possible. This dissection had best be done with the knife recommended for the purpose by Professor Syme—a short, blunt-pointed, stout scalpel, with a strong, roughened handle. In using this knife there is but slight risk of making punctured wounds in the smaller vessels, the occurrence of which predisposes to sloughing of the flap. The dissection is continued backwards until the tendo Achillis is reached and divided.

A straight dorsal incision, at an angle of 45° to the sole of the foot and long axis of the leg, should then be made between the two points already indicated. If the incision be somewhat arched in front, as is done when the plantar incision has been carried farther back than Syme recommended, the danger of opening into the astragalo-scaphoid joint should be borne in mind, as such an accident may be a source of much embarrassment to an inexperienced operator. In the dorsal incision the structures in front of the ankle-joint are divided as well as the lateral ligaments, and the articulation exposed. Some surgeons prefer postponing the division of the tendo Achillis until this stage of the operation is reached, and much may be said in favour of doing so rather than at the termination of the dissection of the plantar flap, as recommended by Syme. The foot is then removed by disarticulation of the ankle-joint. The soft tissues over the malleoli are next dissected back, and these latter, together with a thin slice of the tibia, are removed, and the divided surfaces of the bones covered by the plantar flap. The bone section should be made at right angles to its axis. The anterior tibial artery in front, and the posterior tibial below the inner malleolus having been secured, the edges of the flaps should then be united with numerous points of interrupted suture, careful provision being made for drainage at each angle of the wound. For this purpose it has been proposed to make button-hole incisions in the flap, a procedure which is certainly to be deprecated.

In performing this amputation, it is undesirable to make the plantar incision from malleolus to malleolus, the evil results of such a course being to render the flap unnecessarily long and unsymmetrical, while increasing the difficulties of dissecting it off the bone, and thus imperilling its vitality. The writer has derived much aid in forming the plantar flap—the most tedious and difficult part of the operation—from the use of von Langenbeck's periosteal raspatory. An objection has been made to this plan on the ground that by leaving portions of periosteum in the flap, spicula of bone may be developed, which prove a source of trouble; but such osseous developments the writer has never satisfied himself of, and there is negative evidence to the contrary. In reference to the vitality of the flap, Erichsen does not consider the division of the posterior tibial artery an accident of serious moment,

a view in which Lister and the late Professor Spence coincide.

Mackenzie's Modification, which is similar to that described by Roux, consists in making the flap from the antero-internal aspect of the joint, thereby including the posterior tibial artery, and thus diminishing, it is alleged, the risk of sloughing; but since it has been shown that a wound of that vessel is not so serious an accident as is generally supposed, this modification cannot be regarded as an improvement on the original. In fact, the flap, being one unaccustomed to pressure, is at an obvious disadvantage.

In Pirogoff's Osteo-Plastic Amputation, while the line of incision is the same as in Syme's, the essential difference is that the posterior portion of the os calcis is left in the flap, and subsequently united to the extremity of the tibia. Having made the plantar incision as in Syme's amputation, a straight one is made across the dorsum of the foot half an inch in front of the anterior tibial edge; the tendons and other structures in front, and at each side of, the ankle-joint, are divided, and the articulation opened into. The foot is then extended, and the os calcis divided obliquely downwards and forwards, with a saw following the line of the plantar incision. The soft tissues are then dissected off the malleoli, and these, with a slice of the tibia, removed. The cut surfaces of the bones are then applied closely together, and the edges of the wound united by numerous points of interrupted suture, a small drainage-tube being inserted at each angle.

The objections that have been made to Syme's amputation have been chiefly based on its difficulty and tediousness, the unnecessary shortening of the limb, combined with the risk, despite all precautions, of sloughing of the flap. Pirogoff's modification is undoubtedly a procedure of easier performance, getting rid, as it does, of the difficulty attending the dissection of the flap off the os calcis. Moreover, the stump obtained is longer than in Syme's amputation, the additional length corresponding to the amount of bone left in the flap, while the heel, long accustomed to bear the weight of the body, remains untouched. Possessing as it does these advantages, it may be asked, Why has not Pirogoff's modification superseded Syme's? The answer is that in the majority of cases of caries of the tarsus, the disease is seldom found localised, and the portion of bone left in the flap is liable to become affected, probably necessitating further operative measures, which may involve amputation of the leg. At the same time, if structures, previously healthy are dealt with, as, for example, in cases of gun-shot injury, Pirogoff's method may be selected.

Pirogoff's method has, in its turn, been the subject of much modification; for example, oblique division of the tibia upwards and backwards (Sédillot), with the view of diminishing the tension of the tendo Achillis. This has been properly objected to on the ground of its throwing the point of pressure behind the axis of the leg. Horizontal section of both os calcis and tibia (Pasquier); leaving the malleoli untouched, and placing the cut surface of the os calcis between them (Fergusson); concave section of the os calcis and convex of the tibia (Bruns), are, among others, modifications which have been made, but in which the writer fails to see any advantage. If the operator has any apprehension as to difficulties arising in keeping the cut surfaces of the bones together, tenotomy of the Achilles tendon, or suturing the bones with silver wire or chromicised catgut may be adopted. No other modification of the operation is indicated.

William Stokes.

ANKLE-JOINT, Diseases of the.—The ankle-joint, concerned as it is in transmitting the weight of the body to the foot, and also in the movements of active progression, is especially liable to sprains and concussions, and thus to the various inflammatory conditions to which such injuries give rise.

Synovitis, acute and chronic, is of frequent occurrence. The acute form is characterised by the usual symptoms, pain, heat, and swelling; the movements of the foot on the leg being restricted, and giving rise to increased pain. The swelling is manifest chiefly beneath, and at the sides of, the extensor tendons, but may also extend to the borders of the tendo Achillis.

The *treatment* will consist, in the early stage, of antiphlogistic measures, leeches, or the application of cold; subsequently, of counter-irritation, and the use of pressure by strapping and bandaging. The joint is to be kept at rest by placing the leg on a splint with a foot-piece, such as McIntyre's.

The chronic form of synovitis of the ankle may result from frequent sprains (the joint having once been sprained is liable to a recurrence of the injury because of the resulting relaxation of its ligaments),

or, as is not uncommonly the case, may have its origin in an articular ostitis spreading to the joint. The scrofulous form of the disease more often affects several of the articulations of the foot; it may, however, be confined to the ankle, producing the usual pulpy swelling of the synovial tissue, and, if progressive, leading to ulceration of the cartilages and suppuration of the joint. Matter usually points at the side of the joint, and when this stage has been reached, crepitus will usually be felt on flexion and extension of the foot.

At the commencement of the disease counter-irritation by repeated small blisters, or by the actual cautery, must be used; followed by strapping over mercurial ointment, or by elastic pressure.

In most of the chronic forms of disease of the ankle, or other joints of the foot, the part may be kept at rest by means of a plaster of Paris, leather, or other splint, while the patient goes about with the aid of a peg-leg, which supports the weight of the body on the bent knee, the foot not being used.

The ankle is especially liable to a form of recurrent synovitis, due to the presence of intra-articular adhesions which have had their origin in a sprain or other injury. In such cases there is usually not much synovial effusion, though the amount varies with the use of the joint; but the patient is afraid to use the foot freely, movement in some particular direction being always restricted and painful. Attempts at greater activity being always followed by increased pain and swelling, the patient spends his time between alternations of enforced rest and painful endeavours at resuming activity. These cases are to be treated by forcible rupture of the adhesions, which usually produces an immediate cure. Anæsthesia being produced, the adhesions are ruptured by forcible flexion, after which the foot is freely moved in all directions. The patient is then to be encouraged to use the foot freely. *See* Bone-Setting.

Suppuration of the ankle-joint must be treated by free incision and drainage, and if there be pulpy degeneration of the synovial membrane, the diseased tissue must be scraped or destroyed with caustics.

Should the disease still progress, but yet remain confined to the ankle-joint, excision may be performed; but extension is very apt to occur to the neighbouring joints of the foot, in which case amputation will be needed, either by the method of Syme, or in the lower third of the leg.

J. Warrington Haward.

ANKYLOSIS.—By ankylosis is meant a joint stiff from changes in one or more parts of the articulation, in the synovial membrane and capsule, ligaments, or bones. The term implies that all active disease has ceased. Joints stiff from such causes as cicatricial contraction after burns, or diseases such as ossification of tendons, are said to be affected with spurious ankylosis, but such conditions will not be considered in the present article. Ankylosis, always the result of inflammatory action, may be, (1) soft or fibrous, (2) bony:—

(1). Ankylosis, due to changes external to the actual joint, but involving the parts immediately in relation with it, is one of the commonest forms. It is usually due to traumatic causes. The non-elastic capsule and synovial membrane being torn by the injury, probably associated also with tear of tendons at their insertions, a degree of inflammation is set up. Lymph is effused, and binds the folds of capsule together, or uniting the fibrous structures around the capsule limits mobility. Such adhesions, if neglected, develop ultimately into material more or less fibrous and tough. The inflammation may extend more widely, and the capsule and ligaments, at one time infiltrated and soft, will subsequently shrink and thus further impair mobility. Too prolonged rest, after even slight inflammation, will lead to considerable soft ankylosis, as may often be seen after dislocation of the shoulder. The changes in the cartilage in this form will be merely such as result from disuse.

(2). If the cartilages be involved, as commonly happens in pulpy degeneration of joints, granulation tissue, fibrous according to its age, will unite the opposite articulating surfaces. The disease may stop here, and the bands may even ultimately ossify, but this rarely happens. The cartilaginous tissue loses its characteristic qualities, becomes fibrillated, and degenerates more and more; even though the disease stops short here, with the changes in the parts around, firm fibrous ankylosis results. Commonly the disease extends through the cartilaginous laminæ and the calcified layer at their base, ultimately involving the bone. Now the opposed bony surfaces come into contact. The effused granulation-tissue, filling up the irregular erosions, forms into short, broad, fibrous bands, which firmly unite the opposed surfaces. In the course of time, usually to be measured by months, these bands may ossify; thus bony ankylosis is produced, necessarily associated with fibrous ankylosis around the joint. In

the course of years the line separating the contiguous bones will almost disappear, and on section the cancelli will appear to pass uninteruptedly across. A still more complete bony ankylosis is seen as the result of osteo-arthritis. Here not only are the bones welded together, but the soft parts around undergo complete ossification. This condition usually affects more than one joint. It is most frequently seen in the small joints, such as those of the phalanges or tarsus.

Soft ankylosis will always permit of some amount of movement. If moving the joint, i.e. stretching the adhesions, causes pain, we may judge that the ankylosis is soft; but it may be readily mistaken for that which is bony unless examination is also made under complete anæsthesia. It is very common to mistake a joint held stiff by contracting muscles for one which is really ankylosed. No satisfactory diagnosis, where there is any considerable degree of ankylosis, can be made without the aid of anæsthetics. A greater or lesser degree of ankylosis usually follows a compound dislocation, and the closer the normal apposition of the articulating surfaces the more likely is the union to be bony, e.g. compound dislocation of the elbow or ankle is more liable to terminate in bony union than that of the knee, and spinal caries often results in complete fusion of two or more vertebræ.

Pulpy degeneration of joints, especially of the knee, is apt, after more or less destruction of the cartilages, as the process of natural recovery, to progress slowly to bony ankylosis. In the hip-joint, however, this result is far less common.

The *symptoms* of ankylosis consist of impairment or loss of mobility; pain on manipulation if the soft ankylosis is moderately recent, complete loss of movement under anæsthesia if the ankylosis is bony. The commoner form of ankylosis is the soft, arising from some injury, the most usual being dislocation. A few bands external to the actual joint glue the folds of the capsule together, but every movement causes pain, and consequently rest is persevered in too long; or, as in the case of the shoulder-joint, the movement of the scapula on the trunk is mistaken for movement of the humerus on the scapula. Degenerative changes follow as they would in a perfectly healthy joint kept absolutely at rest. The synovia ceases to be secreted, the vascularity of the membrane diminishes; the cartilage tends more and more to resemble connective tissue; the bone becomes porous, light, and thin. Still, all this can be recovered from if the adhesions be broken through. The folds will again separate, and with the restoration of mobility the structures of the joint will rapidly recover.

Treatment.—It is of the utmost importance to break down, and not merely to stretch, the adhesions; their situation can be ascertained by localising the pain felt on manipulation without an anæsthetic—that is, by stretching. Bearing in mind the anatomy of the joint and the normal movements of which it is capable, a sharp, decided movement should be made, and the adhesion will break with an audible snap—one form of 'bone-setting.' This treatment is especially applicable to ankylosis from traumatic causes, and to those who are pathologically young. Scarcely any inflammation follows if the adhesions be really broken through; the process, if efficiently performed, is more alarming than painful, and the after-treatment consists merely in passive and active movements to prevent the adhesions from re-forming, with shampooing and douching. In slight, soft ankylosis of the shoulder, the wrist, the knee, and phalangeal joints, the result will be successful in inverse ratio to the extent of the adhesions and the length of time that has elapsed since the inflammatory action. The latter can be estimated better by the history than by the amount of wasting of the muscles, for this is often very rapid, especially in cases of ankylosis of the shoulder in elderly people.

In ankylosis from disease, the relation of important vessels and nerve-trunks to the joint, and the possibility of their being adherent to the capsule, must be borne in mind, particularly in such as are likely to be the subjects of atheromatous changes. Especially should this be remembered in the case of the hip and knee, in both of which joints undue extension might lead to serious consequences. In the elbow it is very rare to restore perfect mobility, even after slight ankylosis. In soft ankylosis of the hip in young children, gradual extension, to be applied at the outset in the new axis of the limb, is preferable to attempts to rupture the adhesions. Violent movements are very liable to awaken the hip-joint disease in delicate subjects, and some amount of ankylosis with the limb almost in a straight position is often the best result that can be obtained. The same is true of the knee-joint, if there is backward displacement of the bones of the leg. Soft ankylosis of the knee, with the leg strongly flexed on the thigh, is a common result of neglected inflammation of the joint. Here, gradual

extension cannot be so well employed. Under an anæsthetic the limb can be forcibly straightened, the adhesions being often better broken by strong flexion rather than by extension. The limb can thus be placed in a useful position, even though some degree of backward displacement results.

The results of tenotomy in the treatment of ankylosis are, as a rule, rather disappointing in cases of hip and knee ankylosis; but, as a preliminary to gradual mechanical extension, it is often beneficial. In division of the hamstrings no attempts should be made to divide more than the contracted tendons. Treatment by gradual extension, then, is applicable to those cases where the ankylosis is fibrous and the object is not so much to attempt the restoration of mobility as to place the limb in a useful position. It is especially applicable, therefore, to the hip and knee when the amount of organic change suspected forbids the employment of violent extension; but even where the adherent and contracted parts have been forcibly ruptured, no attempt should be made to place the limb at once and fix it in the position it is hoped ultimately to obtain. The forcible extension should be regarded only as a preliminary to treatment by gradual extension. The weight and pulley will be found to answer better than the more complicated and expensive apparatus.

Bony Ankylosis, when the parts are in good position, should be left alone. An exception may be made in the case of the temporo-maxillary joint, in which, however, disease is very rare. Here, by osteotomy of the ramus of the jaw, a false joint may be established with advantage, and the joint itself has been excised with a good result. Bony ankylosis of the shoulder is exceedingly rare, and admits of no treatment. Increased mobility of the scapula makes very adequate amends for the stiffness of the joint. In the elbow complete mobility may be restored by excision, but only when the patient earnestly desires it and fully appreciates the conditions; an elbow ankylosed at about a right angle impairs but little the utility of the arm. In the case of the wrist no operative interference is admissible. In the phalanges amputation may be necessary to get rid of a deformed finger or toe. In the case of the great toe excision can often be performed with advantage. Bony ankylosis of the hip may demand treatment if the deformity be great. Examination under full anæsthesia is, in this case, imperative, and care must be taken not to mistake the production of lordosis for movement at the hip. The less the destruction of the internal parts of the joint, the more favourable the case for treatment. Cases of osteo-arthritis are the most favourable of all. Subcutaneous osteotomy of the neck of the femur (q.v.), by Adams's or Sayers' method, is the best treatment. The results of the operation in suitable cases are very satisfactory. The bone may be divided also below the trochanters, but this is not so favourable an operation, though sometimes the only one that offers. Complete bony ankylosis of the knee in a faulty position may require osteotomy. The results of Macewen's operation for genu valgum show the amount of deformity that can be rectified by simple osteotomy, and it will probably not often be found necessary—as many advise—to remove a wedge-shaped piece of bone. If done, this should be so performed as to preserve the epiphysial line. Attempts to perform the operation subcutaneously in the case of the knee are not to be recommended. Bony ankylosis of the vertebral joints admits of no treatment, save, perhaps, in the case of the sacro-coccygeal joint. *See* Bone-Setting; Jaws, Closure of the; Osteotomy.

C. T. Dent.

ANOREXIA.—Loss of appetite.

ANOSMIA.—Loss of the sense of smell.

ANTERO-POSTERIOR SPINAL CURVATURE (not due to spinal caries or hip-joint disease) is an exaggeration of the normal antero-posterior curves of the spinal column. If the dorsal curve with convexity backwards is most marked, the deformity is known as *cyphosis* (kyphosis); and when the lumbar curve with convexity forwards is predominant, it is known as *lordosis* (saddle-back). Cyphosis and lordosis are generally present in the same patient, the one compensating the other in restoring the equilibrium of the body. Lateral curvature of the spine is nearly always accompanied by some amount of antero-posterior curvature. *See* Lateral Spinal Curvature. Cyphosis, embracing the whole spine from the neck to the sacrum, is not infrequently met with, where all lumbar hollow has disappeared; but lordosis is always associated with some degree of cyphosis.

The *causes* and *pathology* are the same as in lateral curvature, except that antero-posterior curvature is more often due to paralysis of the erectores spinæ muscles, as in infantile paralysis; lordosis is nearly

always present in marked cases of pseudo-hypertrophic paralysis, when the patient is standing.

At first complete restoration to the normal figure of the spine is possible. In cyphosis, after the lapse of months or years, the bodies of the vertebræ and the intervertebral substances become misshapen, and too much wedge-shaped from before backwards, so that at last they become so fixed or ankylosed that all attempts to restore the spine to a normal, or even improved, position end in failure. It is always easier to restore or improve the position of the spine in lordosis, where there is much less tendency to deformation and ankylosis of the vertebræ.

Symptoms.—The patient generally complains of much backache and neuralgia from irritation of the spinal nerves. The thorax becomes contracted and flattened anteriorly, or is often pigeon-breasted. The scapulæ are too far apart, and their lower angles too projecting. The abdomen is too prominent, and the patient walks with a slight waddling gait. His powers of endurance are affected, and he is easily tired; his general health fails, and congestive headaches are frequent.

The *diagnosis* presents little difficulty. Lordosis cannot be mistaken for anything else. Cyphosis can only be confounded with spinal caries. When the cyphosis is of recent origin, all deformity and unnatural projection of the spine disappear when the patient lies prone on the ground; even in severer cases, where the deformity persists in the prone position, the erectores spinæ muscles feel as soft and normal opposite the chief prominence of the convexity as at any other point of the spine; whereas, in spinal caries, the same muscles opposite the seat of the greatest projection give a more unyielding sensation to the touch, and are apparently enlarged, as compared elsewhere along the spine. This softness of the erectores spinæ muscles, with little or no pain on violently concussing the heels while standing, and with the presence of some slight movement of flexion or lateral flexion even in very severe cases, will confirm the diagnosis of cyphosis from spinal caries.

Prognosis.—The tendency of antero-posterior curvature, especially of cyphosis, is to become gradually worse if left untreated, so that the patient becomes prematurely bowed down to the ground, as in old age.

Treatment.—In lordosis and in cyphosis, where the spine is still movable, the same treatment is advised as in lateral curvature, viz. medical gymnastic exercises, with attention to good postures at all times. No article of clothing is to be too tight across the front of the thorax or neck, when the patient is placed in the most improved position possible.

In lordosis, exercises effecting thorough flexion of the spine, e.g., sitting on the ground with the knees extended, and the patient touching the toes without bending the knees, or the same while he is standing, are very useful in addition.

In cyphosis, where the spine is partially ankylosed, and where there is much pain or aching in the back, relief may be obtained by the wearing of a well-applied plaster of Paris jacket, cut open in front, and made to lace; or a poro-plastic or other support with pelvic band, which will probably have to be worn for several years, till the ankylosis has become so complete as to admit of the patient going about without any support at all, free from pain or discomfort. No treatment is required in cases of ankylosed cyphosis unaccompanied by pain or aching.

BERNARD ROTH.

ANTHRAX. *See* CARBUNCLE.

ANTISEPTIC SURGERY.—By the term 'antiseptic surgery' is meant those modes of treating wounds in which an attempt is made to prevent fermentation in the fluids of the wound; thus applied, the term includes a variety of methods, and the use of a large number of antiseptics.

The original aim of antiseptic treatment was to prevent putrefaction, and the freedom of the discharge from foul smell was looked on as proof that the object of the treatment had been attained, and that the patient was safe from the risks usually associated with, and at that time supposed to be dependent on, a putrid state of the discharge. As experience increased, it was, however, soon found that, in spite of absence of smell from the discharge, the patient was by no means safe from many of the accidents at first supposed to be closely connected with putrefaction, such as suppuration, erysipelas, septicæmia, and pyæmia. The rapid advance of science in this department has now shown that many of these infective diseases are due to the growth of specific micro-organisms in the fluids or tissues of the patient affected; and has further taught us that none of these organisms produce putrefaction in organic fluids. It is thus evident that absence of

smell is no test of the absence of these septic agents from wounds; for, on the one hand, the micro-organisms which cause putrefaction may have been excluded from the wound, or prevented from developing, while, on the other hand, the real septic agents may be present in an active state.

But investigations have taught us that the growth of micro-organisms in an organic material is accompanied by changes in that material, the nature of these changes depending on the variety of bacterium which is there developing; in fact, as the result of the growth of these minute bodies, the organic matter undergoes fermentation. These considerations have led the writer to enlarge the definition of antiseptic treatment from 'treatment directed against the causes of putrefaction' to 'treatment directed against the causes of fermentation'—in other words, against the development of micro-organisms in wounds. It is not necessary in the present article to enter into the reasons for regarding micro-organisms as the causes of fermentations, nor into the mode in which they act; that they are the causes of the fermentative changes which organic material undergoes has been thoroughly debated, and may now be regarded as settled. *See* BACTERIUM.

It must not, however, be supposed that it is only by causing fermentation in the wound that these micro-organisms are dangerous. Some, no doubt, can only grow in the discharges or dead tissues in a wound, and are unable to penetrate into and live in the body; but nevertheless these may lead to the formation of poisonous products in the wound, which, being absorbed, give rise to more or less serious symptoms, and even to death (traumatic fever, septic intoxication, and some forms of septicæmia), while their local effect may be evidenced by inflammation, suppuration, &c. Others, however, can penetrate directly into the tissues, lymphatic vessels, and blood, and, growing there, give rise to most serious affections, (spreading gangrene, erysipelas, pyæmia, &c.) It has, however, been found that means, sufficient to prevent the growth of micro-organisms and the occurrence of fermentation in wounds, are also sufficient to prevent the entrance of these parasites into the body. If, therefore, the point aimed at in the definition be successfully reached, all that is required for antiseptic treatment will be obtained.

It is of importance to note that bacteria are not normally present in the blood or tissues in the healthy living body. This has been demonstrated as regards blood, milk, urine, and various of the internal organs, by experiments which need not be referred to here. It is also found that, with very rare exceptions, the various septic diseases follow wounds—that the bacteria are, in fact, introduced into the body through a wound. In the treatment of a case after operation it is therefore most important, with the view of preventing septic diseases, to direct our special attention to the treatment of the wound, in order to prevent the entrance of the noxious organisms into the body.

There are two modes in which attempts have been made to carry out the principles described above. In the one, various precautions are taken with the view of preventing the entrance of micro-organisms into the wound; in the other, micro-organisms are admitted, and then means are taken to prevent or interfere with their growth and fermentative action.

The first principle is that introduced by Sir Joseph Lister, and his method was at first known as the antiseptic method, though the writer thinks it better to call it the aseptic method, in contradistinction to the second class of methods, which are also all more or less antiseptic. This is the method with which we have to do in the present article.

The second principle may be carried out in various ways, which will be considered separately, though, as a matter of fact, in practice the two are frequently combined.

(*a*) Various antiseptics are added to the discharge, either in the wound, by injection, &c., or after it has left the wound, with the view of rendering it an unfit soil for the development of micro-organisms—*treatment by antiseptics.*

(*b*) Means are taken to allow the discharge to flow away as rapidly as it forms, so that it has not time to undergo fermentation to any extent in the wound—*free drainage.*

(*c*) The discharge may be washed away either by water alone or by water containing antiseptics—*treatment by irrigation and immersion.*

(*d*) The wound may be freely exposed to the air, so as to allow evaporation to take place. In this way the discharge becomes too concentrated to permit the growth of bacteria in it, and at the same time the organisms being supplied with plenty of oxygen, their fermentative action is diminished—*open treatment.* In this method means are as a rule taken to permit the rapid exit of discharge, and also

very frequently the wound is washed out with an antiseptic lotion, so that as a matter of practice all the four principles just alluded to are brought into play.

(*e*) If the parts are kept at perfect rest, the health of the patient good, and not too much blood between the opposed surfaces, healing may occur without inflammation or suppuration. Here trust is placed in the power of the healthy tissues to destroy bacteria. Acting on the last two principles we have *healing by scabbing*.

For the description of the methods of wound treatment mentioned under the second heading, the reader is referred to the special articles on the subject; here we have only to do with the first principle.

In the Listerian method the object is to prevent the entrance of living organisms into the wound, and with this view a large number of precautions are taken, which will be given in detail in the latter part of this article.

A wound treated aseptically, provided that micro-organisms are excluded, that the drainage is good, the stitches not too tight, and no other local cause of inflammation is present, follows what is termed an 'aseptic course.' No inflammation occurs; there is no swelling nor redness of the edges of the wound, the skin around remaining as pale and lax as when it was stitched up at the time of the operation. The wounds are thus quite painless; but not only is there absence of inflammation along the cut edges of the skin, it is also absent from the deeper parts of the wound, and there is no suppuration even where the deep structures are not absolutely in contact. The discharge from the drainage-tube is purely serous, and rapidly diminishes in amount, so as to render the drain unnecessary in a very short time. Further, the scar is linear, and very soon becomes hardly apparent, while it remains movable, and does not become adherent to the deeper structures.

While there is this absence of local disturbance in wounds treated aseptically, the constitutional state of the patient remains good; in fact, if he has not lost much blood during the operation, or if the operation has not caused shock, he is, on recovery from the effects of the anæsthetic, practically as well as before. His appetite is good, and there is no necessity for restricting his diet; at the same time traumatic fever is absent. After an operation performed aseptically, and in which there is no accidental cause of elevation of temperature, such as tension, the temperature remains normal; or if the operation is at all extensive, the following changes are observed. On the evening of the operation the temperature falls below the normal, it then rapidly rises to, or it may be a little above, 100°, reaching its highest point on the following morning or evening, and then it rapidly falls to the normal line again. In some cases, before reaching the normal, it fluctuates for a day or two between 99° and 100°, but the fluctuation is not within the range of fever temperature, but within the normal range. It is very seldom that the pulse rises in equal proportion; indeed it generally remains normal.

Interference with this typical course may be due to various causes, but it is generally occasioned by the entrance of micro-organisms. If micro-organisms have entered, there is no certainty as to the result; suppuration and traumatic fever will almost certainly occur, while any of the traumatic infective diseases—erysipelas, septicæmia, pyæmia, &c.—may appear. Of the disturbing causes not due to micro-organisms, tension in the wound from retention of discharge, or from tight stitches, is the most potent. The elevation of temperature, which follows the retention of discharges in a wound, is often very striking, and the reason of its occurrence is not very clear. At the same time the local effect is to give rise to pain and inflammation in the wound, which, if not checked by restoration of the drainage, may go on to suppuration. This disturbance is easily remedied by proper application of a drainage-tube. If, in spite of thoroughly efficient drainage, the inflammation still goes on, the cause is evidently the entrance of micro-organisms. Tight stitches also cause inflammation of the edges of the wound, which subsides as soon as the stitches are cut or removed, and movement of the parts will also interfere with the aseptic course. The irritation of the antiseptic employed may also interfere with healing, if it is allowed to come directly into contact with the wound. It is for the purpose of excluding the antiseptic from direct contact with the wound, that the layer of prepared oiled silk is applied beneath the dressing.

Carbolic Acid.—Various antiseptics are employed in aseptic surgery. The first which was introduced, and still in many respects the best, was carbolic acid. This is employed in the form of lotions, oily and spirituous solutions, and gauze dressing. The carbolic lotions are of two strengths, 2½ p.c. and 5 p.c. These are watery solutions of the pure acid, and they ought to

be quite clear. If they are not clear, the reason is the presence of impurities in the carbolic acid, which are apt to be very irritating to the wound and to the skin. The 5 p.c. lotion is used for disinfection of the skin, instruments, and hands of the operator and assistants, and also for the spray. The 2½ p.c. is the lotion used for washing the sponges and for cleansing the wound afterwards.

Carbolic oil is employed of various strengths, generally 1 in 5, 1 in 10, and 1 in 20, consisting of carbolic acid mixed with olive oil in the foregoing proportions. The 1–5 oil is seldom used, though it is occasionally applied as a dressing to very foul wounds. The 1–10 oil is used as a dressing for wounds in the neighbourhood of the anus, penis, &c. Carbolic oil (1–20) is used for oiling catheters or other instruments before introducing them into the bladder. In many cases, glycerine solutions of carbolic acid are now employed in place of the oily.

A solution of carbolic acid in methylated spirit (1–5) is also sometimes employed for injection into compound fractures or wounded joints, where the injury has happened some hours before the case is seen.

Carbolised gauze is the material generally employed as a dressing to guard against the entrance of the causes of fermentation. This is ordinary fine unbleached tarlatan, impregnated in various ways with one part of crystallised carbolic acid, four parts of common resin, and four parts of paraffin. These materials, mixed together, are added to an equal weight of unprepared gauze. The gauze ought to be kept in a tin box, closing tightly, to prevent evaporation of the carbolic acid. It is used either in the form of folded dressings, loose gauze, or bandages. The dressing consists of a piece of gauze of sufficient size to overlap a considerable area of skin around the wound; this is folded in eight layers, and beneath the outer layer a piece of macintosh cloth is placed, with the rubber side downwards. This macintosh ought to be sponged with 1–20 carbolic lotion before being placed in the dressing.

The steam spray-producer is ordinarily used. In the glass vessel 1–20 carbolic lotion is placed, and this, mixed with the steam, is diluted to about 1–30.

Carbolised silk is often used for sutures, and is made by steeping silk thread in a mixture of nine parts of beeswax and one part of carbolic acid, melted together. As the thread is taken out of the mixture it is drawn through a cloth to remove the superfluous wax.

Carbolised catgut, made by immersing catgut in carbolic oil, was formerly used for ligatures and sometimes for stitches; but lately a new catgut has been employed, made with a watery solution of chromic and carbolic or sulphurous acids. This new catgut is kept dry, and an hour or two before use it is immersed in 1–20 carbolic lotion.

Sponges are washed after an operation, and are then kept soaking in a jar containing carbolic lotion 1–20. During an operation they are washed in 1–40 carbolic acid lotion.

Salicylic Acid.—Various substitutes are employed in aseptic work, one of the best being salicylic acid. This is used chiefly in the form of lotion, and wool or jute. The lotion is a saturated watery solution, and contains about 1 part of the acid in 300 parts of water. This is only used for washing wounds; carbolic acid is employed for the disinfection of the hands and instruments, for the spray and for washing the sponges.

Salicylic wool or jute are cotton wool or jute containing salicylic acid, and two different strengths are employed, the material having 3 or 10 p.c. by weight of salicylic acid. Glycerine is generally added to the solution in order to make the crystals stick better to the wool. In applying the dressing, a piece of perforated guttapercha tissue, covered by carbolic gauze, is placed next the wound; over this comes one finger's thickness of the strong wool or jute, and then two fingers' thickness of the weak wool. No macintosh is required. In some cases where inflammation is present, this dressing is kept wet with the salicylic acid lotion.

Salicylic acid is also sometimes used as a powder mixed with other substances, such as starch, zinc oxide, &c. The wound is dusted with the powder with the view of forming a crust, and healing is thus obtained by scabbing. This method is really only of use in small wounds. The objections to its use in large wounds are that the pain is great, the material expensive, and there is very apt to be confinement of the discharge.

A salicylic ointment is used for superficial wounds, and is made in the following manner:—Make a basis of two parts of paraffin to one part of vaseline. Take of this twenty-nine parts, and of powdered salicylic acid one part. Salicylic acid cream, made by mixing salicylic acid crystals with

glycerine to the consistence of cream, is very useful for application around a wound where a dressing is to be left on for some days. It prevents and diminishes the eczema which sometimes occurs under these circumstances.

Acetate of alumina is apparently a very good antiseptic, and is used by Maas and others in place of carbolic acid. The lotion is a watery solution of the strength of 2½ p.c. The strength of the spray is also 2½ p.c. A piece of protective, dipped in this solution, is applied next the wound, and covered with lint soaked in the solution. Outside the lint comes a piece of macintosh, and the edges of the dressing are surrounded by salicylic wool.

Eucalyptus oil is a powerful antiseptic which is useful sometimes as a substitute for carbolic acid. It is chiefly employed in the dressing, the gauze being made with eucalyptus oil instead of with carbolic acid. It is not so poisonous nor so irritating as carbolic acid, and is therefore applied in cases where carbolic acid cannot be borne, but it is not so trustworthy as an antiseptic.

Bichloride of mercury is coming very much into fashion of late, and it may perhaps ultimately replace carbolic acid, but as yet there are several grave objections which must be overcome. Max Schede employs two solutions: a weak, watery solution of $\frac{1}{50}$th p.c. strength, and a strong watery solution of $\frac{1}{10}$th p.c. These are used for disinfecting the skin, and as lotions for the wound, &c. For the spray and the disinfection of instruments, carbolic acid is still employed. A sublimate dressing is used, made by soaking gauze or wool in the following solution: corrosive sublimate 10 parts, glycerine 500 parts, and alcohol 4,490 parts. Von Bruns employs wood wool impregnated with ½ p.c. sublimate and 5 p.c. glycerine. Sir Joseph Lister suggests a solution in serum for making the gauze, thinking that the combination with serum diminishes the irritation caused by the sublimate. As yet the best mode of employing it is only being worked out.

Napthalin, thymol, iodoform, and various other substances are also employed.

When a wound becomes quite superficial, various preparations of boracic acid may be used with advantage.

Boracic lotion is a cold, saturated solution of boracic acid in water. Boracic lint is ordinary surgical lint soaked in a hot saturated solution of boracic acid, and then hung up to dry. Boracic ointment of various strengths is also used. The full strength ointment contains, of the same basis as previously mentioned for salicylic ointment, 5 parts, and of boracic acid crystals 1 part. Boracic ointment may also be used of ½ or ¼ the above strength.

For the purpose of purifying sinuses, ulcers, &c., a solution of *chloride of zinc*—40 grs. to the ounce of water—is employed. Care must be taken in injecting this solution into a wound that free exit is allowed, otherwise it may pass into the tissues and cause gangrene.

An Aseptic Operation.—To illustrate the best method of using these antiseptics, let us consider, in detail, the precautions necessary when carbolic acid is employed. It may be convenient, in the first place, to give a list of the various things required:—

Carbolic lotions, 1–20 and 1–40.

Sponges which have been kept soaking in 1–20 carbolic lotion and are washed in the 1–40 lotion during the operation.

A large, flat dish in which instruments can be laid and covered with a layer of 1–20 carbolic lotion.

Small dish, containing 1–20 carbolic lotion, to purify the skin of the patient.

Small dish, containing 1–40 carbolic lotion, in which hands and instruments can be repurified during the operation.

Small dish, containing 1–40 carbolic lotion, in which a piece of protective oiled silk and a piece of carbolic gauze are placed to soak. It ought also to contain a large piece of thin muslin, called a guard, to throw over the wound should the spray stop.

A steam spray-producer, containing 1–20 carbolic lotion in the glass vessel.

Towels soaked in 1–20 carbolic lotion.

Catgut steeping in 1–20 carbolic lotion.

Drainage-tubes, horsehair, and silkworm gut, in 1–20 carbolic lotion.

Stitches, silver wire, carbolised silk, catgut, horsehair, &c., in 1–20 carbolic lotion.

Protective (oiled silk coated with copal varnish and a layer of dextrine), in 1–40 carbolic lotion.

Carbolic gauze kept in a tin box till required.

A gauze dressing containing macintosh cloth, made as already described.

Bandages, of gauze or calico.

Narrow elastic bandage.

Safety pins.

Before beginning the operation, blankets and clothes are covered with pieces of macintosh cloth, outside which the soaked towels are arranged so that instruments, sponges, &c., may be laid down without being contaminated. The skin, in the neigh-

bourhood of the seat of operation, is then thoroughly washed with 1–20 carbolic acid, though this is generally done, in hospitals, an hour or two before the operation. In any case the skin ought to be thoroughly washed with the lotion immediately before commencing the operation. This purification is absolutely essential, because the skin is covered with dust containing bacteria, which also, apparently, are abundant about the hairs, and they, possibly, also pass into the follicles. These must be destroyed, or rendered incapable of development, otherwise they would spread into the wound, and render the other precautions useless. This purification of the skin is carried out by washing it well with 1–20 carbolic lotion, the antiseptic being allowed to act for some time. It is well also, having first washed the neighbourhood thoroughly, to apply, over the seat of operation, a large cloth or towel soaked in the 1–20 solution and to allow this to remain on the part an hour, or longer if possible. The part ought also to be shaved thoroughly, especially the head, where a sufficiently large area of hair should be removed to allow satisfactory overlapping of the dressing.

The purification of the hands of the operator and his assistants ought also to be thoroughly done, special attention being paid to the nails and the folds of skin about the nails. This is best done with 1–20 carbolic lotion, though, in some cases, 1–40 is sufficient, and not only the fingers, but the whole hand, should be washed.

The instruments are purified by immersion in 1–20 carbolic lotion before the operation. A tin or porcelain trough, filled with the 1–20 solution, is employed for this purpose, the instruments being placed in it some time before the operation. They are not merely dipped; they must remain in the lotion for some time, because the carbolic acid requires a little time to act on the grease or dirt on them. The teeth of toothed instruments ought also to be cleaned thoroughly, and forceps locking by catches ought to be widely opened, so as to allow the solution to come in contact with every part. The whole instrument must be immersed, for if only the point be purified, it may happen that the impure handle is inadvertently brought into contact with the wound during the course of the operation.

The spray is useful in many ways. Whether it instantly kills all the bacteria floating in the air is certainly open to question, but it constantly bedews the surface of the wound with carbolic lotion, so that if living organisms do fall in, the action is continued, while it will hinder their development if they should not be killed. It also keeps the hands and instruments constantly moist with the lotion. Fortunately there are not many bacteria floating about in air, unless the dust has been disturbed by sweeping, &c., which, of course, ought never to be done immediately before an operation or the changing of a dressing.

The arteries are ligatured with catgut. There are three different sizes, the finest being that ordinarily employed for the smaller vessels. All ligatures are cut short.

Drainage may be carried out by means of tubes, or by capillarity—best by tubes. India-rubber tubes are employed with holes cut in them at short intervals. They are inserted to the deepest part of the wound, care being taken to use a sufficient number to drain all the recesses. At the outer end they are cut flush with the surface of the skin, because, if they project, they may be compressed and rendered inefficient. To keep the tube from slipping in, two threads of carbolised silk are fastened into it at its orifice and tied in a knot. This knot, held between the dressing and the skin, retains the tube in position. It is not essential that the orifice of the tube should be at the most dependent part of the wound, because the fluid, as it forms, wells out, and, not being putrid, that which lies at the bottom of the tube does not cause irritation. In cases where the most dependent opening would be near sources of putrefaction, it is well to have the drainage-tube in another part of the wound, even though it be not so dependent. Thus, in inguinal hernia the tube would, no doubt, be in the most dependent part if its orifice were close to the pubes, but as that would be too near to sources of putrefaction, such as the vagina and penis, the orifice of the tube ought to be at the outer angle of the wound.

Absorbable tubes are also sometimes employed, made of decalcified bone. The bone is decalcified, drilled, and soaked in carbolic and chromic acids. These tubes do not require removal; they disappear, by absorption, in a few days.

Drainage by capillarity is carried out by catgut or horsehair. These drains are only applicable to wounds, they are not suitable for abscesses.

The accurate stitching of the edges of the wound is another feature in aseptic surgery. In operating aseptically, the same care need not be taken to remove as little skin as possible as is necessary in wounds treated by other methods, where swelling and inflammation of the edges are expected.

One may take away a wide sweep of skin, such as would seem to render hopeless any attempt to bring the edges of the wound into apposition, and yet if the edges can only be opposed, and if the wound remains aseptic, union by first intention may be expected along the whole line. Three kinds of stitches are employed. The first are the so-called 'button stitches.' These are flat pieces of lead with a hole in the middle. They are applied, at some distance, on each side of the edge of the wound, and connected by strong silver wire drawn tight enough to permit the edges of the wound to come easily together. Then silver wire stitches are inserted, taking a good hold of the tissue, termed 'stitches of relaxation,' and, in the intervals between these, numerous 'stitches of coaptation,' consisting of carbolised silk, horsehair, or catgut are introduced, in order to bring the cutaneous margins accurately together. If the silver stitches are found, in a few days, to be too tight, they can be cut, but there ought to be no hurry in removing the stitches unless they are positively doing harm.

The wound having been stitched, and efficient drainage secured, the dressing is now applied. In order to protect the margin of the wound from the irritation of the antiseptic, a piece of protective is interposed between the gauze and the wound. The protective is cut a little larger than the wound, but care must be taken not to put on too large a piece. There is nothing antiseptic in its substance, and it protects the discharge beneath it from the action of the carbolic acid; therefore, if at any part it projects beyond or comes close to the edge of the dressing, it allows the causes of putrefaction to spread inwards beneath it, and prevents the carbolic acid from acting on this putrefying discharge. This protective is dipped in 1–40 carbolic lotion before being applied.

Outside the protective a piece of gauze, wet in the 1–40 carbolic lotion, is placed, overlapping the protective in all directions. If the gauze is not wet, particles of living dust might be applied directly to the wound.

The protective and wet gauze constitute the 'deep dressing.' This may often be left undisturbed for several days, only the superficial dressing being changed. In this way the wound is not irritated by the application of carbolic acid to it every time the dressing is changed. This deep dressing must be treated as a wound, being itself covered with gauze soaked in the lotion. If the deep dressing is to be left on for any length of time it is well to rub some salicylic cream around the wound.

The gauze dressing should overlap the wound to a considerable extent in all directions. It is fixed on by a gauze or calico bandage. During the movements of the patient, the edge of the dressing might become separated from the skin, and air pass into the space thus formed. To prevent this, a piece of narrow elastic bandage is applied round the edge of the dressing, its general arrangement varying, of course, with the situation.

The next point is the changing of the dressing. It is only in very rare cases that it is necessary to change it the same evening. The only cases in which this is usually done are large empyemata or very large abscesses, and cases of amputation at the hip-joint, where the discharge of bloody serum is profuse, and where there is but little space for overlapping of the dressing.

As a rule, the dressing ought to be changed entirely the day after the operation, the deep part as well as the superficial. The dressing is changed under the spray, all the precautions as to disinfection of hands and instruments being taken. In removing the dressing, care must be taken that the edge next the spray is first raised, so that the spray passes into the angle between the dressing and the skin. The condition of the stitches and the drainage-tubes are attended to; a new dressing is then applied in the same way as before described. In future, the dressing is changed whenever discharge is found to have come through at the visiting hour; if there is no discharge through, and no other reason exists for changing the dressing, it is left till next day at visit, and then the same rule is followed. A dressing is never left longer than a week unchanged.

When the wound becomes quite superficial, boracic dressings may be used. The wound is washed with boracic lotion, a piece of protective dipped in the lotion is applied, and outside this one or more layers of boracic lint, overlapping the protective well in all directions. This dressing is changed every two or three days.

Boracic dressing is also very useful for ulcers. Where these are septic, the solution of chloride of zinc—40 grs. to the ounce of water—is thoroughly applied to the surface, and the skin around is washed with 1–20 carbolic lotion. In place of the chloride of zinc solution iodoform is sometimes used. In any case the boracic dressing is afterwards employed. The chloride of zinc or iodoform, as a rule, requires only to be

applied once, but should putrefaction not be eradicated the application is repeated. In some cases boracic or salicylic ointments are preferable to the protective, especially where there is any cavity, or where the patient dresses the ulcer himself. Outside the ointment comes the boracic lint. Where much inflammation is present, the boracic lint may be used as water dressing, the wet boracic lint being covered with a piece of macintosh.

Treatment of Abscesses.—One of the most important points is the position of the opening. The ordinary rule is, as formerly, that the most dependent point should be selected, but there are many cases in which this rule ought not to be followed. The discharge which flows from an abscess-cavity after the first pus is evacuated is, under aseptic treatment, purely serous in character, and apparently unirritating. There is, therefore, no harm done if it is left to well out, so long as there is no hindrance to its exit. On the other hand, if an abscess be pointing, say close to the anus, and is opened where it points, micro-organisms are very likely to get in, and if this occurs, the course of the abscess may be altogether different; the cavity will suppurate, and healing be delayed, or burrowing of pus may occur, and sinuses remain open for a very long time. It is thus of much more importance to avoid putrefaction than to provide a dependent opening. A psoas abscess, for example, pointing at the upper and inner part of the thigh, ought not to be opened where it points, but above Poupart's ligament in the neighbourhood of the anterior superior spine, or, better still, in the loin. Again, retro-pharyngeal abscess is best opened by an incision at the upper and posterior border of the sterno-mastoid, a canal being burrowed in front of the vertebræ to the abscess. This has been done with complete success both by Professor Chiene, of Edinburgh, and by the writer. Again, in hip-joint abscess pointing near the perineum, an incision should be made in the healthy tissues lower down the thigh, and a canal burrowed to the abscess, The great rule, then, in opening abscesses is to make the incision as far as possible from sources of putrefaction.

When an abscess is opened, instead of dealing tenderly with the pyogenic membrane, as was formerly done, under the impression that it was a hurtful thing to injure it, we now empty the cavity thoroughly, especially in the case of chronic abscesses, in order to get out all curdy masses of pus which may have gravitated to the bottom of the abscess, and in many cases we scrape out the pyogenic membrane with a sharp spoon. When this is done, opportunity is given for the rapid adhesion of the greater part of the wall of the abscess-cavity.

The abscess is opened with the same precautions as were previously detailed as regards other wounds, the cavity is emptied, contents scraped out in the case of chronic abscesses, and free drainage provided, the points mentioned before being carefully attended to. The same sort of dressing is applied in the same way, with the exception that no protective is required, its use being to promote healing of the incision in the skin. *See* Abscess.

So much for wounds made by the surgeon; there remains for consideration the case of wounds produced accidentally. Here the problem is different from, and much more difficult, than the former. In the cases we have as yet been considering, we had merely to keep out septic particles; in the present instance, these particles have already gained admission, and therefore we have not only to prevent the entrance of more, but also to destroy those already present.

The purification of the wound is effected by washing it out with carbolic lotion, provided the accident happened within twenty-four hours of the case coming under treatment. This must be done very thoroughly. The best way is to use a syringe, with a gum-elastic catheter attached to it. The point of the catheter is introduced into all the recesses of the wound, and the 1–20 lotion is injected through it. Care is taken that the lotion can flow out freely. The skin around must also be thoroughly washed with the same lotion, and all dirt carefully removed. If necessary, the orifice of the wound is enlarged, and in any case free drainage by means of tubes is provided. The drainage and subsequent treatment is the same as in wounds made by the surgeon. If the wound was made twenty-four to forty-eight hours before being seen, a stronger solution is used, viz., the 1–5 spirituous solution. *See* Wounds.

W. Watson Cheyne.

ANTISEPTICS are substances which are directed against the causes of putrefaction. Now the putrefactive as well as other fermentative processes have been shown to be due to the growth of micro-organisms in the fermenting material. Antiseptics may combat this fermentation in two ways: either they may directly kill the micro-

organisms—the cause of the fermentation, or they may by their presence in the fermentable material prevent the growth of these organisms, though they do not interfere with their vitality. In either case the fermentative change does not occur.

The value of antiseptics has been tested in various ways, but the most exact method is that used by Dr. Koch. It is now ascertained that many of these micro-organisms have two stages of existence—an adult form when the organism is rapidly growing, and a resting or spore form which provides for its future existence. It has further been shown that in the adult form these bodies are comparatively easily killed, while in the spore form they are very resisting. In order, then, to test the value of any particular antiseptic as a germicide, it is necessary to determine its relations both to the adult bacteria and to the spores. To do this, threads are impregnated with pure cultivations of these organisms in both conditions, and are rapidly dried. They are then placed in solutions of the antiseptics to be tested, washed in boiled water, and planted in a suitable soil. If they have not been killed they grow; if they do not grow the conclusion is that they have died. In the case of infective organisms the matter can be further tested by inoculating the threads into animals. The spore-bearing organisms generally used are the bacilli of anthrax; the non-spore-bearing ones are micrococcus prodigiosus. To test the value of an antiseptic to prevent the development of micro-organisms, it is mixed in certain proportions with the cultivating materials.

With regard to the antiseptics used in surgery, the following results were obtained in regard to the destruction of spore-bearing organisms.

a. A certain number destroyed the spores of bacillus anthracis within twenty-four hours. These were carbolic acid (5 per cent. in water), chlorine water freshly prepared, bromine water (2 per cent.), iodine water, permanganate of potash (5 per cent. in water), bichloride of mercury ($\frac{1}{20000}$ in water).

b. In the case of some of the solutions the spores had to be immersed for several days before they were destroyed: perchloride of iron (5 per cent. in water) for six days, chloride of lime (5 per cent. in water) for two to five days, quinine (1 per cent. in water), with hydrochloric acid, for ten days.

c. Others, again, had little or no effect on the spores, such as alcohol, glycerine, boracic acid (5 per cent. in water), benzoic acid (saturated watery solution), thymol (5 per cent. in alcohol).

The adult bacteria and non-spore-bearing bacteria are much more easily killed. Thus carbolic acid solution (5 per cent. in water) kills these in less than two minutes; indeed much weaker solutions act very rapidly: sulphurous acid, unless very strong, has little or no effect on spores, but non-spore-bearing bacteria, if moist, are killed in one to two minutes by a vapour containing ·986 volume per cent. of sulphurous acid; solutions of bichloride of mercury in water of 1 to 5,000, or stronger, probably kill instantly.

For surgical purposes it is also of great importance to know what amount of the disinfectant must be present in any given material to prevent the development of the organisms. Here, also, the bichloride of mercury is by far the most potent, for added to a gelatinised infusion of meat in the proportion of 1 to 3,000,000 no development occurred. Allyl alcohol is also very potent, a very small trace being sufficient to hinder development. Carbolic acid, boracic acid, salicylic acid, benzoic acid, and eucalyptol, prevent development in proportions varying from 1 to 700 to 1 to 1,500; quinine 1 to 625; chloral under 1 to 400; alcohol 1 to 12½; iodine, chlorine, and bromine, 1 to 1,000 to 1 to 5,000.

In selecting these substances for the treatment of wounds, there are several points to be borne in mind, of which the following two are perhaps the most important. In the first place several of the materials mentioned before combine with albumen, and the resulting mixture or compound is generally less powerfully antiseptic than the original substance. Thus, if carbolic acid is added to such a material as Pasteur's fluid (a solution of various salts), a proportion of 1 to 600, or less, is sufficient to prevent development, while in the case of milk the writer has found that the amount of carbolic acid requires to be increased to about 1 to 50 before complete arrest of development occurs. And thus in the case of the discharge from wounds, an antiseptic, which by the above method of investigation is found not to be very powerful, may in reality answer the purpose better than one which is stronger. A striking example of this is shown in recent experiments of Schill and Fischer on the disinfection of phthisical sputum. For it was found that bichloride of mercury, which in reality is the most powerful of antiseptics when added to phthisical sputum even in strong solution,

did not destroy the tubercle bacilli so rapidly as carbolic acid.

Another point to be noted is that some of these antiseptics are objectionable on account of their poisonous and irritating properties. Thus one of the chief objections to corrosive sublimate is the fact that when used sufficiently strong to be really effectual, it causes inflammation of the skin. Of course this objection may in some instances be overcome, and in fact, with regard to corrosive sublimate, Sir J. Lister finds that, when mixed with serum, it loses to a great extent its irritating properties, while it still retains a sufficient amount of antiseptic power.

The manner of using these various antiseptics in the treatment of wounds will be found under Antiseptic Surgery.

W. Watson Cheyne.

ANTRUM, Diseases of the. — *Suppuration or Empyema of the Antrum* is a form of chronic abscess, but with the peculiarity that the pus is seldom completely shut in, so as to produce distension.

In the great majority of cases, the matter constantly escapes by the anterior or posterior nares, and it is this discharge which first attracts the patient's attention.

When escaping from the anterior nares upon the handkerchief, the discharge is apt to be attributed erroneously to ozæna, but the absence of the characteristic crusts and fœtor sufficiently mark the distinction. In ozæna, the patient as a rule has lost the sense of smell, and is unconscious of his offensiveness, whereas in cases of pus in the antrum the patient is conscious of an occasional unpleasant odour, but is not disagreeable to his neighbours, though the discharge when blown on to the handkerchief may be offensive.

Often a patient suffering from pus in the antrum, complains only of a disagreeable taste in the throat and mouth on waking in the morning, particularly if he sleeps habitually on the side opposite to that of the affected antrum, the purulent fluid then slowly flowing backwards into the pharynx, and being partially swallowed, with great detriment to the digestion.

In the exceptional cases where the opening into the nose is closed, the pus tends to accumulate, and produce distension of the antrum, with absorption of the bony walls, by which the characteristic crackling is produced. It may be doubted, however, whether some at least of these cases are not instances of cyst of the wall of the antrum, the contents of which have become purulent.

In cases of distension the pain is severe, and of a neuralgic and intermittent character, but in the ordinary form there is little more than an occasional sense of uneasiness and weight about the jaws, so indistinct as often to be no guide to the side on which the mischief exists. In the great majority of cases empyema of the antrum depends upon inflammation of the lining membrane of the cavity, caused by the fangs of decayed teeth, which, if not actually perforating the membrane, are in close proximity to it, either from unusual depth of the sockets, or from absorption of the intervening thin portion of bone. It is possible, however, that the mischief may be set up by extension of catarrhal inflammation from the nose, by blows on the face, or even by the pressure of parturition in the case of an infant.

A careful examination of the teeth will, in most cases, show which of them is in fault, and though the first and second molars are those of which the fangs most frequently cause mischief in the antrum, it must be remembered that the canine frequently, and the incisors more rarely, are connected with an unusually extensive antrum.

The extraction of a decayed tooth or fang may be followed by an immediate discharge of pus, in which case an enlargement of the opening will probably be required, but frequently the tooth which set up the mischief has been long extracted, and it then becomes necessary to perforate above the alveolus. For this purpose a perforator, a gimlet, or an ordinary trochar of medium size may be employed. If the bone happens to be thin any instrument passes through readily, and the operator is aware that he has entered a cavity, and may, if he does not hold the perforator judiciously short, transfix it, and come in contact with orbital plate. But in many cases the bone is extremely dense, and the instrument is gripped so tightly that it is impossible, until it is withdrawn, to be sure that the cavity of the antrum has been reached.

Whether the perforation be made through or above the alveolus, an ordinary Eustachian catheter of silver or vulcanite will be found very convenient for washing out the antrum, and a simple india-rubber ear-syringe with a bullet-joint will be sufficiently powerful for the purpose. Ordinarily, fluid injected through the perforation flows readily from the nose, bringing away a quantity of more or less inspissated pus of an offensive character; but occasionally the

cavity of the abscess does not communicate with the nose, and the fluid must then be allowed to flow back by the perforation.

The after-treatment of these cases consists in maintaining the aperture, which is often difficult, until all purulent secretion has ceased, in washing out the cavity at least twice daily with warm Condy's fluid and water, and in throwing in a small quantity of stimulating lotion such as

Zinci sulphatis, gr. ij. ad v.; Aquæ rosæ, fʒj.

When the opening is above the alveolus, there is little danger of particles of food entering the cavity; but when the perforation is through the alveolus, food will readily penetrate, unless an artificial denture be applied so as to cover the opening during mastication. If this is employed, a tube should be fitted to the perforation so as to maintain its calibre, and thus the occasional introduction of a trochar may be dispensed with. Still, it must be allowed that the cure of empyema of the antrum is often very tedious, and that many months may elapse before a patient can dispense with daily washing out of the cavity.

Since, as has been already said, distension of the antrum with facial deformity occurs only in cases in which the matter does not discharge into the nostril, it is easy to mistake an instance of the kind for a solid tumour of the upper jaw, should the amount of distension not be sufficient to produce much thinning and crackling of the bone. Again, it appears possible that the fluid portion of the matter contained in the antrum may drain away, leaving behind it a solid mass of inspissated pus and cholesterine, which, as in a case of the writer's, may by its presence induce partial absorption of the floor of the antrum with a protrusion of the palate, and all the symptoms of maxillary tumour. In order, then, to avoid an error which has overtaken very excellent surgeons, it is advisable in all cases of tumour of the upper jaw in which the nature of the swelling is not obvious, to perforate the antrum beneath the cheek, before incising the skin of the face and taking the necessary steps for removal of the jaw.

The secondary effects produced by distension of the antrum are sometimes serious. Thus protrusion of the eyeball from elevation of the floor of the orbit is not infrequent, and cases of permanent amaurosis have been recorded by Salter and Gaine, while occasionally death has been known to follow suppuration within the antrum.

Cysts of the upper jaw are by no means uncommon in which no connection with the teeth can be made out, but which certainly do not fill or in any way occupy the antrum. In fact it may be doubted whether the old term 'hydrops antri' is not altogether a misnomer, the cases which have hitherto been grouped together under that name, being either cysts of the wall of the antrum, or cysts altogether outside the antrum, pushing in its wall as they develop. The history of these cases is one of gradual, painless enlargement of some part of the upper jaw, usually close above the alveolus, the bony wall becoming so thin as to crackle like parchment, or eventually being simply membranous, in which case a characteristic bluish appearance is seen on lifting the lip, and fluctuation can be readily perceived.

In the earlier stage of the complaint, when the jaw is distended and absorption is not so far advanced as to make the nature of the case clear, a puncture with a trochar will probably evacuate cystic fluid, often containing cholesterine, and differing entirely from the mucous secretion of the lining membrane of the antrum. On incising a cyst a quantity of dark-coloured fluid of varying consistency escapes, and the finger passes into a smooth cavity not perforated by the fangs of teeth, and quite outside the antrum. By cutting away a portion of the cyst-wall so as to insure a free drainage, the cure of the cyst is gradually brought about, but very slowly. The same form of cyst is found, but less frequently, in the lower jaw.

Adams, Giraldés, and Luschka have shown that both single and multiple cysts develop occasionally from the wall of the antrum, and project into the cavity, and that polypoid growths form in the same situation. A case recently recorded by Sir James Paget supplies a symptom of such polypoid growths hitherto unnoticed, viz., the constant flow from the nostril of the affected side of clear watery fluid in considerable quantity. The patient, a lady aged 49, suffered for nearly two years from this inconvenience, and was then relieved, and ultimately cured, by the use of sulphate of zinc, locally and internally, as recommended by Brodie in a similar case. The patient dying from causes unconnected with the antrum, its 'floor was found to be covered with two broad-band convex polypoid growths, deep clear yellow with the fluid infiltrated in their tissue. They looked like very thin walled cysts, but were formed of very fine membranous or filamentous tissue infiltrated with serum.'

Epithelioma.—The tubular form of epithelioma may originate in the antrum, or,

commencing in the nose, may secondarily invade the antrum. The growth is characterised by great rapidity of development and softness, and the surrounding structures are apt to be rapidly involved. Hence tumours of this class were formerly considered as examples of soft cancer. When beginning on the nasal mucous membrane, the stoppage of the nostril is generally the first symptom noticed, and possibly temporary relief may be obtained by the removal of so-called polypi. When the disease begins in the antrum it leads to a rapid expansion of the cheek, with stretching and thinning of the skin, which eventually becomes involved and ulcerates, giving exit to a fœtid watery discharge and the protrusion of a yellow fungous growth. The nose and the orbit become secondarily involved, and the growth is apt to find its way into the several fossæ of the outside of the skull.

In the treatment of this form of disease early and free removal of the upper jaw offers the only chance of permanent cure.

CHRISTOPHER HEATH.

ANUS. *See* ATRESIA ANI; FISSURE OF THE ANUS; PRURITUS ANI.

AORTA, Abdominal. *See* ABDOMINAL ANEURISM.

AORTIC ANEURISM has of late years been submitted to surgical treatment with an encouraging amount of success. As regards the pathology, diagnosis, and general treatment of aneurism of the arch of the aorta reference must be made to medical treatises, and the writer will confine himself to the indications for surgical interference of various kinds.

A sacculated aneurism of the arch of the aorta is to be diagnosed in the early stages by its pressure effects, viz., pain, venous congestion and dyspnœa. The position of the sac will materially influence each of these; thus a sac pressing against the sternum is more painful than one pressing back against the trachea, whilst the latter will give rise to urgent dyspnœa in a very early stage. Increased dulness on percussion is a very important sign, and when this is combined with a strong impulse synchronous with the impulse of the heart, but not necessarily accompanied by a *bruit*, the diagnosis of aortic aneurism is confirmed.

The tendency of an aortic aneurism to appear externally is regulated very much by the site of the sac. If on the ascending portion of the arch, the sac presses against the sternum, producing gradual absorption of the front wall of the chest, and communicating a marked impulse to the right side of the sternum as high as the sterno clavicular joint, which may be invaded by the tumour in the later stages. If on the transverse portion of the arch the sac encounters but little resistance in an upward direction, and hence is apt to invade the interclavicular notch, to compress the trachea and occasionally the œsophagus, and to produce marked spasm of the larynx by interference with the left recurrent laryngeal nerve. When a sac of this kind rises into the neck it is a matter of uncertainty to which side it should be allotted, since a tumour projecting most to the right by no means necessarily *originates* on the right side, and *vice versâ*. Some assistance in diagnosing this point may be derived from the radial pulses, which should be carefully examined both with the finger and sphygmograph. A diminution of the right radial pulse would generally indicate an aneurism of the root of the innominate; but the fact must be borne in mind that occasionally the right subclavian comes off from the lower part of the arch and may be compressed by an aneurism of the arch or by some other tumour. It becomes necessary, therefore, to compare the two carotids and to investigate the blood-supply of both sides of the head. The condition of the pupil on the affected side should also be noted, since it is not infrequently contracted from interference with the sympathetic trunk, though in certain other cases dilatation has been noted.

Given a case of aneurism of the arch of the aorta, in which the symptoms are steadily increasing in severity, notwithstanding the employment of rest, regulated diet, and various drugs, the question of surgical interference may be fairly entertained under the heads of *a*, distal ligature; *b*, galvano-puncture; *c*, introduction of certain foreign substances:—

a. The distal ligature may be applied to either carotid and either subclavian; or to the two vessels of the right side, either simultaneously or consecutively. Dr. Cockle was the first to direct attention to the remarkable curative effects produced (under a mistaken diagnosis) upon aneurisms of the arch, by ligature of the left carotid in the hands of Rigen and Tillanus, and at his suggestion the writer tied the left carotid in a case of unquestioned aortic aneurism in 1872. The patient, a farm-labourer of forty-eight, had well-marked symptoms of aortic aneurism, which was thought to involve the transverse portion of the arch

The relief afforded by the ligature of the left carotid was marked. Within forty-eight hours the patient was able to lie on his right side, which he had previously been unable to do. The prominence of the right side of the sternum and right sterno-clavicular articulation gradually subsided, and the pulsation in the episternal notch disappeared. A year after the operation the patient was well and quite comfortable, and a few months later resumed his laborious occupation, with the result that the aneurism began again to increase and eventually burst in the middle line externally, four and a half years after the operation. The aneurism proved to be one of the ascending portion of the arch. The operation has been repeated by Holmes, Barwell, Pirogoff, Küster, and the writer, whose second case proved rapidly fatal from cerebral anæmia, the right carotid proving to have been previously occluded. Still the relief given in at least seven cases is very encouraging, and since, with improved methods of tying large vessels (*see* LIGATURES), the risk of tying the common carotid is considerably reduced, it may be hoped that the operation will be more extensively employed than heretofore.

The double distal ligature has been frequently applied on the right side, and once at least (Barwell) on the left side. In the majority of instances the double ligature has been performed for supposed innominate aneurism more or less involving the aorta, but in several examples the disease has proved to be purely aortic, as in the writer's case which occurred in 1865, the patient surviving four and a half years. Mr. Barwell, in 1879, first applied the double distal ligature on the right side for aneurism diagnosed as aortic, the patient living fifteen months in fair health and comfort, and he was followed by Dr. Lediard, whose patient lived ten months, and by Dr. Wyeth, whose patient lived one year.

Mr. Barwell (*International Encyclopædia of Surgery*) has endeavoured to distinguish the two classes of cases suitable for the distal ligature as follows :—

'*For Deligation of Left Carotid.*—Tumour symptoms upon and somewhat, but not far, to the left of middle line, and rising into episternal notch, or beneath left sterno-mastoid. Left venous congestion, alteration of left carotid, and to a much less degree, of left radial pulse. Paralysis of left vocal cord; obstruction to entrance of air, equal on both sides of chest; sometimes alteration of left pupil.

'*For Deligation of Right Carotid and Subclavian.*—Tumour symptoms on right of median line; marked changes in right radial and carotid pulses; venous congestion on right side, affecting first and chiefly head and neck. Afterwards, with increase of tumour, right arm and chest and right vocal cord may be paralysed; or, tumour symptoms on right of and upon mesial line, running up to sterno-clavicular joint and episternal notch; venous congestion on left side; alteration of right pulse, tracheal dyspnœa.'

It appears to the writer, however, impossible to lay down any hard-and-fast diagnostic lines, since each case must be taken on its merits; but he would remark that in both his cases of distal ligature which survived the operations over four years and a half each, the aneurism was on the ascending portion of the arch, and that both patients were equally benefited, the one by the double ligature on the right side, the other by a single ligature on the left. The balance of safety lies therefore clearly, *cæteris paribus*, in favour of a single ligature on the *left* side.

b. The production of clot within an aortic aneurism by the employment of electrolysis will be discussed under that heading.

c. The introduction of foreign bodies into an aneurismal sac, with the view of entangling fibrine and thus bringing about a cure, is a very desperate remedy. The first case in which the late Mr. C. Moore introduced many yards of fine iron wire, died of acute pericarditis and general inflammatory symptoms due to the foreign body. No better results have followed the substitution of horsehair. Probably the safest foreign body will be found in fine darning-needles introduced in pairs and crossing one another within the sac, so as to entangle the blood and lead to coagulation. The small experience of Mr. Marshall and the writer has been favourable as regards the innocuousness of the method, but not as respects the permanent effects of the treatment. Further experience is wanted as to the time during which the needles may be safely retained—probably at least forty-eight hours. Mr. Puzey's very interesting case will be found in the article ACUPUNCTURE.

CHRISTOPHER HEATH.

AORTIC TOURNIQUET.—A large horse-shoe tourniquet contrived by Lister for compressing the abdominal aorta immediately to the left of the umbilicus in amputating at the hip-joint. *See* DAVY'S LEVER.

APHONIA, i.e. loss of voice—hoarseness or dysphonia, if the voice is only impaired—is caused by conditions in which (*a*) the expiratory current of air is too weak to throw the approximated and tense vocal cords into vibration; (*b*) the approximation of the vocal cords is impeded; (*c*) their tension is either rendered impossible or is excessive; (*d*) the cords themselves are pathologically changed; (*e*) their vibration is rendered impossible.

Such conditions are met with—

(*a*) 1. In cases of emphysema and of extreme general weakness. 2. In cases of complete, or nearly complete, obstruction of the lower air-passages by internal tumours, foreign bodies, sub-glottic webs, external compression. 3. After tracheotomy or wounds of the trachea.

(*b*) 1. In cases of nervous paralysis, as (*α*) in bilateral or unilateral paralysis of the recurrent laryngeal nerves; (*β*) in functional paralysis of the adductors of the vocal cords; (*γ*) in paralysis of the inter-arytænoid muscle; (*δ*) in paralysis of individual adductor muscles in consequence of local disease. 2. In cases of serous infiltration of the phonatory laryngeal muscles arising in catarrhal and inflammatory affections of the larynx. 3. In cases of mechanical fixation of one or both vocal cords in positions other than that of phonation. This may be due (*α*) to cicatrices binding the cord, or cords, to the sides of the larynx; (*β*) to disease of the crico-arytænoid joints, followed by ankylosis; (*γ*) in cases in which anything intervenes between the cords, when they attempt to join. This may happen (*α*) in cases of swelling of the interarytænoid fold; (*β*) in cases of foreign bodies in the larynx; (*γ*) in cases of benign or malignant neoplasms situated within the glottis.

(*c*) 1. In cases of paralysis of (*α*) the crico-thyroid muscles; (*β*) the interior thyro-arytænoid muscles. 2. In cases of ankylosis of both crico-arytænoid joints, in which, though they are fixed in the position of phonation, they are simultaneously bound internally and forwards, so that the cords, though approximated, remain quite lax. 3. On the other hand, a peculiar form of aphonia is produced in spasm of the tensors and adductors (speaker's cramp, aphonia spastica).

(*d*) In many cases of inflammatory or ulcerative disease of the larynx, as in: (*α*) acute laryngitis, (*β*) chronic laryngitis, (*γ*) œdema of the larynx, (*δ*) benign neoplasms, (*ε*) carcinoma and sarcoma, (*ζ*) syphilis, (*η*) tuberculosis, (*θ*) perichondritis, (*ι*) lupus, (*κ*) lepra of the larynx, (*λ*) direct injury of the vocal cords.

(*e*) 1. In cases of swelling of the ventricular bands and chronic laryngitis, the swollen parts resting on, and preventing the vibrations of, the vocal cords. 2. In cases of benign neoplasms resting on the vocal cords, and acting similarly.

It is obvious that in many cases there will be a coexistence of several of the conditions just enumerated.

If the class of cases mentioned in (*a*), in which the cause of the aphonia or dysphonia will either be obvious, or become patent from physical examination of the chest, be excluded from consideration, varied, and pathologically different, laryngeal conditions remain, in which this symptom is present. It is true, that in some of these conditions, as in bilateral paralysis of the recurrent laryngeal nerves (see *Paralysis* and *Spasm* under LARYNX, Neuroses of the), hysterical aphonia, and in spastic aphonia, the vocal disorder manifests itself in a very characteristic form, but even in these cases errors are not excluded, if one trusts only to the patient's history, and to the recollection of apparently similar cases. Thus the writer has known enormous laryngeal papillomata to have been mistaken for hysterical aphonia, speaker's cramp for pharyngitis, &c. In all other cases of aphonia or hoarseness, the diagnosis of the nature, and, still more, of the special form and the extent of the morbid influence, without the aid of the laryngoscope, is purely guesswork; and the most experienced observer will occasionally be liable to serious mistakes, if he trusts to the history of the case, to the general symptoms, and to his auditory faculties alone.

A certain diagnosis of the nature, form, and extent of the cause of aphonia can only be arrived at by combining laryngoscopic examination with the methods just mentioned. In this manner, and on reference to the above list of conditions giving rise to aphonia or dysphonia, the special cause of aphonia in a given case will be elucidated. The peculiarities of all these conditions are fully discussed under LARYNGITIS; LARYNX, Neuroses of the, and Growths in the.

FELIX SEMON.

APHTHÆ. *See* TONGUE, Diseases of the.

AREOLA. *See* NIPPLE AND AREOLA, Diseases of the.

ARM, Amputation of the.—The conditions which, as a rule, necessitate amputation of the arm are compound and extensively comminuted fractures, such as are produced by gunshot injuries, gangrene, strumous disease of the elbow-joint of an extent to contra-indicate resection, necrosis, burns of exceptional severity, contused and lacerated wounds, malignant tumours of the hand or forearm, &c.

The following are the methods practised for this operation, which may be performed at any point below the attachments of the axillary muscles:—

1. The circular method.
2. Syme's modification of the circular.
3. Alanson's method.
4. Oval method (Guthrie).
5. Square-shaped flap method (Sabatier).
6. Antero-posterior flap method (Vermale).
7. Lateral flap method (Velpeau).
8. Musculo-cutaneous flap method (Langenbeck).
9. Long anterior oval flap.
10. Rectangular flap method (Teale).

Of these methods the circular is, in the majority of cases, to be preferred; but the surgeon must use his own discretion in the choice, his selection being guided by a careful consideration of the particular circumstances attending each case.

Speaking generally, he must, in cases especially of serious traumatism requiring amputation, utilise for flaps the integumentary and muscular tissues that are least involved in the injury. For such cases, therefore, no definite rules as regards length, breadth, or shape of the flaps, can be stated. In cases of disease, however, it is different. Here the structures, where the operation is performed, being healthy, the surgeon can select the procedure which, in his opinion, is attended with least risk, and is best adapted for an artificial arm, or other mechanical appliance.

In performing the foregoing amputations, provision must be made to prevent hæmorrhage by one of the following methods:—(1) Esmarch's bandage; (2) Petit's tourniquet on upper part of the arm; (3) Signoroni's tourniquet; (4) digital pressure on brachial artery; (5) digital pressure on axillary artery; (6) pressure on subclavian against first rib.

In the circular amputation, supposing the right arm is the one to be operated on, the surgeon grasps with his left hand and retracts the soft tissues, and with a straight, or somewhat curved, blunt-pointed amputation knife, divides the integument and superficial structures, with a single circular sweep round the limb, severing all the tissues down to the muscles. A flap, consisting mainly of integument and fat, should be dissected back with a full-sized scalpel for a distance of at least an inch and a half, care being taken to include all the subcutaneous tissues with the view of preserving the vitality of the flap. Having dissected and retracted this flap, the amputation knife is then applied to the muscles, and all of them divided at once down to the bone; or the superficial ones may only, in the first instance, be divided, and subsequently the deeper ones, with the vessels and nerves. Owing to the non-attachment of the biceps to the humerus, and the greater tendency it has in consequence to retract, it has been recommended to divide it at a somewhat lower point than the other muscles. The plan of dividing the superficial muscles, and subsequently the deeper ones, is, in the writer's opinion, to be preferred. The muscles having been divided, and the periosteum reached, it should be carefully incised at the point where the saw is to be applied, and the bone then sawn steadily and slowly across. Should the edges of it be sharp, they should be rounded off, either with the saw or bone-forceps, any spicula of bone being removed. The brachial, the superior and inferior profunda arteries, together with muscular branches, will probably require ligature, and should be seized with an artery forceps or tenaculum, and secured with strong carbolised catgut suture, and both ends cut short. If the plan of inserting deep, as well as superficial, sutures, as recommended by Esmarch, be not adopted, provision should be made for efficient drainage, and the edges of the flaps brought together with numerous points of carbolised or chromicised catgut sutures of medium thickness, antiseptic dressings being then applied.

As regards the other methods of amputation, the writer is of opinion that the merits of Syme's modified circular method are not so apparent in amputations of the arm as in those of the leg, thigh, and forearm. The circular operation just described, in which the muscles are divided in layers, includes the advantages claimed for Alanson's operation, in which the muscles are divided obliquely, in both instances the wound being more or less cone-shaped. In the 'oval' method, the writer fails to see any special merit, and none whatever in the 'square flap' method of Sabatier. The antero-posterior and lateral flap operations, and

the musculo-cutaneous flap amputation (Langenbeck), possess advantages which, in the opinion of many surgeons, make their adoption desirable, from the rapidity with which they can be done, and the shapely stumps that result. The rectangular method of Teale, applied to the arm, has many advocates; but, in the writer's opinion, its merits—and they are many—are more apparent in amputations of the thigh than in any others; and in connection with that group of operations, therefore, the method will be more fitly discussed.

In performing the antero-posterior flap method, made by transfixion, care should be taken in making the anterior flap to get the knife in front of the brachial vessels, which can best be done by lifting the anterior muscles well up before transfixing them. The posterior flap should be made somewhat longer than the anterior, which latter should be from two to three inches in length. The flaps then being retracted, any muscular fibres attached to the bone should, with the periosteum, be divided carefully, and the bone then sawn across. The remaining steps of the operation are similar to what has already been described in connection with the 'circular' amputation.

These methods will probably meet the requirements of the surgeon in the majority of cases. WILLIAM STOKES.

ARM and FOREARM, Diagnosis of Injuries and Diseases of the.—Loss of power, pain, swelling, probably distortion, mobility in the continuity of one of the bones, with crepitus on manipulation, following immediately upon injury, are the signs of *fracture*. The humerus is occasionally the seat of *spontaneous fracture*, which in old subjects may be the result of malignant disease of the bone.

Loss of extension power following a fall on the elbow or other direct injury, with pain and swelling behind the joint, where a hard movable mass can be felt, indicates *fracture of the olecranon* with separation; if the fibrous structures around the bone are not torn across, no separation occurs, and the power of extension is not lost. *A movable bony mass* at the inner side of the elbow, after a direct blow on the part, is probably the internal condyle, which has been chipped off; a similar movable mass in other situations may be the result of a fractured exostosis.

Bony distortion about the elbow immediately consequent on injury must be due to *fracture* or *dislocation*, perhaps both. Deformity with crepitus means fracture—possibly dislocation also; without crepitus it means almost certainly dislocation—very rarely *impacted fracture*. The two conditions which may resemble dislocation are, transverse fracture just above the condyles and, in young subjects only, *separation of the epiphysis* at the lower end of the humerus. In the normal state the tip of the olecranon in extension is exactly on the level of the line of the condyles—never above it; in semiflexion it lies vertically below that line—never in front or behind. In fracture or separation of the epiphysis the whole elbow-joint may be displaced, but the relation of the olecranon to both the condyles remains unaltered; any change, therefore, in these relations indicates *dislocation of the ulna* from the humerus. Displacement due to fracture is reproduced immediately after reduction by muscular action; a dislocation, on the other hand, has not this tendency to recur. In *dislocation of the radius* only the relation of the olecranon to the condyles is unchanged, and the absence of the radial head from its usual situation below the external condyle is easily detected.

An abrupt angular bend is often found in young children, at about the middle of one of the bones, and may arise from rickety deformity, greenstick fracture, or, very rarely, intra-uterine fracture. In adults permanent angular deformity is usually due to vicious union after fracture.

Permanent *shortening of the limb*, independent of loss of bony tissue from compound fracture or operation, may be the result of congenital defect, arrest of growth after fracture in infancy, injury or disease of one of the epiphyses of a growing bone, or infantile paralysis. *Lengthening* occurs very rarely in chronic ostitis and in certain cases of osteitis deformans.

Wasting of one or more of the muscles may be due to:—(1) prolonged disuse; (2) injury to the nerves; (3) inflammation in or around a muscle; (4) acute or subacute joint-disease; atrophy of the muscles about the elbow should therefore induce careful investigation of the articulation. In children infantile paralysis is a common cause of wasting of muscles, especially the deltoid. *Hypertrophy* of some of the muscles may be the result of excessive use, and is also present in rare cases of pseudo-hypertrophic paralysis.

Rigidity of the biceps, causing 'bent elbow,' may be produced by:—(1) old inflammation about the muscle; (2) passive

contraction from long use of a sling; (3) reflex contraction from disease of the elbow, or from a wound of a cutaneous branch of the musculo-cutaneous nerve.

Stiff elbow may arise from:—(1) prolonged disuse; (2) adhesions in or around the joint from old disease; (3) bony ankylosis after disease, fracture, or excision; (4) contraction of scars, probably of burns; (5) reflex rigidity of muscles; (6) deformity from fracture; (7) unreduced dislocation; (8) deformity in osteo-arthritis; (9) bony thickening after periostitis.

Loss of power of rotation in the forearm, either by voluntary or passive movement, which is persistent and complete, is found in complete ankylosis of the elbow, in vicious union after fracture of the radius and ulna, and in obliteration of the interosseous space by callus or periosteal bone.

The distressing pain and weakness known as '*tennis-elbow*,' often seen about the upper part of the forearm and elbow in players of lawn-tennis, particularly during the action of pronation, is the result of sprain of the pronator radii teres and internal inter-muscular septum. Similar symptoms, '*sculler's sprain*,' are sometimes met with amongst boating men who 'feather' their oars. An elongated tense swelling over the course of any of the tendons above the wrist, which when moved produce a peculiar creaking in the tumour, coming on, as a rule, after a sprain, or violent twisting movements, indicates *teno-synovitis*.

Sudden loss of power and sensation from interruption of nerve-supply may be caused by:—(1) injury to a nerve by direct wound; (2) complete or incomplete division of a nerve, probably the musculo-spiral, by the fragments of a fractured bone; (3) a violent blow on a nerve as it lies close upon one of the bones. In children, especially about the time of 'teething,' sudden loss of power without loss of sensation is due to infantile paralysis. *Gradual paralysis* following upon fracture is probably caused by implication of the nerve in callus; independently of fracture, it is usually crutch-paralysis or lead palsy.

Sudden, acute pain in the arm during violent attempts at flexion, immediate loss of power, swelling, and extravasation, with a rounded tumour in the mid-bicipital region and a depression above the elbow instead of the normal fulness, indicate *rupture of the biceps*. Rapid *subcutaneous extravasation* and discoloration, ensuing directly upon a strain or blow, point to a ruptured vein.

A pulsating swelling appearing rapidly or slowly after a similar injury means *rupture of an artery*, probably the brachial, and the formation of a traumatic aneurism. A pulsating tumour does not always follow rupture of the artery, in which case the history of the injury and the absence of the pulse below the rupture will point to the diagnosis. Punctured wounds over either of the large vessels may involve the artery, and should be carefully watched, as an immediate *traumatic* or *consecutive aneurism* may result.

A rounded, well-defined tumour in the course of either of the large arteries, pulsating in all directions, is probably an *aneurism*; a distinct blowing or rasping bruit is heard on auscultation, the pulse in the artery below is diminished; pressure on the vessel above arrests the pulsation in the tumour and causes a decrease in its bulk. A pulsating, rapidly-growing mass, possibly of large size, involving one of the bones, probably the humerus, with a soft purring bruit and no alteration in the pulse below, points to *osteoid cancer*.

Fulness and tortuosity of the veins over the bend of the elbow, with pulsation and a soft bruit, are the symptoms of *aneurismal varix*: if, in addition, a distinct pulsating tumour exist, the case is one of *varicose aneurism*.

Stiffness, pain, and tenderness about the elbow, with gradual distension of the synovial membrane, which bulges on each side of the olecranon without obscuring the bony points, are the symptoms of *synovitis*, which may be traumatic, rheumatic, gonorrhœal, or syphilitic. Immediate distension of the joint after injury is caused by effusion of blood. In children, synovitis is usually the effect of injury or 'struma,' or both; if the swelling slowly becomes uniform over the whole elbow, the bony eminences being obscured, *pulpy or 'fungous' disease* of the joint has set in.

The sudden appearance of fluid in the elbow-joint, in patients affected with open sores or suppurating cavities, points to *secondary pyæmic abscess*. Chronic effusion into the elbow-joint, with rough creaking and, in the later stage, bony crepitus and deformity, without very acute pain, as a rule is common in patients past middle age, as the result of chronic *osteo-arthritis*. A similar but quite painless condition, *Charcot's disease*, is found sometimes in those affected with locomotor ataxy. *Bony crepitus* in the elbow may be the consequence of fracture, acute or chronic disorganisation, osteo-arthritis, or Charcot's disease.

Vivid streaks running up the limb, with stiffness, swelling, and tenderness of the lymphatic glands in the axilla or above the elbow, indicate *lymphangitis*. Bright redness, rather diffused excepting at its upper limit, disappearing momentarily on pressure, with a tendency to spread in all directions, slight œdema and stabbing pain, are the signs of *erysipelas*. In young subjects, especially anæmic girls, about the time of puberty, bright red, raised, and circumscribed patches, which appear rapidly and subside in a few days, leaving marks like a fading bruise, are typical of *erythema nodosum*.

General chronic *œdema of the limb* may exist as a sequel to erysipelas or cellulitis, may be caused by obstruction of the venous circulation from thrombosis, or pressure on the veins by tumours or enlarged glands, and may arise from constriction high up accidentally, or in cases of neuro-mimesis and malingering.

Intense pain, tenderness and swelling over either of the bones, without redness in the earlier stages, occurring after exposure or slight injury in young subjects, are almost certain evidence of *acute periostitis*. Dull aching pain, increased at night with some thickening, often ill-defined, and tenderness about one of the bones, occurring most frequently in adults, points to *chronic periostitis*, or *ostitis*. A well-marked circumscribed swelling on the bone, with symptoms of chronic or subacute periostitis, is a *node*, which in adults is, as a rule, syphilitic, in children strumous. A painful, tender swelling around the line of one of the epiphyses, usually that at the lower end of the humerus, not involving the neighbouring joint, excepting in neglected cases, occurring in children who are the subjects of congenital syphilis, is not infrequently seen as a consequence of *syphilitic epiphysitis*, and must be carefully distinguished from pulpy disease of the joint.

An oval, fluctuating swelling, not as a rule painful or tender, over the olecranon, is the result of chronic effusion into the olecranon bursa, '*miner's elbow*,' and is prone to become acutely inflamed after slight injury. A rounded, fluctuating swelling over the lower end of the bicipital groove, slightly movable and not very tender, should lead to a careful examination of the shoulder-joint, as such a tumour is sometimes formed by *synovial extension* in chronic or subacute disease of that articulation. *See* SHOULDER.

A rather hard, fairly-defined mass, situated in the substance of one of the muscles, usually the triceps, often of considerable size, remaining for a long period without change, is probably a *gumma*. Ragged sores, with bases of slough resembling wash-leather, the result of broken-down gummata, are common about the region of the internal condyle of the humerus.

Any rapidly-increasing growth, hard or soft, painless or painful, covered with large veins, which involves all the structures around, infiltrating the skin so that it becomes adherent, is due to *malignant disease*.

A hard, fixed, circumscribed, slowly-growing tumour, springing from either of the bones near one of its extremities, causing little inconvenience excepting that produced by its weight and size, is probably an *enchondroma*. A mass of bony hardness, usually pedunculated, and not very large, springing from either of the bones, absolutely fixed, neither tender nor painful, unless a nerve or muscle is stretched over it, and growing extremely slowly or not at all, is nearly certain to be an *exostosis*. Bony tumours not being exostoses are due to the existence of (1) a supra-condyloid process; (2) ossified nodes; (3) ossified callus about an old fracture. *See* HAND, Surgery of the.

WILLIAM H. BENNETT.

ARNOLD'S LEG-SPLINT consists of a piece of tinned sheet-iron, bent slightly opposite the knee, and turned up at right angles at the lower end, to form a footpiece. The splint should be broader than the leg, so that the latter is not compressed too much by the side splints, which are straight pieces of wood reaching from just above the knee to the footpiece A strap and buckle should be attached to the lower end of each, by means of which they may be fastened together round the footpiece. The splint is slung to a wooden cradle by straps fixed to two pairs of cross-bars, one just below the knee, and the other just above the ankle.

BILTON POLLARD.

ARTERIES, Diseases of.—The diseases of the arterial system may be arranged in the following order:—I. Inflammation and ulceration. II. Degeneration. (*a*) fatty, (*b*) calcareous, (*c*) amyloid. III. Atrophy. IV. Hypertrophy. V. Nervo-muscular disturbance—Raynaud's disease. VI. Embolism. VII. Thrombosis. VIII. Tumours.

I. ARTERITIS.—Inflamed arteries vary greatly in appearance, the diversity depending on essential or accidental circumstances. Thus the process may be acute or chronic; it may affect by preference larger or smaller vessels, and incidentally one or other of

their coats; whilst it may constitute the sole morbid change, or be associated with retrograde metamorphosis, coincidental or consecutive. Hence it is customary to enumerate several kinds of arteritis. At the same time it should be borne in mind that apparently distinct pathological lesions may in reality be only successive stages of a protracted disorder of nutrition.

(A) *Acute Arteritis.*—It is now generally conceded that there is no such disease as *acute general arteritis.* The description formerly given of this supposed erysipelatous condition was founded on error; the staining of the intima with hæmoglobin discharged from the corpuscles being mistaken for inflammatory redness, and decolorised disintegrated blood-clot for purulent effusion. Moreover, at that period arteritis was believed to be a necessary antecedent to thrombosis, and primary diffuse arterial thrombosis, though rare, is known to occur, e.g. in the course of malignant blood-poisoning.

Acute local arteritis is a necessary consequence of severe injury to a vessel; thus it follows partial rupture from accident, and is the means by which an artery is permanently occluded after the application of a ligature. In these instances it is clearly conservative. Acute destructive local arteritis arises by extension of unhealthy inflammation from surrounding tissues. It is most common where the products of exudation are pent up under high pressure, or are allowed to decompose in an open wound. The end of an artery in an amputation stump may be attacked, and then the danger of secondary hæmorrhage becomes imminent. Again, a deeply-seated abscess in the neck or groin may eat its way into a large vessel, and cause serious, nay, even fatal, bleeding. The vasa vasorum of the outer coat dilate, and leucocytes infiltrate its substance. The fibrous tissue softens, swells up, and finally liquefies. Meanwhile the inner coat is involved; fibrin is deposited in the interlaminar spaces and on the free surface; and the endothelial lining is shed. Arteries below the size of the radial do not often rupture, for thrombosis precedes the destruction of the intima; but in larger vessels the blood-stream is strong enough to prevent coagulation in the continuity or to plough up a disintegrating clot in the ligatured end. The splenic, or other artery adjacent to the stomach, may be opened by an ulcer spreading from that organ.

In infective or ulcerative endocarditis, the inner coat of the aorta is sometimes eroded, partly from the friction of a retroverted calcified valve, partly from extension of the inflammation. In the same disease vegetations are not infrequently detached from the valves, and being arrested in the peripheral arteries, they excite acute inflammatory softening, with aneurism or, more rarely, rupture, as a sequel. This is known as *embolic arteritis.* Simple non-infective embolism causes only thrombosis and obliterative endarteritis.

Acute Endarteritis.—This affection selects chiefly the aorta and large trunk arteries. Syphilis has been observed in connection with it, but whether as a cause or coincidence is uncertain. On laying open the artery, small roundish, soft elevations are seen, most of which vary in surface area from the size of a small pea to three or four times that magnitude. They are semi-translucent. In tint they are greyish-pink, or faintly yellow from incipient fatty degeneration; but even then they offer a striking contrast to the dead-white and buff-coloured patches of atheroma. The appearance, which is strongly suggestive of an eruptive disease, is as if gelatine had been sprinkled over the inner coat. Calcification rarely occurs. In the earlier stages the middle and outer coats present nothing abnormal, but later on they are somewhat swollen, especially the outer, for the vasa vasorum are dilated, and the outer coat is more permeable to fluid exudations than is the middle. Under the microscope the diseased structure is found to be thickly set with small round nucleated cells, which lie parallel to the lamellæ. These cells are apparently derived from segmentation of the subendothelial corpuscles, but possibly some are white blood-corpuscles, which have migrated from the lumen of the affected artery.

(B) *Chronic Arteritis.*—Two varieties will be described under this head. (*a*) Chronic deforming. (*b*) Syphilitic.

Chronic endarteritis (arteritis deformans —atheroma) is a disease incidental to age, being seldom entirely absent after middle life. At the same time there is ample proof that the essential morbid change is inflammatory in nature, and further that it is largely dependent on mechanical strain. The evidence on the latter point, both positive and negative, is very conclusive. In the first place, as shown by Moxon, the large arteries are those usually affected; and when the medium-sized ones are involved, the splenic, coronary, and cerebral, which, from their anatomical disposition, are subject to continuous or repeated strain,

are most likely to suffer. Again, the resistance to the local circulation offered by contracted granular kidney induces atheroma of the renal artery. Granular gouty kidney is known to be associated with thickening of the walls of the capillaries and smaller systematic arteries—*arterio-capillary fibrosis*, as it is designated by Gull and Sutton. The adventitia of these arteries is overrun with a hyalin-fibroid material, the tunica muscularis is hypertrophied, and the lumen encroached upon. The obstruction thus engendered gives rise to hypertrophy of the left ventricle, and raises the tension in the larger arteries. Chronic endarteritis is a constant sequel, and apoplexy from rupture of cerebral vessels a frequent termination. This form of vascular disease is more common in men than in women, and among the latter those accustomed to hard manual labour show it most.

Where large arteries pass beneath tendinous expansions or over bones—e.g. the femoral as it goes through the opening in the adductor magnus, and the iliac as it quits the pelvis—there chronic inflammation of the inner coat is wont to develop. Although the morbid process is common enough in the systemic arteries, it is almost unknown in the pulmonary, except where the right side of the heart is hypertrophied from bronchitis and emphysema, or stenosis of the mitral orifice.

Morbid Anatomy.—Chronic endarteritis commences in the deeper portion of the internal coat. The increased bulk causes the intima to rise in the lumen of the artery, so that the general uniformity of surface is broken by irregular elevations which, for the most part, lie with their long axes in the course of the vessel. The direction of the patches is determined by the line of greatest strain. In the aorta it is very manifest, especially when contiguous patches have coalesced. The branches, where they come off from the main trunk, are very liable to invasion, and, by the lateral extension and fusion of isolated patches, ring-like elevations may come to encircle them. In the event of the new tissue undergoing cicatricial contraction, the vessel is constricted—it may be, to obliteration of its lumen.

The elevations before referred to, are, in the first instance, pale yellow and but slightly raised. In the course of growth they assume a grey semi-translucent appearance, and frequently reach a tenth of an inch in thickness. To the feel they are inelastic, quite firm, or even of cartilaginous density. As yet they are smooth on the surface, the endothelial covering being retained. Sooner or later the patches turn yellow in the centre, owing to fatty degeneration of the inflammatory deposit, for there is no formation of blood-vessels in the new tissue. At the same time their consistence is diminished—it may be, even to fluidity. The cavity holding the softened débris is called an '*atheromatous abscess*'; the term, however, is a misnomer, for under the microscope the contents are found to be composed of fat molecules and their derivatives, cholesterine and stearic acid, the former appearing in the form of plates, the latter as acicular crystals. On rupture of the pellicle bounding the 'abscess' on its inner surface, the contents are washed out by the blood-stream and carried into the general circulation, but as the particles are very minute and non-infective, they do not usually give rise to symptoms.

The excavation thus made in the wall of the artery is termed an '*atheromatous ulcer*,' a name not warranted by the nature of the proximate lesion, which is degenerative, not suppurative. There is now opened up the possibility of formation of a dissecting aneurism, but such an event is rare, for the antecedent inflammation has served to weld together the middle and outer coats and the several lamellæ of each. Except in cases where the adventitia is little developed, as in the arteries of the brain, and the intra-pericardial portion of the aorta, rupture is not to be anticipated, for the neoplasia in the outer coat is not subject to fatty softening; moreover, as the perivascular tissue is condensed, and adherent to the wall of the artery, an additional safeguard is furnished.

But the formation of an 'atheromatous abscess' is not a necessary sequel to fatty disintegration of the inflammatory overgrowth. The products of degeneration may remain as a cheesy pulp—hence the name *atheroma*, which is commonly used, however, to indicate the entire disease—or be converted into calcareous plates by the deposition of lime-salts, a process sometimes referred to as '*ossification*,' although there is no production of true bone.

The morbid change which begins in the inner coat implicates, sooner or later, the middle and outer; elasticity and contractility are lost, and the vessel is converted into a thickened, rigid tube. Atheromatous arteries are generally dilated and elongated, for, having lost their power of recoil, they yield before the distensile force of the heart. By reason of their elongation they are thrown into per-

manent curves, a fact that should be borne in mind during the operation of ligature, especially of the external iliac, which often dips into the pelvis. The rigidity and curvature explain the 'locomotive pulse.' The above-mentioned alterations in structure and appearance are aptly expressed by the term 'endarteritis deformans.' Atheromatous softening and calcification of the inflammatory deposit are inversely proportionate to the smallness of the vessel. In the arteries of the brain, for example, although the muscular coat is frequently calcified, and the outer greatly thickened by fibroid overgrowth, caseation of the intima is much less marked than in the aorta and other large arteries, where rapid breaking down and cretification of the new formation are constant.

Microscopy of Chronic Endarteritis.—The deeper part of the internal coat is infiltrated with rows of small round cells lying parallel to the lamellæ. The lamellæ themselves swell up and become indistinct, whilst they are evidently thickened by fresh fibrinous deposit. As the disease advances, the muscular layer is involved and its contractile cells are destroyed. Neither does the adventitia escape, but the process here is mainly or entirely plastic. The proportion of cellular and homogeneous deposit varies considerably, but the latter is generally in excess. As the new growth loses its vitality it disintegrates through fatty degeneration. The cells become granular and break up into molecular débris, which then calcifies or undergoes complete liquefaction. In the latter event cholesterine forms and crystallises out as thin plates. If a calcified patch be treated with dilute hydrochloric acid, and the residue examined under the microscope, it will be seen to consist of amorphous granules and fragments of glassy or faintly fibrillated tissue.

Results of Chronic Endarteritis.—(1) Thrombosis and embolism. (2) Narrowing and occlusion of branches. (3) Aneurism.

(1) *Thrombosis and Embolism.*—Thrombosis is apt to occur about calcified plates, which, having broken away at their edges, act as foreign bodies, and offer resistance to the flow of blood (*see* Thrombosis). Embolism may have its origin in the detachment of calcareous splinters, or of thrombi formed in the artery. Gangrene at the part supplied by the embolised or thrombosed vessel is to be feared.

(2) *Narrowing and occlusion of branches.*—One or more of three factors is concerned. (*a*) Encroachment on the lumen of the swollen intima. (*b*) Contraction of plastic lymph in the adventitia. (*c*) Pressure of an aneurism of the parent vessel. Obliteration is completed by thrombosis.

(3) *Aneurism.*—Chronic endarteritis is a fertile source of aneurism. Although the walls of an artery may be greatly thickened, their power of resistance is diminished, from loss of elasticity. Rupture of an 'atheromatous abscess' does not materially weaken the artery at that point, but it allows the full force of the blood-stream to act over a wider area of softened tissue. *See* Aneurism.

Syphilitic Arteritis.—How far syphilis is directly accountable for disease of the large arteries is a debated point. Aitken believes that it is a common cause of chronic arteritis, and certainly the fact that most of the cases of pathological aneurism in young subjects have a history of syphilitic taint lends weight to this opinion. It cannot be doubted that the virus of syphilis lowers the vitality of the coats of the arteries, as it does that of other tissues, and in this way it may lead to premature decay, and so predispose to inflammatory lesion. Syphilitic disease of the cerebral arteries is a not infrequent cause of thrombosis. It occurs in the shape of gummatous deposit in the outer coat and perivascular sheath; and as a proliferating change in the intima (Heubner), one or other form predominating. Arteries so affected look like dull-white threads or cords, and on examination are found to be much more solid than natural. It is easy to see how the swelling within the vessel, and the pressure without, must narrow the lumen, and obstruct the blood-current.

Barlow has described profound changes in the cerebral arteries of children suffering from congenital syphilis, of the same kind as those recorded by Heubner in the acquired disease. The new growth in the inner coat of the artery is made up of large nucleated cells. All the coats are involved, but the principal change takes place in the intima.

Periarteritis, or inflammation of the outer coat and areolar sheath, occurs under the following forms:—(1) Gummatous exudation into the lymphatic sheaths of the cerebral arteries. (2) Ulceration of a branch of the pulmonary artery skirting a phthisical cavity. (3) Arteritis by spreading of the inflammation from surrounding tissues, as when an artery becomes involved in periphlebitis, or in deep-seated suppuration.

Periarteritis may end in resolution, without local consequences; but there is danger

of thrombosis, aneurismal dilatation, and rupture.

II. Degeneration.—(*a*) Fatty degeneration has already been mentioned in connection with atheroma, where it constitutes an essential part of the morbid process, giving rise to softening and disintegration of the new formation. In this case it is secondary to inflammation. But it occurs widely distributed as a primary change. Thus, in the large arteries, especially the aorta, it affects the stellate subendothelial corpuscles of the intima. It here appears as bright yellow spots or streaks, slightly raised above the surface, and smooth or finely downy. The deeper structures remain intact. It is found at all ages, even in very young children. It is of no clinical significance.

Of far graver import is the fatty degeneration so constantly met with in the cerebral vessels late in life. The adventitia receives the brunt of the mischief, but fat-molecules may be observed scattered through all the coats. As the result of softening, the small arteries burst under the blood-pressure.

In disused or paralysed limbs, the arteries show fatty degeneration of the contractile fibre-cells of the middle coat, and of the connective-tissue corpuscles of the inner and outer.

(*b*) *Calcification* is an important feature in chronic endarteritis, where, as before said, calcareous plates are the abiding mark of previous inflammation and softening. Primary calcification is very common in the medium-sized arteries—e.g. the cerebrals and tibials—of old people, or in those where the middle coat is well developed. Lime-salts are deposited first in the muscular fibre-cells; and, as these lie athwart the vessel, there results a series of streaks or rings which encircle it—*annular calcification*. By lateral extension these rings join and form a rigid cylinder—*tubular calcification*. The process is not confined to the middle coat, for it extends to the others, causing great irregularity and roughness.

The lumen of the artery is diminished. There is a great tendency to bilateral symmetry. The affected vessels, where superficial, can be felt as incompressible cords.

(*c*) *Amyloid degeneration* of the small arteries can be seen in tissues and organs affected with albuminoid disease. It conduces to hæmorrhage, and thus becomes of surgical interest.

III. Atrophy of Arteries forms a part of general and local wasting. According to Virchow, all the vessels are atrophied in chlorosis. If the femoral artery be ligatured for popliteal aneurism, the portion between the ligature and the aneurism, although not obliterated, shrinks to less than half its normal dimensions. The lumen is narrowed, and the coats are reduced in thickness.

IV. Hypertrophy of Arteries.—True hypertrophy occurs in the collateral branches after ligature of the main trunk. The walls are thinner than natural, owing to the dilatation consequent on the rise in the blood-pressure, but still the bulk is increased.

The small arteries are hypertrophied in granular kidney.

V. Raynaud's Disease.—Local asphyxia or symmetrical gangrene, are names given to phenomena which arise out of disturbance of the nervo-muscular dynamism of the small and medium-sized arteries. The subjects of this disturbance are not uncommonly young children, hence the expression *gangrène juvenile*, to indicate one of the pathological accidents of the disease. The fingers, toes, nose, and ears are the parts mostly implicated. The skin is cold, and sometimes cyanosed—*local asphyxia*. At others it is pale and marble-like—*local syncope*. The arteries are not diseased, but together with the capillaries and small veins they are subject to severe and prolonged spasm. The difficulty of the circulation may be so great as to cause gangrene.

As concomitants we may mention the occasional occurrence of erythematous eruption on the skin on different parts of the body, and renal hæmorrhage. The excitability of the vaso-motor centres in the spinal cord is exaggerated, and the irritability of the sensory nerves is increased.

VI. Arterial Embolism has been noticed under 'embolic arteritis' and 'atheroma.' The following are its sources:—

(1) Vegetations, simple or infective, detached from the cardiac valves. (2) Blood-clot dislodged from an aneurismal sac, or from an atheromatous artery. (3) Calcareous plates from the large arteries. (4) Portions of a new growth which has invaded an artery. (5) Venous thrombi in the case of the pulmonary artery.

The results are according to the size and nature of the embolus and the state of the collateral vessels; thus embolism of the pulmonary artery may be suddenly fatal; embolism of the tibials may lead to secondary thrombosis and gangrene; infective embolism may give rise to aneurism, or, less probably, rupture.

VII. Arterial Thrombosis.—The blood may coagulate in the arteries from (1) Laceration of the coats, as in ligature.

(2) Embolic plugging (*see supra*). (3) Continued spastic contraction (see *Raynaud's disease*, above). (4) Hyperinosis, coupled with cardiac failure, as in the case of an acute fever. (5) Disease of the vessel, e.g. syphilitic arteritis and atheroma. Diffuse thrombosis of the tibial arteries is one cause of senile gangrene. Diffuse thrombosis of a large artery—e.g. the femoral—is usually followed by a similar process in the companion vein; gangrene is then inevitable.

VIII. Tumours.—Tubercle is never seen in the walls of arteries, although the perivascular tissue is one of its favourite sites. Malignant tumours occasionally invade an artery, and project into the lumen; but it is surprising how long this is resisted. Syphilitic gummata are found in connection with the cerebral arteries, but strictly speaking they are not new growths.

Augustus J. Pepper.

ARTERIES, Rupture of.—An artery may be ruptured partially or entirely; and either subcutaneously or in an open wound.

Partial Rupture.—In this injury it is the internal, or rather the internal and middle coats that give way.

Instances of partial rupture are met with—(1) In the operation of ligation of an artery. (2) From sudden strain, e.g. during an attempt at reduction of an old dislocation, especially of the shoulder-joint. (3) In crushing of a limb, the vessel being ground against the underlying bone. (4) From the application of violent external constriction combined with traction, as in judicial hanging.

The disposition of the inner and middle coats at the seat of laceration will vary according to the presence or absence of disease of the vessel, and the mode of injury. In simple ligature of a healthy artery the coats are as cleanly divided as though they had been cut with a knife, both in the living and dead subject. At the same time there is very little gaping, and no curling up within the lumen of the vessel, since the tendency of the inner to recoil with the middle coat is insufficient to tear it from its connection with the outer. But when the force employed crushes or twists the artery, the inner coat is raised from its bed, and by virtue of its elasticity it retracts and become rolled upon itself, at the same time that it is drawn inwards by the circular fibres of the muscular coat. Thus a flap-like valve is formed, which arrests or obstructs the current of blood, exactly as happens in torsion.

In chronic disease of an artery the inner coat loses its elasticity, and the middle its contractility, through fatty and calcareous degeneration, whilst all three coats are frequently so blended by fibroid overgrowth as to be practically inseparable. On the other hand the injury may light upon a patch of softening, and tearing through its inner wall lay the foundation of dissecting or other form of aneurism.

The results of Partial Rupture are (1) thrombosis; (2) gangrene; (3) aneurismal dilatation; (4) subsequent complete rupture. Partial rupture, *per se*, usually ends in thrombosis and permanent occlusion, as in ligation; but, as stated above, gangrene may ensue from the combined effects of obstruction in the main artery and the pressure of blood extravasated from a number of smaller vessels. Wide-spread arterial disease conduces to a like result, the rigid anastomosing arteries not dilating in time for the collateral circulation to be established.

Diagnosis of Partial Rupture, when the vessel is comparatively superficial, as it commonly is:—(1) Look for arrested or diminished pulsation in the arteries on the distal side of the seat of injury; (2) examine for a small, more or less firm, circumscribed swelling below where the artery continues to beat; (3) ascertain if the difficulty in the circulation is greater than can be accounted for by the extravasation of blood from small vessels in the muscles and cellular planes of the limb.

Treatment.—Wrap the limb in cotton wool, place it upon a pillow, between sandbags, in a semiflexed and slightly elevated position. Bandages had better be dispensed with, on account of the danger of still further embarrassing the circulation. If gangrene supervenes amputation must be resorted to. If the rupture becomes complete later on, the treatment will be as hereafter advised.

Complete Rupture may occur by avulsion of a limb. The bleeding under these circumstances is less than might be expected, for the internal and middle coats are torn from the outer, and contracting and retracting curl up within the vessel; and the outer coat and the sheath of the artery are folded or twisted over them. Hæmostasis is furthered and may be completed by the formation of a clot. The rupture is termed complete, when the wall of the artery is torn through in one part or throughout its whole circumference. In either case it may take place subcutaneously, or accompany a lacerated wound of the soft parts. It may be complicated, amongst other accidents, by simple or compound fracture.

Subcutaneous Rupture without fracture.—The arteries most commonly injured are the popliteal and the axillary; the former from a violent wrench of the leg, the latter during the attempt to reduce an old luxation of the shoulder-joint. The disaster is immediately followed by severe pain in the part, and this by numbness of the limb, which as a rule the patient is unable to use to any extent. The latter symptom, however, is not constant, either as regards its onset or degree. Pulsation ceases or is much weakened in the arteries beyond, the exact issue turning upon the amount of extravasation, and whether the rupture has involved the entire vessel or only a segment of it. The limb is colder than its fellow, the temperature rapidly falling. Blood escapes from the rent and collects around the artery, forming a tense swelling, or it is driven far and wide among the surrounding tissues; the result varying according to the size of the vessel, the size of the opening in it, and the resistance offered by adjacent structures. Pulsation is mostly absent, and when present it is generally over a limited area. Possibly a loud or subdued bruit may be heard, but it is not conducted along the course of the artery with the same frequency and distinctness as when generated in a pathological aneurism.

Treatment.—The surgeon will be partly guided by the condition of the limb as to the amount of bruising and extravasation. If gangrene has set in, amputation must be performed at once. The liability to gangrene is more remote in the upper than in the lower extremity, and the possession of the arm more essential to the patient than the leg; hence, every attempt should be made to save it. If in rupture of the brachial, radial, or ulnar artery, the extravasation has ceased and is not very extensive, compression should be applied at the seat of injury and over the main vessel higher up.

Under opposite conditions, and also in cases where the diagnosis is doubtful, it will be safer to cut down, turn out the clot, and ligature the artery on each side of the opening in it. The limb should be raised to empty the vessels, and then Esmarch's cord be applied. If difficulty is experienced in finding the ends of the vessel, the tourniquet should be loosened, to allow a jet of blood to escape; or a little dissection made in the course of the artery.

Rupture of the main artery in the lower limb generally calls for primary amputation, but if gangrene has not commenced, and the soft parts are not too extensively damaged, double ligature should be resorted to in the first instance, especially when the patient is young and the vessels presumably free from disease. Augustus J. Pepper.

ARTERIES, Wounds of.—When hæmorrhage is severe, it is generally found that its source is a wounded artery. A vessel may be completely or only partially divided. In the latter case the damage may consist in the artery being split, or in a transverse cut involving a part only of its circumference. Notwithstanding the comparative rareness of these partial divisions, they are of extreme interest to the surgeon, as furnishing a considerable contingent of cases of persistent recurrent bleeding. The explanation as to why the hæmorrhage is so persistent in such cases is to be sought in the anatomical structure of an artery, and by consideration of the process by which nature arrests the hæmorrhage of a completely divided vessel; for if it be remembered how important the contraction and retraction of the vessel are in arresting the hæmorrhage in such a case, it will be seen that the same mechanism causes the opening to gape and remain patent when the vessel is only partly divided. If it be known that a vessel is only partly divided, its division should be made complete, and its ends ligatured.

The details of the treatment of wounded arteries are described under the headings of the special vessels; but, before considering these, it may be well to discuss briefly the general principles on which the treatment of arterial hæmorrhage is conducted, the treatment, in great measure, depending on whether the hæmorrhage occurs from an incised or a punctured wound.

Treatment of Arterial Bleeding in Incised Wounds.—Bleeding vessels should always, if possible, be secured *in situ*. As a rule there is little difficulty in picking up the bleeding artery. Occasionally, however, owing to the bleeding artery lying deeply in the angle or apex of the wound, it cannot be readily secured with the forceps, or it sometimes happens that, owing to the vessel having retracted, the bleeding point itself cannot be seen. In these circumstances a little careful enlargement of the wound, in the direction of the bleeding, will enable the vessel to be secured. Occasionally, especially in wounds of the scalp, it is a better practice to treat the retracting vessel by pressure, or by a harelip pin passed beneath it, than to make anything like a cross-cut to search for it.

A few years back several methods were advocated for securing divided arteries: thus, in preference to the ligature, some surgeons advocated various forms of acupressure or torsion. The advantage of these consisted in avoiding the septic track caused by the ligatures, the ends of which were always allowed to hang out of the wound. Since the introduction of the catgut ligature, which, after the ends are cut off, is left in the wound, such objections have entirely disappeared, and ligatures either of gut, tendon, or Chinese silk, are almost universally employed, and are, by far, the simplest and surest agents for closing the vessels. In some rare cases in which a diseased vessel will not hold a ligature, acupressure may still be usefully employed.

The surgeon, on being sent for to a case of hæmorrhage from an incised wound, will generally find the part wrapped round with handkerchiefs or towels partially soaked with blood. Before removing these, which may have served temporarily to restrain the bleeding, the patient should be gently lifted on to the edge of a bed or couch in a good light. This matter of light is of the utmost importance, making all the difference between success and failure in picking up the vessels. Should the wound be on one of the limbs, a tourniquet, or the finger of an assistant, must be placed in readiness over the main vessel—the femoral or subclavian as the case may be—but pressure is not exercised until required. A basin, a sponge, and cold water being placed handy, all wrappings are rapidly removed from the wound. All clot must be cleanly sponged out, and any vessels that can be seen to be divided, whether bleeding or not, should be tied. If alarming bleeding well up from a main vessel at the bottom of the wound, the finger must be placed over the bleeding point, when a little dissection, with the back of a knife or director, will bring the vessel into view above and below the bleeding point, and two ligatures can be applied with an aneurism-needle. When the bleeding has been arrested, the edges may be brought together in the usual manner.

Treatment of Arterial Bleeding from Punctured Wounds.—Straightforward and easy as may be the treatment of hæmorrhage from incised wounds, the course to be adopted for the arrest of arterial bleeding from punctured wounds forms a grave and complicated question.

The writer believes that the arbitrary rule, that 'in every instance the wound should at all hazards be laid open, and the vessel secured at the bleeding point,' is far too dogmatic, and has led to severe and even fatal operations, many of which were wholly unnecessary.

Without doubt the general acceptance of the principle of searching for the wounded artery has been due to the writings of Guthrie, who in forcible language taught it, to the exclusion of all other forms of treatment. His teaching quickly permeated medical literature, and it soon came to be considered that the surgeon who failed thus promptly 'to look his enemy in the face,' showed timidity, or a want of knowledge in the first principles of his profession.

Surgeons who have performed or witnessed the operation necessary for the securing of the tibial, deeply situated in a punctured wound, will know that Guthrie's description of the ease and certainty of this operation is not merely inaccurate, but misleading, as entirely opposed to the actual facts. Thus Arnott, in his well-known case of ligature of the tibial in a punctured wound, says: 'It is not an operation that should be undertaken inconsiderately, for it requires a good light and intelligent assistance. The case described occurred in the day-time, and from what was experienced I am inclined to think that it could not have been successfully performed under artificial light.'

So eminent a surgeon as Dupuytren readily recognised that the search for wounded vessels deeply situated in a muscular calf was a procedure surrounded by practical difficulties, for, says that author, 'to all who know the depth of these vessels, their relations to the bones, nerves, and muscles, the scheme of cutting down upon the vessels appears impracticable. How could they be distinguished from the soft torn bruised parts which surround them, or how could a ligature be passed and tied at the bottom of a wound deep between the bones?'

It is often argued that, because the treatment of hæmorrhage from an incised wound is so easy, and that from a punctured one so complicated, by converting the one into the other all difficulties will disappear. The fallacy of the assumption that in all cases the characteristics of an incised wound can be given to a punctured one by its mere enlargement, becomes obvious on reflection.

Punctured wounds must of necessity be inflicted by small missiles or narrow instruments, which can penetrate to positions inaccessible by a simple incision. Their direction and depth are often quite unknown, consequently the position and size

of the bleeding vessel is a matter of mere speculation. The bleeding point may be, and often is, far away from the external wound, possibly on the opposite side of the limb, so that a very deep and extensive incision has to be inflicted to secure what may ultimately prove to be an unimportant arterial twig. If, of course, it could be shown that by enlarging the wound the vessel could be secured with little difficulty or risk, while on the other hand, similar forms of treatment commonly resulted in failure, the cutting down doctrine might be accepted in its entirety. Experience, however, leads to an opposite conclusion, and shows that not only the search for the wounded vessel at times proves ineffectual, but that all bleeding might have been permanently arrested without the necessity of any operation.

Guthrie's rule for the treatment of arterial hæmorrhage has purposely been criticised, but it must not be inferred that this plan is never applicable. A wound may be so situated, or the limb in such a condition, that it becomes the safest and most practicable method; but it is specially urged in this article, that the surgeon will best consult the interest of his patient who remembers that the procedure is not to be regarded as a trifling one. For however simple and easy it may be at times, it at others involves a hazardous operation, not to be undertaken without a full conviction of its necessity.

If the surgeon requires any rule, it should rather be that in punctured wounds, unless the exact source of the bleeding is obvious, the careful and even application of pressure should be first tried, reserving active operative interference until so simple a procedure as pressure has proved ineffectual. The surgeon must not allow his judgment to be warped by fear of the failure of the pressure which he employs, and the possibility that he may have to fall back too late on the cutting plan; but he must consider what on the whole is the simplest treatment, and that which is most likely to be successful with the least risk to his patient. The details of treatment will vary according to the locality of the particular artery injured, and are fully considered under the headings of the various vessels. But it may be well before discussing these to consider the general plan of treatment.

Treatment.—The surgeon is hurriedly sent for to a patient who is said to be bleeding to death from a punctured wound. On arrival it will generally be found that natural alarm at the sight of blood has led to the extent of the bleeding being greatly exaggerated, 'the torrents of blood' often meaning but a few ounces. The state of the patient's pulse and his general appearance will usually afford a safe basis for the estimate of the extent of the bleeding; moreover, the effect produced upon the patient is more important than the actual quantity of blood lost. If the collapse be not severe the patient should be at once lifted upon a convenient couch or bed. This should be done with the greatest care and gentleness, the patient being kept in the recumbent position, and on no account allowed to make the least muscular exertion. Bearing in mind what has been stated elsewhere as to nature's process of stopping hæmorrhage, it will be understood that it is of the utmost importance to prevent the blood-coagulum, which has very probably temporarily formed during the period of collapse, from being again broken up by the force of the heart's action—a risk incurred by any exertion on the part of the patient. *See* Hæmorrhage.

The cloths and bandages generally found wrapped round the wound must be removed in a good light. The next steps to be taken will depend on whether the bleeding has ceased or is still continuing.

Treatment when the Bleeding has ceased.—The parts in the neighbourhood of the wound can be gently cleansed of blood with a soft sponge and warm water. But the clot itself seen in the wound should on no account be disturbed, the orifice being simply covered with a couple of folds of lint wetted in cold water or carbolic lotion. The patient should be lightly covered with blankets, in such a way that the wound covered by the lint is exposed, so that any recurrence of bleeding can be at once detected. It is better in these cases, where the bleeding has actually ceased, to apply no pressure, either directly on the wound or indirectly on the course of the vessels, for fear of disturbing the arresting clot.

The clothes if dry may be simply loosened; otherwise they must be cut off, clumsy attempts to remove them being often followed by a fresh bleeding. There is no period when the most absolute rest is so necessary as in the first few hours after a severe bleeding which has spontaneously ceased, for the coagulum that has formed during the collapse is constantly growing stronger by extension within the vessel, and, if time be allowed, will form an effectual barrier before reaction occurs. This rest, so imperative at first, must be en-

forced, though not perhaps quite so rigidly, for several days, and the patient should, on no account, be allowed to leave his bed till the external wound is soundly healed. Want of precaution in this respect is a common cause of traumatic aneurism, unnecessary intra-arterial pressure being put on the sealed end of the vessel before it is sufficiently consolidated to stand it.

Treatment when the Bleeding is continuing.—If the wound be situated in one of the limbs the bleeding must be at once controlled by pressure, either digitally or by the tourniquet on the main artery. In the upper extremity the brachial can be compressed against the middle of the humerus, if the wound be in the forearm or hand. If the bleeding come from a higher point, the subclavian must be compressed. In compressing the subclavian the finger or thumb cannot be relied on except for a short time, a piece of wood or a small poker, covered with lint, being far more effectual.

The femoral artery is best controlled as it crosses immediately beneath Poupart's ligament, its course in this situation lying midway between the symphysis and the anterior superior spine. The mistake very commonly made is that of applying pressure an inch or two below the ligament, a position in which much more force is required to control the vessel than need be applied at a higher point.

The bleeding having been thus temporarily controlled, time is gained for considering the best course to be pursued for its permanent arrest. If the wound is known not to be deep, from the nature of the instrument inflicting it, and moreover, if it is situated over the main vessel of a limb where that vessel is naturally superficial, as in Scarpa's triangle, or along the course of the brachial, or in a position such as in the middle of the neck, where effectual pressure is impracticable, the wound may be enlarged, and the vessel sought for at the injured point.

On the other hand, if the wound be of unknown depth, and in a position in which the main vessels are deeply situated, as in the lower half of the thigh, the calf, the forearm, and the hand, pressure should certainly be tried before resorting to an operation.

Method of employing Pressure.—In order that pressure may be successful in permanently restraining the bleeding it is well to bear in mind the following points:—

1. That blood may be furnished at either end of the divided artery.

2. That pressure is not only required over the wound, but along the course of the artery, both above and below it.

3. The pressure must never be entirely concentrated at a single point, but disseminated along the course of the vessels, for, by distributing the pressure, much less is required to arrest the bleeding than if it be applied on the wound alone.

4. That the whole quantity of blood circulating in the limb can be lessened by careful bandaging from below upwards.

The methods of applying pressure require modification in particular situations, and will be found under the headings of the different vessels. But the following is the general principle.

The bleeding being temporarily arrested by the tourniquet, the wound must be gently washed and sponged as dry as possible. A conical pad, made of from sixty to eighty separate pieces of lint, the smallest the size of a sixpenny bit, the largest an inch and a half in diameter, is applied directly over the wound, and kept in position by two narrow pieces of X strapping. The limb is then very evenly bandaged with a domette roller from the toes or fingers upwards as high as the conical pad. The pad being left uncovered, the bandage is continued upwards to the shoulder or groin, ending off with a spica. Two compresses, prepared by winding strips of lint round a firm foundation, such as the half of a pencil or penholder, are now laid along the course of the main vessel, both above and below the wounded point. These roller-like compresses must be firmly applied and kept in position by separate bandages. Lastly, another narrow bandage is wound round the limb over the conical pad, to exert pressure upon it.

It is a good plan in some situations to have a broad, well-padded splint on the side of the limb opposite to the rollers and pad, so that the bandages which keep them in position do not exert a circular pressure entirely round the limb.

There is great advantage in having the rollers and pad kept in place by three distinct bandages. By this arrangement any one of them may be loosened or tightened, as the case requires, without disturbing the others, which is a matter of considerable importance. The next question which arises is as to the length of time the pressure should be employed.

So long as the circulation has been fairly carried on in the limb—a point easily ascertained by momentarily compressing the capillaries of the toes or fingers—pressure

can be maintained without risk of gangrene. It is very desirable to keep up a moderate amount of compression for a considerable period—an object to be attained by taking great care that it be not too much concentrated at any single point, for, if a bandage be too tight at any spot, not only will it cause pain and restlessness, but it is liable to produce sloughing of the skin. If possible, the firm pressure first applied should be maintained for eight or twelve hours. If pain or discomfort be then complained of, a judicious snip of the bandage here and there at any points which appear to be too tight will give relief. In this way a diminishing amount of pressure can be maintained for several days. Speaking generally, in primary hæmorrhage, if the bleeding has been arrested for twelve hours, the clot within the vessel will have acquired sufficient consistency to prevent its recurrence. During the treatment absolute rest in bed is essential, and the limb should be raised on pillows to a comfortable height.

Occasionally, notwithstanding every precaution and care in the trial of pressure, hæmorrhage will recur. In these circumstances it is possibly due to the premature slipping of one of the pads or bandages, so that it would be right to give it one more trial before abandoning it as useless. Should this second attempt fail, or the limb be in such a condition as to forbid a second trial, the wound should be enlarged and the bleeding-point sought for, with the exception of wounds in a few localities to be described.

Search for the Wounded Vessel.—The patient, under an anæsthetic, being placed in a good light—a matter of the utmost importance—the surgeon passes his left forefinger into the wound, and, if necessary, enlarges the orifice with a probe-pointed knife sufficiently for the purpose. By a little manipulation it can be ascertained when the point of the finger controls the hæmorrhage. A straight probe-pointed knife is then passed down by the side of the finger, and the wound boldly enlarged to a sufficient extent both upwards and downwards. The length of the incision thus made will depend on the depth of the wounded artery, and may have to be six or seven inches in length. The cut must always be made in the line of the limb, a transverse or T cut being, if possible, avoided. Cross-cuts seriously interfere with the vitality of the margins of the wound, and, if extensive, may even imperil the limb itself, from the severance of the collateral circulation.

Harrison Cripps.

ARTERIOTOMY.—The operation, now rarely performed, of opening an artery for the purpose of general blood-letting. The trunk of the temporal artery as it crosses the zygoma, or its anterior branch as it passes on to the forehead, are ordinarily the only vessels suitable. In consequence of the extreme ease with which pressure can be applied over it, the anterior branch should be selected, unless it is abnormally small.

Apparatus required.—Lancet or small scalpel, graduated bleeding-bowl, firm compress of lint, narrow bandage, water and sponge.

Operation.—The vessel having been fixed by placing the finger or thumb on it a little to the distal side of the spot selected for the incision, should be cut down upon and laid open transversely until it has been about half-divided; the necessary amount of blood having been taken, as shown by the graduations on the bleeding-basin, the artery should be completely cut across, the compress applied and retained in position by the bandage. At the end of forty-eight hours strapping may be substituted for the bandage, but the compress itself must not be disturbed till the fourth or fifth day, when the wound should be healed. The complete division of the vessel before the application of the pad is important, in order to more certainly avoid (1) secondary hæmorrhage, and (2) consecutive aneurism. William H. Bennett.

ARTERIO-VENOUS ANEURISM. Under this term are included all cases of abnormal communication between an artery and a vein.

1. *Causes.*—Arterio-venous aneurism is generally traumatic in origin, and the most frequent cause has been phlebotomy; next in order of frequency is gunshot injury, and then stabs and similar punctured wounds. In one case prolonged compression of the femoral artery for the cure of an aneurism on the posterior tibial trunk was followed, ten months later, by an arterio-venous aneurism at the point of compression. In other cases, also, the aneurism has only developed at a long interval after an injury—even as much as twelve or even thirty years. There is another group of cases in which the abnormal communication has occurred spontaneously without any previous injury; many of these are to be regarded as instances of the rupture of an aneurism into an adjacent vein. Since venæsection has become a comparatively rare operation, and always entrusted to skilled hands, this form of disease has

become much less common. It is met with in connection with small arteries and veins, such as the branches of the sciatic vessels in the great sciatic nerve; medium-sized vessels, such as the temporal, occipital, and posterior tibial; or large vessels, as the popliteal, femoral, iliac, brachial, carotid, and even the aorta itself.

2. *Pathology.*—The arterio-venous communication is generally between vessels lying closely side by side; but this is not always the case. At the elbow, for instance, the communication is commonly between the median-basilic vein and the brachial artery; in the neck, arterio-venous aneurism of the external carotid artery and the internal jugular vein has been observed. According to the character of the arterio-venous communication cases of this disease have been divided into two classes, and the division is of much practical importance. Where the two affected vessels are firmly adherent together, with a large or small aperture through the walls where they are in close contact, and the blood passes directly from the artery to the vein, the condition is known as *aneurismal varix*, for the aneurismal tumour which is produced is, in fact, a dilated vein. In many other cases, however, there is a consecutive or a spontaneous aneurism developed in connection with the artery, which also communicates with a vein, and the condition is then known as *varicose aneurism*, the important feature of the case being the existence of a veritable aneurism. In *aneurismal varix* the aperture of communication between the artery and vein may in recent cases be slit-like, but in old cases it becomes rounded, with smooth, thickened edges. The artery above and below the aperture is considerably dilated, and its walls are thinned.

In some cases these changes have been most marked above the communication, and the vessel below has been described as contracted, while other observers have described the arterial changes as most marked on the distal side of the aperture into the vein; these changes may be met with at a considerable distance from the original lesion. The vein becomes greatly distended and pouched immediately opposite the opening into the artery, and its walls become thickened; these changes affect the veins for some distance, especially on the cardiac side of the arterial aperture, and they are not limited to the trunk immediately affected, but involve also the branches opening into it. Thus, in an aneurismal varix of the femoral vessels at the groin, the superficial epigastric, circumflex iliac, and external pudic veins were enlarged, as well as the femoral and internal saphenous trunks. In *varicose aneurism* the condition of the affected arteries and veins is the same as in aneurismal varix. In addition there is an aneurism. Where the aneurism is 'consecutive' or traumatic in origin it is usually of small size. In the cases of spontaneous aneurism with communication with a vein the tumour has generally attained a large size before it has, by the influence of continuous pressure, caused absorption of the wall of the vein. The openings of the artery and the vein into the aneurism vary in size and in relative position, sometimes being on opposite sides of the sac and at others close together. The sac of the aneurism contains only a small amount of laminated fibrin, even if any be present.

3. *Symptoms and Diagnosis.* — The symptoms common to all cases of arterio-venous aneurism are (1) the presence of a tumour with expansile pulsation synchronous with the action of the heart; (2) distension of the veins of the part on both the distal and the proximal side of the swelling; (3) a very marked purring or rasping thrill, which is felt at its greatest intensity over the arterio-venous communication, but is conducted for some considerable distance along the veins of the part. This thrill is continuous over the 'aneurism,' but is exaggerated by each cardiac systole; in the veins at some distance from the tumour it may be intermittent and systolic only. (4) A loud buzzing, hissing, or rattling murmur, heard loudest over the aperture in the vein, where it is continuous, but accentuated at each beat of the heart; the bruit is conducted for some distance along the distended veins, gradually becoming weaker and systolic only. This murmur may be audible to the patient and even to the bystanders, and, heard through a stethoscope, it may be of painful intensity. In addition, there is sometimes a soft blowing aneurismal murmur. Pressure over the swelling, just where the thrill and bruit are most marked, may abolish the thrill, and greatly lessen or abolish altogether the loud bruit, and these effects are believed to be due to the pressure being applied so as to close the opening into the vein. There may be severe pain from pressure upon the nerves of the part, or œdema from obstruction to the venous circulation. The peculiar thrill and murmur are the features which enable the surgeon at once to recognise an abnormal communication between an artery and a vein, and they are due to the passage of blood from the artery into the vein. If

the aneurism be deep, and the aperture into the vein be small, these signs may be absent, and the diagnosis be rendered impossible; and one case has been reported in which, from the small size of the artery involved, pulsation was not detected in the tumour.

The diagnosis between an aneurismal varix and a varicose aneurism may be impossible where the disease affects a deep vessel and the aneurism is small. Aneurismal varix is less formidable than a varicose aneurism, and its symptoms and the disturbance of the circulation it entails are less severe: it may remain stationary for many years, causing little inconvenience to the patient except the consciousness of the murmur and of the thrill. Varicose aneurism runs a more rapid course. If, when the artery leading to the swelling be compressed so as to arrest all pulsation, the swelling collapses completely without the application of any or of but very gentle compression, the affection is a varix; but if, on the contrary, when pulsation is thus arrested, the veins collapse, but a distinct tumour remains, which can only be emptied by compression, it indicates that there is an aneurism. Similarly in the cases where light pressure upon a particular spot stops the thrill and murmur, if it be found that by this means the swelling collapses, it is a varix; while, if there is still a swelling with expansile pulsation, it shows the case to be an aneurism. Where, in addition to the loud murmur characteristic of an opening into a vein, a soft systolic blowing bruit can be detected, it is strong evidence of the presence of an aneurism. This bruit may be only audible when the flow of blood into the vein is arrested by pressure over the aperture of communication. In some cases there is the history of a simple aneurism and the subsequent development of the characteristic thrill and bruit; in other cases, again, there is a history of an aneurismal varix becoming suddenly larger, more painful, and causing serious interruption to the circulation of the limb, from the formation of an aneurism. It is impossible to distinguish between these two affections in the orbit.

4. *Treatment.—Aneurismal varix*, as a rule, requires only palliative measures. The distended veins have thickened walls, which resist the force of the blood flowing into them from the artery, and after a while the swelling ceases to grow, and the patient is not exposed to the danger of its rupture. In such cases, external support by a bandage, or an elastic webbing made to fit the part, fulfils the indications for treatment. Should the varix be painful, or in any other way disable the patient, means for its cure may be adopted. Of the plans of treatment which have been suggested the best is the ligature of the artery above and below the communication with the vein: this operation is attended with unusual difficulty owing to the dilatation of both the artery and the affected vein.

In *varicose aneurism*, the existence of the aneurismal sac, with all the perils associated with that condition under other circumstances, necessitates curative treatment; and whether causing severe symptoms or not, so soon as the diagnosis of aneurism has been arrived at, careful attempts at its cure must be made. Several methods are open to the surgeon. Where by compression at one spot the characteristic thrill and bruit are lost, digital or instrumental compression of the main artery above should be combined with it; this sometimes proves quickly successful. Where it fails, or cannot be carried out, and the aneurism is on a limb, the patient may be anæsthetised, and an elastic bandage applied to the limb below and above the tumour sufficiently firmly to arrest the circulation completely. By this means the aneurism and the connected vessels are filled with stagnant blood: this alone may secure clotting, as in simple aneurism, or an electric current may be passed through the blood by means of needles inserted into the aneurism, or coagulants, such as perchloride of iron, may be injected into the sac. Electrolysis may be applied without previously arresting the circulation, but coagulants must never be injected unless this precaution have been taken.

Should coagulation be obtained by either of these means, the clot should be protected from the full force of the circulation by digital or instrumental compression of the main artery for two days at the least. When these measures fail, or cannot be carried out, an incision should be made over the tumour, in the line of the artery, and that vessel ligatured above and below the sac—if possible, without opening the aneurism. The application of a single ligature to the artery above the sac should not be practised in the limbs, as it has often failed to obtain a cure. In varicose aneurism of the orbit the proper treatment appears to be the ligature of the common carotid artery, and, should this fail to arrest the pulsation in the tumour, it should be followed by the direct application of electrolysis to the aneurism. *See* Orbital Aneurism.

A. Pearce Gould.

ARTERY-FORCEPS.—The object of an artery-forceps being to arrest hæmorrhage during an operation as rapidly as possible, it must necessarily be fitted with a spring or catch so as to hold its position when released by the surgeon's hand. The *serre-fine* or twisted wire of the French instrument-makers has never been a favourite with English surgeons, on account of its small size, but the larger metal clamp commonly known as the 'bull-dog' was formerly a good deal employed.

The *forci-pressure* forceps, introduced into practice by Sir Spencer Wells a few years back, has been largely adopted by operating surgeons, and has the great convenience that it is readily applied, and maintains its hold so thoroughly that, at the conclusion of the operation, the vessel is found to have been effectually occluded by the mere pressure; or, if not, it can be easily twisted with the same instrument, over which, also, a ligature can be tied if preferred. Köberle's forceps is practically identical.

For taking up arteries at the conclusion of an operation many surgeons prefer a pair of ordinary dissecting-forceps, by which the vessel is readily seized and drawn out of its sheath for the application of a ligature. But a ligature is not easily tied upon an artery held by such an instrument, since the blades are apt to be included in the knot.

Liston's artery-forceps, with expanded blades and sharp points, is a more generally useful instrument, and has the advantage of a spring-catch; but it is dangerous when applied too near a main trunk, which it may accidentally pierce, so as to give rise to further bleeding.

Asalini's forceps is kept closed by a spring, so that the pressure of the fingers is required to open it, and this must be again relaxed in order that the points may seize the vessel. A noose of ligature is usually placed around this forceps before it is applied, and is then slid down over the mouth of the vessel by those surgeons who employ it.

A *torsion-forceps* is made with broad serrated ends, and the blades are usually fitted with a sliding-button, by which they are approximated and held upon the artery to be twisted. There appears to be no reason why this inconvenient arrangement should not be replaced by a spring-catch, as in Syme's artery-forceps.

ARTHRITIS. *See* JOINTS, Diseases of.

ARTICULAR CARTILAGE, Diseases of.—The changes which originate in articular cartilage are mostly rather of the nature of degenerations than active disease; and inflammation of this structure is certainly, in most cases, secondary to affections of the synovial membrane, or of the joint-ends of the bones.

In acute inflammation of joints, especially of the septic variety, the articular cartilage often undergoes a rapid dissolution, which is undoubtedly due to the inflammatory disturbance of its nutrition. If such a joint be examined, it will be found that in addition to the swelling and vascularity of the synovial membrane, parts of the cartilage have undergone thinning, softening, or even entire removal, so that in some places the articular lamella of the bone is exposed, and in others the cartilage is loosened or detached.

In the more chronic forms of joint-disease, such as, for example, the scrofulous, the cartilage becomes inflamed and ulcerated in consequence of the encroachment upon it of granulation-tissue, either from the synovial membrane upon its surface, or from the bone beneath. From whichever surface the process may originate, the destruction of the cartilage is correspondent to the advance of the granulation-tissue. If from the synovial surface, the cartilage becomes thinned, pitted, roughened, and changed to a yellowish tint; the bones eventually becoming exposed, and undergoing a similar process of ulceration. If from the bone surface, the same changes occur on that side of the cartilage, large pieces of which may be detached as by a process of necrosis.

There is, moreover, another class of cases of joint-disease, in which the cartilages become early affected by the ulcerative process in consequence of the stimulus of a synovial inflammation, which, without having the extremely acute or irritative qualities of the septic form, is yet of a progressively destructive kind. In these cases the synovial membrane, though very vascular, is but slightly swollen or thickened, and the amount of fluid in the joint is usually but small, yet the cartilages are found to be extensively ulcerated, so that the articular lamella is exposed at a comparatively early stage of the disease. This form of joint-disease affects most commonly the hip-joint.

Microscopic examination of inflamed articular cartilage reveals the following changes:—There is, first, an increase in the size and number of the nuclei of the

cartilage-cells, and absorption of the hyaline intercellular material; then, as the process goes on, the nuclei undergo granular degeneration, and those cells nearest the surface rupture and allow the escape of their nuclei; thus there ensues a loss of substance, and by the extension of the process the cartilage is gradually destroyed.

In the more chronic cases the cartilage may be seen to have undergone fibrillation rather than ulceration; or its destruction may be limited to the points at which the under- or overlying granulation-tissue has invaded it.

The *symptoms* of inflammation of articular cartilage are not in any way characteristic. The tissue is insensitive, and probably the spreading to it of inflammation from the synovial membrane or bone cannot be recognised until ulceration has occurred and the bone is exposed. When, however, this stage has been reached, the exposure and inflammation of the articular lamella gives rise to painful startings of the limb, which are greatly aggravated by any movement of the joint, and which become a prominent feature in the symptoms. This distressing muscular spasm is especially apt to occur just at the commencement of sleep, when, the voluntary control of the muscles being withdrawn, the sensitive bone-surfaces are drawn into acutely painful contact, and the patient awakes with a cry of pain. This is especially the case in disease of the hip-joint, and gives rise to the characteristic 'night-scream' of children thus affected.

The results of ulceration of the cartilage will vary much with the age and reparative power of the patient, the kind of disease with which it is associated, and the acuteness or chronicity of the process. If the disease is arrested before any considerable destruction of the cartilage has occurred, the surface may heal by the formation of fibrous tissue, which may merely fill up the gap, or may form an adhesion to a corresponding point upon the opposite surface of the joint. If the cartilage be extensively removed, either the joint will be destroyed by suppuration, or the destructive process coming to an end, there will be an effort at repair, and the opposed bone-surfaces will become firmly adherent by fibrous or osseous anchylosis.

In the *treatment* of ulceration of articular cartilage, rest and extension of the limb are primary essentials. Extension by a pendent weight, or suitable splints, will do much to prevent the painful muscular spasm described above; though occasionally this distressing symptom may necessitate tenotomy of the irritated muscles.

For the same purpose, also, the internal administration of opium, or the subcutaneous injection of morphia, is frequently necessary. The joint-disease (of which the ulceration of the cartilage is usually but a part) must, of course, be treated as a whole; but it may be added that in those cases in which the symptoms of ulceration of the articular cartilage are prominent or of early occurrence, counter-irritation, especially by the actual cautery, will usually be found to give great relief.

Besides the inflammatory affections above described, articular cartilage is liable to certain degenerative changes and disturbances of nutrition. A common condition in old people is a variable amount of fatty degeneration, in consequence of which the cartilage becomes thinned, roughened, and of a yellowish colour. In other instances fibroid changes occur, giving rise to a loss of smoothness and elasticity, generally with some atrophy. Such conditions, however, are not recognisable during life.

In gout a deposition of urate of soda takes place in the cartilage, interfering with its nutrition, and giving rise to wasting and calcareous degeneration.

Finally, in osteo-arthritis, the first changes are observed in the cartilage, which loses its proper smoothness, and becomes wasted and worn away at the points of greatest friction, while at the same time some irregular thickening occurs at its edges, where least subjected to pressure. *See* Osteo-Arthritis.

J. Warrington Haward.

ARTIFICIAL ANUS. — The term artificial anus is applied to certain cases in which the lumen of the bowel communicates with the surface of the body through a breach in the intestinal wall. This communication may be met with under many different conditions, but to all such the present term is not applicable. In artificial anus the aperture in the gut is large, and opens directly upon the cutaneous surface of the body; the bowel is practically, if not in fact, connected with the integuments, and the escape of fæces is thus direct, and not through an intermediate fistulous passage. In other instances there is a communication between the lumen of the bowel and the cutaneous surface, but it is not direct. The gut in which the abnormal aperture exists lies at some distance from the surface, and between the bowel and the skin stretches a long fistulous

passage, or a large abscess cavity intervenes, or the communication between the two parts is still more indirect. To these instances the term fæcal fistula, or stercopurulent fistula, is applied. In other cases again the bowel communicates with a mucous cavity such as the bladder or vagina, but to such examples the terms vesico-intestinal and vagino-intestinal fistula are applied. The term artificial anus, therefore, is used in but a limited sense; the limitation is arbitrary, and is based upon therapeutic grounds. The methods available for the treatment of artificial anus on the one hand, of vesico-intestinal and allied fistulæ on the other, and of fæcal fistulæ, so called, on the third part, are, as will be shown, very different.

Artificial anus may be divided into three varieties: 1. Congenital, 2. Accidental, and 3. Acquired.

1. To only one congenital condition may the present term be with propriety applied, to the condition, namely, where a Meckel's diverticulum opens at the umbilicus. This diverticulum, it may be remarked, is the remains of the vitelline duct, and in its most perfect condition it exists as a tube which extends between the navel and the ileum from one to three feet above the ileo-cæcal valve. This tube has a structure identical with that of the bowel from whence it springs. After the separation of the umbilical cord it is possible that it may open upon the surface and discharge fæcal matter. Such discharge is usually scanty and intermittent. It may persist for many years after birth. In most cases the opening, which is always small, will close spontaneously as the umbilical cicatrix contracts. Its closure may be aided by the application of the actual cautery, or, in instances where a somewhat larger aperture than usual exists, by a slight plastic operation.

2. In the accidental form of artificial anus the abnormal opening in the gut is brought about either by a wound, or by gangrene of the part, or by a perforating ulcer. If by a wound, then the damaged gut must have protruded at the orifice in the parietes at the time of the accident, must have become engaged in that wound, and ultimately have formed adhesions there. If, by means of a deep stab, a portion of the bowel—as, for example, the descending colon—is opened behind the peritoneum, so that that membrane is not damaged, the contents of the gut may be discharged upon the surface, but the condition would more usually lead to a fæcal fistula than to an artificial anus. In the same way gunshot wounds can only under rare circumstances lead to an artificial anus in the limited sense of that term, while they are frequently the cause of a fæcal fistula. Gangrene after strangulated hernia is a very common, and, indeed, the usual, cause of artificial anus. The gangrene may involve only a part of the convexity of the strangulated loop, or may implicate the whole of it, or the whole of the upper limb of the loop. Any form of ulcer of the intestine may lead to perforation. If the perforation takes place through a part of the bowel not covered by peritoneum, as at the posterior part of the descending colon, the intestinal contents find their way into the subserous tissue, an abscess is formed, and when that discharges itself through the skin, a fæcal fistula is formed, rather than an artificial anus. For this reason artificial anus can hardly result from ulceration having its seat in the colon, unless it be in the transverse colon. When such a form of abnormal opening has developed, as a result of intestinal ulcer, it will usually be found to have involved the small intestine. The ulcer, before it perforates, leads to some local peritonitis, by means of which the diseased loop becomes adherent to the parietes. By the time perforation occurs extravasation is prevented by the adjacent adhesions. An abscess follows, which in time breaks through the skin, and leads to an artificial anus.

3. In the acquired form the condition is the result of a colotomy or an enterotomy.

Anatomical condition.—There is, as a rule, only one opening in the skin, though in rare cases there may be more than one. The integument about the abnormal orifice is usually depressed, contracted, thickened, and excoriated. In cases of any standing it is continuous more or less directly with the mucous lining of the bowel. The gut—especially when it is a portion of small intestine—is much bent at the seat of the loss of substance. So great may be this bending that the segment of bowel below the anus may be parallel with that above it. As a result of this bending, a valvular fold appears on the wall of the bowel facing the aperture in the skin—on such part of the intestinal wall, indeed, as is left undestroyed. This fold is placed at the summit of the bend. Its extent depends upon the amount of intestine lost, and upon the acuteness of the angle formed in the bowel at the site of the artificial anus. It is more marked when the small intestine is involved than when the lesion is in the colon. It is perhaps most highly developed

in cases that have resulted from gangrene. This valvelike fold or *éperon* is the chief cause of the permanency of the artificial anus, and the main obstacle in the way of spontaneous cure. It is often so extensive as to entirely cover over the opening in the bowel below the anus, and in any case acts as a conduit to direct the intestinal contents to the opening in the skin. The mesentery in the angle, which is always turned away from the surface, is found to be thickened, shrunken, and contracted, and takes a part in maintaining the permanency of the *éperon*. The bowel below the fistula is contracted, pale, and more or less empty, while the bowel above is often distended and not infrequently hypertrophied. The nature of the intestinal contents will obviously depend upon the part of intestine involved. The amount that escapes varies. All the fæces may be passed by the artificial anus in some cases, while in others there is but slight escape of fæcal matter, or only an occasional escape. The discharge from the fistula is influenced also by position, by the general health, and by the state of the bowels.

The skin about the abnormal opening may become the seat of much erythema or of erysipelas. The end of the bowel above the anus may become plugged or be occluded by acute bending, and symptoms of intestinal obstruction may follow. Much trouble — chiefly in the form of nausea, vomiting, and colic—may be occasioned by an accumulation of fæcal matter in the bowel below the artificial anus. The intestine may become prolapsed through the abnormal opening. This prolapse usually involves only the mucous membrane, but it may involve all the coats of the bowel. In the latter case it may be extensive and may even attain the length of one or two feet. As a rule the prolapse involves only one end of the bowel, and most frequently the upper end; it may, however, involve the lower end only. The prolapse may be reducible or irreducible. In certain cases a hernia has appeared at the seat of an artificial anus, the protrusion having been covered either by the thinned tissues about the anus, or by the wall of the bowel that is involved therein.

The *Prognosis* is unfavourable. When the anus involves the jejunum the patient, as a rule, soon dies of marasmus. When the middle ileum is implicated there is usually much wasting and malnutrition. When the lower ileum or colon is involved, the health need not become impaired by reason of the premature escape of the contents of the bowel. The condition usually involves much mental distress. In certain cases—more especially when the lesion has been due to hernia—spontaneous cure has followed at the end of weeks or months. Spontaneous cure, however, in the condition to which the special term artificial anus is applied, is quite rare.

Treatment.—The skin about the artificial anus must be protected as much as possible. It may be painted with collodion, but the collodion only obtains a very temporary hold of the integument. It may be kept constantly oiled with vaseline or with simple ointment. Attempts may be made by means of thin india-rubber tissue to conduct the escaping fæces away from the skin into a proper receptacle. The general health should be supported. If the fistula lie in the colon, the motions should be kept soft and constipation be carefully guarded against. Inordinate intestinal movements should be checked by opium. The diet must be cautiously selected, and be composed only of the most digestible materials. A suitable pad must be worn to receive the escaping fæces. Some are made for the purpose by instrument-makers, but as a rule the patient will construct some pad of his own which will suit the purpose better than a more elaborate receptacle. In any instance the most scrupulous cleanliness must be insisted upon. In slight cases spontaneous cure may be brought about by closing the abnormal aperture by pressure. This pressure may be effected by means of a truss or by a disc fixed over the fistula; or the edges of the anus may be approximated by strapping. In a recent case Mr. Banks effected a cure by inserting a piece of india-rubber tube into the two ends of the bowel. This brought elastic pressure to bear upon the *éperon*, while, at the same time, it maintained the passage of the intestine free.

The great obstacle to cure is the *éperon*. This has been kept thrust back by means of ivory plugs carefully fixed in the part, and attempts have been made to destroy it by the frequent application of caustics or the occasional use of the actual cautery. It must be confessed, however, that these various measures are of little avail. They possibly do no harm, but they certainly do little good. In any case of persistent artificial anus it is better to adopt a careful palliative treatment, to allow a reasonable time to elapse for the development of any evidences of spontaneous cure, and then to treat the condition by some radical means if it still remains without improvement.

These latter measures may be considered under three heads: 1. Denonvilliers' operation; 2. Dupuytren's operation; and, 3. Resection of intestine.

1. The operation of Denonvilliers is merely one of the many that have been proposed for the cure of this condition by what may be termed plastic measures. In the present procedure the mucous membrane is dissected up on either side of the artificial anus, its edges are freshened and then united by sutures. The integument is next dissected up, its edges are in like manner freshened and are approximated by sutures. This operation is of little value. It is well known that mucous surfaces are not readily induced to unite, and the barrier offered after the operation to the pressure within the bowel is very slender. The procedure, moreover, leaves the *éperon* untouched, and thus fails to attack what is probably the real cause of the persistence of the fistula.

2. In Dupuytren's operation the *éperon* is destroyed by inducing gangrene in it. This is effected by means of Dupuytren's enterotome. The enterotome is a strong pair of forceps with a male and female blade which can be freely and closely approximated by means of a screw. The *éperon* is taken up between the two blades, which are at once screwed together as tightly as possible. In from eight to ten days the *éperon* will have become ready to be separated, and the instrument may then either come away of itself, or—if it still holds on—may be removed. A free communication is thus established between the bowel above and below the abnormal opening, and a spontaneous cure commonly follows, the parts being left practically to themselves. In the reported cases such cure has followed the operation at a period varying from a few weeks to three or four months after the removal of the enterotome.

3. In this procedure the two ends of the intestine concerned in the artificial anus are resected, and the cut ends at once approximated by sutures by the first of the two methods described in the account of resection of the intestine. *See* Colectomy; Enterectomy. The edges of the openings in the integument are freshened and the parietal wound is closed after the sutured bowel has been reduced into the abdominal cavity. By this method the artificial anus can be readily and surely treated, and the success of the operation in the fistulous conditions which have followed strangulated hernia has been very encouraging. It is certainly a great advance upon the uncertain, tedious, and somewhat dangerous procedure of Dupuytren. The resection operation is by no means free from danger, but its risks are, in the writer's opinion, capable of being estimated and to a great extent guarded against.

Frederick Treves.

ARTIFICIAL LIMBS, The Selection of.—The Lower Extremity.—The chief types of artificial limbs for this, are (1) the common pin or kneeling leg, (2) the bucket leg, (3) the bucket leg with a knee-joint, (4) the artificial leg proper, commonly described as the 'cork leg,' by those who are not aware that cork is no longer used in its construction.

The common pin or *kneeling leg* is made of wood (usually beech or ash for men, and willow for women). The socket is shaped like the letter U. The stem is a simple upright pin, pole, or stick, in fact the ordinary 'wooden leg.' A broad leather girdle surrounds the socket up to the middle of the thigh, a waist-band fixes the upper extremity of the outer branch of the U to the pelvis. This outer branch extends upwards much higher than the inner. The lower end of the pin is shod with leather, and sometimes provided with a spring. The weight of the body bears directly upon the bent knee as it lies in the fork of the U.

The bucket leg is a somewhat superior article to the pin leg. Its socket is bucket-shaped, and resembles an immense thimble inverted, and is made of willow wood and leather. The stem resembles that of the pin leg. When used for amputation of the thigh it is frequently made with a joint at the level of the knee, an obvious improvement.

The artificial leg proper. This is almost entirely made of willow; and the writer is told that the best wood grows on the banks of the Kennet, and is not easy to obtain. A certain amount of leather is used, especially in the upper parts. The joints are of wood, and the fastenings are of German silver with screws of plated steel. When used for a thigh amputation, an artificial limb contains joint mechanism for both the knee and the ankle. Sometimes this consists wholly of rubber bands; but the best makers usually dispense with these, and employ instead a strong spiral steel spring and a 'tendon' of the strongest catgut covered with leather. The spring passes down, inside the calf, from the knee to the heel, and when the knee is slightly bent pushes the heel down, at the same time

lifting the toes. This is exactly what takes place when the artificial foot is carried forward in walking. On the other hand, the catgut 'tendon' (which lies side by side with the steel spring in the calf, but has a different attachment at the knee), comes into play when the knee is extended. It then drags on the heel, and holds the foot firmly down, so as to make it possible to stand on tiptoe by inclining the body forward a little. Thus the catgut tendon assists in the push off, and the steel spring tilts the foot up free of the ground, in the movement of walking. The mechanism just described is that of the well-known 'Anglesea leg.'

When the wearer sits down and bends the leg to a right angle, the steel spring is temporarily released from pressure at its upper end, and does not return into play until the knee is extended again about thirty or forty degrees. Braces of buckskin are used for both men and women, the former wearing them simply over the shoulders, the latter wearing also a waistbelt, to which the shoulder braces are attached in such a way as to leave the breasts free from pressure.

For a case of amputation below the knee with a long and good stump, it is sometimes unnecessary to take any bearings from the thigh. Artificial limbs, to take bearings from a bent knee (after the manner of the kneeling or pin-leg,) are sometimes made with a mere 'stop' knee-joint, and sometimes with a 'spring and tendon action knee-joint,' analogous to that described above.

For amputation below the knee in cases *where the bearings have to be taken from the thigh* as well as from the leg, artificial limbs cost as much as do those for thigh amputations. Artificial limbs for very high amputations of the thigh cost a few pounds extra according to the difficulties of the case.

Artificial limbs for *exarticulations at the hip*, whether done subperiosteally or otherwise, are for the most part useless, and are therefore dear at any price. The writer thinks, however, better results might be got by taking a firmer and more complete hold of the pelvis than is usually attempted, and is at present making some experiments in the matter.

For *Syme's*, *Pirogoff's*, *Chopart's*, and *Tripier's* amputations, the lost parts are replaced by new ones of light wood. As the bearings are directly on the stump itself, or on the heel in the last two cases, the artificial foot has merely to be fixed in position. This is usually done with a pair of steel rods, one on each side the leg, and a leather case, laced round the calf.

The kneeling or pin leg is not only excellent for permanent wear, when the amputation is in the upper third of the leg, but is often worn temporarily while the stump of a lower amputation, e.g. a Syme, is still tender and unfit to bear pressure.

When a Chopart is done in childhood, the limb does not grow as fast as its fellow. Consequently the instrument-maker must either fit on a high boot, or else apply a foot entirely artificial, attempting to conceal (not generally with much success) the knobby stump which now constitutes a kind of false and unsightly ankle. From an instrument-maker's point of view, Chopart's amputation should never be performed in childhood.

Lost toes; Hey's amputation, &c.—The patient gets his boot-maker to pad the shoes in a suitable manner.

The stump-boot.—This is a cylinder of leather which grasps the calf, and is shod with leather like a boot. It is a cheap instrument for a case of Syme's amputation. It has no foot, but merely a circular sole of the same radius as the cylinder itself.

The Upper Extremity.—Here again the materials are willow-wood and leather. But the hand and fingers are made of the wood of the lime tree. Proportionately, much more leather and less wood are used than in the case of the lower extremity.

Elbows are merely fitted with hinge-joints, unless a part of the forearm is left, when any power of pronation or supination should be carefully utilised. The elbow should be supplied with a little catch capable of fixing it at any angle.

The hand is fixed into the wrist by a metal socket and catch, and can easily be removed. The thumb contains a steel spring which opposes it to the fingers. The finger-joints are as a rule free from springs, but are purposely made to work passively with stiffness. But both thumb and fingers can be fitted with a grasping mechanism worked by either (1) the extension and flexion of the elbow, or (2) the pronation and supination of the forearm.

Sets of instruments are supplied (spoon, fork, knife, brush, hook, &c.), which screw into the palm of the hand, but have the appearance of being held by the thumb and fingers. But if a simple hook, with one or two instruments, such as a fork and spoon, be supplied instead of the hand, we get what is called a *bucket arm and hook*, much cheaper than 'an artificial arm,' by which is understood one with a hand. Not only

table instruments, but trade instruments and tools, are made to screw into both artificial hands and bucket arms.

Artificial thumb and fingers.—When parts of the hand are lost, it is sometimes for the sake of appearance rather than for any other object that the mechanician should be applied to, except when a thumb is left without a finger to oppose to it, or *vice versâ*, or when both thumb and fingers are gone. In the former case especially excellent practical results can be obtained.

The cost of these appliances varies with the case, but is not usually much less than that of a new hand and forearm.

It has been already mentioned how useless all appliances are for most cases of amputation at the hip-joint. Artificial arms for amputation at the shoulder-joint are useful in an æsthetic rather than in a practical sense.

General remarks.—The various appliances in ordinary use in this country have thus been briefly described. Their merits have been tested by experience, and are not small. But an artificial limb of any kind, standing side by side as it usually does with its fellow, constructed by nature, does not, and never will, bear the comparison. Hence there are constant efforts to produce new forms of artificial limbs. It would be out of place to discuss here all these. Mention may be made of the artificial leg of Dr. Hermann, which will firmly support the weight of the body at whatever angle the knee may be bent, and the artificial limbs termed 'the Beaufort,' which occupy a position, as regards both appearance and price, midway between the complete artificial limbs described in this article and the mere bucket and pin legs.

General remarks on the choice of an appliance.—As a rule the simpler the appliance the more useful it is. This applies especially to the lower extremity. The direct contrary is generally believed by the ignorant. For example, a labourer wearing a bucket leg after a high thigh-amputation, does not get on very well. He longs for an expensive artificial limb with a knee-joint and foot. Nothing but experience will convince him that the latter will be even less useful. On the other hand a gentleman with a first-class artificial leg is often guided by common sense into getting for himself a simple 'bucket leg with knee-joint' to use for rough and active work.

It is extravagant and silly to supply growing children with elaborate artificial legs and feet. They require bucket legs, stump-boots, and the like, which can be frequently readjusted to their height, and are strong enough to stand playground usage.

Congenitally short arms and legs, if very short indeed, should be treated as mere stumps and fitted with artificial limbs. A clever instrument-maker will utilise every peculiarity of such a limb to increase its hold of and firm bearing on the appliance. Of course, if an arm has anything approaching to a useful hand attached to it, it is scarcely right to bury it in an artificial limb.

Measurements. — Space will not give room for elaborate details. Where possible, it is best to let the instrument-maker take his own measurements, or, when that cannot be done, to write to him for a paper of printed forms, diagrams, and directions. In remote regions attention to the following rules may suffice :—

(1). State whether a right or left limb is required.

(2). Give full measurements of the sound limb.

(3). State the exact spot where the amputation has been done (in inches.)

(4). Give a complete series of measurements of the stump.

(5). If the growth of one limb has not kept pace with that of the other side, indicate the exact position of each joint by measurements.

(6). Give tracings of the stump of the sound hand (or foot, as the case may be).

Casts are useful in the case of Chopart's amputation, or when a hand or fingers or thumb may be required. A tracing does for a Syme. A boot is useful.

The measurements of a sound leg should be taken with the knee extended. Of girths, there should be sent, one of the waist, two of the thigh, one of the knee, one between the knee and calf, one round the calf, one round the ankle, one between the last two. Send the exact height in inches of each girth measured. Send a shoe-maker's measurement of the foot, or else a shoe.

Of perpendicular heights, do not omit to send (1) the height from the fork to the ground ; (2) the height from the summit of the bent knee to the ground, and (3) from the middle of the calf to the ground.

Similar principles can be applied by any intelligent person to the upper extremity ; but it should be measured with the elbow bent. C. B. Keetley.

ARTIFICIAL PUPIL. *See* Iris, Diseases of the ; Iridectomy.

ARTIFICIAL RESPIRATION. *See* Suspended Animation.

ASPHYXIA. *See* SUSPENDED ANIMATION.

ASPIRATION.—Before attempting to aspirate, it is necessary to thoroughly disinfect the needle, or trocar and canula, by means of the flame of a spirit lamp, or by some strong antiseptic agent. In using Dieulafoy's aspirator, the whole interior of the apparatus must be cleansed by allowing a quantity of strong carbolic solution (1 in 20) to pass through the tubes. Any defect in the taps or working of the syringe will then be detected. Great care must be taken, in using the finer needles, to push on in one direction only; and when using the aspirator for exploratory purposes, to establish the vacuum in the needle so soon as it has penetrated the skin and superficial structures. If, on pushing the needle as far as is thought judicious, no fluid be obtained, the needle must be withdrawn, and a fresh exploratory puncture made in another direction. The selection of the size of the needle or trocar to be used depends on the situation of the fluid and on its suspected character.

An advantage claimed for Dieulafoy's aspirator is that if the needle become choked it may be cleared by pushing down the piston, and driving some of the fluid back; but in using Potain's aspirator, the canula may be cleared, when necessary, by the careful introduction of a pilot trocar.

In acute abscess, aspiration rarely effects a cure, and is not advisable, but has been successfully employed in some acute cases of pelvic and abdominal suppuration. In some rapidly-forming pus collections, such as certain pyæmic abscesses, and in empyema in young children, aspiration may sometimes be employed with success.

Chronic abscess, unconnected with bone-disease, may occasionally be cured by one or more aspirations.

Large chronic abscesses in connection with disease of the spine, and of the hip, have been successfully treated by repeated aspirations. The indication for continued perseverance in this treatment is the increasing length of the interval between the successive accumulations in the cavity. In these bone abscesses, and especially in spinal abscess, unfortunately the pus generally rapidly re-collects after aspiration; and very often, owing to the amount of cheesy material in it, there is great difficulty in its evacuation. The largest trocar should be used, with antiseptic precautions, and care is necessary, in withdrawing the canula, not to leave any pus in its track, or a sinus is likely to be established. Aspiration must of course in all cases cease at once if blood should flow in any quantity.

Effusion into the pleural cavity is best evacuated by the aspirator. The operation is a little longer than tapping with special trocar and syphon tube, but there is less chance of the admission of air, and greater certainty of obtaining the fluid when negative tension exists. If the fluid be found to be purulent, it is generally best in adults to provide free drainage at once; but not infrequently in children, after one or two aspirations, there is no further secretion.

Pericardial effusion may be withdrawn safely by using a fine needle. The puncture should be made in the fourth or fifth interspace, about two inches from the left side of the sternum, and the needle must be passed upwards and inwards. To avoid penetrating the heart, it is important to obtain the vacuum in the needle so soon as the point is beneath the skin, and the needle should be held steadily during the flow of the fluid. *See* PARACENTESIS.

Hydatid cysts in the liver and other organs, when they contain clear fluid, will often shrivel up after aspiration; but relapse sometimes occurs after an apparent cure. A suppurating hydatid cyst, or an abscess of liver, may be explored by means of an aspirator, and their situation and depth from the surface determined; but for the treatment free drainage is necessary.

When there is a large collection of free fluid in the peritoneal cavity, a small syphon trocar is generally employed for its evacuation; but the aspirator is by far the safer instrument when the fluid is localised, or there is a doubt as to the diagnosis. For the exploration of any deep-seated collection of fluid in the abdominal cavity, only the finer needles should be used, and great care is necessary that intestine does not lie in front of the swelling at the seat of puncture.

A hydronephrosis may be aspirated at a point just below and anterior to the last rib; but the situation of puncture will vary according to the particular case.

Retention of urine may be relieved by the aspirator.

In aspirating joints, the interior of the joint must not be scratched with the needle or canula, and the limb must be kept at rest after the operation. The knee-joint not unfrequently requires aspiration for chronic effusion, or for distension with blood as a preliminary to the treatment of a fractured patella; and for the withdrawal of pus in certain pyæmic effusions, where the distension of the joint is sudden and unattended with signs of destructive changes. The

aspirator or hypodermic syringe may also be employed for the purpose of diagnosis in doubtful effusions into a joint.

The aspirator has been recommended for the relief of gaseous distension of the bowel, and as a method of treatment in certain cases of strangulated hernia. It is, however, preferable to use a very fine trocar and canula, and to allow the air to escape without assistance by aspiration, which only tends to increase the chances of fæcal extravasation. The treatment of hernia by fine puncture has found little favour with English surgeons, and can only be very rarely advisable. BERNARD PITTS.

ASPIRATOR.—This instrument was introduced into practice by Dieulafoy, in 1869, and with slight modifications the simplest form now in use is that designed by the inventor. It consists of a glass syringe, in which the nozzle has been replaced by a threeway tap. This tap places the cylinder of the aspirator in communication with two tubes, one connected with a hollow needle, and the other for carrying aspirated fluid away from the cylinder. It is so designed that the passage to either or both can be closed; in the latter case when the piston is withdrawn a vacuum is formed in the cylinder. If now the communication with the hollow needle is opened, the fluid in any cavity into which the needle has been inserted flows into the cylinder, and by turning the tap the communication with the needle is closed, and on depressing the piston the fluid obtained can be ejected, and the process repeated. The tubes are made of india-rubber, with coils of wire inside to prevent them from collapsing. The needles vary from $\frac{1}{60}$ to $\frac{1}{12}$ of an inch in diameter.

The advantage of using a hollow needle is that a vacuum can be produced in it as soon as the skin is penetrated, and it is then hardly possible to pass it without result through a collection of fluid.

Potain's Aspirator is a very useful one for ordinary practice. The apparatus consists of two parts—an exhausting syringe, and a glass bottle in which the vacuum can be produced. The apparatus is so fitted that any ordinary bottle with a narrow neck, and which will hold from two to three pints, can be employed. In the neck of the bottle is fitted a rubber plug, through which passes a metal tube with two branches, each of which is closed by a tap, while their extremities are fitted for receiving the conical metal ends of the india-rubber tubes which lead to the exhausting syringe and the hollow needle respectively. In place of the needle a trocar and canula can be used; but it is essential that the tube leading to the exhaust bottle should be attached at an angle to the canula, so as to permit of the trocar being withdrawn beyond the point of attachment of the tube without the possibility of admitting air into the canula.

In the aspirator just described, as the fluid does not come in contact with the syringe, the instrument is easily cleaned, and is not so likely to get out of working order as Dieulafoy's aspirator. With care in turning the taps, the bottle when full can be emptied, and again put in use, and large quantities of fluid be drawn off with little trouble or manipulation, the needle or canula remaining *in situ* during the process.

For exploratory purposes a small aspirator made on the same principle as Dieulafoy's may be employed, but a large-sized hypodermic syringe, with a long fine needle, is an excellent practical substitute. One loses, however, the advantage of the previous vacuum in the needle, and, consequently, fluid situated at an uncertain depth in a solid organ like the liver might be overlooked. BERNARD PITTS.

ASTHENOPIA.—The term asthenopia signifies *weakness* of sight, as opposed to *dulness* of sight, or amblyopia, and is characterised by the patient having good vision so long as distant objects alone are regarded, and for a short time even when near objects are looked at, but in the latter case soon becoming fatigued and exhausted. It is usually regarded as presenting three forms, or perhaps, more correctly speaking, as attributable to three causes—weakness of the ciliary muscle, weakness of the internal recti-muscles and weakness of the retina. These are named respectively accommodative asthenopia, muscular asthenopia, and nervous asthenopia.

1. *Accommodative asthenopia.* This form is associated with hypermetropia (q. v.) In the hypermetropic eye the focus for parallel rays lies behind the retina, so that an effort of accommodation is required even to see distant objects distinctly; still greater of course must the effort be to see near objects from which proceed divergent rays. In moderate degrees of hypermetropia, and in young persons in whom the nervous power is considerable, the ciliary muscle active and the suspensory ligament and lens resilient, the effort can be maintained for a considerable period, even when minute objects are closely examined; but sooner or later the muscle becomes exhausted, and

then, if work is still persevered in, the muscle either passes into a state of cramp, known as spasm of the accommodation, or—which is far more common—the symptoms of accommodative asthenopia are experienced. These symptoms are that, after reading, writing, or paying attention to any near object for some time, a sensation of fatigue is experienced in the eyes. The letters of a word, or the lines on a page, or the stitches in work, become confused and run together, and though at first, by making a stronger effort, reading can still be continued, in the course of time, varying, with the degree of hypermetropia from a few minutes to an hour or more, everything becomes confused, and even moderately large print is illegible. Then the eyes become hot and feel full. The lids are swollen and congested. The secretion of the Meibomian glands being disordered, the edges of the lids become sore, and ciliary blepharitis is sometimes established. The conjunctiva is reddened. There is an increased flow of tears. The patient feels inclined to squeeze the lids together and to rub the eyes strongly with the fingers. He has often to rest them by looking away from the book or work, and finds relief in bathing them with cold water. Improvement is felt when books are put aside and open air exercise taken. In some the eyes are worst at night, especially if the type and the light are alike bad; but in others the vision is most dim in the morning, perhaps for the same reason that after a long and severe walk the muscular pain is greatest in the morning and wears off after gentle exercise. Muscæ and spots are often complained of. These are sometimes visible, and are doubtless particles of pigment detached from the ciliary processes or uvea by the rubbing and pressure of the eyes. Failure of the power of accommodation often makes itself felt during convalescence from some disease, when, owing to general weakness of the nervous system, the effort previously made without difficulty to overcome pre-existing hypermetropia can no longer be made. The treatment of accommodative asthenopia must consist either in giving up all near work and leading an out-of-door life, or in the use of appropriate correcting glasses. The rules by which the selection of these should be undertaken are given in the article on hypermetropia. *See* Refraction, Errors of; Hypermetropia.

2. *Muscular asthenopia* is due to defective power or 'insufficiency' of the internal or external recti-muscles. On looking at a distant object the visual axes in a healthy person are parallel, but when near objects are regarded, not only is there an effort of accommodation, which is effected by the ciliary muscle, but the internal recti contract, and the visual axes are made to converge. If either of the internal recti are weak, an unusually strong nervous impulse has to be generated by the nerve-centre to maintain the contraction of the muscle, and fatigue, soon amounting to pain, is experienced. After a little while the effort can no longer be sustained, and then the eye rolls outwards, under the influence of the opposite rectus, and diplopia results. In some cases the effort is so trying that severe headache and even vomiting may be induced when close work is compulsory, whilst in others chronic conjunctivitis may be established, with frequent attacks of phlyctenular ophthalmia. The insufficiency of the rectus internus can easily be ascertained by a simple experiment. A thick black line three or four inches long should be ruled vertically in the middle of a sheet of paper, and in the centre of the line a spot or short cross-bar made. A prism of 10° or 12° should now be held with the base downwards before one eye. If the recti are in a normal condition, and the sheet be held at a distance of about six feet, two images of the spot will be seen, one exactly above the other, but only one of the line through this will appear prolonged. If, however, there is insufficiency of one muscle two lines as well as two spots will be seen, and the image seen by the eye before which the prism is placed will be higher than the other, and crossed or shifted to the opposite side. The reason of its occupying this position is, that the prism throws the image upon a lower part of the retina, and, in accordance with the law of projection, it appears to be higher, whilst the weak internal rectus muscle being no longer compelled to contract in order to effect the fusion of the two images, gradually yields to the external rectus, and the eye rolls or deviates outwards and, again in accordance with the law of projection, gives a crossed double image, so that if the right internal rectus is insufficient, the image is on the left side, and *vice versâ*.

The degree of insufficiency may be approximately ascertained by a simple proceeding, for by still keeping the prism with its base downwards before the eye, it is only necessary to place a succession of prisms with their bases inwards before this eye until one be found which causes the two images to be superimposed—that is, to give two spots but only one line—and the amount of insufficiency is at once deter-

mined. Unfortunately, in many instances the position of rest or equilibrium is not immediately assumed by the eye at fault, a strong nervous impulse being still directed to the muscle even when the images are separated by the first prism, and hence the amount of latent divergence is often considerably under-estimated. The treatment of muscular asthenopia must consist in the employment of appropriate prismatic glasses, superadded to those that are requisite to correct any other error of refraction, such as myopia, astigmatism, &c., with which insufficiency of the internal rectus is often associated. *See* Strabismus; Ocular Muscles, Affections of the.

3. *Nervous Asthenopia.*—This form of asthenopia appears to be associated with general depression of the nervous system, and is then due to the circumstance that the patient, whilst possessing perfectly normal vision, cannot, without great distress, bring the ciliary muscle into action. As soon as a book is taken up or sewing commenced, the mere effort of accommodation, which in health can be easily and long sustained, occasions an insupportable feeling of fatigue, and it is quickly put aside. Such a condition may not infrequently be seen in women recovering from their confinement, in children suffering from spinal disease or convalescent from measles, scarlet fever, or diphtheria, in those who have suffered from hæmorrhage; and the writer has repeatedly observed it in riveters and fitters in Chatham Dockyard after contusions of the eye, to which they are particularly exposed. It may also be noticed as a symptom in the early stage of sympathetic ophthalmia. In these, as well as in the former class of cases, the powers of the retina appear to fail, a dark spot or scotoma quavers before the eye, confusing, or altogether obliterating, the outline of any object that is attentively regarded, and a contraction of the field of vision may sometimes be noticed. The retina seems, in some instances, to be hyperæsthetic, so that bright lights, especially when they flicker or vary in intensity, annoy and distress the patient. The most careful examination of the eye by means of the ophthalmoscope often fails to discover any abnormal condition (*see* Accommodation, Disorders of). The treatment should be both local and general, the local treatment consisting in directing the patient to desist from all work requiring close attention, and, where intolerance of light is a prominent symptom, the protection of the eyes with smoked, blue, or green glasses. The general treatment must, of course, depend on the conditions of the system to which the asthenopia may be referable. The best remedies are strychnia—which may either be injected in doses of one-twenty-fifth up to one-tenth of a grain every day, or may be taken in the form of tincture of nux vomica, in doses of ten to twenty minims—and such tonics as quinine, iron, arsenic, and sulphate of zinc. As a rule, such cases ultimately, though often but slowly, recover.

Henry Power.

ASTIGMATISM.—A condition of the eye in which entering rays are unequally refracted in different meridians, such rays being consequently never focussed to a point, as in the ordinary eye. *See* Refraction, Errors of.

ASTRAGALUS, Dislocations of the.—The astragalus may (1), whilst retaining its relations to the tarsal bones, be dislocated from the tibia and fibula. These tibio-tarsal dislocations are described as dislocations of the Ankle-Joint. (2) Whilst preserving its relations to the tibia and fibula, it may be dislocated from the bones of the foot; these dislocations are described as Sub-Astragaloid. (3) It may be separated from its normal attachments both to the tibia and fibula and to the bones of the tarsus, and be displaced alone. These proper dislocations of the astragalus will be here described.

The proper dislocations, or enucleations, of the astragalus are usually described as four in number, viz.: *forwards*, *backwards*, *inwards*, and *outwards*. But the forward dislocation includes displacement in three directions, viz. *forwards and upwards*, so that the head rests above the scaphoid and cuneiform bones; *forwards, upwards, and outwards*, when the head rests on the cuboid; and *forwards, upwards, and inwards*, when the head rests above and internal to the scaphoid. So also the backward dislocation includes dislocations *directly backwards*, and dislocations *backwards and outwards*, and *backwards and inwards*. Besides the direction of its displacement, the dislocated bone may be found rotated on a vertical or on an antero-posterior axis. For these rotations, Barwell suggests respectively the terms 'version' and 'torsion.' It has even happened that the bone has been turned completely over, so that the under surface looked upwards.

The forward dislocations are caused by over-extension of the foot. The ligaments

attached to the astragalus are thus torn through, and the tibia, gliding down on its posterior surface, forces the bone out of its bed. Rognette, experimenting on the dead subject, found that he was only able to produce a forward dislocation, and he therefore concluded that the others were produced secondarily.

Symptoms.—The sign by which the injury may be recognised is the presence of an abnormal bony prominence projecting boldly beneath the skin in front of the ankle. The rounded head of the astragalus will be recognised at the anterior part of the prominence, and behind this will be felt the trochlear surface. The presence of the latter is of importance, and sufficient to distinguish this injury from subastragaloid dislocation of the foot, which has often been confused with it. When complete, the height of the foot is diminished, owing to the tibia settling down upon the os calcis, and the malleoli are brought nearer to the ground. At the same time the motions of the ankle are lost. When the bone is inclined outwards the foot is somewhat inverted, and when inwards the foot is everted.

To reduce this dislocation the patient's leg should be flexed to a right angle with his thigh, to relax the gastrocnemius; one assistant should then fix the knee, whilst a second, seizing the heel with one hand and the instep with the other, makes extension on the foot. The surgeon then, by pressing on the astragalus with his thumbs, may succeed in replacing it. Should extension and manipulation fail to reduce the bone, the tendo Achillis should be divided, by which means the soleus is paralysed. Any other tense tendons—the peronei, anterior tendons, or tibial—may also be divided, to aid in reduction.

All attempts to reduce the bone having failed, the foot may be secured on a splint and left covered by an icebag till the swelling has subsided. A fairly useful limb may in this way be obtained. More commonly, however, the skin sloughs over the bone and necessitates secondary excision. The statistics at present are in favour of secondary rather than primary excision, but if the case were treated from the first antiseptically, it is probable that these statistics would be modified or reversed. The writer would throw it out as a suggestion that, under these favouring circumstances, a free exploration might be made and all opposing bands divided till the astragalus could be replaced. There is no good reason for supposing that, because it was temporarily detached from its connections, it must therefore of necessity become necrosed, and the experience of simple complete dislocations favours the view that it would recover.

Dislocation backwards is caused by over-flexion of the foot on the leg. The ligaments are in this way torn, and the tibia, descending upon the neck of the astragalus, forces the bone into the space beneath the tendo Achillis. The bone may be found lying directly beneath the Achilles tendon, or it may be deflected to one or the other side; hence we have dislocations directly backwards, backwards and outwards, and backwards and inwards. If forced directly backwards without rotation or version the tendo Achillis may be pressed upon, as happened in a case described by Phillips, where this tendon was made 'to describe an angle of 40 degrees.' At the same time that the projection behind is noticed, a deep hollow can be felt with the finger immediately in front of the ankle, whence the bone has been displaced. Another symptom that has been noticed is extreme flexion of the great toe, which is readily accounted for when the position of the groove for the flexor longus pollicis on the back of the astragalus is remembered. The malleoli descend, and the foot has sometimes presented an appearance of slight shortening, but it is neither inverted nor everted. It should be remembered that, owing to the hollow in front of the tendo Achillis being liable to be filled up with blood-effusions after injuries to the ankle, the backward dislocation may be overlooked, and this occurred in a case related by Boyer, and in another described by Fergusson.

To reduce this dislocation, the leg should be first flexed on the thigh, then, extension being made on the instep and heel and counter-extension at the knee, the surgeon should endeavour to press the bone forwards into its place. At first the foot should be strongly flexed, and when the bone has been engaged in the gap between the tibia and os calcis, the foot should be gradually brought down to a right angle, at the same time that forward pressure is still exerted on the astragalus. Of eight recorded cases only one was reduced, and in this case both malleoli were fractured, but the patients have recovered with useful feet. Owing to the space into which the dislocation takes place, there is less stretching of skin and less necessity for excision in this than in other dislocations of the bone. If compound, it is probably the best practice to

excise immediately attempts at reduction have failed.

The lateral dislocations of the astragalus are almost invariably compound, and usually associated with fracture of one or both malleoli.

In *dislocation inwards* the bone escapes below the tendon of the tibialis posticus. The bone is seen protruding beneath the inner malleolus, and is often rotated on an antero-posterior axis. This torsion of the astragalus, so frequently noticed, appears to be caused by the pressure of the opposite malleolus, whilst the tendon of the flexor longus pollicis behind probably determines the axis of rotation. As might be expected in this dislocation, the posterior tibial artery is sometimes ruptured and the accompanying nerve lacerated.

In *dislocation outwards*, the bone protrudes immediately beneath the outer malleolus, and above the tendons of the peroneus longus and brevis. The outer and inner malleoli are almost always fractured, but in a few instances they have both escaped. The foot is bent inwards, and the bone protrudes between the malleolus and os calcis.

In the treatment of the compound dislocations of the astragalus, inasmuch as the violence producing them is great, the question of amputation will have first to be decided. This will be determined by the amount of damage to the soft parts, the injury to vessels, exposure of tendons, and comminution of bones. Having decided against amputation, the surgeon will probably attempt, by extension and manipulation, to reduce the bone. Should he fail in this, there still remain two courses open to him. He may saw off the projecting head, and then again endeavour to effect reduction, or he may proceed at once to excise the whole bone. Even rupture of the posterior tibial artery and laceration of its accompanying nerve (though injuries adding much to the responsibility of an attempt to save the foot) should not alone frame the surgeon's resolution in favour of amputation, for in a case of this kind related by Astley Cooper, the bone was excised and recovery took place. R. Clement Lucas.

ATHEROMA. *See* Arteries, Diseases of.

ATLANTO-AXIAL DISEASE. *See* Caries of the Spine.

ATLAS, Fracture and Dislocation of the. *See* Back and Spine, Injuries of the.

ATRESIA ANI (Imperforate Anus). A congenital condition from arrest of development at an early period of intra-uterine life, resulting in an absence of the normal communication between the surface of the body and the interior of the lower end of the alimentary canal. This canal is, at the fourth week of intra-uterine life, a tube, closed at both extremities, and opening anteriorly at its lower part into the sac of the allantois, of which the intra-abdominal part subsequently becomes by development the bladder and urachus. About this time a depression is formed on the surface of the embryo at the site of the future anus, and by the upward extension of this the anal channel is developed, the upper end of which is in close proximity to the lower end of the bowel. By absorption of the intervening tissues the normal opening is established. At the same time a separation is being formed between the rectum and the bladder. This is usually completed by the tenth week of fœtal life. During the next few weeks, the growth of the perineum separates the urethra in the male, and the genital tract in the female, from the rectum. But this process of development may be arrested in any stage and in varying degrees.

Sometimes at birth the anus is almost or altogether absent. This constitutes atresia ani. In other cases the anus is well-formed, but is separated from the bowel by a thin membranous septum, constituting atresia recti. In other cases the rectum may have been badly developed, so that the bowel may cease at the level of the promontory of the sacrum or even higher. Again, imperforation of the bowel may be complicated by the persistence of a communication between the rectum and the bladder or urethra in the male, or the genital tract in the female; or, more rarely, there may be abnormal fistulous openings on the back and abdomen. Another rare form of atresia ani results, not from mal-development, but from adhesion of the epithelial surface of the anal passage. The diagnosis of these cases cannot cause any difficulty. If the anus be absent the defect must be at once apparent. But if there be an anus, and an obstruction higher up, the absence of any alvine discharge and the vomiting which will speedily supervene, together with distension of the abdominal parietes, will indicate the nature of the case, of which assurance can be obtained by the introduction of a blunt probe into the anal passage. The discharge of meconium by the urethra, vagina, or fistulæ elsewhere, will demonstrate the additional complications.

Treatment.—If atresia ani be due merely to epithelial adhesions, traction from the median line on both sides of the perineum will suffice to separate them, and re-adhesion may be prevented by the occasional introduction for a few days of a pledget of oiled lint. If there be a membranous septum between the anus and the rectum this will usually bulge downwards in the straining efforts of the infant to defecate, and a linear or crucial incision, with possibly excision of a part of the membrane, will give the requisite relief. If the septum be higher up, then division of the posterior wall of the anal passage may be requisite to bring it into view. If the anus be absent, or if a considerable thickness of tissues intervene between it and the rectum, a more troublesome operation will be requisite. The child should be placed in lithotomy position with the buttocks well raised, and, the bladder having been emptied by a catheter, an incision should be made in the median line backwards from the margin of the anus, if present, or from the normal situation thereof, if absent, and the dissection carried upwards in this plane, if necessary, along the concavity of the coccyx. If by this dissection the lower end of the bowel can be exposed, two sutures should be passed, first through one margin of the skin-wound, then across the bowel, and next through the other margin of the skin. The bowel should then be incised, the loops of suture drawn down and divided, and the bowel thus secured by four sutures to the skin. If this dissection should fail to expose the bowel, firm pressure should be made on the abdomen; and if this convey to the finger of the operator pressed into the perineal wound a distinct sensation of bulging, so as to indicate the near proximity of the bowel, the cartilaginous portion of the coccyx may be removed, so as to give more room, and the dissection continued a little higher. If the bowel can be thus brought into view, an attempt should be made, as before, to secure it to the skin, as otherwise a stricture will be inevitable.

But if this prove impossible, the bowel must be incised *in situ*, and the surgeon must endeavour, by the introduction from time to time of laminaria bougies, to keep the passage patent. If abdominal pressure, however, give no satisfactory indication of the proximity of the bowel, it is better to cease from any further perineal exploration, and to make an artificial anus. This may be done by Amussat's operation in the left loin, or by Littre's operation in the left groin. Amussat's operation is by no means easily performed on the infant, from the limited space in which the surgeon has to operate, and the difficulty of maintaining cleanliness with an artificial anus in this position is much greater in the infant than in the adult. Littre's operation is free from both of these objections, and may be performed as follows:—An incision, an inch in length, should be made in the abdominal wall, commencing a finger's breadth internal to and on a level with the left anterior superior spinous process of the ilium, and extending downward parallel with Poupart's ligament. The skin, fasciæ, and aponeurosis of the external oblique muscle having been divided, the fibres of the internal oblique muscle must next be carefully scratched through, as a muscular branch of the deep circumflex iliac artery always passes at this place between the internal oblique and transversalis abdominis muscles. The transversalis muscle and fascia must next be divided, when the sigmoid flexure may, if distended with meconium, as is usually the case, bulge into the wound.

If, from intra-uterine peritonitis, the peritoneal surfaces are adherent, this cavity will not be opened, and the projecting bowel should be at once attached to the skin wound by half-a-dozen sutures; but if the bowel is not distended, or if it is empty and collapsed, as may happen when the operation has been postponed for some days, and there has been persistent vomiting, the peritoneum must be divided and the bowel, if requisite, drawn forward and secured as before, care being taken to include in the sutures the divided edges of the parietal peritoneum. A linear incision of about half-an-inch in length should then be made in the bowel, and the edges secured by sutures to the skin wound. Starch-powder will protect the skin from irritation, and a pad of tenax may be used to receive the fæces. In some cases the sigmoid flexure is so distended as to lie in the right iliac fossa; but statistics of cases that have been examined after death prove that this does not occur so frequently as to justify operating on the right side in the first instance, when the probability of opening the cæcum will be very great.

If there be a recto-vesical or urethral communication, and if it be impossible to effect an opening from the perinæum, Littre's operation should be performed, to divert the course of the fæces and allow of the possible closure of the abnormal channel. Subsequently, by the introduction of a probe through the artificial anus, the course and extent of the bowel may be explored with

the view, if possible, of making an opening in the perineum.

If there be a recto-vaginal or uterine communication the child will not be in any immediate danger, provided that the aperture be large enough to admit of a free discharge of fæces; but as such a channel has a natural tendency to close, an attempt should always be made to establish an opening in the normal region. If this fail, and the abnormal passage diminish so as to cause obstruction, it may, if accessible, be dilated, or Littre's operation be performed.

No rule can be laid down as to the treatment of fistulæ in other parts of the body. They are very rare, and each case must be decided on its merits.

The prognosis will depend on the condition of the child and the nature of the obstruction. If the child be otherwise well developed, and the obstruction be due to epithelial adhesion or a membranous septum, the result of treatment will probably be good. This is true also of cases where dissection is requisite to expose the bowel, if this can be attached to the skin. When this is impossible, the passage of fæces over a raw surface, and the necessarily frequent introduction of dilators, will greatly diminish the chance of a successful result. Cases have been recorded of infants, on whom the operation for artificial anus has been performed, having lived to adult age. But these cases are few in number, and, according to the writer's experience of hospital patients, the infants have usually died within three months.

JEREMIAH MCCARTHY.

ATROPHY.—Atrophy, when the result of simple senile decay, is of importance mainly as providing an index to the declining functional and nutritive activity of organs and tissues, and thus furnishing the surgeon with the knowledge that structures so affected are liable to suffer in unusual degree from the immediate and remote consequences of injury and disease. The wasting incidental to age may involve most or all of the tissues, but it is often concentrated on one or a few, notably the vascular system, the muscles, and the bones. In the arteries, fatty atrophy of the constituent elements is commonly associated with fibroid substitution and irregularly disposed calcification. From these combined changes the walls of the vessels lose their resiliency and contractility, and the calibre of the small and medium-sized arteries—in which the blood-pressure is not sufficient to cause dilatation—is diminished. The vasa vasorum, too, are implicated in the process, and not seldom their lumen is obliterated. The above-mentioned conditions constitute the chief anatomical factors of continued primary bleeding following wounds, of late recurrent hæmorrhage after ligature, and of dry gangrene. Fatty metamorphosis of the heart, and of the cornea (arcus senilis) is a frequent concomitant of arterial degeneration. *See* ARTERIES, Diseases of.

In the fragilitas ossium of old people, the rind of compact tissue is attenuated, and the cancellous structure rarefied, whilst the spaces are filled with fat. An example may be seen in the neck of the femur, which is shortened and set at a more acute angle with the shaft—circumstances which favour the occurrence of intracapsular fracture from slight and indirect violence.

Another familiar instance of senile atrophy of bone is seen in the edentulous lower jaw.

In a few instances atrophy takes place apart from obvious degenerative change in the tissue-elements—e.g. as the glandular acini of the breast shrink on the cessation of lactation, the epithelial cells which line them simply waste away without their protoplasm being converted into molecules of fat; and again, as the contents of the fat-cells disappear in starvation they are often replaced by a clear fluid, which gives rise to a serous œdema of the cellular tissue, a condition well-known to pathologists as co-existing with emaciation, but the process is one of infiltration and not true metamorphosis. In the majority of cases, however, *the mode of atrophy* is apparent, being effected or accompanied by one or more of the various forms of degeneration. Thus, in the development of arcus senilis, and in senile rarefaction of bone, the connective tissue cells are converted into fat, and in inflammatory disintegration both fat and mucoid material are found in abundance, as may easily be seen in caries. Lastly, as nutrition fails in the arteries, and in the rib-cartilages, the parts become petrified with lime-salts; calcification, in short, when it occurs, is the final stage, and its result the abiding mark of the spoiling of tissues.

Atrophy of an organ is always accompanied by a proportionate loss of function. The bulk is at the same time usually, but not invariably, diminished. A bone may be so fragile as to break on the application of very slight force (spontaneous fracture) and yet it may retain its normal size. This is known as eccentric atrophy. More rarely there is actual enlargement of the part in

spite of the atrophy of its special histological elements; thus, whilst the muscles of the calf are fast losing their contractile fibres, fat may be infiltrated into the cells of the interstitial tissue in quantity more than sufficient to make up the deficiency. Fatty substitution attains its maximum in these cases of pseudo-hypertrophic paralysis. Atrophy is termed *essential* when it happens without any assignable local cause—e.g. fatty degeneration of the corneal corpuscles, and of the endothelial lining of arteries. It is called *secondary* when due to some manifest means of disturbance of nutrition either by direct interference with the circulation, or indirectly through partial or total abrogation of function. Atrophies from continuous pressure come under the former category, those arising from disuse of a part under the latter.

Causes and Varieties of Atrophy.—(1) *Physiological Atrophy* — 'Development and growth, maintenance and repair, decline and death, together with the discharge of function, make up the sum total of the life-history of all the tissues.' After parturition the *uterus* undergoes involution, or reversion to its quiescent state, from atrophy of its muscular fibre-cells, many of which are removed by absorption subsequent to molecular disintegration. At a certain epoch the *thymus* gland is subject to atrophy. Later on a similar fate awaits the *thyroid body*, in which colloid degeneration of the epithelial cells within the acini is a conspicuous feature. It is an interesting fact that the normal retrograde metamorphosis is not unfrequently disturbed, disorderly hypertrophy masking the intrinsic atrophy, so that instead of the bulk of the organ being lessened it is increased. Senile atrophy stands, as it were, on the frontiers of health and disease. In its incidence it is physiological, in its progress it becomes pathological; partly by reason of other changes being linked with it, and partly because the various systems and organs are not affected in like degree nor even simultaneously, there is a disturbance of the metabolic equilibrium of the tissues.

(2) *Atrophy from Diminished Function* is exemplified in the wasting of paralysed limbs; in the shrinking of muscles and the partial absorption of bones concerned in an unreduced dislocation; and in the loss of substance which gradually ensues in a stump after amputation.

(3) *Atrophies of Nervous Origin.*—There can be no doubt that when the innervation of a part is disorderly or absent, certain errors of nutrition are liable to supervene, and amongst them is atrophy. In no other case is it more manifest than when a nerve-trunk is severed. The distal portion dwindles away, as the white substance of Schwann is removed by absorption. Meanwhile the consistence of the nerve is sensibly diminished, so that in the operation for effecting union of the segments the difficulty of retaining them in apposition, under tension, increases in proportion to the length of the interval that elapses between the infliction of the injury and the attempt to repair it. *See* Nerves, Injuries of.

One of the most prominent features of Charcot's disease of the joints is the erosion of the articular surfaces of the bones; the head and neck of the femur, for instance, have been found absent. By some pathologists it is contended that the atrophy is entirely owing to excessive friction, or in other words that the influence of the nervous system is merely permissive, the normal check upon movement of a diseased joint being annulled, owing to the analgesia of the limb. The balance of evidence, however, seems to be in favour of the hypothesis which supposes the wasting to be in some measure directly due to perverted function of the nerves. *See* Charcot's Disease.

The degree of atrophy of the muscles in caries of joints varies within considerable limits. In cases where the pain is severe and lasting it is often surprisingly marked, both as regards extent and rapidity; not that the atrophy is so much the immediate consequence of the pain, as that the latter is the indication of active disturbance of normal innervation.

(4) *Atrophy from Partial Deprivation of Blood-supply.*—There are several ways in which this result is worked out:—(*a*) The nutrient artery of a long bone may be compressed by a tumour or torn through in fracture; (*b*) or the obstruction may be on the venous side of the circulation, the proper renewal of arterial blood being prevented; wasting of the testicle from varicocele, and of the liver-cells in portal and systemic venous congestion, are apposite examples. Under such conditions an ill-developed form of fibrous tissue supplants the more highly specialised elements, and, contracting, strangles the smaller vessels—an additional source of atrophy. (*c*) In atrophy of the hard palate from a badly-fitting obturator, and of the kidney from impaction of a calculus in the ureter, the pressure is diffused and acts alike on arteries, veins, and capillaries. Cornil and Ranvier have shown that there is something

more than simple absorption from starvation, for the tension on the tissues sets up inflammation, which is rarefying in the more exposed parts, whilst it is condensing in the deeper. Thus after maceration of vertebræ excavated by an aneurism, the eroded bone is seen to be closer in texture than normal cancellous tissue. AUGUSTUS J. PEPPER.

AUDITORY NERVE. *See* EAR, INTERNAL, Diseases of the.

AURAL EXOSTOSES.—Aural exostoses of the nature of spongy osteomata are the most frequent form of bony tumour in the ear, and are definable by the following characteristics:—They are usually pedunculate, may be somewhat movable, occur singly, and at any point in the meatus, very rarely in the tympanum, but commonly at the junction of the cartilaginous and osseous portions; are of rapid growth, and are associated with suppuration; may be preceded by polypus, and are often developed, by ossific growth, from polypoid granulations; and can be removed by simple operative measures. On microscopic section they show a structure similar to that of newly formed bone, with the free surface bounded by a finely papillate fibrous membrane coated with squamous epithelium, and the osseous trabeculæ constituting a framework for a vascular medullary tissue, containing, in the most internal portions, spindle in addition to round cells.

Other growths, of compact but not ivory-like consistency, constitute the majority of the multiple exostoses. Microscopically they resemble syphilitic nodes of the cranial flat bones. Within their epithelial and fibrous investment are seen, at right angles to the surface, somewhat irregular Haversian canals of periosteal origin, containing blood-vessels; these canals are fewest in the more compact, slow-growing tumours.

Ivory aural exostoses, or, rather, hyperostoses, occur in the form of a ridge-like protuberance, or as one or more rounded broad-based tumours, usually on the posterior wall and near the orifice of the external meatus, are neither of congenital nor of active inflammatory origin, are of slow growth, and are commonly met with in both ears. They are more frequent in the male than in the female sex. Externally they are covered with a smooth, hairless insensitive cutis. Of extreme hardness, they present microscopically the characters of excessively dense bone. The external squamous and fibrous coating is thin, and contains few and small vessels. The bony lamella, between which lie lacunæ with blood-corpuscles, do not follow the course of the vessels, but run parallel to the surface, at right angles to which usually pass the canaliculi. Vessels are perceptible, as a rule, only where at its base the tumour becomes continuous with the temporal bone.

Etiology of aural exostoses.—Assigned causes for aural exostoses in various cases are partial hyperplasiæ during the stages of development of the osseous meatus, occurring in the form of small symmetrical, comparatively innocent, bilateral osteomata (Politzer); circumscribed and diffuse inflammation of the external meatus; heredity, which, or else mechanical irritation, may account for the frequency of aural exostosis among the aborigines of America, as evidenced by their skulls; and syphilis, gout, and rheumatism. In nearly all instances of double ivory exostosis, mechanical irritation due to habitual sea-bathing seems to have been the initial cause.

Rate of Growth.—The compact aural exostoses are the most slowly formed; and the spongy osteomata, as one might infer from their larger vascular supply, are of comparatively rapid growth. It would be somewhat difficult to arrive at an approximate estimate of the rate of development of the ivory exostoses, as their existence in the ear is commonly overlooked until they cause uneasiness by pressure on the meatus, and interfere with audition.

Treatment.— For the removal of exostoses the gouge or, in the case of pedunculate growths near the orifice of the outer ear, the gouge and mallet have been recommended. The galvanic cautery, the chain-saw or écraseur, the trephine used in places for the induction of caries, polypus snares, and dentist's forceps, have all, with more or less success, been resorted to. Bonnafont's method of establishing the patency of the meatus by the introduction of a plug between its wall and the contained tumour is barely practicable, according to the writer's experience, on account of the intense pain it gives. Von Tröltsch's prolonged dilatation with laminaria tents seems scarcely more satisfactory as a radical mode of dealing with the obstruction to hearing caused by an exostosis. The use of a dentist's drilling machine, first suggested by Dr. Matthewson, of New York, for the channelling of the very hardest ivory exostoses, has been found productive of eminently good results.

For the ready and safe performance of the operation, however, there are several requisites, namely, a couch for the patient sufficiently high to permit of the proper

application of the drill, a steel guard to fit round the exostosis and to protect adjacent parts, drills of various sizes and shapes for the gradual enlargement of the opening to be made, and assistants to work the treadle of the machine, to administer an anæsthetic, to hold the steel guard in position, and to sponge or syringe-out blood effused in the meatus. It is highly important to begin the drilling operation close to the guard, as thereby the exact direction in which to work is ascertained, and always to proceed with both slowness and caution. The subsequent treatment of the patient resolves itself, usually, into combating, if necessary, the effects of secondary inflammation. Granulations in the meatus sometimes retard recovery. For these tannic acid is a useful astringent; and Dr. Victor Bremer, of Copenhagen, recommends the application of pin-shaped pieces of *Laminaria digitata*.

In the case of multiple exostoses, drilling is usually unnecessary, as, in consequence of mutual pressure and interference with growth, these usually leave a passage in the meatus sufficient for the transmission of sound: this, if blocked with cerumen or a polypus, is not cleared without difficulty. By the use of bone-forceps, which may be preceded by drilling, aural exostoses, other than the ivory-like growths, may in many instances be very readily removed. In one case operated on by the writer, a dentist's elevator served to sever the tumour from its base.

The possible importance of prompt perforation or removal of an aural exostosis has been illustrated by several examples of death, owing to the imprisonment of discharges through stenosis of the meatus. Obviously an operation for the removal of exostosis is indicated in all cases of otherwise irremediable deprivation of hearing.

G. P. Field.

AURICLE. *See* Ear, External, Diseases of the.

AXILLA.–The deep and roomy axillary cavity is one of considerable surgical importance, as it transmits the large blood-vessels and nerves of the upper extremity and contains numerous glands in connection with the lymph-ducts of this limb, and of the walls of the chest and abdomen. These structures are packed in a mass of lax connective and adipose tissue, which may be readily infiltrated by a large quantity of effused blood or inflammatory exudation, and offers but slight resistance to the expansion of any rapidly growing tumour. The anterior or pectoral wall, with its broad level surface, is formed in great part by the pectoralis major. Along the well-marked inferior border of this wall, or just behind it, are situated some lymph-glands, which are usually the first to become infiltrated in cases of cancer of the breast; and at its upper and outer limit is the interspace between the pectoralis major and deltoid muscles, which may be obliterated by effusion within the capsule of the shoulder-joint, and through which the pus of a deep axillary abscess sometimes comes to the surface. Near the unyielding inner wall, formed by the first four ribs and the serratus magnus and intercostal muscles, will be found the nerve of Bell and a chain of deep-seated glands, which receive lymph-vessels from the breast and the front of the chest, and of the abdomen above the level of the umbilicus. At the outer part of the cavity, bounded by the upper extremity of the humerus and the coraco-brachialis muscle, is the large vasculo-nervous cord formed by the axillary artery with its vein and the nerves of the brachial plexus. Here is another set of glands which are liable to become enlarged in cases of inflammatory irritation or specific inoculation on any part of the surface of the upper extremity.

The back of the cavity is securely closed by the scapula and the subscapularis and other muscles; and here, in connection with the subscapular artery is a third set of glands, which are connected with the lymphatics of the back of the chest. Through the open apex of the axilla, bounded by the clavicle, the scapula, and the first rib, which transmits the large vessels and nerves from the neck to the upper limb, blood, pus, and other inflammatory effusions, and even rapidly growing and infiltrating tumours, may spread from one region to the other. The large quadrangular base of the cavity is covered by thin, soft, and very sensitive skin, studded by long fine hairs, and abundantly supplied with sebaceous and sweat-glands. As a result of its situation and structure this portion of the general integument is a frequent seat of boils, of small superficial abscess, and of inflammatory eruptions due to direct irritation.

The chief point of interest in connection with the deep fascia of the axilla is its disposition in two layers, one connected with and enclosing the pectoralis major, and the other and deeper layer enclosing the pectoralis minor, and being continuous above with the costo-coracoid membrane, and below with the so-called suspensory ligament of Gerdy, which plays an important part in cases of deep-seated axillary abscess. The

large vascular trunks as they pass through the cavity, are surrounded by the brachial plexus, which here begins to spread out, the median nerve passing almost directly downwards to the inner side of the arm; the musculo-cutaneous nerve being directed outwards and downwards; the ulnar nerve inwards and downwards; and the musculo-spiral and circumflex nerves backwards and downwards. The thick and strong cords of the plexus are rarely torn through, save in cases of very severe injury, but are often compressed in cases of luxation of the head of the humerus, and also during the growth of a large tumour. The nerve which is mainly, if not exclusively, affected in instances of 'crutch paralysis' is the musculo-spiral.

The axilla, which is traversed by numerous branches from the main blood-vessels, is readily infiltrated and occupied by effused blood in cases of fracture and other injuries. In rapidly expanding tumours of the axilla this space is soon obliterated, the growth tending to extend most freely downwards, so as to project beyond its base and to separate the arm from the side of the chest. In sub-coracoid luxation of the head of the humerus the upper part of the space is occupied by the displaced bone.

Acute cellulitis of the axilla may occur either as a localised affection, or in association with a like condition of the arm or the whole of the upper extremity. In the former instance it is usually the result of inoculation with some septic virus, and is marked at first by deep-seated pain in the axilla. The integument soon becomes red and œdematous. As a rule this inflammatory affection is remarkably rapid in its progress, and the zones of invaded connective tissue rapidly undergo sloughing. The constitutional symptoms are generally very severe, and the patient often passes into a condition of intense septicæmia.

Circumscribed suppuration in the subcutaneous connective tissue of the armpit —*superficial axillary abscess*—may be due to local irritation, to lymphangitis, or intense cachexia. The abscess consists in a rounded fluctuating swelling, which is very tender and covered by tense and highly congested skin. In a case of this kind a free incision should be made at an *early stage*, in order to prevent penetration of the pus into the deeper portions of the axilla, and the formation of one or more obstinate sinuses.

Deep-seated axillary abscess may be acute or chronic, and again, either primary and dependent on some local cause, or secondary and due to the spreading of pus from some other region. A purulent collection in the axilla may be part of a larger abscess due to suppuration in the neck, to necrosis of the scapula, or to disease of the shoulder-joint. Instances have been recorded of empyema which had perforated the thoracic walls so as to produce a deep axillary abscess.

Primary acute abscess of the axilla is often the result of septic absorption, but may arise spontaneously or from contusions or sprains. The most frequent cause, however, is sympathetic glandular inflammation, excited by some wound or scratch or an open sore on the hand or breast. Whatever may be the cause of deep-seated abscess in the axilla, the arrangement of the fasciæ met with in this region plays a very important part in the seat of the purulent collection. The so-called suspensory ligament of the axilla formed by the process of fascia, which, after having enclosed the pectoralis minor, is inserted into the floor of the cavity, influences, at any rate in the earlier stages, the course taken by the pus. Hence, owing to this lamina, there are two forms of deep axillary abscess—one beneath the pectoralis major, the second at a greater depth, and beneath the pectoralis minor. In the former case the pus would make its way to the anterior border of the axillary fold, or in the furrow between the deltoid and pectoralis major. In the latter case, the pus, being bound down by the clavi-pectoral fascia, would have a tendency to surround the vasculo-nervous cord and to ascend into the neck, and might there infiltrate extensively the cellular spaces, and ultimately spread through the superior aperture of the thorax into the anterior or posterior mediastinum. There is often a tendency for the pus to burrow beneath the latissimus dorsi and into the subscapular fossa, and in some instances it has been known to extend as far as the brim of the false pelvis.

But few points of special import have to be mentioned with regard to the treatment of deep-seated abscess of the axilla. Suppuration being clearly indicated, it is necessary to afford vent to the pus without delay; and, after making an incision, it is well to use a director and dressing-forceps, as in other cases of opening a supposed abscess which is situated at some depth from the surface, and in the midst of important vessels and nerves. As the abscess-cavity contracts, care should be taken to keep the arm at rest and in contact with the side of the chest, as healing may be retarded by free

movement of the limb, and fistulous tracks thus be established.

The most frequently observed of the many forms of *Glandular swelling* in the axilla are:—simple, acute, and chronic adenitis, strumous and syphilitic enlargements, secondary cancerous infiltrations, and lymphadenoma. Swellings of an inflammatory character, if acute, may in most instances be readily recognised, and usually there is evidence of some lesion of the lymphatics of the hand or of the thoracic or abdominal parietes. Such swellings do not of necessity run into suppuration. With chronic adenitis there is usually associated some well-marked cachectic condition. Syphilitic adenopathy, when occurring in the axilla, consists in the usual marked induration and slight enlargement of a few separate and freely movable glands, and is thus distinguished from the large lobulated and softened masses formed by the coalescence of glands undergoing strumous degeneration. Lymphadenoma, which often co-exists with like growths in other regions, presents a large and rapidly-growing but painless tumour of firm and elastic tissue, and with a generally smooth surface, marked at one or more parts by distinct lobular projections. The glands most frequently affected in cases of cancer of the mamma are those situated along the lower border of the pectoralis major and on the inner wall of the cavity near the superior digitations of the serratus magnus.

The *Tumours* met with in the axilla are mostly of glandular origin, but other forms of new growth occur, which either spring from adjacent bones or originate in the soft and proper structures of the cavity. Of the former the most frequent examples are hard (exostosis, enchondroma) or soft (carcinoma, sarcoma) growths originating in the scapula, the upper part of the humerus, or a rib. Of the second class of tumours many varieties have been observed — such, for instance, as cystic, lipomatous, fibrous, fibro-cystic, erectile, and primary sarcomatous growths. To these may be added a few instances of new growths connected with the nerves of the brachial plexus, such as neuromata and cysts. A very frequently noted characteristic of axillary tumour, even when of a very benign character, is rapidity of growth and consequent size, the large and loosely-packed cavity of the armpit favouring free expansion of the new growth, which in the early stages of the development causes but little if any disturbance, and is concealed by the pectoral muscles and the scapula. In almost every case of large or rapidly-developing tumour of the axilla, the attention of the surgeon is directed to a series of symptoms due to compression of the axillary blood-vessels and of the cords of the brachial plexus.

The subject of the *operative removal of axillary tumours* is one of much importance. A small and freely movable growth may in most instances be excised readily and with little danger. With regard to large growths which occupy most of the cavity and protrude beyond its inferior limits, the question of excision will be influenced by the diagnosis as to the nature of the tumour and the extent to which the large vessels and nerves, and also the integument, are implicated. Very large fibrous, fibro-cystic, and cystic growths have been successfully removed from the axilla, and in most cases of such forms of tumour operative interference may be considered as justifiable if the patient be in good condition. In lymphadenoma of the axilla the enlarged glands, according to Erichsen, form no attachments to surrounding parts, and may be readily removed by enucleation. The attempted removal of a very large lobulated lipoma or enchondroma is likely to be attended with much difficulty and risk, in consequence of the irregular extension of the growth around large vessels and nerves and into other regions. In the case of a very large, rapidly-growing, and fixed tumour, associated with considerable œdema of the upper extremity and indications of obstructed circulation and nerve-compression, the probability of a successful extirpation would be small, as both artery and vein, together with the cords of the brachial plexus, would almost certainly be found implicated in the disease. No attempt should be made to remove a large sarcomatous tumour, especially when the skin is ulcerated.

The enucleation of enlarged strumous glands from the armpit is usually a tedious and difficult operation, and is hardly justifiable, except in the rare instances in which the patient is in good condition and the glandular disease is very troublesome, rebellious to ordinary treatment, and limited to the axillary region. In the operative treatment of carcinoma of the breast, careful dissection of the axillary cavity and enucleation of both enlarged and apparently healthy glands have of late been advocated by many English and German surgeons. In operations of this kind, and also in the removal of any large axillary tumour, it will often be found necessary to make partial or complete division of the

pectoralis major. The great danger is wound of the axillary vein or some large tributary. The knife should be laid aside as soon as possible, and the finger-nails and blunt instruments used to dislodge the growth, the surgeon taking care not to tear it away rashly and with too great force, as large venous trunks may be readily lacerated.

Wounds of the Axilla.—Serious direct and penetrating wounds of this region are not often met with, the cavity, especially when the arm is near the chest, being well protected on every side. In most instances of deep wound of the axilla, associated with division of a large vessel or nerve, the cause is a gun-shot wound, a sword-thrust, or a stab with a knife or dagger. A deep punctured wound, implicating merely a small arterial or venous branch, may, in consequence of the laxity of the axillary connective tissue, cause considerable effusion of blood and temporary distension of the cavity. In the case of a deeply penetrating wound, the absolute diagnosis as to whether the main trunk or a branch has been divided is uncertain and difficult. If the bleeding is very copious and the wrist-pulse cannot be felt, the main artery has very probably been wounded. The radial pulse, however, sometimes persists, though much weakened, in cases of partial division of the axillary artery. If there be much swelling and lividity of the upper extremity, with congestion of the superficial veins, the pulse being still perceptible, the injured vessel is very likely the axillary vein, although this is much less frequently wounded than the artery. If the hæmorrhage, at first severe, ceases or decreases, and the radial pulse can still be felt, the chances are that some large branch, either arterial or venous, has been wounded. Numbness of the upper limb, with more or less marked and diffused paralysis in connection with a punctured wound of the axilla, indicates a lesion of one or more large nerves.

In wounds of the axillary artery or one of its large branches, the results vary in different cases according to the extent of injury to the vessel and the nature of the wound in the skin and other structures of the axilla. Here, as in any other region traversed by a large arterial trunk, there may be very profuse and rapidly fatal hæmorrhage from a wide wound, freely exposing the injured vessel; or there may be repeated effusion of large quantities of arterial blood into the space in connection with a long and very narrow puncture, or, again, temporary arrest of the bleeding, with the formation, after a certain interval, of an arterial or arterio-venous aneurism. Two instances have been recorded of spontaneous cure of division of the axillary artery, but such a result must be very rare.

Treatment.—In the event of spontaneous arrest of hæmorrhage in penetrating wound of the axilla, it is better not to interfere at all, but to keep the patient quiet and carefully watch for any symptoms of arterial injury that may occur. Pressure, if it readily arrests the bleeding, should be gently and carefully maintained. In cases of free and persistent bleeding from a large open wound, or of rapid infiltration of the soft parts under the skin and fascia, an attempt should be *promptly* made to secure the artery at the seat of injury. The subclavian artery being commanded just above the clavicle by pressure, a steady dissection should be made down upon the wounded vessel, the surgeon being guided by the position of the external wound. If on free division of the infiltrated structures and removal of clots, the artery can be exposed at the seat of injury, this should be secured by two ligatures, one above, the other below, the wound, and the vessel, if not completely divided, be cut through between the points of ligature. The difficulty of finding the wounded artery may be so great, and the symptoms so urgent, as to lead the surgeon to have recourse to ligature of the subclavian in the third part of its course. The results of this operation, however, under such circumstances, have hitherto proved very unsatisfactory, and except, probably, in instances of but a small puncture of the axillary artery or one of its branches, it has almost always been followed by a renewal of the hæmorrhage. On failure of this procedure, amputation at the shoulder-joint will afford the only chance for the patient.

For the treatment of the remote results of wound of the axillary artery, *see* Axillary Artery, Aneurism of the.

Wound of the *axillary vein*, may, though rarely, be produced in any of the ways already mentioned, but most frequently occurs during the removal of a large tumour from the axilla. Sometimes only a branch is divided or torn by the surgeon; but this, when the injury occurs near the junction of such branch with the trunk, is as serious a condition as a wound of the main vessel itself. Such wounds are dangerous on account, not only of hæmorrhage, but of the entrance of air into the vein. Immediately profuse bleeding from a large vein is detected, a ligature should be applied. Should the main trunk be much wounded,

it ought to be secured by a double ligature. Such practice, however, unless applied under antiseptic conditions, is not free from danger, as phlebitis and pyæmia may be thus produced.

Simultaneous wounding of both axillary artery and vein, though a serious injury, does not necessitate primary amputation at the shoulder-joint. Indeed, several records of this double injury seem to indicate that the patient is in a somewhat more favourable condition than after wound of only the artery. The hæmorrhage, according to Böckel, may soon cease, and an arterio-venous aneurism result, which may be more favourably dealt with than a large false or traumatic aneurism. *See* Arterio-Venous Aneurism.

A subject of much interest in connection with axillary injuries, is that of wounds of large vessels in certain cases of dislocation of the head of the humerus. Such injury may occur in a recent case of uncomplicated dislocation, even when no attempt at reduction has been made; in a case of dislocation complicated by fracture; or—and these are the most frequent instances—in cases of old dislocation, treated either by very forcible extension or extreme abduction and elevation of the upper limb. The vascular lesion consists usually in either complete rupture of the axillary artery, or in separation of one of the large branches close to its origin. Some instances have been recorded in which the injured vessel was the axillary vein, and in some few serious hæmorrhage was caused by the rupture of several small arterial and venous branches. In those cases in which rupture of the axillary artery is caused simply by elevation of the arm in an attempt to reduce an old dislocation, some special conditions must exist to account for the injury; for the proportion of these unfortunate instances to those of successful reduction by much force of a dislocation of very long standing is very small. These conditions, it has been stated, are degeneration of the arterial walls and firm adhesion of the displaced extremity of the humerus to the surrounding parts, especially to the large vessels. In a collection of thirty-one cases published by Mr. Callender, in 1866, all the patients save one were over fifty years of age; but in a more recent and fuller table published by Dr. Körte, of Berlin, fifteen out of forty-eight patients were under this age, and six of these were between twenty and thirty years of age. In cases in which the luxation is quite recent, the vascular injury is due either to direct action of the head of the humerus, to unnecessary violence in reduction, or, in complicated dislocation, to a puncture by the sharp end of a fragment of bone. *See* Arteries, Rupture of.

In some cases of ruptured axillary artery the blood is poured out very rapidly into the subcutaneous soft parts of the axilla and chest and back, and the patient dies within an hour; in other cases a well-marked traumatic aneurism is developed within a few hours or days after the injury; and in others, again, the swelling is formed very gradually, and is not observed until after a considerable interval.

The prognosis in cases of this injury is most unfavourable, especially when the dislocation has been of long standing and the patient is advanced in years. According to Körte, who has studied this subject very carefully, in cases of small tumour not presenting the characteristic signs of an aneurism, the most suitable treatment is complete rest of the limb, with pressure over the axilla, the patient being carefully watched. In cases of rapidly-developed and undoubted aneurismal swelling, antiseptic ligature of the subclavian artery would offer the best, but a slight, chance of success. If the tumour have existed for some time, and its pulsation is not arrested by pressure on the subclavian artery, the only possible operative treatment would be incision of the tumour and double ligature of the wounded artery. Edward Bellamy.

AXILLARY ARTERY, the, extends from the outer border of the first rib, whence it passes with a gentle curve across the upper part of the axilla, to end at the lower border of the teres major muscle. The artery is divided into three stages by the pectoralis minor.

1. The stage above the pectoralis minor, or first stage, passes from the first rib to the upper border of this muscle. In front are:—the skin, superficial fascia, platysma, and descending branches of the superficial cervical plexus, deep fascia; the pectoralis major, beneath which is a triangle—the clavi-pectoral—overspread by the clavi-pectoral or costo-coracoid fascia. Through the fascia pass the acromio-thoracic artery, the cephalic vein, and the external anterior thoracic nerve. On a plane anterior to and below the artery is the subclavian vein; behind and above, the cords of the brachial plexus; internally, the serratus magnus.

Ligation.—Three methods of incision are in vogue. 1. A semilunar from near

the sternal to near the acromial end of the clavicle. 2. A straight incision along the clavicle with similar limits, to which a second vertical incision is added, separating the deltoid from the pectoralis major. 3. A vertical incision alone, separating the two last-mentioned muscles. The first-mentioned incision, commencing just below and external to the sternal end of the clavicle, is made by a sweeping cut downwards, ending at the anterior border of the deltoid. The coverings mentioned above are cut through, severing the pectoralis major from the clavicle. Feel for the edge of the pectoralis minor when the shoulder is pressed backwards, and pushing the finger still further backwards, recognise the pulsations of the axillary artery. Push the shoulder forwards, clear the artery of cellular tissue, and avoiding the vein in front and the cords of the plexus behind, pass the needle from before backwards, and obliquely from within outwards.

2. The second stage of the artery, that beneath the pectoralis minor, has this muscle in front; the vein internally and below; the cords of the plexus begin to surround the artery, but are still placed for the most part behind.

Ligation at this stage is performed by cutting, in the line of the artery, through everything till the artery is reached.

3. The third stage, or that beyond the pectoralis minor, ends at the lower border of the teres major muscle, i.e. some distance down the humeral shaft. In front are the cutaneous structures, and the pectoralis major for a short distance above; behind it rests on the subscapularis, latissimus dorsi, and teres major; internally and below is the vein. The cords of the brachial plexus are named outer, inner, and posterior, according to their relations to the artery; the median nerve lies in front.

Ligation.—Place the limb in the position of abduction, and rotate it outwards. The artery is found at the junction of the anterior and middle thirds of the axilla from before backwards, just under cover of the bulge of the coraco-brachialis. Make an incision along this line for three inches, cutting skin only; raise and divide the deep fascia upon a director. Pull the axillary vein backwards, when the nerves associated with the front and inner side of the artery appear. Draw the median nerve forwards, the internal cutaneous and ulnar nerves backwards, expose the artery, and pass the needle from behind forward.

JAMES CANTLIE.

AXILLARY ARTERY, Aneurism of the.—Aneurism of the axillary artery is probably met with more frequently than that of any other large artery save the popliteal, but, in the majority of cases, is due more to injury than to arterial disease. The tables that have been formed of recorded cases of this affection all include a number of instances of traumatic axillary aneurism from wound, laceration, or rupture, and of aneurism following a blow on the shoulder. As might be concluded from these facts, axillary aneurism occurs much more frequently in males than in females (12 to 1), and is more often met with on the right than on the left side. In fifteen cases collected by Mr. R. W. Parker, of spontaneous external aneurism in persons under the age of twenty, one only is included in which the axillary artery was affected.

There are certain special points to be noted with regard to the signs and symptoms of a typical axillary aneurism. In the first place, the swelling, as a rule, increases very rapidly. To the expansion of an aneurismal sac, as to that of a rapidly growing tumour, but little resistance is offered by the lax cellular tissue of the axillary space, and, in the course of six weeks or two months, a large and very apparent pulsating tumour may be developed. The tumour springs most frequently from the lower part of the artery, and projects directly downwards between the folds of the cavity. In cases where it arises from a higher part of the artery, it has a tendency to project upwards towards the clavicle, and occasionally even into the posterior triangle of the neck. The elevation of the shoulder so often observed in cases of large aneurism in the axilla is due, partly to pressure of the sac on the lower surface of the clavicle, and partly to constant voluntary efforts made by the patient to relieve compression of the cords of the brachial plexus. The sac of a large axillary aneurism may cause serious lesions both to the walls and contents of the cavity, and much disturbance in the blood-supply and innervation of the upper limb. The clavicle, or the first two or three ribs, may be eroded, and the sac, Böckel states, may project into the thoracic cavity or open into the shoulder-joint. The pressure of the sac on the nerves, as in cases of large solid tumours, causes numbness of the upper extremity and severe neuralgic pains. Owing to obstruction of the circulation through the axillary vein, the whole limb becomes congested, œdematous, and cold. The disturbance in the flow of blood through

the artery may cause considerable diminution, or even complete arrest, of the radial pulse, and some loss of muscular power.

The *diagnosis* of true axillary aneurism is not usually attended with any difficulty. Several instances have been recorded in which experienced surgeons diagnosed the swelling as an abscess, but in these the affection consisted in a large diffused aneurism of traumatic origin. The conditions most likely to be confounded with circumscribed aneurism in the region of the axilla are those of a large and soft malignant growth, and of osteo-aneurism of the upper extremity of the humerus. In the former instance the clinical history and general condition of the patient with regard to cachexia and rapid emaciation, and in the latter instance the starting-point and situation of the growth, will probably serve to render the diagnosis clear.

The *treatment* of axillary aneurisms, which up to 1860 had consisted almost invariably in the application of a ligature to the third part of the subclavian artery, has since been much modified in accordance with more recent views as to the risks of the Hunterian operation when applied to this affection, the condition of the artery at the seat of aneurism, and the advantages of digital compression. In 1860, Mr. Syme advocated a return to the old method of treating axillary aneurism by incising the sac and applying a double ligature to the affected artery. The risks of ligature of the subclavian artery must always be great in consequence of the proximity of the sac and the free collateral circulation; and the old operation, even in the hands of the most experienced surgeon, must be regarded as a very heroic and hazardous proceeding. Save when contra-indicated by large size and rapid expansion of the sac, and by extreme elevation of the clavicle, digital compression should always be tried in cases of circumscribed aneurism of the axillary artery. This method has been strongly advocated by Mr. Holmes, who is of opinion 'that there are a great number of axillary aneurisms, both traumatic and spontaneous, which are amenable to gradual, intermitting pressure, when carefully applied to the artery above the tumour, and that in cases where this is not possible, from the pain which the patient experiences on pressure, the application of rapid total compression, under anæsthesia, may effect a cure.' If compression should fail, the surgeon may then have recourse to ligature of the subclavian, or, in the presence of any insuperable difficulties in the performance of this operation, to the old method as advocated by Syme; or, if the aneurism be of considerable extent, to removal of the upper extremity at or near the shoulder-joint. In instances of ruptured artery and large diffuse traumatic aneurism, it will be found necessary to expose the vessel and to secure it by ligatures above and below the seat of injury. EDWARD BELLAMY.

AXILLARY ARTERY, Wounds of the. *See* AXILLA.

AXIS, Fracture and Dislocation of the. *See* BACK AND SPINE, Injuries of the.

B

BACILLUS. — A rod-shaped form of micro-organism, belonging to the class of Schizomycetes (q.v.) and forming the genus Desmobacteria of Cohn.

Most forms are several times longer than their breadth, and the protoplasm is usually continuous within the cellulose sheath; in a few it is occasionally interrupted. The bacilli possess all the characters common to the Schizomycetes, but reproduction is brought about not only by simple longitudinal extension, followed by fission, but also by spore-formation. By fission, one rod has been found to double itself in twenty minutes at 35° C. In reproduction by spore-formation, the rod usually extends into a long filament (*leptothrix*), in the protoplasm of which there appear at intervals bright spots, which soon develop into (oval) spores. By the rupture of the filament these are liberated, and develop into rods by an extension at one point of their protoplasmic body pushing outwards the hyaline covering or sheath. Many bacilli, however, do not form *leptothrix* threads, and spores appear in the protoplasm of the adult rod, the sheath of which bursts, and the spore is freed. The presence of oxygen appears to be necessary to spore-formation.

(1) The SAPRIC bacilli, of special surgical interest as occurring in putrefying fluids, are :—

B. subtilis, found in putrid hay infusions and grows readily in animal fluids, e.g. serum, &c.

B. ulna. A much larger form, being more than twice as thick, found in putrefying animal tissues.

B. sapricus. A non-motile form found shortly after death in human blood-vessels (Klebs and Bond).

B. butyricus, found in fluids in which butyric fermentation is going on.

(2) The PATHOGENIC bacilli are of the greatest importance, as several diseases have been clearly proved to be due to their mycotic action.

B. septicæmiæ. (a) Of mice, Koch. An exceedingly small organism found in putrid fluids. Œdema is produced at seat of inoculation, the spleen is swollen, and the rods are mostly found in the leucocytes. (b) Of man, Klein. Also small organism, but larger than (a), figured by Klein, as found in lymph glands.

B. anthracis. This organism forms the poisonous element in splenic fever in animals, and malignant pustule (q.v.) and wool-sorter's disease in man. It is found throughout the blood cramming the small vessels, causing inflammatory changes in the respiratory passages and lungs, swelling of the spleen (sometimes), and occasionally intestinal lesions.

B. anthracis symptomatici. The 'quarter evil' of animals, in which a hæmorrhagic œdema is produced at the seat of inoculation and consequent death from sapræmia (q.v.). The effects are proportional to the number of bacilli injected.

B. of malignant œdema (Koch), found in putrid fluids (? a form of *B. sapricus*) &c. Causes gangrenous œdema, with swelling of spleen and parenchymatous organs, together with petechiæ in and inflammation of serous membranes. The writer has twice seen similar organisms in traumatic gangrene, with similar post-mortem appearances.

B. tuberculosis. (a) Of man (Koch). A small organism, the protoplasm of which often has a beaded appearance. Found in the giant cells and caseous masses of tubercular lesions throughout the body; and when cultivated, inoculations produce a similar disease. The presence of the bacilli in sputum affords a valuable aid to the diagnosis of fatal phthisis. (b) Of animals. A similar though smaller bacillus is found in tubercular lesions of animals, the same being macroscopically different from the disease in man. It is doubtful at present if this form is communicable to man.

B. lepræ (Hansen). A small bacillus presenting the same behaviour to reagents as the *B. tuberculosis*; is found in enormous quantities in the corpuscles forming the leprosy nodules and thickenings of connective tissues.

B. equiniæ. A small bacillus found in the nodules, &c., of glanders both in man and animals.

B. nomæ (Lingard & Batt). In spreading ulcerative stomatitis, bacilli have been found at the margin of the disease. Death appears to follow from sapræmia, produced by swallowing the putrid discharge, since the writer has found a progressive anæmia, &c., in a case of this disease.

B. of swine plague (Klein). In swine-plague, the organs throughout the body contain bacilli closely resembling *B. subtilis.* The lesions produced are swelling of the spleen, pneumonia, necrosis of small patches in the liver, &c.

B. malariæ. Organism found in blood of malarious patients, which inoculated into rabbits produced a fever said to resemble malaria (?).

B. of choleraic diarrhœa from putrid meat (Klein), An organism found in two important epidemics of diarrhœa, fatal in five cases. The organisms were rounded at ends, and ·003—009mm. in length. Inoculation on animals produced similar fatal disease.

B. of lupus. In lupus corpuscles, &c., is found a small bacillus, the relation of which to syphilis and tubercle remains unknown.

B. typhoidus. A short thick organism found in the lymph-glands and spleen, in cases of typhoid fever. It is of doubtful importance.

For *B. choleræ*, see *Vibrio.*

VICTOR HORSLEY.

BACK AND SPINE, Injuries of the.—Here, as elsewhere, injuries may be met with ranging from the most trifling to the most severe. But there is perhaps no class of cases in which early diagnosis is more often difficult, or prognosis uncertain, from the fact that the slighter degrees of injury to the spinal cord or the offshoots from it, may at first give rise to no symptoms, and may lead to a sense of security as to the future which a more certain pathological knowledge would have proved to be unwarranted. But although the graver injuries of the spinal column, its fractures and dislocations, are usually fatal, or cause lifelong incapacity from simultaneous damage to the spinal cord, there

nevertheless are not a few instances where recovery has taken place, or life been prolonged in comparative comfort, even after spinal injuries of apparently the most hopeless kind. The greater boldness in treatment which has followed a more extended pathological knowledge has shown us that the once hopeless view entertained of all fracture-dislocations of the spine is not altogether warranted. Not a few cases are now on record in which the reduction of a displacement or dislocation of the spine has led to a speedy subsidence of the symptoms which were due to pressure on the cord, and whose continuance was an exceeding danger to life, with the fortunate result of bringing about recovery, or at any rate of delaying the fatal end.

Sprains and Wrenches compose by far the largest proportion of the injuries to which the spine is exposed; and giving rise, as they often do, to severe and extensive pain, as a prominent symptom, they are liable to cause much hesitation and difficulty in diagnosis, and thereby lead to treatment unsuitable perhaps for their relief and cure. The cervical and cervico-dorsal regions, where movement is free and extensive, and in not much less degree the lumbo-dorsal region of the column, provide the most numerous instances of simple sprain, although no part of the spine can be said to be exempt therefrom, and now and then cases are met with where the whole vertebral column has been subjected to a severe wrench. Amongst the many causes of this injury, the commonest perhaps are the lifting of heavy weights, or the sudden and inordinate bending of the spine from indirect violence, whereby some fibres of muscle or ligament are stretched or strained, or it may be ruptured, either in voluntary efforts to straighten the column, or when unconsciously it is being held rigid and secure against the violence to which it is being subjected. Be the precise cause, however, what it may, the patient feels that he has ricked or twisted some part of his spine, and the local symptoms are usually such as are met with after a like injury in the neighbourhood of any mobile part or joint, and consist in local pain and local tenderness, stiffness and rigidity, and inability to move without suffering, and in the severer cases some undoubted swelling, either from extravasated blood or simple serous effusion.

It must be remembered, however, that such are the smallness and depth of many of the muscles and ligaments, that visible signs of injury are often absent, and we have to rely on the symptoms alone, their mode of onset, and the history of the injury. The local pain may come on almost immediately after the accident, and it is often extremely severe—a common experience after injury of muscular and ligamentous fibres; and this severity of the pain it is which too often leads to an erroneous belief in the existence of injury of deeper and more important structures. And when to this are added unwonted rigidity of the spine and inability to move without much pain, then the suspicion seems strengthened that the spinal cord or its coverings have not escaped injury. The suspicion is too likely to grow into belief, which, unfortunately, may lead to unsuitable or even harmful treatment, if the severity of pain on movement is such that the patient feels the greatest dread in moving at all, or if his attitude be so constrained and his gait so hindered that he presents a condition of pseudo-paralysis. Or again, in cases of severe lumbar sprain, the muscles and ligaments may have been so placed *hors de combat* as to lead to great difficulty in micturition and defecation, results which are by no means uncommon in lumbago, whether due to cold or injury, and which indicate how largely the ease and perfection of these acts depend upon the functional integrity of the muscles which support the spine. The combination of symptoms may suggest very grave inferences, though happily experience tells us that in the great majority of cases they indicate nothing more serious than muscular or ligamentous strain—an injury painful enough in itself, but rarely warranting a dread of future mischief, which may add to the patient's anxiety and thus retard his convalescence.

Far better, however, to draw an unwarranted inference from the symptoms than to fail to recognise the presence of injury to more important parts, for it cannot be forgotten that some of the ligamentous structures of the column are in close proximity to the spinal canal and the blood-vessels within it. Laceration of the posterior common ligament, for instance, cannot occur without risk of injury to the spinal membranes—not immediately, perhaps, by implication of them in the same lesion, but by extension of inflammation from the injured part, if sufficient rest has not been allowed for perfect recovery. So also the ligamenta subflava are in direct relation with the meningo-rachidian veins, and severe laceration of the one may be associated with rupture of the other. Hæmorrhage may thus arise within the

spinal canal, not of itself perhaps sufficient to cause appreciable symptoms, but yet enough to be the starting-point of inflammation about the membranes and, it may be, of ultimate degeneration of the spinal cord. Herein lies the danger of any form of accident whereby the spinal column has been inordinately bent, that some one or more of the structures which are contiguous to internal parts may have been hurt, and there are no special signs or symptoms at hand to show that such has been the case.

Perfect rest is at first essential, not only to permit subsidence of swelling, whether superficial or deep, visible or out of sight, and to allow of repair of the injured muscular or ligamentous fibres, but also, and of even more importance, to avoid the risks of inflammation which want of quiet may engender in and about the injured parts. The length of time during which absolute rest is necessary must depend upon the extent of the injury and the mode of the accident, but better too much rest at first than too little. As the pain on movement lessens, so we have an indication that movement is less undesirable than before. The continued application of warmth is most comforting to the patient, and nothing is so beneficial perhaps as a large linseed poultice in which he may lie. For internal medicinal treatment there is usually no call, unless the patient be the subject of rheumatism or 'rheumatic gout,' when, as is well recognised, any muscular or ligamentous pain is likely to be severe and troublesome, and therefore, it may be, to demand the administration of alkalis, of iodide of potassium, of salicylate of soda, or quinine. Constipation must be relieved by occasional aperients, or better by simple enemata, and difficulty in micturition had better be met by the careful use of a soft catheter.

Sufficient rest having been given, the later treatment must consist, as in the case of the larger joints, in movement rather than in fixation and enforced rigidity of the affected part. This is frequently one of the surgeon's chief difficulties, for the pain on movement may be so considerable, and so prone to return for some time after it seemed to have disappeared, that the patient can hardly believe that movement, which at first may aggravate his pain, should be the proper treatment to remove both pain and stiffness. Movement and the application of heat may be combined, while the patient is still in bed, by the old remedy of ironing the back with a hot iron, a means of treatment very often beneficial from the heat compelling the patient to shrink and move, and thus calling into action fibres over which he might not otherwise be able to exert the influence of his will. The relief is often striking; as we see after the manipulation of a joint stiff from sprain, the passive movement soon becomes active, and with the disappearing stiffness the local pain and tenderness considerably subside. It is in these cases that great benefit may be derived from systematic exercises on the Zander method; and the daily application of the continuous or interrupted current to the affected parts, or, better, of both combined, may sometimes give relief when other means have failed. It is essential that the current be strong, and that it be brought to bear on a considerable extent of surface by the use of large flat plates.

In cases of severe contusion or sprain of the dorsi-lumbar spine we sometimes meet with hæmaturia, the result of structural injury to the kidney. By itself the symptom is not serious, unless the amount of bleeding be very large, and even then it is amenable to treatment by the administration of ergot or gallic acid, with perfect rest. The bleeding usually subsides in course of time, as the breach in the kidney becomes repaired, and there is no evidence to show that such an injury is liable to give origin to a chronic nephritis. Lacerations of the kidney by themselves are not commonly fatal, and it is rare to have an opportunity of post-mortem examination, unless there be some other serious lesion which complicates the case.

Spinal Injuries of Railway Collisions.—What has been absurdly termed the 'railway spine' is an affection of the spinal column essentially similar in all its characteristics to the injuries already described. It is a common experience after railway collisions to meet with many cases where there is complaint of pain either about the spinal column itself or in the muscular structures on either side of it; and the combination of symptoms is precisely such as we meet with after other and less special forms of accident. The only difference—if, indeed, difference it be—consists in the fact that many diverse parts of the spine may be affected at the same time. Cervical, dorsal, lumbar, and sacral regions may each and all be simultaneously wrenched or sprained, and as a consequence there may be very severe suffering throughout the whole spine and its neighbourhood, causing much alarm as to the extent of the injury, and inducing a belief that some

serious lesion has been inflicted on central structures. The mode of accident is precisely such as would be expected to give rise to spinal wrench or sprain, for the victim of a collision is thrown backwards and forwards in the carriage, and during this violence—against which he is well-nigh powerless—the muscles and ligaments of the spine, as of other parts, are 'set,' or unconsciously contracted, in order to render the spinal column rigid; and thus it happens that the brunt of the violence falls on those structures whose office it then is to prevent undue bending of the spinal column and damage to the important organ within. The result is spinal wrench or sprain, giving rise to acute pain on movement, to local tenderness, to great stiffness, to difficulty in micturition and defecation, and to that sense of weakness in the legs which is common in lumbago, and which is due to the muscular and ligamentous structures of the spine having been rendered functionally inert. And, in the very severest degrees of this form of injury, it seems probable that there is sometimes strain or stretching of the nerve-trunks as they pass outwards through the spine, as evidenced by tingling or pain in their peripheral distributions.

The pain may come on almost instantly after the accident, or it may be delayed for some hours or days, until, by some particular movement, those fibres which have been injured are called into action and their damage is thereby revealed. The cases may vary in every degree of severity, from slight pain lasting only for a few days, to pain and tenderness and stiffness abiding for many months, and causing long-continued incapacity. Unfortunately the sufferers from this form of accident have to contend against influences which may very seriously retard their progress towards recovery. In the first place, it is unusual to find that a spinal sprain is the sole injury received. The circumstances of many collisions are enough to produce a very profound effect upon the whole nervous system, and symptoms may in consequence be developed indicative of very considerable functional disturbance of both cerebral and spinal centres. A condition of nerve-exhaustion or neurasthenia is induced as the result of severe shock—in the judgment of the writer, of shock from fright—which manifests itself in various ways, and complicates the vertebral sprains which otherwise would seem of less importance, and be no less amenable to treatment than sprains inflicted in other accidents. There arise derangements of the circulatory and vaso-motor systems, as shown by palpitation, alternate sensations of heat and cold, sweating, diarrhœa, menorrhagia, and polyuria; sleeplessness, restlessness, nervousness, loss of memory or inability to sustain attention, asthenopia, loss of control over the emotions, early fatigue, whether from physical or mental efforts—symptoms all indicative of some change wrought on the nervous centres, cerebral, spinal, and sympathetic, whereby they are rendered functionally incapable of the same work or control over other organs as before.

Very variable, also, in degree and in duration, may such symptoms be. The exhaustion may be slight and temporary, or may be so profound as to place life in peril, and cases are not unknown where death has occurred from simple nervous exhaustion, without any discoverable pathological changes. The effect is, doubtless, to a large extent, dependent on the nervous temperament of the individual, and experience shows that those in any way predisposed to nervous disorders, who inherit a nervous diathesis, or in whose families nerve-disease is common, are especially prone to suffer from such symptoms after railway collision. Recovery, however, is the usual rule, with appropriate treatment and after adequate time, every effort being made to secure perfect rest of body and mind, and the avoidance of everything conducive to mental worry and anxiety. And this other circumstance may have a potent influence in delaying convalescence—that the sufferer receives compensation in money for the injury sustained. It is unnecessary to enter at length into this matter here; suffice it that the hope of compensation is abundantly proved by experience to interfere very seriously with recovery. While in some cases it acts, doubtless, as a temptation to gross exaggeration and imposture, especially where the injury has been slight; in other and more numerous instances it merely acts as a hindrance to recovery, by preventing the requisite voluntary effort being made to throw off the invalid state. For the sufferer knows that, as long as compensation is to be had for his incapacity, there is no occasion for him to do the best he can to earn his own living by resuming his daily work.

In not a few instances, also, there is a nervous, but really honest, dread lest some mistake be made in the settlement of a rightful claim, quite apart from the worry that is necessarily incidental to legal proceedings. And thus the want of occupation, the invalid life of comparative comfort at another's expense, the uncertainty and un-

settlement of mind when a man is waiting to see how his case may turn out, make him alive to every morbid sensation that may arise, and foster a state of chronic invalidism which is the result of his present mode of life rather than of any injuries received. On the one hand, the want of movement and exercise perpetuates the pain and rigidity of his spine; and the general circumstances of his state, upon the other, tend largely to keep up those symptoms which are cerebral rather than spinal, and the best hope of recovery from which depends, most surely, on the return to a natural mode of life. Hence the phenomenon is not uncommon of the very rapid recovery of patients after compensation has been received, not because they have been wanting in *bona fides*, but simply because the chief obstacle to recovery has been removed.

The line of treatment to be followed in spinal wrenches and sprains has been already indicated, and for the general condition of neurasthenia we must be guided by the grand principle to secure adequate rest for the organs which have been disturbed, and especially for the brain. On all persons who have been shaken in a railway collision the advisability of complete abstinence from bodily and mental fatigue, for a time proportionate to the injuries received, should be enjoined. Here, a few days may suffice to bring about perfect recovery; there, a much longer period may be necessary; but of this there can be no question, that any endeavour to walk off the effects of the accident, or to work in spite of the brain-exhaustion so early felt, will only prolong the illness, and may bring forth symptoms which otherwise would never have appeared. No medicinal treatment is of any special avail. Rest must be secured at night by one of the narcotics, if need be, in ordinary use; and the writer would say a word in favour of opium, too much neglected nowadays in the treatment of the sleeplessness and exhaustion which are so often seen together. A note of warning cannot be withheld against the frequent administration of bromide of potassium in these cases of neurasthenia. An admirable remedy for securing sleep at night, either alone or combined with chloral or cannabis indica, it is wholly unsuitable as a sedative to compose 'the nerves,' whose agitation is rather an evidence of exhaustion and loss of control than of superabundant energy from central irritation. Given in large and repeated doses throughout the day, bromide of potassium is fraught with the gravest evil, for it merely acts as a powerful depressant, and keeps up the very condition of nervous exhaustion which we are anxious to remove. Cases, not a few in number, have come under the observation of the writer, where to the symptoms of neurasthenia from railway shock have been added those of bromism from poisoning with this drug, and where improvement has begun the moment it has been withdrawn.

Intraspinal Hæmorrhage. — Some of the spinal ligaments are closely contiguous to vessels in the spinal canal, and, as a consequence of the severest degrees of bend or sprain, we may have laceration, not only of muscular and ligamentous fibres external to the spinal canal, but of vessels also which lie within it. Hæmorrhage may thus arise, and blood be poured out within the spinal canal, and, if sufficient in quantity, may give rise to definite symptoms. These, however, are rarely the symptoms of loss of blood, but are rather due to the pressure of the effused blood upon the cord itself, or on the nerves coming off from it. Impaired innervation of the parts below the seat of lesion is found, amounting either to total paraplegia, or to some less serious impairment of motion and sensation. The difficulty of diagnosis in these cases is often extreme, for the surgeon has to decide between the existence of grave cord-lesion, and simple pressure on the cord from extravasated fluid.

The history of the accident, and the progress of the symptoms, often provide the only clue; and as, after injuries to the head, gradually deepening coma is often the chief symptom of hæmorrhage within the skull, so the early advent of a paralysis which steadily increases until complete, or almost complete, paraplegia has been reached, after some accident likely to cause severe spinal wrench or sprain, may help to exclude the existence of any graver injury than hæmorrhage. And this sequence is of especial value where the symptoms have not followed instantaneously upon the accident, as is the usual result of simultaneous crush of the cord in fracture-dislocations. The blood may be poured out between the dura mater and the bone, or within the sheath of the dura mater itself, but the symptoms give no evidence of the exact site of the blood, and depend wholly upon the quantity effused.

Treatment must be directed to lessen the hæmorrhage, and so to limit the possible damage to nervous structures, for any continued pressure upon the cord must not only interfere with its functional utility,

but may also lead to pathological changes in the cord itself. Absolute rest, the application of ice to the spine while the patient lies upon his face, and the administration of ergot, are possibly the best means for staying the bleeding, though, unhappily, its tendency is to increase, on account of the laxity of the tissues into which the blood is poured. The gravity of the symptoms is due, not to the amount of blood alone, but to the position of the hæmorrhage; for, as in dislocations and fractures, the higher the seat of the lesion, the less chance is there of recovery, or even of prolongation of life. Cases have not been few, however, amongst the comparatively rare instances of this injury, where the hæmorrhage has been low down in the spinal canal, and where there is every reason to believe that the blood has been absorbed, and recovery has been complete.

Short of this result, however, there is the possibility of some permanent damage by pressure on the cord or nerve-roots, some abiding impairment of motion or sensation in the parts below the seat of lesion; while the tendency of secondary degeneration to spread in the direction of certain 'centres' in the cord, may make a small and otherwise unimportant hæmorrhage the starting-point of wide-spread disease. Treatment in such cases must be persevering and continuous. Perchloride of mercury and iodide of potassium, or ergot, with counter-irritation by blisters to the spine, may lead to the absorption of the remaining blood, or of any inflammatory lymph which may have been effused around it; while the systematic exercise of the limbs in those movements which have been impaired or lost, with the aid of electrical treatment properly applied by competent hands, may do much to reopen those nervous channels which have been blocked at the seat of lesion.

Laceration of Membranes and Traumatic Meningitis.—This is happily a rare occurrence as the result of simple sprain of the spinal column. The acute form is most commonly induced by gunshot or other injury, which lays open the theca vertebralis, and seriously damages other parts as well. Inflammation starts at the seat of wound, and thence spreads rapidly upwards and downwards until the whole cord perhaps is bathed in pus. The same course of events has been known to follow some less serious lesion of the spine, either, it may be, from septic contamination, or from previous ill-health of the patient. The rapidity with which inflammation spreads is sometimes terrible, and amply justifies the term 'foudroyant' which has been applied to this form of meningitis. Ushered in with rigors or shivering, the temperature soon runs high; tenderness and pain are more or less marked throughout the spine, with dread of being touched or moved, and irritation of the roots of the nerves gives rise to extreme restlessness, to muscular spasm, and widespread cutaneous hyperæsthesia or tenderness. Opisthotonos, too, may occur, either from irritation of the posterior cervical and dorsal roots, or as an instinctive means of relaxing the muscles in order to relieve pain. Vomiting and delirium may also be prominent, and the patient rapidly wastes. Death occurs early, and we find *post mortem* a layer of lymph, in which the amount of pus may vary, on the inner surface of the dura mater, while the meshes of the pia mater are distended with sero-purulent exudation. As to treatment, it is impossible to speak with any degree of hope. Ice should be continuously applied to the spine, and it may be well to try the effect of repeated small doses of calomel, so as to bring the patient rapidly under the influence of mercury. Ergot, belladonna, and aconite have also been recommended, but it is very questionable whether any medicinal influence can be brought to bear on the cause of the inflammation.

Not less important than cases of acute traumatic meningitis are those where the meningeal inflammation is sub-acute or chronic, and where the absence of any definite symptoms of inflammation *per se* leads very often to the greatest difficulty in diagnosis. The development, however, of a low form of inflammation which leads to thickening and induration of the spinal membranes, and their adhesion together or to adjoining parts, is one of the results to be feared after any and every severe wrench of the spine—a kind of accident which may be calamitous in the future because we are at a loss to know whether the injury has really been of such a nature as to lead to meningitis, or to tell how and when it may begin. It can only be conjectured that it arises as an extension inwards of inflammation from some point of injury or irritation in some part of the spinal column external to, or immediately adjoining, the spinal canal. Pain and local tenderness and spinal stiffness are such ordinary evidences of simple and even slight sprain, and are so often absent even when pachymeningitis exists, that alone they are untrustworthy signs of subacute intra-rachidian inflammation, and unless

there be some distinctive symptom of nerve-disorder a diagnosis can only be most uncertain. Pain or hyperæsthesia in the region of special nerve-distributions, alterations in the reflexes, departures from the normal reaction to electricity of different muscles, anæsthesia in various degrees, impaired motor power, atrophy or rigidity of individual muscles or of groups of muscles with the same nerve-supply, are therefore of much greater value as symptoms of some meningeal thickening than are spinal tenderness, stiffness, and pain.

It is in these cases that from very small beginnings much havoc may be wrought by secondary degeneration of the nervous centres, and it is therefore all the more incumbent on the surgeon to pass by no symptoms suggestive of meningeal inflammation in the very earliest moments of the disease. And in chronic meningitis, with its various consequences, as has been seen already in acute, one has, unfortunately, too often to recognise the futility of treatment, and the only hope may lie in the possibility of a syphilitic taint being at the root of the mischief. The long and persistent administration of iodide of potassium and mercury, separately or combined, may help here, as in other late manifestations of acquired syphilis, while in the absence of that taint they may possibly tend to the absorption of simple inflammatory products. Nor should we fail to make use of counter-irritation, in the shape of blisters to the spine—a mode of treatment once in common vogue for spinal diseases, but now, perhaps, too much neglected or despised.

Fractures and Dislocations of the Spine.—Simple dislocation without fracture is not so uncommon as it was at one time thought to be, and it is in such cases, rather than in cases of fracture or fracture-dislocation, that recovery is most likely to ensue. And the reason thereof is that in simple dislocation the spinal cord is much less liable to severe injury, that its structure is less likely to be disorganised by the crushing into it of sharp fragments of bone, and that there is a better chance of being able to remove the simple pressure which the displaced vertebræ are exercising upon it. Thus accurate diagnosis is, if possible, of supreme moment. That a grave injury has been inflicted on the cord can be told at once with only too much certainty, for on that point the immediate paraplegia leaves no doubt; but we have to discover how and where the lesion has been caused. The point where can be learned by application of our knowledge of nerve-distribution, and by deciding the line—often a hyperæsthetic line—where palsy begins; but the manner how, whether by instant crush from displaced bones, by the simple pressure of extravasated blood, by severe bend and therefore disorganisation of the cord, or by simple concussion of the cord, is frequently a matter of the greatest uncertainty. We have to fall back upon a history of the accident, and upon careful examination of the spine itself, to feel or see whether there be any projection or displacement obviously discoverable by physical signs.

The presence of a projection, and therefore of displacement, should at once raise the question whether steps should not forthwith be taken to reduce it, so that the surgeon may remove the pressure from the cord, and give the best chances of recovery. If the cord itself be undamaged, and the paraplegic symptoms be simply due to the pressure of displaced bone upon it, then—as the record of several cases has proved abundantly—the symptoms may at once subside, and recovery may in the end ensue, when time has been given for repair of the spinal injury. And even when there is something worse than simple pressure, and the cord is being lacerated by some sharp fragment of bone, the reduction of displacement may perchance release the cord, and thereby lessen the risks of inflammation and add to the chances of life. Help in diagnosis may be obtained from knowing the site of the injury; for of the three regions, cervical, dorsal, and lumbar, pure dislocations are found most often in the first, and as we go lower down dislocations become rarer and fractures more common, though commonest of all are the two combined. In whatever region dislocations occur the intervertebral substance is more or less torn and lacerated, and, as a rule, the vertebra which is upper at the seat of separation, carrying with it all the vertebræ above it, is dislocated forwards on that which is below, as, for example, the fifth cervical upon the sixth; and *post mortem* we never find a vertebra separated from both its neighbours. One or both of the articular processes are usually at the same time dislocated, while there is an almost infinite variety in both the character and degree of the injuries to ligamentous structures.

Everything, doubtless, depends on the mode and severity of the accident, whether the separation be great or little, whether it be, or be not, associated with fracture, and

whether the cord be much or little damaged. Here, again, there is infinite variety. In the cervical region, for example, there may run, in connection with the dislocation, a line of fracture through the spinous processes or the laminæ of the displaced vertebra and its neighbours. There may also be fracture through one or more of the bodies, but whatever the precise lesion, whether in this region or in others, it sometimes happens that by its own natural resilience, and by that of its various ligaments, the displacement is only momentary, and the spine at once springs back into its natural position. But in that moment the damage to the cord was done. Lower than the cervical region pure dislocations are extremely rare, for, in consequence of the anatomical formation of the dorsal and lumbar vertebræ, a much greater force is necessary to produce separation, and fracture with dislocation is almost invariably found. The line of fracture may run through almost any point of the vertebral arches; there may be endless variety in the extent of the displacement of parts so detached, and very commonly there is fracture through a vertebral body also. The chances of successful reduction of displacement in the lower parts of the column are, unhappily, small, for it is well-nigh impossible to use sufficient force in the right direction, and it is questionable whether in any but a small minority of cases good will result from prolonged attempts to replace the parts in their proper relative positions. Post-mortem examination proves only too clearly that the displacement is often permanent and irreducible, and that the spinal cord has been irreparably damaged. It is found soft, pulpy, and diffluent at the seat of injury, either because it has been crushed by the displaced bones, or because its structure gave way in the excessive bend to which it was subjected. For these injuries, in whatever region, are most commonly caused by some severe and sudden bend of the spine, usually from indirect violence, in such a manner that the spine is bent upon itself, the weight of the parts above and below the site of bend adding momentum to the original violence.

Cases are not few where a wholly unsuspected fracture—'latent' fracture, as it has been termed—has been found after death, while both the nature of the accident and the symptoms afterwards had led to the belief that none was present. Settled pain in the region of one or two vertebræ, increased by manipulation of the spinous processes, and a sense of weakness or want of support at one point of the back, may be the only symptoms present—symptoms wholly subjective, but nevertheless deserving of great regard in face of the risk of secondary implication of central structures. Extravasation of blood within the theca vertebralis, meningitis, myelitis, suppuration,—these are the dangers to be feared, and we name them, not because they are common results of simple fracture without immediate injury to parts within the canal; but rather as a warning, and forcibly to urge the need of taking all conceivable care until time has been given for reunion of the fracture.

Dislocations of certain Vertebræ.—Dislocation of the *occiput from the atlas* is so rare that it may be left out of account in treating of spinal injuries, but dislocation of the *atlas from the axis* is by no means uncommon, as the result of falls upon the neck or head, or of any sudden strain upon the uppermost part of the spine, such as must be caused in execution by hanging. Death is usually instantaneous from crush of a vital part of the cord, for the rupture, which is almost invariable, of ligamentous structures—of the transverse ligament usually, of one or both check ligaments according to the nature and violence of the accident—allows the cord to be pressed forwards from behind and squeezed against the odontoid process. A like result may ensue from sudden and violent rotation of the head, whereby one of the check ligaments is torn, and laceration of others immediately follows. Instant death is the usual rule, but even in this region, bearing within it structures essential to life, there are exceptions.

Dislocations, uncomplicated with some fracture, are almost unknown between *the axis and the third vertebra*, separations between the first and second being the usual injury in this part of the neck. The cases, however, are numerous in which there has been fracture, with or without displacement, of the upper vertebræ, both from direct and indirect violence, and not a few where union has taken place and death been due to some other cause. It is in the lower part of the neck—below the third vertebra, that is—where dislocations most commonly occur, giving rise, in addition to the symptoms of cord-injury, to local pain, undue mobility, deformity, irregularity or gaping of the spinous processes, and, in some instances, well-marked projection in the pharynx, with, it may be, difficulty in swallowing. Reduction should be attempted, if need be under the influence of an anæsthetic, as soon as

possible, warning having been given beforehand, both to the patient and his friends, that the procedure of reduction is not without its own immediate dangers.

Unilateral dislocations may occur in the cervical spine; separation of an inferior articular process from the superior of the vertebra next below it being sometimes caused by sudden and extreme rotation of the neck, or even by turning the head too sharply to one side. The diagnosis is comparatively easy; the face is turned and fixed towards the side opposite to the injury, there is obvious deformity and local pain, and more or less of paralysis. Reduction must be undertaken at once, by forcible traction on the head, so as to disengage the processes, and then turning the head and upper spine into their proper axis. Counter-extension may be obtained by placing the knees against the patient's shoulders, and success is often indicated in the reduction of this dislocation, as of others which are bilateral, by an audible snap. The prognosis is favourable or the reverse according to the amount of palsy—of probable damage, that is, to central structures—and to the presence or absence of fracture. The after-treatment should obviously be directed to securing perfect rest and immobility for several weeks after the accident—a matter of no small difficulty, it may be, in bilateral dislocations when continuous extension may have to be maintained in order to prevent a return of the dislocation.

Paraplegia, or paralysis of motion and sensation—of motion, usually, more complete than of sensation—of all parts below the seat of injury, enables us to fix the level of the spinal injury and of the cord lesion; in the estimation of which it must be borne in mind that the cord is usually crushed at, or a little below, the level of the lower border of the displaced vertebra, and that the nerves issue from the spinal canal at a lower level than their origin from the cord. Their obliquity within the canal gradually increases from above downwards, and the nerve-supply is thus interrupted lower than the number of the displaced vertebra implies; while conversely, when we are endeavouring to decide the site of spinal injury by noting which nerves are completely paralysed, the fracture is really higher up than the level at which such nerves come out of the spine. Prognosis depends materially upon an accurate knowledge of the site of the lesion. The higher we ascend in the column, the greater is the danger to life, for the nearer are we to the respiratory centres, whose early involvement in inflammation is surely fatal. The cervical nerves, the eighth alone excepted, are named, it must be remembered, from the vertebra above which they come out, and the fourth cervical nerve, which chiefly supplies the diaphragm, issues above the fourth cervical vertebra, and upon the implication of its centres virtually depend the chances of recovery, and the length of life. Cases are on record, however, in which life has been prolonged even after severe damage to the cord above the origin of the phrenics—a circumstance due, in all probability, to the fact that the cord had not been injured in its entire thickness.

The chances of life are naturally much lessened when diaphragmatic breathing alone remains, the thoracic muscles of respiration being paralysed. The diagnosis of this form of breathing is free from much difficulty, its departure from the normal being most striking and characteristic. The thoracic walls do not remain motionless, as might be expected from palsy of the muscles which move them; but, by the influence of atmospheric pressure, they move at the wrong time, sinking when the diaphragm descends, and rising somewhat suddenly when the diaphragm becomes flaccid. Thus the enlargement of the chest-cavity, from contraction of the diaphragm, is counteracted by sinking in of the chest-walls just at the very moment when they ought to be expanding, and extra work is thus thrown upon the diaphragm. Respiration therefore becomes gradually more and more embarrassed, although sometimes it is marvellous how long life may continue with diaphragmatic breathing alone. The lower the seat of injury, the less likelihood is there of the cord having been entirely destroyed, and the cases are not few in which after fracture-dislocation in the lower dorsal and lumbar regions, there has been recovery sufficient to allow of very fair enjoyment of life. In such cases it is most important to re-educate the paralysed muscles, so soon as time has been allowed for consolidation of the fracture; for if any healthy structure remains, the functional restoration of the cord may be materially advanced both by exercise of the will upon the paralysed muscles, and by the proper and persevering use of electricity, by galvanisation of the cord and of the nerves and muscles below the seat of lesion, to call them into activity and reopen the obstructed paths in the medulla. It is a great mistake to rest satisfied with life having been spared, and not to make most strenuous efforts at an early date to

bring about some restoration, be it only partial, of the functions of the cord.

Paralysis of the bladder, as a usual rule, is complete, owing to the fact that both sets of muscles which govern the act of micturition are paralysed. But we may have palsy of the one without the other, and the separate and seemingly contradictory phenomena of retention and incontinence. The sphincter vesicæ and the detrusor urinæ have, in all probability, distinct and antagonistic centres in the cord. The healthy act of micturition consists in reflex excitation and action of the detrusor with, at the same time, inhibition of the centres of the sphincter, which thereupon relaxes; and although these centres usually act automatically on the requisite stimulus, they are under voluntary control during the integrity of the spinal cord. If this integrity be destroyed by lesion above these local centres, paralysis will be complete or incomplete according to the amount of interference with the spinal centres themselves. Let the centres *per se* be unaffected, and the cord destroyed higher up, all voluntary control is cut off, and micturition may occur in a seemingly natural way from time to time as the bladder fills, without the knowledge of the patient. On the other hand, the character of the act may vary according to the affection of the local centres themselves. Opinions have differed as to the advisability of using the catheter in these cases, some surgeons deeming it unnecessary, others fearing that cystitis may be caused thereby. There need, however, be no difficulty in avoiding the introduction of septic or unclean matter into the bladder by the use of an instrument which is perfectly clean, for which purpose it is well to keep the catheter continuously in carbolised water; and there can be no question as to the desirability of preventing the patient, or his bed-clothes, from being perpetually soaked in urine. On the whole it seems better to use a soft catheter morning and evening, or oftener if need be, to ensure the complete evacuation of the bladder, to avoid the smell of incessant urinary flow, and to keep the patient dry. But, above all things, let care be taken that the catheter is absolutely clean, and that it be passed with all tenderness.

The act of defæcation, like that of micturition, is a complicated one, for although under voluntary control, it is also under the immediate influence of spinal centres, of which one is for the muscles of expulsion, the other for the sphincter to close the orifice. Contraction of the one set of muscles, and relaxation of the other ordinarily go together; but if voluntary control be withdrawn, defæcation may occur unknown to the patient, whenever his rectum is sufficiently loaded to excite the reflex act of expulsion, the sphincter being at the same time paralysed. The rectum, however, is not so continuously filled as the bladder, and there is no constant discharge of fæces, as there is of urine when the sphincter vesicæ is paralysed. Be the precise nervous mechanism what it may, the difficulty and duty arise of endeavouring to keep the patient clean and dry. Occasionally, however, we meet with the opposite trouble of constipation from the normal peristalsis of the intestines being annihilated, and to this may be added alarming tympanites from palsy of the intestine.

Interference with the normal action of yet other supposed centres in the cord gives rise to a symptom very often met with in cases of fracture-dislocation, i.e. priapism —a vascular turgescence, or quasi-erection, of the penis, which is most frequently seen after injuries high up, but which may be present when the lesion is quite low down, even in the lower dorsal or lumbar region. This used to be regarded as a symptom of grave import, but probably without due warranty, for there is no evidence to show that, by itself, it is a more certain evidence than others are of grave and fatal injury to the cord. The precise manner in which priapism is caused is not known. By some it is thought to be a merely passive condition, due to vaso-motor palsy, which permits filling and distension of the vessels of the erectile tissue; while others look upon it as due to irritation of supposed sexual centres in the lumbar portion of the cord.

Few questions in connection with these injuries of the spine and spinal cord are of greater interest than the variations of temperature observed in different cases. It seems impossible to predict of any injury that it will be followed by a high temperature or by a low one, and little more has yet been done in elucidation of the differences than the careful observation of unusual examples of one condition or the other. Excessively high temperatures of the paralysed parts have been most often met with in injuries of the cervical cord; but yet very low temperatures have been noted in apparently similar cases, while in some an early high temperature has been followed by an abnormally low one until the time of death. As far as can be told, there is no special lesion to account for these differences. It has been observed, however, that in cases

of high temperature the pulse is usually full and bounding, while in the opposite the pulse is small and feeble, and to Mr. Hutchinson we owe the suggestion that the character of the circulation really determines the degree of temperature. Parts paralysed naturally develop less heat, and when nearly the whole body becomes a cooling area, as after cervical injuries, the bodily temperature will be low unless the strength of the circulation be such that the free supply of blood to the paralysed area not only prevents a fall in temperature, but even creates a balance on the other side. Notwithstanding thermometrical observations, the whole question of temperature variations is still very obscure.

Bedsores and changes in the urinary excretion demand the attention of the surgeon; for, though not adding materially to the patient's suffering, they have their own special dangers. *See* BEDSORES; BLADDER, Diseases of the.

CONCUSSION OF THE SPINAL CORD.—The question whether there is such a thing as true 'concussion of the spinal cord' need not long detain us. That the brain may be structurally injured by pure concussion is of course an accepted fact within the experience of all, but it is a wholly different matter with reference to lesion of the spinal cord. Medical literature, it is true, contains not a few cases of traumatic lesions of the cord, which have been attributed to the effects of concussion; but in the judgment of the writer this has been the result of a too ready trust in a supposed analogy between the brain and the spinal cord. It has not been sufficiently recognised that the physical surroundings of these two organs are widely different; and it does not follow in the least that because they are parts of one system they are therefore both liable to the same form of injury. The brain is so lodged in the skull as to be especially prone to suffer structural injury from concussion-blows upon the head; the spinal cord, on the contrary, surrounded by fat and fluid and suspended to the sides of the chamber in which it lies, is placed so as to be securely protected from any evil consequences of similar injuries to the back or spine, and the analogy between brain and spinal cord is in this respect deceptive and unwarranted. Nevertheless there are cases of cord-lesion which can be satisfactorily explained on no other hypothesis than that of concussion; but when we have excluded those cases where the bruising of the cord has been produced by actual crush of displaced vertebræ, by severe and sudden bend of the cord itself, or where the symptoms have been due to the pressure of blood, it is singular how very few remain. And it is well that it should be so, for a new danger would be added to life if an organ of such vast importance in the animal economy as the spinal cord were liable to structural lesion from the same kinds of force as cause concussion-lesion of the brain. A lesion which may be of small size and possibly of small moment in the case of the brain, cannot be otherwise than of great moment, even if only of small size—in the case of an attenuated and slender cord which is the sole medium of communication between distant parts. And happily, as a matter of fact, the spinal cord is very rarely thus injured in the absence of injury to the form and structural integrity of the spinal column.

THE OPERATION OF TREPHINING THE SPINE proposed many years ago, and adopted several times, has made no progress in surgery, nor is it likely to do so. In cases of fracture-dislocation the cord is usually damaged irreparably; and when permanent pressure is exerted on the marrow by displaced bone, exact diagnosis is often impossible, and the physical difficulties of removing or elevating the displaced vertebra—be it remembered the body of a vertebra, and therefore far removed from the surface—would be almost insuperable. And we should add gravely to the dangers of the case by laying open the spinal canal. Here, again, a too ready assumption of analogy between brain and spinal cord led in all probability to this operation, which a clearer understanding of the physical differences in the situation of the two organs would have shown to be little feasible, and less likely to be followed by good results. It is an operation not within the range of practical surgery.

PUNCTURED WOUNDS.—Some of the most formidable injuries with which the surgeon has to contend are punctured wounds in the cervical region. The horizontal direction of the spinous processes in this part of the column renders it comparatively easy to open the spinal canal, to incise the theca vertebralis, or even to wound the cord; but in other regions also the spinal canal may be opened by some sharp instrument, such as the point of a sword, if the force of the blow has been great, and its direction sufficiently oblique. The extent of the injury will be revealed only by the resultant symptoms of nerve-impairment, of more or less paralysis, and possibly also by the escape of cerebro-spinal fluid. While surgically of the gravest moment, these cases are, at the same time,

worthy of all study from the light thrown by the symptoms on the physiology of the cord. The danger of meningitis is great, and if the cord has been wounded, there is risk that repair may be imperfect, or that the injury may be the starting-point of secondary degeneration. It is important to cleanse and close the wound, removing any foreign body suspected to be present, and to keep the spine at perfect rest.

Little less serious, because of the difficulty of treatment, are punctured wounds of the large vessels in the posterior part of the neck: the posterior auricular, the arteria princeps cervicis, and the occipital, the vertebral, and profunda cervicis. The record of cases seems to show that ligature of the carotid trunk is usually of little lasting avail for the arrest of hæmorrhage from its branches, owing to the very free cross-anastomoses, while ligature of the first part of the subclavian is likewise impracticable. The surgeon must therefore rely on the less formidable procedure of finding, by careful dissection, the precise vessel which has been wounded, and placing a ligature above and below the bleeding point. This is the line of practice which ought invariably to be followed, if the hæmorrhage is such as to indicate that any large vessel has been wounded. The danger to the patient even of free incision, to find and secure the vessel, is far less than that of repeated hæmorrhages and burrowing of blood throughout the tissues of the neck. After puncture of the vertebral artery, however, it may be no easy matter to put a ligature upon it as it lies within its bony canal, and ordinary pressure upon the surface is likewise of little or no use in arresting the bleeding. It is essential to expose the bleeding point, and here success has attended the practice of careful plugging against the transverse process; and in a recent case the plan was adopted of plugging with antiseptic material which it was possible to leave in the wound long enough to secure complete occlusion of the vessel.

In all these operations it is important to carry out most thorough antiseptic treatment, so as to avoid the risk of spreading suppuration in the deeper parts of the neck. For suppuration itself may lead to opening of some deep vessel, and in a remarkable case, recently under the care of Mr. Banks, of Liverpool, when the patient had nearly perished from loss of blood, that surgeon cleared out a huge mass of putrid blood-clot which filled up the whole posterior part of the neck from mastoid process to clavicle, and applied ligatures with success at the very origin of the occipital artery, just in front of the transverse process of the atlas, where the bleeding point was found. Antiseptic surgery and antiseptic plugging hold out better hope of success than has hitherto often attended the treatment of these very dangerous wounds of the vertebral artery; while the avoidance of after-suppuration goes a long way to render less formidable the requisite operation of free dissection to find the source of hæmorrhage after punctured wounds in the posterior parts of the neck. HERBERT W. PAGE.

BACTERIUM.—An oval or ellipsoidal micro-organism, forming a definite genus in the class of Schizomycetes, viz. the micro-bacteria of Cohn. As a rule the length is never more than twice the breadth. The term bacterium was formerly used to denote the whole class of Schizomycetes, but it is now restricted to those falling under the above definition.

For general characters, see the article SCHIZOMYCETES.

The bacteria reproduce themselves mainly by fission. There has also been described (Dallinger) a fusion of two individuals (*B. termo*) with the resultant formation of a cyst containing spores, which on liberation develop into adult bacteria.

(1) SAPRIC BACTERIA are two, as known at present, and the first is more important, being supposed to be the agent by means of which putrefaction goes on in animal fluids, resulting in the formation of the alkaloidal substance sepsin, the poison of sapræmia.

B. termo. Usually dumb-bell in shape, perhaps from rapid multiplication. Injection into the tissues or blood of animals produces no effect. It is very active, and provided with a flagellum.

B. lineola. Found in ponds, and forms the common bacterium fungus on boiled potatoes. It is larger than *B. termo.*

(2) The PATHOGENIC BACTERIA are very interesting from their excessive virulence.

B. septicæmiæ (Koch & Davaine) is an oval organism, the protoplasm of which is collected at each end, leaving a central clear space. That observed by Koch was found in septicæmia of birds, being obtained from putrid meat, while Davaine's experiments were carried out in rabbits, the organism being derived from putrid ox-blood. The latter organism exists in the blood to such an extent that a billionth of a drop has proved fatal, and even a trillionth (Davaine).

B. of chicken cholera. The organism of this infectious disease is supposed to be a bacterium. VICTOR HORSLEY.

BALANITIS is an inflammation of the mucous membrane covering the glans penis. It may be the result simply of want of cleanliness, and this is especially the case in young subjects with long foreskins. It is, however, more usually an accompaniment of gonorrhœa, and arises from the extension of the inflammation of the urethra to the surface of the glans penis. A further extension of the disease to the mucous layer of the prepuce constitutes what is called balano-posthitis. The symptoms are itching and swelling both of the glans and the prepuce, which latter sometimes becomes œdematous. There is also a profuse discharge of fetid pus. If the prepuce can be drawn back and the glans exposed, the latter will be found swollen, red, and bathed in fetid discharge. Frequently the epithelium becomes eroded, leaving superficially ulcerated surfaces.

Sometimes crops of herpetic vesicles appear, which run together, forming ulcers which might possibly be mistaken for chancres. In fact, it is necessary to remember that a balanitis may be caused by syphilitic chancrous erosion of the glans. The absence of urethral discharge, the defined ulcer, the induration, and, especially the history as to the period of incubation, will all help towards the formation of a correct diagnosis in such a case. The extension of the inflammation to the prepuce is marked by a still further swelling of that part, caused by effusion into the cellular tissue between its two surfaces; the result being complete inability to retract the prepuce, constituting a phimosis.

It is in conditions like this that some difficulty arises in making a right diagnosis as to whether the patient is suffering from gonorrhœa or syphilis. The absence of any history of a sore, the failure to detect any indurated or painful spot beneath the prepuce, the unmixed purulent discharge, the scalding on passing water, and the presence of chordee, are all symptoms leading to the conclusion that the case is one of balanitis arising from the infection of a gonorrhœa. On the other hand, the history of the presence of a sore, and the detection of a painful and indurated spot beneath the prepuce, the admixture of blood with the discharge, the enlargement of the inguinal glands, and the absence of scalding and chordee, would all point to the presence of a chancre beneath the inflamed prepuce. When the prepuce is short and the orifice small, a paraphimosis is occasionally formed by the prepuce slipping back behind the corona, the swollen condition of the glans rendering it impossible to replace it at the moment. The contracted preputial orifice acts as a tight constricting band, causing considerable swelling and œdema of the surrounding parts. The pain is sometimes excruciating, and unless relief is soon afforded, ulceration, or even sloughing, of the parts may take place.

The *treatment* of balanitis varies with the intensity of the disease and the complications which require to be met. When it arises in a young subject, from the collection of secretion beneath a long prepuce, simple attention to cleanliness will go far to effect a cure. The prepuce should be drawn back twice or three times a day, and the parts thoroughly washed with tepid water and dried. They should then be dusted over with a powder consisting of equal parts of starch and boracic acid, and the prepuce replaced. In the event of a recurrence of the disease, circumcision should be performed as soon as the discharge has been arrested. It is well known that amongst the Jewish community the rite of circumcision confers immunity from this disease. When, however, balanitis arises as a consequence of venereal disease, more active measures are needful.

In addition to the ordinary treatment of gonorrhœa, if the inflammation is confined to the glans, it will often suffice simply to cleanse the parts three or four times a day, and keep them dusted over with the starch and boracic acid powder, or the simple insertion of dry lint between the glans and the prepuce, frequently changed, will sometimes effect a cure. If the disease has extended to the prepuce with much swelling of the parts, hot fomentations and an occasional warm hip bath will be found useful. The application of nitrate of silver, either by passing a solid stick underneath the prepuce, round the glans, or else by injecting a solution (gr. 40–f℥j.) is useful, followed by the constant use of a lead and opium lotion, applied externally on lint and injected underneath the prepuce. As soon as the prepuce can be withdrawn, if the surface of the glans is found to be eroded, one of the best applications is the oleate of zinc spread thickly on lint on both sides, and inserted between the glans and the prepuce. If phimosis is established it can seldom be needful to resort to operative measures for its relief during the acute condition. Hot fomentations, soothing injections, rest in bed, and keeping the penis in an elevated position, will be useful.

Should it, however, be needful to expose the glans, the prepuce should be slit up on its dorsal surface, but the completion of the operation should be deferred until a later period. When paraphimosis exists, means should at once be taken to effect its reduction. *See* PARAPHIMOSIS.

PAUL SWAIN.

BANDAGES are usually made of unbleached calico, but in special cases and for special purposes a variety of materials are used, the chief of which are washed calico, linen, flannel, lint, muslin, gauze, elastic webbing, and india-rubber.

Whatever material is used it should be sufficiently firm and strong to effect the object for which the bandage is applied, and at the same time be supple enough to be evenly adapted to the inequalities of the limb. If the bandage is to be applied wet, washed calico should be used; when warmth combined with some amount of elasticity is required, flannel is very useful; whilst, if elasticity is the property mainly desired, elastic webbing or Martin's india-rubber bandages are the best materials; if lightness and open meshes into which plaster of Paris may be rubbed are required, nothing is better than the kind of muslin known as crinoline.

Bandages are classified as 1. *Simple*; 2. *Compound*. A simple bandage consists of a continuous piece of material wound up into a roller, and hence called a *roller* bandage.

A compound bandage is more complex, and requires more than one continuous piece for its formation; the four-tailed, the many-tailed, the T-bandage, and the suspensory bandage, are compound bandages.

The *Roller* bandage is made by tearing the material used into strips, varying in width from three-quarters of an inch to six inches, and in length from two to ten yards, according to the part of the body for which it is required; for the fingers it should be three-quarters of an inch wide, and a yard and a half long; for the upper limb and head from two to two and a half inches wide, and six yards long; for the lower limb two and a half to three inches wide, and six or eight yards long; for the body four to six inches wide, and ten yards long.

No selvage should be included in the bandage, as it would be liable to cause uneven and painful pressure.

Bandages should be tightly and evenly rolled. If a bandage be rolled up from one end only it is called a *single-headed* roller, whilst if from both ends it is called a *double-headed* roller. A roller bandage is said to have two extremities, a head, body, and two surfaces; the free end is called the *initial extremity*, and that in the centre of the roller the *terminal extremity*, whilst the intervening portion is the *body*; so much of the bandage as is at any time rolled up is known as the *head*; the two surfaces are inner and outer.

When applying a bandage, the surgeon should stand in front of the part to be bandaged, and, if a limb, he should take care to place it in the position it is intended to occupy, for a subsequent alteration of it not only disarranges the bandage, but renders it liable to constrict the limb. He should hold the roller in the right hand if the left limbs are to be bandaged, and *vice versâ*, and then, placing the initial extremity on the front of the limb, he should fix it by a circular turn, so placed that the bandage is laid on from the inner to the outer side as it passes over the anterior surface of the limb.

To remove a bandage, the terminal extremity should be taken up by one hand and passed behind the limb to the other, and by this back again in front, the folds of the bandage being gathered together into a bundle as they are transferred from one hand to the other; by a quick succession of these movements the bandage will be rapidly and tidily unwound, and will not be twisted upon itself.

In applying a simple bandage to any part, one or other of the following methods, either alone or in combination, will be used. They are named according to the arrangement of the turns of the bandage.

The *Circular* bandage consists of a number of turns arranged so that each accurately covers the preceding one; it is used to keep dressings on the forehead, the sides or back of the scalp, or the neck, and to retain pads on particular points.

The *Oblique* bandage is applied by allowing the roller to follow its own course smoothly up the limb; the result of this is that parts are left uncovered between the turns of the bandage. It is used to retain dressings, such as fomentations, which require frequent changing, and is of special value in the application of the earlier layers of plaster or other immovable bandages, where a number of layers are used, for in that case all the intervals may be subsequently covered in; and there are the advantages that the bandage lies quite smoothly without reverses, and also that the fibres run more nearly longitudinally and so afford extra strength, and obviate the tendency to transverse cracking, which

is so liable to occur when the bandage is applied spirally.

The *Spiral* bandage is, as its name implies, wound spirally round the limb; each circle of the spiral should overlap the preceding one by about one-third of its width; it is only applicable to regions where the size keeps the same or but slightly increases, as the fingers, just above the wrist and ankle, the upper arm, or the chest.

The *Spiral* bandage *with Reverses:* when the spiral bandage is applied to a part whose circumference rapidly increases in size, the roller will, if laid on evenly, soon run upwards obliquely and leave an interval between two successive turns; in such cases it is necessary to bring the bandage down to the proper level by what is called *reversing*, or so turning it on itself that what was before the upper border becomes the lower, and the inner surface the outer. To reverse the bandage the roller should be unwound for two or three inches beyond the place where the reverse is to be made, and the part of the bandage which is already applied should be drawn firmly to the limb, and, in the case of a left limb, the left thumb placed on the lower border of the bandage at the required situation. With the head of the bandage held loosely by the right hand in the supine position, a movement of pronation will fold over the upper border so as to make it the lower one, and then the roller can be carried onwards evenly round the limb, overlapping one-third of the previous turn, until it reaches a point in a line with the previous reverse, where the whole proceeding should be repeated. Before removing the thumb which fixes the lower border of the bandage, the roller should be drawn tight, in order to make the reverse lie smoothly and prevent wrinkling of the bandage. The reverses should be made to fall in one line along the limb, and should be so situated as to avoid bony prominences. This method of bandaging is chiefly used for the forearm and leg, and should not be used for other regions if the simple spiral bandage will do.

The *Figure-of-eight* bandage is another method of bringing the bandage down when it is advancing too rapidly up the limb; but it is more especially adapted to covering joints such as the ankle, knee, wrist, and elbow: it consists of two circles joined together like a figure of eight, one of them being above the joint and the other below, whilst the crossings are made to fall in one line along the front or outer side of the joint. Though chiefly used for joints, it is applicable to all parts of limbs; but it has, in the latter cases, the disadvantage that the lower border of the upper circle does not lie evenly against the limb, and it is only by the gradual ascent of the lower circles that a tidy, even covering is obtained.

The application of the above methods of bandaging to individual parts is hardly called for in a work of this nature, but some of the more useful special bandages will be described.

The *Halter* bandage is useful for retaining dressings on the chin, vertex of the head, and nape of the neck. Place the initial extremity of a single-headed roller, two inches wide, on the vertex of the head, and carry the roller down the side of the face just in front of the ear, beneath the chin and along the opposite side of the face to the vertex, where it will cross the initial extremity at an acute angle. Then direct it obliquely backwards, in front of and below the parietal eminence, to the nape of the neck, and thence horizontally round the front of the chin and onwards to the nape of the neck again, where its direction must be changed so that it passes below and in front of the parietal eminence of the other side to the vertex, where the terminal end may be pinned; or, if required, the whole series of turns may be repeated.

The *Knotted* bandage is used for making pressure on the temporal artery. Put a pad or graduated compress on the bleeding point, and then, standing on the opposite side of the patient, take a double-headed roller and apply the portion of bandage intervening between the two heads over the compress, and carry each roll circularly round the head until they reach the compress again. Then, if it be the left temporal artery that is to be compressed, the roll coming round the front of the head should be taken in the right hand and turned round the lower border of the other one, and carried upwards with its outer surface applied to the scalp, whilst that now in the left hand should be passed downwards beneath the chin with its inner surface applied to the face. Each roll must be carried round the head, and, meeting again at the injured temple, a second 'knot' should be made, and the ends of the bandage directed horizontally to the opposite side of the head and pinned. The first 'knot' should lie over the compress, and the second accurately over the first, so that their full pressure may be gained.

The *Capelline*, or recurrent bandage of the head is useful for making pressure or

retaining dressings on the scalp, and a modification of it is used for bandaging stumps. For the scalp a double-headed roller, two inches wide and six yards long, with one head about a third larger than the other, is required. The operator should stand behind the patient with the larger head in his right hand, and the smaller in his left, and the intervening portion should be placed as low down on the forehead as possible, so that any tendency to upward displacement may be prevented by the frontal protuberances. Both heads of the roller are then carried backwards to the nape of the neck, where the smaller one is taken in the right hand, twisted round the lower border of the other, and directed vertically over the scalp to the root of the nose, whilst the larger is continued horizontally round the head to fix the vertical one in front; after which the latter is carried backwards again to the occiput, a little to one side of the first turn and slightly overlapping it, and is fixed by the continuation of the horizontal turn. Similarly, the smaller head of the roller is carried backwards and forwards over the scalp, first on one side of the middle line and then on the other, until the whole of it is covered in. The horizontal portion must always cross the other superficially, so as to fix it, preparatory to its being turned back again. Finally both heads of the roller will be running nearly horizontally. They should be looped together at the occiput and carried forwards to the forehead, where the ends may be tied or pinned together.

For a *Stump* a single-headed roller will suffice. Take a few circular turns round the limb a little above the end of the stump; fix the bandage on the under surface by the fingers of the left hand, and take a longitudinal turn over the face of the stump and fix it on the upper surface by the left thumb. Repeat the longitudinal turns first on one side of the middle line and then on the other, fixing each as before, until the whole stump is covered in; and finish off by a few circular turns so as to fix the longitudinal ones in their proper places.

The *Spica* bandage is named from its fancied resemblance to a spike of barley: it is essentially a figure-of-eight bandage, one loop of which is larger than the other. It is used for the shoulder, thumb, and groin.

For the shoulder a roller bandage, two and a half inches wide and seven yards long, will be required. Protect the folds of the axilla with cotton wool, and fix the bandage by a few circular turns round the upper arm; carry the roller round the back of the chest and the opposite axilla to the front, and onwards till it crosses the commencement of the same turn on the outer side of the arm, and then direct it beneath the axilla to the front again, and a second time carry it over the shoulder and round the chest and axilla as before. The whole series of turns must be repeated till the shoulder is covered; and as they intersect on the outer side of the arm and shoulder, they should overlap one another by about one-third of their width.

When the turns of the bandage are placed successively higher and higher on the shoulder, as above described, the spica is called *ascending*, but if the first turn is made over the shoulder at the root of the neck and succeeding ones lower and lower, it is termed *descending*.

The spica for the groin is used to make pressure over the abdominal and femoral rings as a temporary support to herniæ, and to retain dressings on any part of the inguinal regions. Take a roller three inches wide and seven yards long, and fix the initial extremity by a circular turn round the upper part of the thigh, passing from the inner to the outer side in the usual way, and then carry the roller round the pelvis between the great trochanter and the crest of the ilium on each side, and next obliquely across the lower part of the abdomen to the front of the thigh, where it will cross the commencement of the same turn, and thence direct it round the thigh and forwards between its inner surface and the scrotum. Repeat the figure-of-eight loops round the thigh and pelvis as often as necessary, and make each turn overlap the preceding one on the thigh by about half its width. It is usual to place the first turn over the lower part of the groin, and the subsequent ones successively higher and higher (*ascending spica*), but they may be laid on from above downwards (*descending spica*).

To bandage both groins, commence with a circular turn round the pelvis, and then direct the roller across the lower part of the abdomen to the left thigh; take a loop round this and continue the bandage round the back of the pelvis to the right thigh, and, after encircling that, carry the roller across the lower part of the abdomen and round the entire pelvis to the left thigh. The turns round the thighs are made alternately and pass from the inner to the outer side on the front of the left one, and from the outer to the inner on the right; when the bandage

is completed, there will be, in addition to the intersections on the thighs, a third series of them over the middle line of the abdomen.

The spica for the thumb requires no further description than that it consists of figure-of-eight loops, placed alternately round the wrist and the ball of the thumb until the latter is sufficiently covered.

T-bandages, either single or double, have the shape indicated by their name, the former having only one vertical piece, whilst the latter has two, which are attached, at a short distance apart, to the horizontal limb: they are chiefly used for retaining dressings on the perineum and the parts about, but may be used for the scalp, chest, &c. For the perineum the horizontal portion is fixed round the body just above the iliac crests, and the vertical one made to lie over the mid-sacral region. For the female the vertical portion is undivided and is brought forwards between the legs, over the vulva, and fixed to the front of the horizontal segment; for the male it is split along the middle for a sufficient distance to allow of the ends being brought forward on each side of the scrotum. For the scalp the horizontal portion is fixed circularly round the forehead and occiput, and the vertical one carried backwards, from the former point, over the vertex and fixed to the horizontal portion behind. For the chest the horizontal segment of the double bandage is fixed round the body, and a vertical portion brought forwards over each shoulder, and fastened in front.

The Many-tailed bandage, or bandage of Scultetus, is used where it is wished to combine even support with ease of removal; it is most commonly used for the chest and abdomen. A sufficient number of transverse strips of calico or flannel are arranged parallel to and overlapping one another by about one-third of their width, and fixed so by being stitched along the middle to another strip at right angles to them. To apply it, the connecting piece of the bandage should be placed in the middle line behind, and the transverse pieces brought round the body or limb successively and crossed in front. To prevent the bandage slipping when applied to the chest or abdomen, two strips should be attached to the upper end of the connecting piece, and brought over the shoulders like braces and attached in front.

The 4-tailed bandage consists of a piece of calico split from either end to within a few inches from the middle; it is mainly used for the lower jaw, but is also applicable to the knee and the vertex of the head. For the jaw it should be about four inches wide and fourteen long, with a hole or slit made near one edge of the bandage in the middle to receive the chin, and be split to within two inches of the centre. Put the smaller segment over the lip and fix the tails corresponding with it below the occiput; carry the other ones upwards in front of the ears and fasten them on the vertex; the two pairs should be attached to one another along the middle line of the vertex, so as to prevent their slipping. For the vertex, take a broader bandage with tails of equal width, and place the undivided portion on the top of the head; direct the anterior pair of tails backwards and tie them below the occiput, and the posterior ones forward and tie beneath the chin; for the knee, place the undivided portion over the patella, cross the tails of the bandage behind the knee, and tie the lower ones in front of the lower part of the thigh, and the upper ones in front of the tubercle of the tibia.

The triangular bandage, or the Esmarch bandage, is made by cutting a piece of calico, about forty inches square, diagonally into two halves; of the three borders, the longer is called the lower and the others the side borders; of the three angles that opposite the lower border is called the point and the others the ends. Though of much use as a temporary bandage, on account of its wide applicability, it is not much used in civil surgery, and so calls for but little mention here. To make a small sling, i.e. for the hand and wrist, with a triangular bandage fold it lengthwise twice, throw one end over the shoulder of the injured side, and bring the other one round the front of the wrist and over the sound shoulder and knot it to its fellow. To make the larger sling, i.e. for the whole forearm, place the unfolded bandage on the chest with the point of it towards the elbow, and one end thrown over the sound shoulder; next bend the elbow and bring the forearm to the chest against the middle of the bandage, and support it in that position by carrying the other end of the bandage over the shoulder of the injured side and tying it to its fellow. Finally fold the point of the bandage round the elbow and upper arm, and pin it in front. To make the shawl-cap for the scalp, fold the lower border of the bandage and place it on the forehead with the point hanging down to the nape of the neck; next carry the ends round the head, crossing them behind, and tie them together on the forehead, and finally turn up the point and pin it to the body of the bandage above.

The triangular bandage is also used to retain dressings on the breast and on the gluteal region, and as an improvised suspensory bandage. BILTON POLLARD.

BARBADOES LEG. *See* ELEPHANTIASIS ARABUM.

BATTEY'S OPERATION. *See* OÖPHORECTOMY.

BAVARIAN SPLINT. *See* IMMOVABLE BANDAGES.

BEDSORES.—Whenever prolonged and continuous pressure is maintained on a part there is much danger of gangrene occurring; the pressure impedes or completely arrests the circulation, and if continuously maintained for a sufficient time, death of the affected part will occur from that cause alone. But if the pressure be not prolonged to this degree, the tissues and vessels will be so injured that, on the re-establishment of the circulation, inflammation which may terminate in gangrene will occur, and especially will this happen in old and enfeebled persons and those whose constitutional powers are lowered by fever. In addition to simple pressure there are other potent agents in the causation of bedsores, such as the irritation of urine, fæces, the secretion of the skin itself, creases in the bedclothes, crumbs of bread, &c. Many of these causes are liable to come into greater prominence in some cases, such as fractures of the spine, in which the lower part of the body is paralysed and in which the urine and fæces are passed involuntarily.

In certain injuries of the nervous system bedsores appear very rapidly, and that too when the greatest care is taken to prevent injurious pressure and irritation of discharges; these bedsores are described by Charcot as 'acute'; they may appear within a very few days or even hours after the injury. In surgical practice they are mostly met with after spinal injuries, though they may occur after injuries to the brain; in the latter case they are situated on the upper and inner part of the buttock of the paralysed side, whilst in the former they are situated in the mid-sacral region just above and to the inner side of the cerebral one; the spinal bedsore usually begins on the fourth or fifth day. Acute bedsores are considered by Charcot to result from a lesion of trophic nerves, and by others to be due to vaso-motor paralysis; they are, however, of comparatively rare occurrence.

The simple pressure sores are met with in the regions most pressed upon during prolonged confinement to bed, viz. over the sacrum and trochanters, but they may occur over the elbows, scapulæ, and on the heels, &c.; and sores identical in nature and known as 'splint-sores' may be met with over any of the bony prominences, due to the pressure of splints. The skin first inflames, and if the cause persist, vesication follows; the cutis next loses its vitality and an eschar or superficial cutaneous slough succeeds; this is slowly detached from the surrounding healthy skin, leaving a more or less deep excavated ulcer of unhealthy aspect, and sometimes exposing a portion of carious bone or even opening up the spinal canal and giving rise to septic meningitis.

Treatment.—This should be mainly preventive, and in the hands of the nurse; all sources of irritation should be scrupulously avoided; too continuous pressure on any one region should be prevented by changing the position of the patient where this is possible, and where not it should be evenly distributed and moderated by water-beds, ring-pillows, &c. The parts pressed upon should be systematically washed night and morning, and rubbed with some stimulating and astringent lotion such as spirits of wine, or a solution of bichloride of mercury in proof spirit (2 grains to the ounce). In the erythematous stage the part may be painted over with collodion, with one of the lotions mentioned above, or with a solution of nitrate of silver (10 grains to the ounce). When sloughs have formed, their separation may be hastened by poultices or fomentations, and after their detachment, if stimulants seem indicated, equal parts of resin ointment and balsam of Peru may be applied, and when the sore begins to fill up and look healthy it may be treated as a simple ulcer, provided always that pressure be reduced to a minimum.

BILTON POLLARD.

BELLOCQ'S SOUND is an instrument devised to assist in the operation of plugging the posterior nares. It consists of a curved canula, shaped like, but of larger size than, a Eustachian catheter. This contains a stilette terminating in a piece of watch-spring, at the extremity of which is an eyelet for carrying a thread. The canula being passed along the floor of the nose, the watch-spring is made to protrude into the mouth by means of the stilette, and the thread can thus be readily caught and employed to draw a piece of whipcord through the nostril, to which a suitable plug is attached.

BISTOURY.—A French term which has been adopted by English surgeons. There are several varieties of bistoury—viz. straight and curved, sharp and probe-pointed. The straight, sharp-pointed bistoury is useful in amputating fingers, the curved in opening abscesses; the probe-pointed instruments are useful in dividing fistulæ and the stricture in hernia.

BITES OF VENOMOUS INSECTS AND REPTILES. *See* STINGS OF INSECTS.

BLADDER, Diseases of the.—ATONY OF THE BLADDER.—*Loss of Contractile Power of the Muscular Coat.*—This affection is induced in various ways; most frequently by moderate obstruction to the outflow of urine, a difficulty not sufficient to cause hypertrophy of the muscular coat. Probably a constant factor, as a predisposing cause, is a tendency to degeneration of the muscular tissue; certainly it is very frequently present in these cases. Indeed, it is not otherwise clear why obstruction should cause muscular hypertrophy in one individual and atrophy in another. This affection is often miscalled 'paralysis'; but it is quite distinct from true paralysis, consequent on disease or injury of the nervous centres. In paralysis the urine stagnates in the bladder through want of nervous stimulation of the muscular coat, not from impediment to its escape.

The *causes* of atony are: urethral stricture; prostatic hypertrophy or enlargement at the neck of the bladder; stone or tumour in the bladder; habitual fæcal distension of the rectum; repeated delays in emptying the charged bladder; sudden retention caused by gonorrhœal inflammation and swelling of the neck of the bladder.

Two forms of *stricture* cause habitual partial retention. One exists as a membranous band passing across the lumen of the urethra, near the meatus urinarius. Such a band, by exciting reflex spasm of the perineal muscles, causes habitual partial retention of urine. When more deeply placed, i.e. in the bulbous portion of the canal, the stricture has longer extent, and consists of induration of the submucous tissue. Such a contraction need not greatly diminish the size of the stream, and its existence may therefore not be suspected. *Prostatic hypertrophy*, chiefly affecting the middle lobe, in certain elderly men, may develop sufficiently to hinder the outflow also without materially lessening the size of the stream, though its force is weakened. Not only tumours produced by overgrowth of the prostate, but also those which form in the walls of the bladder, especially if placed near the floor, interfere with the proper contraction of the organ, and may give rise to atony of its coats. *Calculus* excites atony in bladders of which the muscular coat is degenerating, by the frequent calls to void urine it excites exhausting the contractile force. When atony or sluggish contraction is due to *distension of the rectum* and colon, the nutrition of the muscular tissue of the viscera generally is bad, and with the bladder thus predisposed to inertia, the mechanical impediment determines the distension. In women with the same predisposition, the gravid uterus sometimes causes atony. When this has happened, the bladder remains lax, and gets more and more distended, until a considerable abdominal tumour is formed.

Again, atony arises from neglect of the calls to micturate, either from hysterical perversity, or because some urethral affection makes the act painful, as in women who have a vascular tumour of the urethra. It is met with also in lethargic persons, with minds absorbed in mental occupation, who delay to empty the bladder, and so train it to over-distension. In this way the bladder may attain enormous dimensions. In one instance the writer drew off seven and a half pints from a bladder which reached to the epigastrium, and had been mistaken by the homœopath in attendance for a visceral cancer. Atony in young men occasionally follows what is called gonorrhœal retention: that is, the complete closure of the bladder by inflammatory swelling of the neck. Besides atony, this very painful affection may leave behind it, as sequelæ of the diminished evacuating power, cystitis, or interstitial nephritis, and thus gravely affect the patient's health.

The *symptoms* that attract the patient's attention to his condition are usually a slight discomfort and imperfection in voiding urine. The stream is a little delayed, wants force, and the terminal ejection is imperfect. Also, if the patient neglect the call to micturate, he finds the power somewhat impaired when he does begin. There is also some irritability of the bladder. Urine is voided more often than formerly. Sometimes a little pain is felt deeply in the perineum and the call to micturate is more imperative than in health. Or, the first symptom noticed may be involuntary discharge of small quantities of urine when the patient coughs or laughs—an occurrence that is generally attributed to loss of power to retain urine,

not to the overflow of a really distended bladder. When stricture is the cause, the patient may have noticed a little whitish discharge from the urethra. With enlarged prostate, the patient is mainly annoyed by the necessity for rising at night to pass water, by the inconveniently frequent calls to micturate in the morning, and by troublesome oozing of urine into his dress. He generally complains that the stream will not come at once; he has to wait and strain a little. When stone or vesical tumour is concerned in the imperfect contraction, the symptoms of these affections usually overshadow those of simple distension.

When the overcharge has lasted a long time, or has followed gonorrhœa, catarrh or chronic cystitis begins. The urine becomes turbid, has a faint disagreeable odour, is often neutral or alkaline, and when time has allowed the mucus to subside, an opaque white deposit collects. If the affection has lasted several months, the urine may be ammoniacal or fetid, dark and very turbid, or even ropy, from a copious secretion of muco-pus. When this condition is present, the discomfort of the patient reaches absolute pain and distress. But in a considerable number of cases the condition has been so gradually produced, and the sufferings refer so vaguely to the bladder, from which, without ever quite emptying it, the patient expels with little difficulty about the usual amount of urine, that he often attributes his discomfort to troubled digestion, made irritable, partly through pressure and displacement of the viscera by the overfilled bladder, partly by their sympathetic disturbance. It is in such cases that the affection is often overlooked, or diagnosed as ascites or visceral tumour. When the patient is examined, the following conditions are discovered. In ordinary cases the distension of the bladder does not present a tumour obviously rising above the pubes, and the suspicion of atony is only proved to be correct by examination of the bladder. A bladder which has been gradually expanded during months or years through increasing relaxation of the walls, forms a tumour in the middle line that extends upwards from the pelvis towards or even into the epigastrium, or one of the hypochondriac regions. But even when the organ is so much distended as to invade the abdomen, the swelling does not resemble that of the healthy bladder when full. The swelling is ill-defined, and fluctuates readily on palpation. This character, combined with the unexpected height to which the tumour has mounted, often misleads the physician.

The existence of an imperfect evacuation of the bladder is ascertained by directing the patient to void urine; and then, having placed him in the horizontal position, if the collection of urine is large, by passing a catheter to draw off and measure the residue. As the urine escapes through the catheter, the want of contractile force will be shown by the stream subsiding to a dribble or stopping altogether, unless the bladder be artificially compressed by the hand on the abdomen, or by the patient's coughing or straining. The state of the urethra may be examined by passing a bullet bougie (No. 25 French scale) along the penile urethra to the bulb. Should a membranous contraction exist near the meatus, the passage of the bougie will be arrested, and the amount of the narrowing can be gauged by a smaller bougie. To detect stricture beyond the penile portion, the stem of the bougie must be bent that it may pass under the pubic arch, or an ordinary bougie of the same size may be used instead. This latter instrument will reveal stricture at the bulb, and by the way it stops at the neck or enters the bladder, will often indicate a prostatic enlargement. The diagnosis of atony arising from neglect or other non-obstructive cause is founded on the absence of obstruction, and by the presence of the signs appropriate to those causes.

Pathology.—Habitual retention favours attenuation of the coats of the viscus; the muscular fibres are small and pale; their contractile power is diminished, and in time is lost; the ureters and the pelves of the kidneys become dilated, and the pyramidal and cortical portions wasted or absorbed. Thus the secretive power of the glands is much lessened; and the consequences of imperfect depuration of the blood follow. The mucous membrane of the bladder and ureters and pelves becomes congested and inflamed. This slight chronic irritation is apt to become acute, and to cause fatal nephritis when the urine is withdrawn by catheter in cases of advanced degeneration of the kidneys. Under acute inflammation, the mucous membrane of the bladder grows dark red, or slaty, is marked by ulcers or shreddy patches of adherent pus, and the atrophied kidneys are destroyed by suppurative nephritis. In many cases, of course, the evidence of the disease which has occasioned the atony will be present in addition to those of the atony itself.

The *treatment* consists in attacking and removing the cause, or if that be not possible, in palliating its effects. If stricture

be present, it must be widened until No. 20 of the French scale can be passed easily through it; meanwhile the bladder must be regularly emptied twice daily, or more frequently according to the amount of distension, to assist the contraction of the muscular coat by removing the strain. In simple cases the bladder often regains good tonicity and complete power of evacuation. The patient must be trained to pass the catheter himself once in twenty-four hours to ensure the complete evacuation of the urine, and to wash out the bladder through the catheter so long as mucus renders the urine turbid.

If these precautions are neglected, the evil will reappear. When no grave renal or vesical disease exists, the urine quickly recovers its normal acidity and clearness, and the bladder most of its tonicity.

When the atony has been slowly developed, and the expansion of the bladder has become very great, it is necessary to take precautions in the evacuation. The patient should lie down, and a body roller be applied, that as the urine escapes the pressure on the abdominal organs may be maintained, by drawing together the wrappings of the band. The whole quantity should not be removed at one sitting. When the bladder is so far relieved that it sinks into the pelvis, the rest of the urine may be left till next day and then withdrawn. If the urine is turbid, the bladder should be washed out with 6–8 ounces of cold water, containing one part in eighty of carbolic acid. The catheter should be carefully oiled before it is used, with weak carbolic oil, to prevent the introduction of septic agents. A common result after the abstraction of large collections of urine, is subacute cystitis, pyelitis, and fatal nephritis, due, it is believed, to the sudden removal of pressure from the kidney, and to the introduction of sepsis by the use of unpurified instruments. The catheter should always be withdrawn on each evacuation, until several days have elapsed. When the viscera have become accustomed to the absence of pressure from retained urine, and the urethra to the passage of the catheter, that instrument may be tied in, and the bladder kept constantly empty by continuous drainage through an india-rubber tube into a vessel under the patient's bed. The end of the tube should be submerged in carbolic water, as an antiseptic precaution. This rest to the coats of the bladder is a valuable restorative of the tonicity of the organ, and also useful for extinguishing chronic cystitis or vesical catarrh, should that be present. Contraction may be quickened by injecting three ounces of cold water (50° F.) into the bladder once or twice daily, according to the effect produced every time the urine is drawn off. Adjuvants to the cold water injection of the bladder, or its continuous drainage, are douches on the sacrum and pubes; small doses of copaiba, oil of sandal wood, &c. Most important aids are regular evacuation of the bowels, and also improvement of the patient's general health by tonics, sufficient exercise, and regularity of *régime* and diet in every particular. If practicable, warm sulphur baths and residence in a mild winter climate should be enjoined. By these aids to the regular evacuation of the bladder, the progress of renal disease is impeded, and life is prolonged and rendered enjoyable even when the tonic power of the organ is not thoroughly restored.

Inflammation of the Bladder.—*Cystitis, Acute and Chronic; Catarrh.*—Cystitis (inflammation of the mucous membrane of the bladder) has two forms—the chronic and the acute; the former being far more frequently met with than the latter. Usually the term 'catarrh' is limited to the chronic form, but not always so. In both forms inflammation of the bladder is a consequence of disease elsewhere, being, probably, never a primary affection. In the great majority of cases the affection is due to incomplete evacuation of urine, but many other causes may produce cystitis.

The obstructive causes are described under Atony of the Bladder, and need be only recapitulated here. They comprise stricture of the urethra; permanent enlargement or swelling and irritability of the prostate and vesiculæ seminales; gonorrhœal inflammation of the mucous membrane of the neck; stone or other foreign body; or tubercular disease or tumour. Special to women, as obstructive causes, are the pressure of the gravid uterus or of prolonged parturition, the irritation of a vascular growth in the urethra, or neglect to empty the bladder.

Among less frequent non-obstructive causes are—stone in the kidney; excessive coitus in elderly men; hæmorrhage and loaded rectum. Cessation of the catamenia sometimes excites cystitis. In weakly children of both sexes, but more frequently in scrofulous or rickety girls, cystitis occurs occasionally without any apparent obstruction to evacuation. Surgical processes, such as the passing or tying-in of catheters, sounding, the operations of lithotomy or of lithotrity, or for the removal of vesical tumours,

will excite cystitis. Again, cantharides and, possibly, certain general conditions—such as the gouty diathesis, the debility accompanying typhoid fever or other visceral inflammations—are set down as causes of cystitis.

The chronic form is kindled generally by causes which, of slight effect at first, increase in severity with time. Acute cystitis is the result of sudden or of violent injury; the more dangerous form being that which follows severe operations on the bladder, or the acute congestion of an hypertrophied prostate. The less grave one is that which spreads from the prostatic urethra to the neck and floor of the bladder, but seldom extends over the whole surface of the mucous membrane. So, also, it is acute cystitis which sometimes occurs during the progress of other acute visceral inflammations, or from absorption of cantharides, or after operation on the rectum.

Pathology.—In the common chronic form, the mucous membrane of the floor of the bladder is swollen and uneven, being somewhat mammillated and softened. The colour is red in patches, from capillary engorgement. In long-standing cases, the small veins show as arborescent injection. This increased vascularity affects a larger surface the more the inflammation approaches acuteness. The patches are not evenly coloured; the little projections of the mucous surface being dull red, while the depressions may be of normal tint or even paler than natural. When the affection has lasted some time, the mucous membrane is hardened as well as thickened, but unevenly; some parts are more firm than others, and the red colour is replaced by ashy-grey patches scattered over a generally bluish-grey surface. To these ashy patches adhere layers of viscid exudation, dotted with small concretions of phosphate of lime. Again, in cases of long continuance, the mucous membrane is depressed into pouches where the adherent patches are thicker and more loaded with phosphates. After the inflammation has long continued in the bladder, the lining membrane of the ureters may undergo similar changes throughout their length, though it is usual for only the pelves and calyces of the kidneys (one or both) to be attacked. The pyramids and cortical tissue of the kidneys are also affected with interstitial nephritis and the changes of structure that follow that affection.

In the violent, acute form of cystitis, the bladder surface is very uneven, and of dark crimson colour throughout, approaching to black in the lower portions. The mucous membrane is much softened and destroyed in small areas; the muscular fibres may be exposed, or even perforated to the peritoneal cavity, allowing escape of urine and peritonitis. Whether the cavity be contracted by hypertrophy of the muscular coat, or simply dilated by yielding of the walls to the habitually excessive collection of urine, the inflammatory changes of the organ are not thereby affected.

The contents of the bladder after death vary in character with the amount of inflammation; in the limited chronic form it has a faint but peculiar odour, and is more or less turbid, with a purulent sediment in the *bas fond*. In cases of long standing, where the mucous membrane is indurated, the urine has a most nauseous odour, and contains plentiful flocculent mucous and phosphatic concretions, varying in size from a pin's head to a large pebble.

Symptoms.—In the early stages of the chronic form the symptoms are often too slight to excite the patient's attention, and consist in more frequent calls to evacuate urine that is turbid with muco-pus, and most so at the end of the flow. It is still acid or neutral, and not increased in quantity. If the urine is allowed to stand for a few hours, a light, opaque, white deposit forms of mucus and pus cells. The amount of muco-pus secreted increases greatly with the duration of the disease. It may remain long purulent and not streaky; but usually it becomes viscid, ropy, and of a greenish-yellow tint, settling with a dense deposit which adheres closely to the sides of the vessel which holds it. In this state the urine has a peculiar nauseous odour characteristic of cystitis. After the affection has lasted a few weeks the urine is often bright red from admixture of blood that has oozed from the congested blood-vessels. When the highly acute form is present, the urine is scanty in quantity, though the urgency for micturition is great; probably the diminished quantity is due to extension of the inflammation to the kidneys. The muco-pus is also less, though the urine is darkly coloured by extravasated blood. Though *pain* is at first absent, soon some uneasiness is felt after passing urine, for a few minutes, in the perineum and in the hypogastric region just above the pubes. After a while actual pain comes, and micturition, growing very frequent, causes severe smarting, most violent at the end of the act, when a few drops of pus or blood are expelled from the bladder. Sometimes

this smarting is due to masses of gelatinous mucus impeding the flow of urine, and thereby increasing the spasmodic endeavours of the bladder to eject its contents. Behind the pubes also aching pain is felt, and a desire to void more urine when the flow has ceased. In very severe cases, when the bladder cannot get rid of all its contents, the aching pain may radiate to the groins, the insides of the thighs, and to the abdomen or loins. The bladder is tender to pressure of the finger in the rectum or above the pubes, and the organ can often be felt as a tumour lying behind the pubes. If there be partial distension from obstruction, these symptoms are increased.

The *constitutional disturbance* in the chronic form is nil, or amounts only to a sense of discomfort or uneasiness.

The *course and termination* in the chronic form depends greatly on the cause; when arising from moderate obstruction, the increase in severity is very slow. The removal of the cause, when that is possible, usually cures the disease, and it is said that both the chronic and acute varieties may subside spontaneously. At any time the acute form may be superadded, and the case then proceed rapidly and steadily to a fatal termination. The acute form arising from injury to the bladder is of short continuance. The constitutional disturbance is great. The temperature rises to 103° or 104° F., perhaps with a premonitory shiver, and is followed by tremulous pulse, restlessness, thirst, dry tongue, hiccough or vomiting, great prostration, and, if relief is not afforded, death in from four to twelve days. The severity of the sufferings depends greatly on the amount of obstruction that exists to the escape of urine. Should acute cystitis supervene upon a hæmorrhagic congestion from an hypertrophied prostate, the agony is excruciating and unceasing, and quickly exhausts the patient's strength. In most cases death results from implication of the kidneys in the inflammation, and their ultimate destruction. Less often the end is reached through peritonitis or septic blood-poisoning.

The *diagnosis* depends on the presence of increased frequency of micturition; of pain felt during and just after the act; of suprapubic pain or tenderness; of the mixture of pus and blood in the urine. Especially characteristic is the ejection of pus or blood at the end of micturition.

The *prognosis* depends on the cause. The chronic form is eminently curable if the cause be removed and the kidneys be not affected. Even if the cause still remain, unless it produce ulceration of the mucous membrane (such as a malignant growth), the affection may be palliated sufficiently to prevent suffering and the shortening of life. The less acute form, if speedily relieved, is also in most cases curable. Severe injury to the bladder usually excites inflammatory processes which extend beyond the organ itself, and the patient dies rather from the effects of the disease on other organs than from cystitis itself.

Treatment.—In all cases of cystitis the first step is to ensure that the bladder shall be completely emptied as often as is needful to restrain the frequent call to void urine. A good measure of the proper length of the intervals between the passings of the catheter is the number of hours of ease which the patient enjoys after the bladder has been cleared. As the irritation subsides, the catheter may be used only once or twice in twenty-four hours; but until the patient can completely empty his bladder naturally, the residual urine should be regularly removed for him. When required only once or twice a day, the patient will easily learn to perform this little operation for himself. If the cystitis be due to stricture of the urethra, widening of the contraction alone often suffices to cure the affection. Where the cause is enlarged prostate, regular evacuation of the bladder by instrument must be maintained for the remainder of the patient's life. In manipulating on such patients, the utmost gentleness must be observed, and small, pliant catheters employed that will slip past the obstruction readily. *See* CATHETERS.

If the call to micturate be very frequent, the effect of tying in a soft catheter should be tried—one of soft rubber if it can be passed—in order to drain the bladder continuously. Unfortunately this plan, though usually soothing, cannot always be carried out if the patient has not been previously accustomed to the passage of instruments; because in many persons the constant presence of a catheter soon excites pain at the neck of the bladder, with febrile disturbance and increase of the local inflammation. If this condition arise, the catheter must be removed, and be passed every three or four hours until the urethra has grown tolerant of the instrument. This usually happens in a few days, when the instrument may be tied in again. In certain cases also, though the constant presence of the catheter is borne, the viscid mucus chokes it, and the catheter must be removed

for cleaning. Hence, in the majority of cases, the catheter should be passed when needed and not be tied in.

Injections, when the acuteness of the inflammation is past, are useful; but while that is at all acute, the mechanical distension of the bladder, however gently it is done, commonly gives pain. In the very severe traumatic form of acute cystitis, all that can be attempted is the injection of an ounce or two of tepid water to clear away or to dilute the thick mucus, when it clogs the eyes of the catheter.

In chronic cystitis, when the bladder is not tender on pressure, injections are a valuable resource. In the first place, the interior of a bladder is often so altered by imperfect contraction of the muscular coat, by sacculation, or by obstruction at the neck, that it is impossible to completely empty it. The warm water dilutes the residuum, washes out the remainder of the muco-pus, and thus replaces with simple water the small quantity of decomposing urine that irritates the mucous membrane. So, also, when the amount of mucus is small, and the catarrh due mainly to imperfect evacuation from atony of the bladder, a cold injection will stimulate muscular contraction. It must be moderately cool at first by using water of the temperature of the room; and, when the patient is habituated to that, by chilling the water artificially to 45° or 40° F. Certain astringent drugs dissolved in the water also appear to be beneficial. A valuable one is the sulphate of quinine, in the proportion of two grains and two minims of diluted sulphuric acid to the ounce of water.

If the urine be fœtid, or contain much pus, injection of this solution twice daily will clear away in three or four days all fœtor, and greatly check the secretion of pus. Quinine is especially serviceable when the urine contains free ammonia. When the deposit is mainly flocculent mucus, the nitrate of silver, one-fourth or one-half of a grain to the ounce, is sometimes beneficial, but it should always be discontinued if it cause pain. Sulphate of zinc or sulphate of copper may be employed in similar cases at the same strength. But all astringent salts are very uncertain remedies. Boracic acid and borax are soothing, perhaps more so than plain water; and they appear to check the formation of the tough mucus which clogs the catheter. The cold saturated solution of boracic acid must be warmed by immersing the bottle containing it in hot water before using it. A solution of borax, eight or ten grains to the ounce, with as much glycerine, appears to have the same effect in arresting the secretion of muco-pus. Carbolic acid, in the proportion of one part in sixty of water, is also employed to check inflammation and as a disinfectant, but the writer has not seen any other good result from the use of this agent. On the contrary, it is apt to cause pain and irritation, and hence should be used only in cases of chronic catarrh. As a purifier of the instruments used, carbolic acid may be added to the lubricating oil, in the proportion of 1 to 16, with advantage.

The mode of injecting is the same whatever solution is employed. An india-rubber bottle, holding four or six ounces, is fitted with a tap and nozzle which will enter the catheter. This is carefully filled to drive all the air from it, and when the urine has been drawn from the bladder, one or two ounces, according to the irritability of the viscus, are thrown in. The fluid must never be forcibly driven in, nor in quantity sufficient to cause pain. The injection is at once allowed to escape by removing the nozzle from the catheter. A fresh portion is then thrown in and run off until the fluid returns from the bladder clear of mucus.

The patient should always lie down when this operation is first practised; but when he has become used to it, especially if the bladder does not empty itself readily, he may stand up and lean against a wall during the washing. He can thus learn to wash the bladder himself, either with an elastic bottle, or with a glass funnel and a short length of indiarubber tubing, down which he can pour and extract successive portions of lotion until the bladder is clear.

In chronic cases, when the mucus is copious and tenacious, it is well to use a No. 20 or No. 22 (French scale) flexible catheter of single web and large eyes, to which a four-ounce bottle, with Weiss's wide tap, is fitted. This apparatus, being of great interior calibre, allows larger clots of mucus to escape from the bladder than will come through an instrument of fine bore. The bottle may be used also as an exhaust by allowing it to expand after compression, while still attached to the catheter. In this way, fœtid urine and tenacious clots can be sucked away from the bladder. The bottle must, of course, be refilled with clean solution two or three times during the operation.

Calculi and phosphatic concretions must be crushed and cleared away at one sitting: the sooner the better, unless the cystitis be very acute, when it is better to reduce the

intensity of the inflammation by rest and drainage before submitting the patient to so severe an operation as lithotrity. The thorough removal of all foreign collections from the bladder usually cures the cystitis when it is due to this cause. This fact should be never forgotten when chronic cystitis follows lithotrity. In most cases it is due to a fragment of stone having been left in the bladder. The writer has seen thorough cleaning of the bladder cure cystitis for a time, even when a malignant growth in the wall of the bladder was the cause of the cystitis. Though the arrest of the cystitis was only temporary, the fortnight or three weeks passed without pain was very important to the patient.

There are certain cases of cystitis which do not yield to the methods described; for example, cases of large and very irritable prostate in old men, or of tubercular disease of the neck of the bladder in young men. Here, relief from the agony of constant, painful micturition can always be given by incision into the membranous urethra in the perineum between the bulb and the prostate, through which the bladder may be continuously drained. In tubercular ulceration the benefit is sometimes marvellous. In huge prostatic deformity the mere incision into the membranous portion is not always enough, and a tunnel through the substance of the prostate has been successfully made to give ease to the patient's suffering.

The general regimen of a patient with cystitis is important. Locomotion and exposure to cold must be scrupulously avoided. During the acute stages the patient must keep his bed absolutely. When the affection is subacute, he should stay in one room and be chiefly in the horizontal position. If sufficiently recovered to bear exercise, walking is better than driving in a chair or in a carriage. Long journeys should not be undertaken while any cystitis remains. A long railway journey has often excited a violently acute cystitis when the patient has been suffering from the chronic form or from urethritis. The body should be very warmly clad, especially the abdomen and the lower extremities, to produce free action of the skin. The diet should be light; all stimulants containing alcohol prohibited; also effervescent drinks, coffee, tea, and cocoa should be avoided, coffee and tea altogether, and cocoa taken only in small quantities and weak. Milk should be largely given, and if the kidneys are gravely affected, it may be, with or without ice, the only article swallowed. Where solid food is given, no more liquid should be drunk than is needed to quench thirst, that the secretion of urine may not be stimulated beyond what is unavoidable. Icing the barley-water, toast-and-water, or other drink, also renders it a better quencher of thirst, and therefore less will suffice. Of medicines which are reputed to affect cystitis, acute or chronic, directly, decoctions of triticum repens, or of alchimella arvensis, are perhaps the most likely to be effective; but their influence is very uncertain. To allay spasm and pain, opium and extract of belladonna are useful in suppositories. Belladonna must be cautiously employed, especially in elderly men, lest it increase the loss of tone of the muscular coat, and it should be given only when the pain is acute. In chronic catarrh, decoction of pareira brava with four or five minims of copaiba, or oil of sandal-wood in small doses, is useful. Benzoic acid in four-grain pills, at the rate of six or eight pills daily, is sometimes beneficial as a balsamic in chronic catarrh. More trustworthy in cases of subacute cystitis is buchu tea. Unfortunately, both pareira and buchu are apt to produce indigestion, and thus cause more discomfort than they allay. When given at all, they should be given in large quantities; in every twenty-four hours, 1 or 1½ pint of the decoction to be drunk, in three or four portions. Acids, except the mineral acids, in small tonic doses, are of no avail. Alkalinity of the urine in cystitis is due to the conversion of urea into carbonate of ammonia, and its production will be prevented by clearing the bladder of decomposing urine and pus. In cases of chronic cystitis due to atony, alkalies are chiefly beneficial when the patient is gouty and the urine highly acid.

For the acute cystitis which is a complication of gonorrhœal urethritis, the catheter is seldom needed, and injections would be mischievous. The *treatment* consists in the frequent use of sedatives in the form of very hot hip baths (104°–110° F.) for ten minutes, hot poultices, belladonna suppositories, eight to ten leeches to the perineum, subcutaneous injections of morphia, or of morphia and atropine, saline aperients, and low diet. Liquor potassæ, with tincture of henbane or of belladonna in camphor water, is also a very useful sedative in these cases. They may be given alone, or decoction of triticum repens may be given as well.

For old chronic cases, the winter should be passed in a warm climate; and a course of the sulphur waters at Bath, Strathpeffer,

Harrogate, or Schlangenbad will greatly increase the tone of the bladder, and notably diminish, when it does not wholly remove, the muco-pus from the urine.

Neuralgia of the Bladder.—Pain, referred to the bladder, almost always to its neck, without actual disease of that part, is caused by a great variety of local affections and also by certain conditions of general disturbance. Nearly always the cause can be traced, and its removal cures the pain. Nevertheless, in a very few cases, the cause cannot be discovered: such, for want of a better knowledge of their origin, are termed *simple neuralgiæ*. In health the neck of the bladder is at all times highly sensitive, and often suffers from increased sensibility when other viscera are affected; while the remainder of the bladder, unless diseased (by inflammation or ulceration, for example), is probably quite insensible to the touch of foreign bodies.

The causes of painful conditions of the bladder, it has been already said, are most numerous. In respect of age, the middle age mainly suffers from this affection, though neither old age nor childhood is exempt. Of specific local causes, all which interfere with the evacuation of the bladder are sources of pain to this viscus—viz., stricture, enlargement of the prostate, calculi, gravel, atony of the bladder, tumours or indurations of its walls. The passage of sounds, falls on the perineum, pressure by the gravid or displaced uterus, constipation and loaded rectum, even excessive purging, may excite this form of pain. So, also, disease of the kidney, womb, or rectum; especially fissure of the anus, piles, or ascarides may set up nervous pain in the bladder. More distinct causes are disorders of the digestion, imperfect function of the liver or stomach, indulgence in certain alcoholic drinks such as punch, imperfect assimilation of food, or changes of tissue which produce highly acid urine or excess of uric acid, or the reverse—neutral urine with excess of phosphates. Exposure of the surface of the body to cold or a sedentary life are also causes of pain commencing in the neck of the bladder, but radiating widely elsewhere. Persons of rheumatic, gouty, or nervous constitution are prone to suffer from these pains. Excessive coitus and masturbation frequently set up pain at the neck of the bladder, principally through provoking long continued congestion of the erectile tissue and vascular structures placed there; probably also in part through the nervous prostration which follows these excesses. The debility resulting from long residence in hot moist climates, especially when the patient has suffered from malarial fever, both favours the production of the pain and increases its severity. Some of the most severe cases which the writer has seen have been in anæmic patients from India, the Straits' Settlements, or the Philippines.

The *symptoms* vary in different persons. Frequent calls to void urine are generally present, though not always so. Pain, usually intermittent—almost constant in severe cases—is felt in the perineum. It is variously described as an aching, as a sense of weight or of tightness, increased by sitting on a cushioned seat or when the sensitive neck of the bladder is pressed by the weight of the body. In some persons the pain is referred to the suprapubic region, in others to the symphysis. This form is more common in persons who indulge too much in stimulating food and drink. The pain is rarely confined to the localities just mentioned, but radiates to the groins, insides of the thighs, loins, sacrum, and lower part of the belly. It is often accompanied by depression of spirits and anxiety, or by irritable temper. The pain is usually worse by night than by day; that is, when the body is warm in bed and the genital organs congested by sleep. It is also very severe in persons of whose families some members suffer from ordinary gout, and who, though no local affection connected with the pudenda be detected in themselves, have eczema elsewhere more or less severely. In certain patients—usually those afflicted with dyspepsia—there is a tendency to spasm, and the patients are much alarmed by a liability to difficulty in micturition, which their fright may exaggerate to almost complete retention. Such spasm is, of course, quickly allayed by a hot hip-bath, a saline purge, or other simple remedy. In all cases the affection is very apt to return if the original cause be permitted to regain activity.

The *treatment* is general and local. The general treatment consists in removing the functional disturbance, if any exist; in ensuring the proper action of the digestive organs; in curing or alleviating any local ailment; in restoring the patient's strength; and, if there be any history of previous malarial attack, in using arsenic, bark, or quinine in full doses. A diet and regimen must be observed which will prevent the reproduction of the condition which favoured the excitation of the neuralgia. Thus the diet must be light but nutritious; alcohol must be most sparingly taken—to be wholly avoided in nearly all cases. Laxatives and

diluent drinks, to render the urine of low specific gravity and of weak acidity, are needed. Long journeys are hurtful, particularly railway journeys, which in many persons excite prostatic congestion; and sexual commerce must be kept at a minimum.

The local treatment consists in the cure of any ailment discovered on careful examination of the urinary organs with the sound and finger in the rectum. When signs of disease are absent, the cautious passage of full-sized sounds at intervals of two or three days is often very effective. They may be followed by tepid injections into the bladder, slowly given, and at first not more than two or three ounces at a time; then increasing to six or eight ounces as the bladder becomes habituated to the distension. The injections may be cooled to 50° or 40° if the tepid ones fail to relieve pain. Tepid douches to the hypogastrium, perineum, or the sacro-lumbar regions, are sometimes beneficial. They should be applied for ten or twenty minutes if they cause no pain. Counter-irritation also, in the form of blisters to the perineum—small, and frequently repeated, are occasionally serviceable; but the writer has seen this remedy more often increase than allay vesical neuralgia. In some cases of general debility, without any marked functional derangement, local treatment has effected a complete cure in less than a month, but such success is not to be counted on. The most trustworthy treatment is a careful attention to diet and regimen, and to restoring the general health of the patient.

BERKELEY HILL.

BLADDER, Extroversion of the. *See* ECTOPIA VESICÆ.

BLADDER, Puncture of the.—When a patient is suffering from retention of urine, from whatever cause, and the surgeon is unable to introduce a catheter, the bladder is punctured by trocar and canula, and the urine evacuated. The operation is occasionally employed in enlarged prostate, and tumours of the bladder and prostate, when acute retention of urine is not present. It is also practised by some surgeons in the treatment of certain forms of urethral stricture.

Before puncturing the bladder for retention of urine, the surgeon must satisfy himself that retention is really present, and must have made every effort to pass a catheter (*see* RETENTION OF URINE).

The bladder may be aspirated above the pubes, or it may be tapped (1) above the pubes; (2) by the rectum; (3) from the perineum: (4) through the symphysis pubis; (5) under the symphysis pubis.

When there is hope that the relief from retention will only be required temporarily, *supra-pubic aspiration* of the bladder is the safest operation. Should retention recur, aspiration may be repeated two or three times with safety, and it has been performed ten or twelve times in immediate succession without bad result; at the same time it should be remembered that fatal extravasation and abscess have followed a second introduction of the needle. It will therefore be wise, if aspiration has to be several times repeated, to tap at once above the pubes with trocar and canula, leaving the canula or a catheter in the wound. Supra-pubic tapping ranks next to aspiration in safety and convenience. Rectal tapping is falling into disuse, owing to the obvious inconvenience it causes the patient. The other methods are surgical curiosities.

1. (*a*) SUPRA-PUBIC ASPIRATION OF THE BLADDER consists in the introduction of a fine trocar into the bladder above the pubes, and in the withdrawal of the urine through the trocar by pneumatic aspiration. No anæsthetic is necessary. There are many aspirators sold, the best perhaps is usually called Potain's; it consists of an exhausting syringe attached to a cork, which can be fitted into a wine decanter or any other bottle sufficiently large, and through the cork also passes another tube connected with the trocar. The receiving bottle is exhausted. The patient lies upon his back with the knees slightly raised; an assistant steadies the distended bladder by pressing with his hands in each iliac region, and the trocar, having been carefully carbolised, is thrust through the skin about half an inch above the pubes downwards and backwards into the bladder; then a tap is turned and the urine flows into the receiver. Aspiration should be kept up during the removal of the canula, to prevent the escape of any urine into the tissues. This operation may be repeated perhaps twice or thrice, when, if no instrument can be passed by the natural passages, the surgeon is recommended to perform—(*b*) *Supra-pubic tapping.* It is desirable, but not absolutely necessary, to administer an anæsthetic. The pubes should be shaved, and a small incision made, about an inch long and ending half an inch above the pubes, through the skin and fat down to the linea alba. An assistant steadies the bladder, and a curved trocar (the ordinary rec-

tal trocar is very suitable) is then pushed through the linea alba downwards and backwards into the bladder. The urine is allowed to escape, and if the canula is a small one it can be tied in by tapes attached to a T-bandage and plaster. Or, better still, a soft catheter can be introduced through the canula and be tied in. After the canula is removed, a piece of tubing can be attached to the catheter, and the urine can thus be led into a receptacle by the side of the bed. The operation is simple and safe, and the bladder is easily drained until an instrument can be introduced through the urethra.

If for any reason the surgeon prefers to tap the bladder by the rectum it is done as follows:—

2. Rectal Puncture of the Bladder. The bowel is cleared by an enema, an anæsthetic administered, and the patient is held in the lithotomy position. While an assistant presses the bladder downwards the operator introduces the first and second fingers of his left hand into the bowel and defines the prostate, especially its upper border. He then takes the rectal trocar in his right hand, *with the point drawn just inside the canula*, and introduces the instrument along the groove between his two fingers which are lying in the rectum, until it has fully passed the posterior margin of the prostate. The handle is then firmly depressed, and the trocar and canula are thus pushed into the bladder. After the urine is drawn off the canula can be removed or retained as the surgeon deems best. This operation has many disadvantages. It is somewhat dangerous and may lead to troublesome fistula. It can rarely be required now.

3. Puncture through the Perineum. A large, straight trocar and canula are used. The patient is held in the lithotomy position. The surgeon's left forefinger is passed into the rectum, and the trocar is thrust into the perineum about an inch above the anus and pushed, upwards and backwards, into the bladder. The canula can be retained.

4. Puncture through the Symphysis Pubis.—A medium-sized hydrocele trocar is used. It is introduced, without preliminary incision, through the centre of the symphysis, and pushed downwards and backwards into the bladder.

5. Puncture under the Symphysis Pubis.—The penis is forcibly pulled downwards and backwards and the trocar thrust under the pubes into the bladder.

G. Buckston Browne.

BLADDER, Rupture of the, is a breach in the vesical wall, caused either by external violence, or by forces acting within the body itself. In the former case the rupture is *traumatic*: in the latter *idiopathic*. In either form ruptures fall naturally under two heads: *extraperitoneal* and *intraperitoneal*; the former including (*a*) *partial* ruptures, or rents in the mucous coat only, or in the mucous with part of the muscular; and (*b*) the important group of *subperitoneal* ruptures. Occasionally multiple rents are found in an injured bladder.

1. The *causes* of ruptures are divisible into *predisposing* and *determining*. Distension of the bladder is the main predisposing condition of an uncomplicated traumatic intraperitoneal rupture, and is present in the great majority of instances of ruptures of all kinds. When the viscus is empty, or contains but a small quantity of urine, a rent in the bladder anteriorly may be occasioned: (*a*) by a fractured pubic ramus; (*b*) by great violence applied to the hypogastric region, as when the wheel of a heavily laden waggon passes over the abdomen, or a mass of earth falls on the part; and (*c*) by the same force by which the innominate bones are violently separated at the symphysis pubis. The base of the bladder may also be split by disruptive force, which tears open the perineum and lacerates the rectum. Other predisposing causes are intoxication, and some obstacle to the passage of urine from the bladder. Differences of habit and occupation render males far more liable than females to rupture of the bladder. In the *traumatic* cases the determining cause is usually some force applied to the hypogastric region. Even the strain of the abdominal muscles against the distended bladder in falls backwards, and lifting heavy weights, may suffice to occasion the lesion. Violence applied to the back has also been noted as a cause of rupture in several cases. The site of the rent will depend upon the degree of distension, the nature and mode of application of the violence, and the position of weak spots in the bladder-wall.

Idiopathic ruptures include all cases in which no external violence has been applied to the abdomen; ruptures from over-distension due to various causes, as, e.g., stricture, enlargement of the prostate, hysteria, retroversion of the gravid uterus, extra-uterine fœtation, labour, and alcoholism; ruptures in the fœtus, and ruptures due to ulceration, the result of certain diseases, viz. fever, erysipelas, syphilis, tubercle, cancer, and calculus.

2. *Pathology.*—In the *idiopathic* cases rupture is often preceded by some change in the organ itself. Thus long-continued obstruction to the passage of urine, whether from stricture or enlargement of the prostate gland, occasions hypertrophy of the muscular fibres of the bladder, and the formation of 'tunicary herniæ,' or diverticula of the mucous membrane, which protrude through the muscular fibres, commonly either at or near the summit of the bladder, or posteriorly at the level of the insertion of the ureters. As these pouches are sometimes immediately under the peritoneal tunic, and sometimes unconnected with the serous coverings, ruptures due to stricture or hypertrophy of the prostate may be either intraperitoneal or extraperitoneal. A second condition, occasioned by obstruction of the urethra, especially when instruments have been passed, is inflammation of the mucous membrane of the bladder, determined, perhaps, by decomposition of retained urine. The inflammation may end in ulceration, softening, sloughing, or gangrene of some spot in the bladder-wall, a termination exemplified in cases of rupture from retroversion of the gravid uterus, and some prostatic cases. A third effect of obstruction is thinning and weakening of the vesical tunics. The final cause of rupture may be muscular action in efforts to pass water, and straining at stool. In rupture during labour the neglected and distended bladder is placed between two forces, the contraction of the abdominal muscles and some part of the child's body, or the forceps of the medical practitioner. The rent may either be into the peritoneal cavity or into the vagina. After the completion of labour rupture may occur sooner or later in consequence of the injury sustained by the bladder during the process, and from subsequent neglect.

Each kind of rupture has its own form of breach in the bladder-wall. The ordinary form of uncomplicated rupture from blows, kicks, and falls, is a lacerated rent, one inch to three inches in length, vertical, oblique, or transverse. The more or less vertical rent at the upper part of the posterior wall of the bladder, commencing near the urachus, is the most typical, and results from the sudden application of equable violence to the hypogastric region, driving the fluid against the posterior wall, which is burst open by the expanding force. In retroversion of the gravid uterus, the opening is either a rent with gangrenous edges, or a sloughy hole or gangrenous perforation. In cases of stricture and retention, where the rupture follows over-distension and straining, the aperture is usually a small perforation, or a short rent of about half an inch, or a triquetrous opening, or a round hole lined by mucous membrane. In cases of hypertrophy of the prostate, the opening may be smooth and rounded, or a narrow rupture with thinned or sloughy edges.

In *traumatic* cases blood is often poured out freely. Submucous extravasation will be found, either confined to the neighbourhood of the rent, or spread over a wider area. A considerable amount of blood has been found in some intraperitoneal ruptures in the cavity of the abdomen, whilst in some of the extraperitoneal cases blood may collect and form a swelling in the hypogastric region. After rupture the bladder either collapses or contracts, and is usually incapable of holding more than a few ounces of urine.

3. *Symptoms.* — The typical primary symptoms of rupture are a feeling of something giving way, excruciating pain, shock, inability to stand or walk, desire, but want of power, to micturate, and removal from the bladder with the catheter of blood only, or a small quantity of bloody urine. When the point of the catheter impinges against a sound portion of the viscus, it will be found difficult to rotate the instrument and to depress it between the patient's thighs, but if there is an intraperitoneal rent on the posterior wall, the catheter may suddenly slip through the opening into the peritoneal cavity, become freely movable, and withdraw a large quantity of fluid in place of the small quantity of blood, or the few ounces of blood and urine, previously removed. As the contraction of the muscular fibres of the bladder cannot assist the flow, and as the abdominal muscles are exerted only for the business of respiration, the urine will either well out gradually and run down by the side of the catheter, come out almost *guttatim*, or pass from the instrument in an intermittent stream during the periods either of inspiration or expiration. As a general rule the patient from the first is unable to make water, and may continue to exhibit this inability to the end. Ability to micturate, however, has been observed both in intraperitoneal and extraperitoneal cases, and in both sexes. It is relatively more frequent and in greater perfection in the extraperitoneal cases. Sometimes the patient passes water, with or without difficulty, immediately after the accident, and not subsequently, sometimes in small quantities throughout the illness, sometimes on the second or third day, and

sometimes at a later period. When passed it is generally with difficulty, and the amount will be less than it ought to be. Occasionally there will be incontinence of urine. Very rarely indeed the patient may pass water naturally every day and be independent of the catheter.

In the *intraperitoneal* ruptures the symptoms are decidedly more severe than in the extraperitoneal cases. The shock at first is greater and the well-known symptoms of peritonitis speedily supervene. The patient will lie in bed with his knees drawn up, or be propped up with pillows, to relax the abdominal muscles. He will have a pinched, anxious, haggard, and even ghastly expression of countenance, look pale and anæmic, and be tormented with a frequent or constant desire to pass water, leading him to make many ineffectual efforts to empty his bladder. He will suffer from thirst, and sooner or later be troubled with vomiting, bringing up a greenish-yellow liquid, and even the water which he has drunk copiously to quench his thirst. The pulse will be small, feeble, irregular, and rapid, varying between 90 and 130, and the respirations hurried. The abdomen will be tense and tender, tympanitic above, dull and fluctuating below. There may even be a more or less defined and fluctuating swelling, resembling the bladder, between the umbilicus and the pubes, due to urine temporarily confined by the disposition of the coils of intestine. Throughout the illness there will be marked restlessness and insomnia. As the case proceeds, the symptoms become aggravated, the swelling and tension of the abdomen increase, clammy sweats appear on the skin, the hiccough and vomiting become more urgent and distressing, the pain is intolerable, the countenance sunken and ghastly, the voice low and feeble, and the patient may sink into a state of collapse, or into a typhoid condition attended with delirium and coma. If the patient survive so long, there may be marked signs of amendment about the fifth or sixth day. The rent in the bladder is under repair, or gets blocked up by intestine or omentum, and the patient may sit up in bed, pass water voluntarily, take food without rejecting it, be freer from pain and comparatively cheerful. Relapse speedily occurs, and the patient sinks.

In *extraperitoneal* cases, the general and local symptoms will be those usually attending extravasation of urine. When the rent is in front, the urine either forms a circumscribed collection outside and anteriorly to the bladder, occasioning marked dulness on percussion; or it becomes widely diffused, mounting up towards the umbilicus between the peritoneum and abdominal muscles, and then finding its way to the subcutaneous fascia or into the peritoneum, or passing into the iliac fossæ, or through the obturator foramina and the inguinal and femoral canals into the scrotum and thigh. When the rent is behind the prostate, the fluid will ascend into one or other of the iliac fossæ. Wherever extravasation occurs it sets up inflammation of the connective tissue and fasciæ, followed in due time by suppuration and sloughing. Occasionally the urine is collected in a kind of sacculus, the walls of which are composed of connective tissue thickened by lymph, simulating the appearance of a lining membrane to the adventitious cavity.

Diagnosis.—The chief mistakes which occur in practice are: 1. Overlooking the lesion altogether, or mistaking it for some other affection, such as peritonitis. 2. Mistaking an extra-peritoneal for an intraperitoneal rupture. 3. Mistaking a contusion of the bladder or of the abdomen for a rupture of the bladder.

The first mistake is not likely to occur to a well-informed and sagacious practitioner, if the case is typical. Clear evidence of fulness of the bladder at the time of the accident, of violence applied to the hypogastric region, of the occurrence of the typical primary symptoms, and the results of examination of the bladder and abdomen, will establish the diagnosis beyond a doubt. But the surgeon may have to do with a patient under the influence of alcohol, who recollects nothing, and felt nothing of the accident, and he may have to trust mainly to his own skill in interpreting symptoms and in manual and instrumental examination. The behaviour of the catheter, the nature and quantity of the fluid withdrawn by it, and the total or restricted ability of the patient to micturate, will be the most reliable guides. If these are insufficient, the bladder can be injected with a warm solution of thymol. If the bladder be sound, it will form a circumscribed tumour in the hypogastric region, and the fluid will be recoverable; if ruptured, the fluid will become diffused among the intestinal coils, be felt by the patient in the flanks, and will not return readily or completely through the catheter.

The second mistake will be less likely to occur if the surgeon carefully considers the mode of occurrence of the injury, whether it is complicated by fracture or not, and the effects of catheterism. In extra-

peritoneal ruptures, fracture of the pelvis is a frequent cause or accompaniment of the bladder-lesion; the primary symptoms are less marked, the constitutional condition less serious, the catheter rarely leaves the bladder, and evidence of extravasation in the hypogastric region, flanks, scrotum, or thighs, will soon be forthcoming. If the surgeon is satisfied that the bladder is ruptured, but cannot arrive at a certain conclusion as to the kind of rupture present, he can either explore the bladder from the perineum, or make an incision immediately above the pubes, and examine the anterior aspect of the organ, before proceeding to open the peritoneum.

The third mistake arises chiefly from over-estimating the amount of urine in the bladder at the time of the accident; through attending to the time which has elapsed since micturition without regard to the quantity of liquid ingested; from forgetting that the secretion of urine is often either suppressed or greatly diminished for some hours after severe abdominal contusion; and from regarding the passage of a catheter by a medical practitioner, and failure to draw off urine, as necessarily indicating an empty bladder.

Treatment.—As there is no indubitable case of spontaneous recovery on record after intraperitoneal rupture of the bladder, it is essential that the surgeon should form his diagnosis immediately, and act without delay. The indications are mainly two: first, the removal of the effused urine, and secondly, the prevention of the further escape of urine through the rent in the bladder into the perivesical connective tissue or the peritoneal cavity. For these purposes the intermittent use or constant retention of a *catheter* in the bladder, attempted *washing out* of the peritoneal cavity or adventitious pouch in the perivesical fascia through the rent in the bladder, *tapping* the recto-vesical cul-de-sac, and *paracentesis abdominis*, either with an ordinary trocar or the aspirator, are not trustworthy.

The peritoneal cavity can only be efficiently cleared of urine and blood by *abdominal section* and careful and thorough sponging. Prevention of further accumulation and transmission of urine into the peritoneal sac in the male may be secured by sewing up the rent in the bladder with carbolised silk sutures, with or without paring the edges of the ragged rent. If this procedure be adopted, the bladder should be injected with water before the abdominal wound is closed, to make sure that leakage is not possible. Perineal urethrotomy, either median or lateral, should then be performed, the lateral operation being preferable. A tube can be retained in the bladder. Some surgeons prefer the performance of perineal urethrotomy or cystotomy in the first instance, and abdominal section afterwards, and if there is any doubt as to the diagnosis, a preliminary exploration of the bladder would remove it; otherwise the sequence of procedures cannot make any difference. After the operation, hypodermic injections of morphia will be of service. Abdominal section ought to be performed within the first twenty-four hours to have a good prospect of success, and further experience is required to test the value of all operative measures.

In the female, intraperitoneal rupture of the bladder should be treated by vaginal cystotomy and abdominal section, with careful cleansing of the peritoneal cavity.

In extraperitoneal ruptures, cystotomy, combined with incisions above the pubes and into any parts where extravasated urine finds its way, will offer the best prospect for the patient. WALTER RIVINGTON.

BLADDER, Tumours of the. — Tumours of various kinds have long been recognised as affecting equally the male and female bladder. Those of a cancerous nature have been more familiar to surgeons than other forms of less malignant tendency, and hitherto accounted rare. During the last ten years the latter have been studied, and also found removable by operation in some instances, a condition which does not characterise cancerous growths.

The greater number of these, namely, twenty-three cases, have occurred in the experience of the writer; hence the result of his researches will form the chief basis of the present article.

Tumours of the bladder may be classified as follows:—I. Tumours composed of homœoplastic elements.

1. The *simple mucous polypus* at present met with only in the bladders of children, and mostly appearing to be analogous in structure to the soft nasal polypus, a form of myxoma; while occasional specimens contain, in addition, more of the deeper normal fibres of the structures from which the growth arises. The growths are numerous, evidently rapidly formed, soon fill the bladder, and in the case of female children sometimes issue by the external meatus, and present in the vagina.

2. *Papillomatous Tumours.*

a. Fimbriated Papilloma is now held to designate that product which has been

familiarly known as the 'villous' growth, a term which is objectionable on several grounds. The most obvious character of the growth is a structure in which the vesical mucous membrane is developed into fine papillæ, which consist of long fimbriated processes of extreme tenuity, and usually form a group arising from a small circumscribed base.

b. Fibro-Papilloma. Here the papillary processes, although present in more or less abundance, do not constitute the chief part of the structure, which is more solid than the preceding, and consists of the constituents—unstriped muscle and connective-tissue fibres—of the submucous tissues of the vesical coats. The papillæ are sometimes shorter, less developed than, the 'fimbriated' processes of the previous division.

3. *Transitional Tumours.*—This term is for the present used to designate certain examples of tumour, the chief structure of which is that of 'fibro-papilloma' just described; but presenting also, intermixed, some suspicious-looking cells, which may be merely leucocytes, but which may sometimes suggest to the observer that the growth is intermediate in structure between the foregoing and a formation of a malignant type, 'sarcoma.'

The three foregoing varieties are, comparatively speaking, by no means uncommon.

II. Tumours composed of heteroplastic elements:—

a. Epithelioma.

b. Sarcomata, round and spindle celled; rare.

c. Scirrhous, encephaloid, and melanoid cancers.

d. Dermoid tumour; rare.

Symptoms.—Regarding the forms most commonly met with, or those of the first group, the earliest symptom is mostly hæmorrhage; and it occurs before unduly frequent micturition is complained of, and before it is painful. On the other hand, when the tumour is of the malignant type or approaches thereto, pain and frequency of passing water generally precede the appearance of blood, sometimes for a considerable time. There is nothing very characteristic in the hæmorrhage, excepting the one important circumstance always to be inquired for, and, if possible, to be observed by the surgeon himself; namely, that in the act of micturition the stream may sometimes commence without any blood-stain, or with only a slight admixture, and end of a bright red colour from the presence of much fresh blood. With such an occurrence, and no recent urethral lesion having been made, the source of hæmorrhage must almost always be vesical. Supposing in such circumstances that the absence of stricture, ordinary diseases of the prostate, calculus of the bladder, and cancer have been ascertained by sounding and by rectal examination, it remains only to observe certain products which the urine itself may contain.

Very little positive evidence is obtained by rectal and vesical examination except in hard, cancerous deposits, which are thus easy to identify. The result is generally negative, or nearly so, when a growth of the papillomatous or of the allied variety is present.

The examination of the urine, however, is highly important. Its object is to obtain disintegrated portions of the tumour if present, and to identify their structure under the microscope. An excellent way of obtaining such specimens is to wash out the bladder freely with warm water. It rarely happens that this process fails to detach fragments sufficient for our purpose if there is a growth in the interior.

The presence of a non-cancerous tumour being verified or strongly suspected, the bladder should be explored, and the tumour removed if practicable; no other treatment is of any service. The best mode of accomplishing this is by external urethrotomy, a simple procedure involving little or no risk, and not by cystotomy—some rare cases excepted—since it is always more or less dangerous.

Operation.—The steps of the operation which the writer adopts are as follows:—The position of the patient and the accessories are the same as for lithotomy. A median staff with a short curve, deeply grooved, is passed into the bladder, and the patient is held by two assistants in the usual manner, another holding the staff. The surgeon introduces into the rectum his left forefinger, so as to feel with its tip the position of the grooved staff, and verify the apex of the prostate, on which he places his finger as a guide. Maintaining his left index in the position described, he makes, with a long, narrow, straight-backed bistoury, a vertical incision through the skin and cellular tissue in the middle line, about an inch and a quarter long, the lower end terminating about three quarters of an inch above the anus. He next enters the bistoury, with its cutting edge upwards, in a horizontal direction, at the lower part of the incision, just above the upper border of

the bowel and parallel with it, and guided partially by the left index, directs the point to the membranous urethra, which it penetrates, entering firmly the groove of the staff. He then incises the urethra on the staff for a few lines, and withdraws the bistoury, cutting slightly a little of the tissues upwards as he does so, avoiding as far as possible any section of the bulb itself, and making room enough only for the finger to enter. He now inserts in the groove of the staff a tapering director and presses it inwards along the urethra to the bladder: when arrived there the staff is withdrawn, the director remaining, and on it the left index is gently insinuated to the neck of the bladder, entering which, he at once recognises the form and position of the growth, and determines whether he can or cannot attempt to remove it.

If the surgeon finds a polypoid growth he should introduce a pair of forceps into the cavity of the bladder, and use them without aid from the finger. The forceps should have wide and serrated margins where the blades meet, so as to crush, but without power to cut, the tissues seized, and should be provided in different forms. The simplest should be like an ordinary lithotomy forceps. Others should be curved, for seizing tumours which are situated laterally and near to the neck of the bladder, in which last-named position the straight forceps is powerless to grasp the tumour. When the blades are free, if they are opened easily and widely, the polypus is almost sure to be within their grasp. No suprapubic pressure, as a rule, should be made during this act, so as to disturb the contour of the bladder. He should never drag or pull forcibly, but rather 'bite' off the growth with the blades, twisting it somewhat perhaps. After this the finger alone may often remove it safely. Every time the forceps has removed a portion, the finger should examine the interior, before the forceps is introduced again. And in no case where the tumour is a flattened growth with broad base, should an attempt be made to separate it very near to the walls of the bladder, which might thus be fatally injured.

There is one circumstance important to be noted, especially in dealing with the less prominent growths, viz., the effect of strong supra-pubic pressure made by an assistant in relation to their mode of presentation to the finger of the operator engaged in exploring the bladder, and in estimating their size and form. If that pressure is considerable, it forces the upper wall of the bladder into its own cavity, and thus gives to the growths a larger contour than they possess, and makes them apparently salient to a much greater extent than they really are. Thus an eager or inexperienced operator, unaware of the effect of supra-pubic pressure, might be led to seize the mass presented to the forceps by the influence of this pressure, and, under the belief that it was a large growth, he might inflict a fatal wound by crushing a double fold of the coats of the bladder, and so making an opening in the peritoneum. To avoid such a catastrophe it is only necessary, first, to decline the attempt to destroy any growth which is clearly not sufficiently salient to admit of complete or nearly complete removal; and, secondly, never to employ the forceps while forcible supra-pubic pressure is made—at least, no more pressure than is desirable just to steady and support the bladder and the parts adjacent.

But other means may be used according to the judgment of the surgeon. A very small écraseur, with violin-string ligature, may be manipulated by the side of the index finger, and used in polypoid forms of tumour. In the cases of women such a tumour may sometimes be slowly and carefully brought into view by traction on the forceps, and then the pedicle may be ligatured, as the writer has done in two instances.

After the operation a tube has usually been introduced and left for two or three days. As a rule, however, it appears advisable not to employ one.

It may be remarked, as before observed, that the incisions necessary for the proceeding are simple and harmless to the last degree. The writer has never met with any untoward result from them. The risk of removing the tumour is, however, sometimes considerable, but even this depends very much on the care, judgment, and self-command of the operator. It is not at all difficult to inflict fatal injury on the organ by an attempt to remove a growth either too completely or too vigorously.

There is good reason to believe that entire removal of the base of papillomatous formations is not absolutely necessary, and that cicatrisation prevents further development where the growth has been nearly, and not quite, removed.

The presence of cancerous disease of the bladder, and especially the scirrhous variety, may almost always be determined by rectal examination: the irregular knotty feel of the hard deposit in the situation of the prostate and beyond it are quite charac-

teristic. Such a condition, associated with much pain, occasional bleedings, and frequent micturition, go far to establish the diagnosis. In regard to treatment, that only which renders life endurable by alleviating sufferings which inevitably become severe in the later stages of the disease, is desirable; and it consists in the administration of morphia, the subcutaneous injection being the most efficient form in these cases. It may here be emphatically stated that if the physical characters and symptoms, especially the former, indicate the presence of a growth of this nature, any operative proceedings for its removal must be not merely futile and imperfect, but extremely dangerous, and ought not to be undertaken. It does not follow, however, that in such cases the drainage of the bladder by a perineal opening may not, in certain circumstances, be a useful proceeding to relieve suffering or prolong life, &c. HENRY THOMPSON.

BLEBS. *See* BULLÆ.

BLENNORRHAGIA. *See* GONORRHŒA.

BLEPHARITIS. *See* EYELIDS, Diseases of the.

BLINDNESS.—The term blindness is used in two senses—a strict or scientific sense, in which it means inability to distinguish light from darkness, and a loose or popular sense, which may mean any condition impairing vision, or, indeed, mere temporary incapacity for opening the lids, vision being otherwise perfectly preserved. In the true sense, when the patient has no longer even quantitative perception of light, blindness is always the result of some lesion of the nervous system, such disease having its seat either in the recipient apparatus or retina, in the conducting apparatus, optic nerve, chiasma, or tract, in the percipient apparatus or corpora quadrigemina and optic thalami, or, lastly, in the intellectual visual centre; situated, according to some, in the occipital lobes of the cerebrum, and, according to others, in the angular gyrus, the tract or fibres of Wernicke establishing the communication between the corpora quadrigemina and the cortex cerebri in the former case, and radiating fibres effecting the transmission of the impressions in the latter case. Congenital defects, traumatic lesions, hæmorrhage, inflammation and its consequences, syphilitic and other tumours of the brain, may attack, compress, or destroy any of these parts, and total blindness of one or both eyes may be the result.

It is impossible to determine from the censuses of this country whether those who are termed blind are only blind so far as to prevent their being educated, or obtaining their own living, or whether they are wholly incapable of perceiving light. Moreover, no clear distinction is drawn between cases of complete blindness and those in which, whilst one eye is really blind, the other still retains some perception of light.

The present article will be devoted to the consideration, not only of the completely blind, but also of those cases of great impairment of vision which, whilst varying from mere perception of light to the recognition of large objects, yet practically render the subject unable to pursue any of the ordinary vocations of life. It is, indeed, very difficult to draw any line between mere weakness of sight and blindness. There are cases, for example, of astigmatism, of cataract, and of retinal or choroidal atrophy, in which vision may be assisted, and even rendered tolerably good for a short period or for certain purposes, but, as a whole, may prove insufficient for the ordinary duties of everyday life.

It is found convenient in practice to distinguish three degrees of blindness:—(1) Complete blindness, in which there is no perception of light. Vision is then said to be abolished; $V = 0$. (2) That degree of blindness in which only the difference between light and darkness can be distinguished; $V = \frac{1}{\infty}$. The patient is then sometimes said to possess quantitative perception of light; and, thirdly, that degree in which there is qualitative perception of light, expressed by $V = \frac{1}{1000}$. In this degree the patient can distinguish large objects, masses of colour, the movement of the hand between the eye and the light, and may, perhaps, even be able to count the fingers, but is unable to do more than grope his way from place to place.

Distribution of Blind Persons.—The distribution of the blind varies considerably in different areas. Thus, in the census of France in 1861, the number of blind in the Département du Vendée was only 24 in 100,000 inhabitants, whilst in the department of Eure it was as high as 121 in the same number, a difference too striking to be attributable to defective registration.

The census returns for 1881, published in 1883, contain many interesting facts in regard to the number, distribution, and occupation of the blind in England and Wales. The total population is given at

25,974,439, and the total number of blind is returned at 22,832. Of these, 1,958 were blind from birth, a large proportion of them probably in consequence of an attack of purulent ophthalmia. Of the 22,832 blind, 12,048 are males, 10,784 are females. The distribution of the blind in England is as follows:—

Counties	Total Population	Number of Blind	Males	Females	Blind from Birth
Northern:—					
Durham	1,624,213	1,259	723	536	112
Northumberland					
Cumberland					
Westmoreland					
Yorkshire	1,420,001	2,294	1,234	1,060	223
North-Western:—					
Cheshire	4,108,184	3,004	1,628	1,376	317
Lancashire					
North-Midland:—					
Leicestershire	1,637,865	1,429	733	696	129
Rutlandshire					
Lincolnshire					
Nottinghamshire					
Derbyshire					
West-Midland:—					
Gloucestershire	3,029,504	2,914	1,606	1,308	267
Herefordshire					
Shropshire					
Staffordshire					
Worcestershire					
Warwickshire					
South-Western:—					
Wiltshire	1,859,013	2,354	1,257	1,097	174
Dorsetshire					
Devonshire					
Cornwall					
Somersetshire					
Eastern—					
Essex	1,343,524	1,308	673	635	127
Suffolk					
Norfolk					
South-Midland:—					
Middlesex, excluding London	1,596,259	1,434	694	740	119
Hertfordshire					
Bucks					
Oxfordshire					
Northamptonshire					
Huntingdonshire					
Bedfordshire					
Cambridgeshire					
South-Eastern:—					
Surrey	2,487,076	2,025	1,022	1,003	156
Kent					
Sussex					
Hampshire					
Berkshire					
London, including parts of					
Middlesex	3,816,483	3,214	1,551	1,663	252
Surrey					
Kent					

The following statistics, showing the steady decrease of blindness in the population—the result, it is to be hoped, of improved knowledge and care in treatment of diseases of the eye of all kinds—are interesting:—

	Number of Blind	Number of Blind in one million	Number Blind of one eye
1857	18,306	1,021	979
1861	19,352	964	1,037
1871	21,590	951	1,052
1881	22,832	879	1,138

Number of blind in one million of persons of the same age:—

Age	Both Sexes	Males	Females
0	166	172	161
5	288	312	263
15	388	449	328
20	422	491	359
25	645	800	494
45	1,625	1,947	1,326
65 and above	6,715	6,897	6,929
Mean	879	953	809

These figures must, however, be regarded as only approximations to the truth, for the instructive essay of Zehender shows only too well how fallacious such statistics may be, for in the official census of Mecklenburgh-Strelitz, the number of blind persons was returned at 480, but of these Zehender ascertained that 16, or 3½ per cent., were not totally blind, whilst in Mecklenburgh-Strelitz out of 73 returned blind, 5, or 7 per cent., were not blind; and on the other hand, in the former State 48, and in the latter 12 totally blind persons had been overlooked. The same defects of enumeration would probably be found in all censuses; but, even if this be allowed, it is still found that, in the geographical distribution of blindness, great differences exist in different countries. Thus in Holland the proportion is only 4·45 per 10,000; in Austria, 5·5 in the same number; United States, between 30° and 40° lat. 6·36, between 40° and 50° 4·65, including Canada. The author of the article 'Blindness' in the *Encyclopædia Americana* (1883), gives the proportion as 8·75 for America generally; Switzerland, 7·61; Sweden, 8·05; Belgium, 8·1; France, 8·36; Germany, 8·79; England, 9·84; Italy, 10·15; Spain, 11·09; Hungary, 12·01; Norway, 13·63; while in Finland it reaches the number of 22·45 in every 10,000 of the population. It is somewhat remarkable that the Jews have a higher proportion of blind than the Christians, in Germany the numbers being about 8 per 10,000 amongst Christians, and about 12 per 10,000 in Jews.

Etiology of Blindness.—Blindness is more common in hot and in cold climates than in temperate, from causes that may easily be conceived. In hot climates the glare and heat of the sun, combined with the dryness of the atmosphere, the deficiency of water for purposes of ablution, the extraordinary number of flies and other insects, and perhaps the greater activity of all germs of disease, render inflammatory affections common, and every traveller notices the frequency of ophthalmic disease and of cases of blindness in Egypt, Palestine, and India. On the other hand, in the Arctic regions, and especially in Finland, where the proportion of blind persons rises to a higher number than in any other nation, blindness is of frequent occurrence, partly, no doubt, owing to exposure to cold, and the strong reflection from the surface of the snow, but chiefly owing to the unwholesome hygienic conditions that are constantly present. The huts are overcrowded; men and animals live in close proximity with each other, and the inadequate provision for the escape of smoke, and of the exhalations from the skin, constitute precisely those conditions which every physiologist would acknowledge to be most detrimental to health, and to be exactly adapted to the production, maintenance, and propagation of disease.

M. Dumont, from an examination of the histories of upwards of 2,000 blind persons, the term being here used in the popular sense, found that the cause of blindness was: smallpox, 262; ophthalmia, 566; injuries, 181: amaurosis, 535; cataract, 66; amaurosis and cataract (glaucoma ?), 426; hydrophthalmia and various other causes, 20; total, 2,056. Bergmeister, in his Report on the Niederöstreichische-Landes Blinden Schule in Purkersdorf, which contained 75 children (39 boys and 36 girls), states that the cause of the blindness was blennorrhœa in 12 cases = 20 per cent.; measles in 12, congenital and hereditary blindness in 14, hydrocephalus in 7; other affections of the brain in 5, scarlet-fever in 6, injury in 2, Egyptian ophthalmia in 2, scrofulosis, rachitis, diphtheritis, each in 1 case, masern in 3, and there were 10 cases of doubtful origin. Of the 150 eyes in these 75 children, 95 were absolutely blind, and the remainder could distinguish between light and darkness. V. Millingen, in his

Report of his Private Dispensary at Constantinople, states that he observed 326 cases of blindness in the three years 1877, 1878, and 1879. The causes of the blindness were—Blennorrhæa-neonatorum, 4·3 per cent.; conj. gonorrhœica, 5·2 per cent.; blennorrhœa acuta, 3·4 per cent.; conj. diphtheritica crouposa, 3·6; keratitis ulcerosa, 20·7; iritis, 8·6; irido-choroiditis sympathetica, 3·7; atrophia nervi optici, 16·6; retinitis, 6·4; glaucoma, 8; retinitis albuminurica, 4·2; and the remainder from myopia, buphthalmia, microphthalmia, abscessus corneæ, keratitis bullosa, and sublatio retinæ.

Other authors, by whom the causes of blindness have been very carefully investigated, are—Schmidt Rimpler, Katz (1874), Stolte (1877), v. Zehender (1871), Seidelmann (1876), Emmert (1874), and above all by Magnus (1883) who has condensed and tabulated, as well as expressed in graphic form, the numerous observations and statistics of his predecessors. In the representation he has given of the causes of blindness in 2,528 cases, carefully examined by competent authorities, he distinguishes four classes: first, cases of congenital blindness; secondly, cases of blindness consequent on idiopathic diseases of the eyes; thirdly, blindness from injuries; and lastly, blindness occasioned by various diseases of the system at large. The particular diseases in each of the above classes, with their percentage proportion, is as follows:—

1. *In congenital blindness*, anophthalmos and microphthalmos, constituted 1·06 per cent.; megalophthalmos, 0·43; cataracta accreta congenita, 0·11; choroiditis congenita, 0·15; atrophia nervi optici, 0·75; retinitis pigmentosa, 0·75; congenital anomalies of the cornea, 0·07; congenital amaurosis from atrophy of the retina, 0·19; congenital tumours, 0·03; unnamed or indeterminate forms of disease, 0·23.

2. *Blindness from Idiopathic Diseases of the Eyes.*—Purulent ophthalmia of infants 10·87; trachoma and purulent ophthalmia of adults, 9·49; diphtheritic conjunctivitis, 0·35; diseases of the cornea, 8·06; irido-choroiditis and cyclitis, 8·86; choroiditis myopica, 0·94; various forms of choroiditis, 1·10; retinitis pigmentosa acquisita, 1·26; retinitis apoplectica, 0·11 per cent.; neuro-retinitis, 0·79; sublatio retina (detachment of the retina), 4·74 per cent; glaucoma, 8·97; idiopathic atrophy of the optic nerve, 7·75; tumours of the eye and adjoining parts, 0·35; indeterminate causes, 3·36.

3. *Blindness from Injury.*—Direct injuries to the eye, 4·03: unsuccessful operations, 1·93; injuries of the head, 0·27; sympathetic ophthalmia following injury to one eye, 4·50.

4. *Blindness caused by Various Diseases.*—Syphilis, 0·47; blennorrhœa gonorrhœica, 0·91; scrofulosis, 0·03; disease of the membranes of the brain, iridochoroiditis associated with meningitis, 1·42; disease of the brain, causing atrophy of the optic nerve, 6·96; disease of the spinal cord, leading to atrophy of the optic nerve, 2·33; atrophy of the optic nerve or neuritis after hæmatemesis, 0·39; atrophy of the optic nerve, after vomiting, without discharge of blood, 0·079; atrophy of the optic nerve after hæmorrhoidal hæmorrhage, 0·039; atrophy of the optic nerve after erysipelas of the face, 0·079; atrophy of the optic nerve in insanity, 0·039; atrophy of the optic nerve in epilepsy, 0·158; atrophy of the optic nerve in dysentery, 0·029; retinitis nephritica, 0·198; cardiac disease, 0·039; pregnancy and confinement, 0·43; typhus, 0·94; measles, 0·63; scarlet fever, 0·51; small-pox, 2·21; exanthematous attacks, the nature of which is unknown, 0·23; amaurosis from intoxication, 0·03; diseases of the orbit, 0·03.

From a study of this table it will be seen that six forms of disease, the purulent ophthalmia of children, trachoma, diseases of the cornea, usually ulcerations, irido-choroiditis, glaucoma, and idiopathic atrophy of the optic nerve, constitute no less than 54 per cent. of all the causes of blindness, whilst the first two, which constitute together more than 20 per cent., may be regarded as almost, if not altogether, preventable; both arise from impurity and unwholesome hygienic conditions, and not only is the recognition of the disease at an early period in both instances easy, but the means of arresting their progress are always at hand, and can be applied with facility.

Congenital Blindness.—According to Magnus this constitutes 3·77 per cent. of all cases of blindness. It may be the result of various pathological conditions, the causes of which are not always very clearly defined. The most common conditions are either entire absence or imperfect development of the globe of the eye, which, together with congenital atrophy of the optic nerve, make up about 60 per cent. of all the cases of congenital blindness. Megalophthalmos forms 16 per cent., and the remaining 24 per cent. is made up of choroiditis and anomalies of the cornea.

Tumours of the Choroid and Indeterminate Conditions.—As might be expected from the development of the eye and ad-

joining parts, the globe may be defective or absent, whilst the lids, lacrymal organs, and conjunctiva may be fully formed. In many cases a cyst has been found in the orbit, and the writer has seen one case of bilateral anopthalmia in which a soft vascular mass, deeply pigmented, could be seen through the attenuated skin of the inferior lid of the left side, giving the impression that it was the displaced and partially developed choroid. Megalophthalmos, or enlargement and thinning of the coats of the eye, is probably due to intra-uterine processes of inflammation, and it has been observed as a concomitant of hydrocephalus. That heredity plays a part in the production of congenital blindness cannot be doubted after the careful consideration that Magnus has devoted to this subject. The principal constitutional diseases of the parents that lead to ophthalmic disease in the offspring are scrofulosis, tuberculosis, syphilis, and lepra. In all the inherited tendency to disease exhibits itself, particularly in low forms of inflammation of the cornea (*see* CORNEA, Inflammation of the), and the affection in the child may appear at any age between birth and fifteen or twenty years. From Magnus' observations it appear that about 23·5 per cent. of those who are the offspring of blind parents, are either born blind or have some defect of the eyes whilst the remainder have perfect vision. Dumont, however, who examined 1,168 cases of blind people in relation to this point, obtained evidence of heredity in only 68 cases, or about 5·8 per cent.; and, as in cases where the retina and its functions are at fault, there seems to be no great tendency for the same disease which is present in the parent to propagate itself to the child, but a distinct tendency to the transmission of some ocular defect.

Consanguinity.—To what extent consanguinity of the parents influences the ratio of ophthalmic disease and blindness in the children, has not been certainly determined, but there seems reason for believing that some affections—as, for example, retinitis pigmentosa—are especially liable to occur in the offspring of blood-relations. Thus, in Sämisch's clinique in the ophthalmoscopic hospital at Bonn, out of 60 cases of retinitis pigmentosa, 15 were the children of consanguineous marriages, which is undoubtedly a large proportion; and the ratio found by Leber was almost identical—18 cases in 66, the former representing 25 per cent., the latter 27 per cent. Mooren estimates it at 33 per cent., and Fienzal at 38 per cent. It may therefore be accepted as an approximation to the truth, that in about one-fourth of all cases of retinitis pigmentosa, the parents are blood-relations.

It will be seen from the above table that Magnus only admits about 11 per cent. of blindness to be due to purulent ophthalmia in Germany, and perhaps, if absolute loss of vision is considered, this may be true, but other authors, who probably use the term blindness in a less strict sense, give a far higher proportion. Thus Bourjot St. Hilaire believed that amongst the blind who presented themselves to him in the course of twenty years 27 per cent. were due to this cause. Appia found a proportion of 25 per cent. According to Claisse, amongst the 208 pupils in the Institute of Paris 95, or 46 per cent., had lost their vision from purulent ophthalmia. Reinhard, who drew his conclusions from an examination of twenty-two institutes for the blind, of which the greater number were in Germany, believed that 40 per cent. resulted from it. Lastly Daumas declared, at the Congress of Paris, that it was the cause of 69 per cent. of blindness.

The importance of the prevention of blindness, from a purely national and economic point of view, has been interestingly worked out by Magnus for Germany. He estimates the work done by each individual to be two marks per diem, or 600 marks per annum, the mark being about ten pence, and further they require for their maintenance one mark per diem; on the whole, therefore, the yearly loss to the state on each blind person is 765 marks. But in Prussia the number of blind persons is 22,677, of which, however, 2,875 have not attained their twentieth year. Putting these aside, the total annual loss to the State by the blind is about 20 million marks, or nearly a million sterling.

Preventibility.—The researches of Cohn seem to show that of 1,000 cases of blindness 238 were unavoidable, 438 were possibly preventible, and 329 were certainly preventible. It is of high importance, therefore, from every point of view, that a sound knowledge of the causation and treatment of the more important diseases of the eye leading to blindness should be taught in our hospitals and schools, made a prominent subject in all surgical and medical examinations, and in every way disseminated through the community. Much may undoubtedly be done to prevent blindness by recognising early such diseases as purulent ophthalmic trachoma, glaucoma, &c., and employing efficient treatment; and by

adopting means to protect the eyes of those engaged in dangerous occupations.

Occupations suited for the Blind.—The occupations that *can* be followed by the blind are very various, about 300 being returned in the last census. Some of these are of course selected by the blind because they appear to be the best adapted to enable them to obtain a livelihood, such, for example, as basketmaking, brushmaking, bootmaking, matmaking, and music. Others show the dangers that beset certain trades and employments.

Asylums, &c.—Several of the larger cities in England contain institutions for the reception and education of the blind. Amongst the most noted of these are the blind asylums of London, Liverpool, Worcester, York, Norwich, Manchester, Bristol, Edinburgh, and Glasgow.

The first asylum for the blind in Christendom was founded by Saint Louis in 1251, and was intended to receive 300 of the poor blind of Paris, but no efforts were made for their education. In 1783, Valentin Haüy, having heard a blind pianist, Mademoiselle Paradis, who read music by means of pins, and who had learned geography by means of relief maps, conceived the happy idea of instructing other blind persons by the same method. An experiment on a boy proving satisfactory, he obtained funds from the Société Philanthropique to support twelve blind youths in a house in the Rue Notre Dame des Victoires, and the good example was soon followed in other countries.

HENRY POWER.

BLISTERS are subcuticular accumulations of fluid produced by an acute superficial inflammation of the skin, accompanied by effusion of serum and escape of white corpuscles beneath the cuticle, which is thereby raised up into a bleb. Blisters are met with in surgical practice as the result of burns and scalds, friction, and contusions or lacerations of deeper parts as in simple fractures, as well as from a variety of other causes; if due to inflammation alone, the effusion is serous or sero-purulent, but if there be also extravasation of blood into the limb, as in fractures, the effusion is often blood-stained.

Here we are more concerned with blisters produced by the surgeon with certain therapeutic objects, such as the relief of pain, or as a means of influencing more deeply seated inflammations, either in the way of checking them, or causing absorption of chronic inflammatory products. The most common substance used for this purpose is cantharides, either in the form of emplastrum cantharidis, liquor epispasticus, or charta epispastica. Before using either of them the skin should be well washed and dried; the length of time during which the plaster should be kept on the skin will vary, with the delicacy of it, from six to twelve hours. The liquor epispasticus is a solution of cantharidine in acetic acid and ether; it is a thick, greenish fluid, and only requires painting over the part; it is the most 'elegant' and generally useful preparation of cantharides. Blisters may be more rapidly produced by the application of chloroform in such a way as to prevent evaporation—usually on a piece of lint covered by a watch-glass, and held against the skin for a few minutes. Liquor ammoniæ fort. and the hot iron (temperature 120° F.) will produce the same effect, and the latter will do so very rapidly (10 seconds). The treatment of the blister when formed will depend on whether it is simply employed as a counter-irritant or to produce a continued discharge. In the former case the blister may be snipped here and there in dependent positions, and a pad of some antiseptic and absorbent wool applied; in the latter case the cuticle should be removed, and as soon as it can be borne the raw surface should be dressed with some irritating ointment; this is, however, a most painful procedure and one which is not often resorted to.

BILTON POLLARD.

BLOOD-CYSTS. *See* HÆMATOMA.

BLOODLESS METHOD OF OPERATING. *See* ESMARCH'S BLOODLESS METHOD.

BLOOD-LETTING, a method of treatment which, although somewhat limited in its scope in purely surgical practice, is of great service in certain cases.

Blood-letting is said to be *general* when blood is taken from a vein or artery so that the amount in the vascular system is materially diminished, as shown by diminution in the tension of the vessels; it is termed *local* when, by means of leeches, cupping, or scarification, blood is taken in smaller quantities, with a view to relieving limited congestion and vascular tension. It may be safely said that in these two methods the surgeon possesses the means of treating, in a powerful and beneficial manner, those acute inflammations and engorgements of certain important organs and serous membranes associated with hard pulse, great pain and distress, occurring from injury in persons of healthy con-

stitutions. A point of particular importance is the aptitude possessed by blood-letting for alleviating pain and distress of the kind mentioned, as it is upon this ground, rather than upon its power as a direct antiphlogistic, that its value in surgery depends. The greater the pain and distress, the greater are the indications for the treatment.

In *general* bleeding this is well shown in cases of fractured ribs, with wound of the lung, in which the pain and dyspnœa are intense, the relief afforded by blood-letting by venesection in a full stream until the pulse is affected being most marked. An equally good result may be obtained in the same way in fractured ribs with high temperature, acute pain, and hard pulse, without lung-injury. In meningitis produced by injury, it is necessary to speak less positively; at the same time, if the disease is very acute, and the treatment adopted early, there is little doubt that, in a subject previously healthy, venesection may be practised with advantage; every care, however, should be taken to distinguish between true acute traumatic meningitis and tubercular meningitis, following on injury, in which bleeding is inadmissible.

In *local* blood-letting the same point may be illustrated. Most surgeons are familiar with the relief afforded by the application of a few leeches (from four to six) over the most painful spot on the belly in a case of acute traumatic peritonitis without visceral lesion; the same result may be obtained by similar means in nearly all cases of acute traumatic synovitis, especially of the knee-joint. So great is the relief in many such instances that the first calm sleep, ushering in recovery, follows immediately. To cases like those mentioned, blood-letting, in surgical practice proper, will for the most part be limited, and even in these the treatment, to be useful, must be applied early, when the symptoms are increasing in acuteness or remain stationary; if the climax has been reached, and the disease has assumed in the least degree the low type, the time for bleeding is gone by. One condition the surgeon may have to deal with, in which, independently of inflammation, the indication for bleeding is obvious, viz. apnœa, with great engorgement of the veins about the neck following attempts at strangulation, for it is reasonable to suppose that the removal of a few ounces of blood by opening the right external jugular vein, if done early enough, may perhaps relieve an overloaded heart so much as to enable it to resume its normal action.

Caution.—Blood-letting should not be practised without due consideration, since its effect is more than momentary, and may be followed by much depression; nor should the operator, in general bleeding, start with a fixed purpose of removing a given number of ounces of blood; but let the pulse be most carefully watched, and it will surely indicate by its diminished tension when enough has been drawn. Loss of blood is badly borne by infants, the very old, the prematurely aged, the feeble and cachectic; if, therefore, it should be necessary to take blood from such as these, let not a drop more than is really necessary be removed.

For operations for General Blood-letting, see Arteriotomy; Venesection. *For operations for Local Blood-letting, see* Cupping; Leeches; Scarification.

William H. Bennett.

BOILS consist in a circumscribed inflammation of the skin and subjacent connective tissue, accompanied by fibrinous exudation, and usually followed by sloughing of the central portion of the parts involved, and expulsion of the slough through a small hole upon the surface.

The *causes* of boils are various and somewhat indefinite. Sometimes boils are almost epidemic, and they are generally more frequent in the spring and autumn. They are apt to attack the plethoric, as well as those who are debilitated by lactation, diabetes, or zymotic disease. Sudden changes of diet and mode of life, such as the patients of hydropathic establishments have to undergo, are apt to induce them. The same effect is observed in young servants, and in youths training for athletic sports, where the changed conditions are accompanied by a more liberal supply of meat. The affection has also been noticed to attack with great violence those who have eaten the flesh of diseased animals. They are not infrequent among medical students who breathe the vitiated air of dissecting and post-mortem rooms. Where there is already a constitutional predisposition, the exact site is often determined by some local irritation, such as the friction of the nates in rowing, the pressure of certain articles of dress, the application of a poultice or plaster. They may also be set up by the absorption of putrid matters through the skin, and from this cause those engaged in pathological work frequently suffer from boils upon the back of the hands or wrists.

Symptoms and Course.—Boils may be single or multiple, and they may occur successively in different parts of the body. An itching spot appears usually at the opening of a hair-follicle, and soon develops into a small red lump. This is frequently surmounted by a vesicle or pustule, which bursts or dries up. As it grows, the swelling becomes of a bluntly conical shape, tender, painful, and of a bright red colour. At first it is hard, but it soon begins to soften, and the pain becomes of a more throbbing character. In a few days an opening forms at the summit, and some pus is discharged. At the bottom of the opening is seen a yellowish mass, consisting of a slough of fibrous tissue infiltrated with lymph. This—the so-called *core*—after a few hours escapes through the opening, and leaves a flask-shaped cavity, which contracts and fills with granulations. In a day or two it heals, and a small scar is left upon the skin. Another variety, called the *blind* boil, is less elevated and more diffused. It is slow to discharge itself, or it may remain as a firm indolent swelling for several weeks, and then undergo resolution without any suppuration.

There is usually but little constitutional disturbance in those affected with boils. A slight chilliness, with a transient feeling of malaise and irritability, may accompany the onset, but afterwards the only trouble is that caused by the local pain. When, however, they occur in already debilitated patients, the symptoms may partake of a hectic or even typhoid character; and cases are on record in which the disease has proved fatal by the supervention of pyæmia.

The inflammation attacks more especially the sebaceous follicles of the hair-bulbs. Boils, therefore, are not found in parts in which these structures are absent, such as the palms and soles. When they occur in the follicles of the eyelashes, they are called *styes*. They may also attack the ceruminous glands of the ear, and sometimes they affect the sweat-glands, especially those of the axilla.

Diagnosis.—The red, indurated, and tender base, which is large in proportion to the small pustule at the apex, will distinguish boils from impetigo, ecthyma, or the blebs which sometimes follow poisoned wounds of the skin. Carbuncle, a closely allied affection, is easy to recognise by its larger size, more flattened surface, and the numerous apertures which lead down to the central slough. Malignant pustules are usually confined to those who have been exposed to the specific contagion of that disease, and the absence of pain, together with the peculiar character of the eschar, will be sufficient to lead to their identification. The gummata of syphilitic or tubercular patients occasionally resemble boils, but they may generally be known by their attacking chiefly the subcutaneous tissues, and by their bursting with a larger external opening.

Treatment.—The patient should take a plain nutritious diet, with only a moderate quantity of animal food. Unless there is much debility, there is no advantage in the use of alcoholic stimulants. He may take sulphate of quinine three times a day, in 2-grain doses, with a grain of sulphate of iron, and from 5 to 10 drops of dilute sulphuric acid, accompanied by ʒss. of sulphate of magnesia if the bowels be not well opened. The administration of as large quantities of quinine as can be borne without cinchonism has sometimes proved beneficial. Sulphide of calcium, in $\frac{1}{6}$-grain doses every hour or two, has been recommended; and some cases improve rapidly under the administration of yeast in doses of a tablespoonful three times a day, half an hour before meals. A change of air often succeeds where other remedies have failed.

For local treatment the boil may be covered upon its first appearance with a thick layer of collodion, or it may be touched with nitrate of silver. The extract of belladonna alone, or in combination with an equal quantity of glycerine, is also a good application in the early stage. Later on, considerable relief is afforded by a linseed meal poultice, but as there is some risk of irritating the adjacent skin, and setting up fresh boils by this remedy, it is well to sprinkle it with olive oil, or the dilute solution of the subacetate of lead, before putting it on the boil. When these applications are inconvenient, the elevation may be protected by a covering of plaster spread on soft leather, in which a hole should first be punched at a point corresponding to the apex of the boil. It is only in cases in which the pus is very slow in reaching the surface that an incision is required; and then it should only be a deep vertical puncture in the centre of the boil, made with a narrow double-edged knife.

N. Davies-Colley.

BONE, Diseases of.—The various forms of disease which attack the human skeleton are the same in kind as those which are seen in the soft parts, modified of course

by the anatomical and physical peculiarities of the bony structure. The slowness with which the morbid changes are effected is one of its striking peculiarities. Consequently amongst diseases of bone we find some of the most chronic disorders from which the human body is capable of suffering. If, as in some of the acute inflammatory affections, rapidity of action should ensue, the death of the part involved is the usual termination. Although so slow in exhibiting pathological change, bone is nevertheless capable of the most perfect repair. Although slowly, it produces granulations as readily as any other tissue of the body, and, provided its vascular connections have not been completely annihilated, the bone is reproduced almost in its original form. Its rigid and inelastic structure is no doubt the reason for the frequency of necrosis, and the inability of the veins of the medullary canal to collapse from the same cause, coupled with the absence of valves, is undoubtedly the origin of the pyæmia and septicæmia so frequently seen in inflammatory affections of bone, in the days when decomposition of the discharges was not prevented by suitable antiseptic precautions.

The diagnosis of bone-disease, i.e. of bone being the part affected in any given swelling, must first engage our attention. The freedom of other, and especially the superficial structures, is the most important negative evidence. In infiltrating and inflammatory swellings, however, the soft tissues are sometimes very rapidly involved, and then we have to rely upon other symptoms for the diagnosis. Generally we are able to say that the bone itself feels enlarged, or that the tumour or swelling is fixed and attached to bone; and if the superficial structures are engaged, we are often able to obtain evidence of pain and tenderness having been felt before the external parts exhibited any swelling. In most of the diseases of bone, however, the first and most important symptom is an enlargement which is quite clearly deep-seated. The patient usually complains of a dull, aching pain, which is especially troublesome at night on getting warm in bed, and keeps him awake for many hours. The pain is scarcely ever acute, and is sometimes the only symptom of which complaint is made. A sense of increased weight is also occasionally felt.

The differential diagnosis between the various affections of bone has next to be considered. The patient's history may often be of great service, first, as to the possibility of the disease being due to accidental causes; but even here there may be exceptions of considerable importance, e.g. acute diffuse periostitis often has a history of some slight and trivial accident preceding the onset of the symptoms of inflammation. So much is this the case that some surgeons look for and expect to find a history of injury in almost all cases of diffuse inflammation of periosteum. Again, in sarcoma of bone it is not uncommon to have a history of injury of considerable severity, and, within a very short time of the accident, a tumour is discovered in the part injured. This form of tumour has lately been dignified with the name of 'acute traumatic malignancy.'

It is well to bear in mind that ostitis, periostitis, and osteomyelitis, are so intimately united, both in their pathology and in their clinical symptoms, as to be occasionally confounded with one another. Almost every inflammation of bone, of whatever kind, is at times spoken of as periostitis, whereas the periosteum has, in most of such cases, only been secondarily involved, ostitis or osteomyelitis being the primary condition. The cases in which the periosteum is primarily or principally involved are, however, sufficiently distinct; and there should be no difficulty, at any rate, in distinguishing the cases of periostitis when this membrane is alone affected. *See* Periostitis. Acute inflammations of the bone, periosteum, or medulla, taken as a group, are readily separated from the other diseases of bone by the suddenness of the attack and the acuteness of the process of inflammation. The history also of a previous illness, such as one of the specific fevers, or the occurrence of a slight and trivial accident in a young subject, would be additional evidence in favour of this view of the case.

The chronic diseases may present a little more difficulty. The patient can scarcely say when the affection began. He may have suffered pain at night for some months; or when first his attention was directed to the part of which he complains, the state of things may have been in the same condition as at the time when he asks your advice. In the one case a history of long-preceding pain would point to chronic inflammation of bone; and in the other, the presence of an enlargement which, when first noticed, was of such a size as to lead him to seek advice for that alone, would indicate a new growth such as an exostosis, or possibly a sarcoma of bone. But an examination will probably at once

clear up the difficulty. The first point necessary to ascertain is the presence or absence of inflammation. This will be decided on ordinary grounds which we need not here discuss. The acute inflammatory affections have been already mentioned, and will be further described, each in detail, under their appropriate titles. The symptoms of subacute or chronic inflammation might perchance be mistaken for those of a sarcoma of bone. They are both infiltrating in character: both may feel hot and inflamed to the hand: both may be either endosteal or periosteal. The question naturally arises, Does the swelling fluctuate? is it solid or fluid? If it be dense and solid throughout, and occupy nearly the whole shaft of a long bone which seems to be uniformly enlarged throughout its whole length, there can be no difficulty in ascribing it to chronic ostitis. But if the swelling occupy one end of a long bone, and if that should be the lower end of femur or head of tibia, the case may present greater difficulties. Clearly, if fluctuation be detected, and the fluid seem quite close to the surface, the case will probably be one of abscess, and if the bone is much enlarged all round that part of its circumference, the pus will, in all probability, be due to inflammation of the cancellous tissue. More commonly, however, the pus has not thus made its way to the surface, and its presence is only detected by the excessive tenderness which is exhibited on pressure at one spot. For further information, *see* Abscess of Bone.

New growth affecting the same part may also give rise to an elastic feeling very closely resembling fluctuation. But the tumour generally presents greater irregularity of outline, and varies considerably in its elasticity and resistance to pressure in different parts. In the periosteal sarcoma, the growth will probably be situated on one side, whilst in the central or endosteal form of tumour the whole outline of the bone, at the part affected, will be lost: and, in addition, such unmistakable evidence of its nature as 'egg-shell crackling' and pulsation may possibly be obtained. A sarcoma affecting the centre of the shaft of a long bone is at first often fusiform in shape, but rapidly assumes much larger dimensions than any chronic inflammation would produce; and, if endosteal, it is not infrequently indicated by spontaneous fracture. *See* Tumours of Bone.

An exostosis requires very little explanation. It is generally a pedunculated growth of small size, attached by preference to the bone in the neighbourhood of epiphyseal lines, and starting into existence about the age of puberty. On examination it is not uncommon to find more than one, or even a considerable number, in different parts of the body. Further details will be found under Exostosis.

The osseous deformities of rickets and congenital syphilis will be found described in the articles on those diseases. Softening of bone and spontaneous fractures will be found described under Osteomalacia and Fragilitas Ossium. The curvatures of the long bones, especially those of the lower extremities, which occur in old age, and are attended with a large development of osteoporotic new bone, both in the long bones which are deformed and in the skull, will be found described under Ostitis Deformans. If a sinus should exist when the case first comes under observation, the surgeon is referred for information to the articles on Caries and Necrosis.

The constitutional condition of the patient may throw some light upon the nature of the disease, and should be carefully considered in relation to the various affections which have been named. High fever may be expected in cases of acute diffuse periostitis and osteomyelitis. If of recent origin and considerable intensity, and the local symptoms bear out this conclusion, the information gained by the thermometer will give great precision to the diagnosis. Hectic fever also may be observed in these cases when the disease is of some duration; and its presence or absence may aid the surgeon considerably in forming an opinion as to the prognosis. But the general condition of the patient, his tolerance of the constitutional and local disturbance which he is undergoing, and the probable duration of the disease, should have due weight in estimating the chances of recovery.

Of all the constitutional diseases, syphilis is the most important to recognise, and should always be looked for in subacute and chronic cases. The periosteal nodes generally appear during the early stages of this disease, so that one may expect to find some other evidence of syphilis, either in the throat, on the skin, or in the glands. This is of importance, as it will lead the surgeon to place the patient under the influence of mercury, after having relieved the painful nodes by iodide of potassium. In enlarged and thickened bone, such as osteosclerosis, in gummatous periostitis, and in intractable ulceration of bone, sometimes called syphilitic caries, a history of the disease should,

if possible, be obtained, as it enables the surgeon to treat the constitutional affection with greater confidence. But too much reliance must not be placed on the absence of such a history, for experience teaches us that many cases must be classed as syphilitic on account of their exact similarity both in the course they run, the prognosis that must be given, and in the treatment that is essential for their cure, although the history of the disease be decidedly deficient in many of its most salient features. Many cases of ostitis that were formerly looked upon as strumous, are now regarded as due to congenital syphilis. They occur generally in the middle of the shaft of a long bone, such as the tibia, about the age of puberty, and are exceedingly chronic. Confirmation of the diagnosis should be looked for in the eyes, teeth, and physiognomy of the patient, and if possible the brothers and sisters should be examined in the same way, as in suspected cases of congenital syphilis. The epiphysitis that occurs somewhat earlier in the history of such patients might possibly be confounded with rickets, but this has received full attention in the article on diseases of the epiphyses.

Struma and tubercle must also receive their share of attention in the chronic, slowly suppurating, diseases of bone, such as caries and chronic abscess. It is unnecessary to point out here the way in which this is to be done. The history and physical examination may indicate pretty clearly that the patient is predisposed to these affections. H. H. Clutton.

BONE-GRAFTING. *See* Grafting.

BONE-SETTING.—The term 'bone-setting' was first applied to the proceedings of certain irregular practitioners, who flourished chiefly—so far as this country is concerned—in the North of England, and who were accustomed to treat by rough manipulation, and frequently to cure, joints which had been left in a disabled condition either by disease or by injury. Their manipulation was commonly attended by the production of sound, which the operators would explain to be the noise made by a displaced bone in the act of returning to its socket; and they were, as a rule, sufficiently ignorant to believe this explanation themselves, as well as sufficiently earnest to succeed in imposing it upon their patients. Hence, when a joint which had been under medical treatment, and remained crippled in spite of it, was cured by the handling of a 'bone-setter,' he would say, and the patient and his neighbours would believe, that the doctor had overlooked a dislocation. Of late years the whole subject has been carefully studied by surgeons, instead of being, as formerly, pooh-poohed by them. It has been found that in a very large number of cases of injury, and in some cases of disease, the rest which commonly forms part of the treatment, produces an injurious effect, as well as a beneficial one; and that it leads to the formation of adhesions, either within or around the affected joint, by which its mobility is impaired. The formation of such adhesions may sometimes be prevented by early recourse to passive, or even active, motion; but, if once formed, they can only be got rid of by tearing. In the course of the necessary manipulation they yield with a distinct sound, for which the original bone-setter was always on the watch; and the old term has been retained, as affording a convenient expression for the modern practice. The bone-setting of the surgeon differs from that of the quack, to the extent that the former understands the pathology of the cases to which it is applied, and confines its application to those in which it is needed and is calculated to be useful.

It will be convenient to consider first the conditions which call for the employment of bone-setting, and these are all forms of partial ankylosis. The cause of the partial ankylosis may be either disease or injury of the affected joint, or of some parts contiguous to it; the effects of such disease or injury being aggravated by prolonged abstention from movement, and the ankylosis itself not coming into prominence until the endeavour to move the joint is resumed.

The pathology of these cases is to some extent conjectural, since they rarely become the subjects of post-mortem examination; but there can be no doubt that conjecture and analogy are sufficient to afford correct notions of the conditions which commonly exist.

The occurrence of inflammatory (i.e. rheumatic or pyæmic) mischief in a joint, an actual injury, such as a sprain, befalling it, or the fracture of the shaft of one of the bones entering into its formation, are, all of them, conditions which have been customarily treated by enforced rest and restraining apparatus. The rest itself, and the pressure of the apparatus, combine to promote the exudation of more or less plastic fluid from the blood-vessels; an exudation which will, of course, be still further promoted, and be rendered more

highly plastic, when the joint-structures are themselves affected. The exudation may occur within or around the cavity of the joint, within or around the sheaths of the neighbouring tendons, or it may be more widely diffused among surrounding structures. The tendency is to consolidate and contract, to glue together the adjacent folds of synovial membranes, to unite tendons to the sheaths in which they should move freely, to permeate and condense inter-muscular and superficial connective tissue, to compress blood-vessels, and generally to arrest movement and to diminish functional and nutritive activity.

The impediments to movement are strictly mechanical; and hence, when these impediments produce traction on parts which are not normally adherent, the traction is apt to be painful, and may be followed by increased swelling, by tenderness, or by other signs of increased local inflammation.

The *symptoms* are, that a joint which has been subjected to any of the incidents above mentioned, which has been inflamed, or injured, or long restrained from movement by reason of a neighbouring fracture, does not recover its mobility. It can usually be moved to some extent, but its movements are limited, and any attempt to transgress these limits is attended by pain, and is often followed by fresh evidence of active mischief. It is frequently possible to discover by pressure some spot which is acutely tender. The joint is usually somewhat swollen, the skin covering it more or less congested, glossy, or tumid; and the muscles of the limb are wasted in a degree corresponding with the length of time during which they have been inactive.

The *treatment* must be considered under two heads; first, with reference to the cure of the above-described conditions; secondly, with reference to the means by which their occurrence may be prevented.

For the cure there is only one available method, namely, rupture by manipulation of all adhesions which impede movement. Experience has abundantly proved that, although the mere extension of the adhesions gives much pain, and sometimes excites fresh inflammation, the complete rupture of them by a single movement is not more painful in the first instance, and is never followed by any subsequent trouble. Unless in very slight cases, a patient for whom it is proposed to break down adhesions should always be placed fully under the influence of an anæsthetic. The question of pain is only a secondary one, and the majority of people would have sufficient fortitude to bear the operation; but it is highly important to overcome the instinctive resistance of opposing muscles; and it is almost equally so to allow the surgeon to proceed with deliberation and care, feeling his way as he goes, and not desisting until the complete range of mobility is restored. It must be remembered that a certain knack is required in breaking adhesions, and that different joints require somewhat different handling, the details of which it would be difficult to convey without the aid of illustrations. In the last four or five years much has been written on the subject, and, among others, the writer has given the necessary illustrations, and full verbal descriptions of them, in his work on 'Bone-setting (so-called).'

When adhesions have been broken, the most important part of the after-treatment is that the joint should be taken into use immediately. Supposing the knee to have been affected, the patient should be made to bend it freely, and to put down the foot and walk on the same day, and every day afterwards until the cure is complete. Any return to splints or bandages, or to enforced rest, will certainly be followed by reunion of the adhesions, and by renewed incapacity.

Under the influence of functional use, the swelling around the joints will gradually disappear, the muscles will recover their tone and vigour, and the old troubles will be forgotten; although, of course, time will be required for the full completion of reparative changes. But, if the operation of breaking the adhesions is followed by inaction, all that is gained at the time will be lost, and the treatment will have to be repeated before a cure will be obtained. It is hardly necessary to say that, especially in cases of long standing, recovery may be much promoted, after the adhesions are broken, by the diligent use of passive movement, by frictions, and by the more skilled forms of friction which are known as shampooing or massage. These, however, must be auxiliary to the movements effected by the patient, and must not be expected to supersede or to replace them.

It is not unnatural that surgeons, who have seen the recurrence of inflammation which is apt to be produced by the slight extension of joint-adhesions, should fear to permit free movement immediately after adhesions are broken. Reflection will show that the two conditions have nothing in common. The inflammation following slight extension was due to the drag of the

stretched adhesions on neighbouring parts; but, by the complete rupture of the adhesions, all possibility of dragging is taken away. In considering the means by which partial ankylosis may be prevented, it is needful for the surgeon to clear his mind of one of the ancient traditions of his art, and to realise the fact that 'rest,' although sometimes a necessary part of treatment, is at best a necessary evil, not to be resorted to without necessity, and not to be continued a day after it can be dispensed with.

In some cases of fracture, enforced rest of the neighbouring joints is imperatively necessary; but, even then, the surgeon should never forget the consequences which this rest may produce, and should be on the watch to employ passive movement at the earliest possible time.

In cases of another class, in which rest is commonly employed, it is from the first not only unnecessary, but always and actively injurious. Sprains of every description, and accidental ruptures of muscular fibres during effort, should be treated by strapping and bandaging, and the moderate use of the affected limb should not be interfered with.

When this method is pursued, a short time will suffice for complete recovery from an injury which, if treated by the old plan of rest and fomentations, would mean imprisonment to a bed or sofa for weeks, probably followed by permanent diminution of strength and usefulness.

WHARTON HOOD.

BOUGIES—so called because wax tapers (bougies) were at first generally, and are still occasionally, used for the purpose—are supple instruments for passing along the gullet, rectum, or urethra, to widen those passages when narrowed. They vary in length and size, to suit the different canals they are to traverse, being about 2 feet long for the gullet, 8 or 9 inches for the rectum, and 13 inches for the urethra. Their thickness varies also greatly, and is measured in this country by scales which vary with different makers. The French scale, which is generally adopted on the Continent and in America, and is coming into usage here, enlarges by equal increments, each size being 1 millimetre larger than the preceding one. Those used for the urethra are made in three forms, of which there are several varieties, and range from 1 millimetre to 40 millimetres in circumference. The 'English' or 'gum elastic' bougie, of tawny brown colour, is made of a seamless tube of silk woven like a stocking. Several coats of copal varnish are laid on until a fine smooth surface is obtained. This bougie is cylindrical, of the same thickness throughout, rigid when cold, but pliant when warmed to the temperature of the body. If kept bent for several weeks it takes a 'set' which it is slow to lose. If well made it is tough and durable even when rigid, but if badly made the English bougie is apt to snap if bent suddenly.

The French bougie is more flexible than the English; it is similarly woven of silk, but the shape is better adapted to pass along the urethra. It is covered with black varnish. The full width of the bougie reaches to about the lower third; from thence to the point the bougie tapers gradually, and is very pliant near the tip. When the tip is a little bulbous the bougie is called 'olivary,' but this form is also made to taper to a moderately fine point without a bulb. In a well-shaped olivary bougie the 'swell' of the tip is just sufficient to remove all sharpness from it, and the tapering end itself is so supple that it bends easily if the tip catches in an obstruction. This pliancy diverts the point and lets it slip past the obstacle. The tapering bougie is less durable than the English 'gum elastic' one, especially if really made in France, for the imported ones are not so well varnished or so tough and smooth as those of English manufacture. But the genuine French article is the better shaped: the English imitation often does not taper rapidly enough; the point is stiff, and cannot yield at once to an obstruction. Again, the olive of the tip is apt to be too large, and form a real boss as thick or thicker than the widest part of the bougie. The flexibility of the tapering bougie has been modified by the introduction of leaden stylets, themselves tapered to a fine point that penetrates to the tip of the bougie. Instead of a wire stylet, the bougie may be filled with fine shot. By either plan the instrument may be bent to any curve, and will keep the curve while it is being passed along the passage. Bullet bougies (*bougies à boule*) are used for exploring canals. They consist of a slender tubular stem, to which the necessary stiffness is given by inserting a leaden wire into it. The stem ends in an egg-shaped bulb. In these bougies the stem remains of the same thickness, while the bullets range in circumference from 8 millimetres to 40 millimetres. The stem may be usefully marked at each inch from the bullet with a ring, the ring at the fifth inch in urethral bougies being broader than the rest, to serve as a landmark from which to count.

For passing through strictures too narrow for woven bougies, others of whalebone, catgut, and silkworm gut are used. Whalebone is troublesome from its rigidity, but that can be lessened by steeping the bougie in boiling water. Catgut is apt to get rough, and, after soaking for a short time in the mucus of the urethra, it becomes inconveniently supple. Silkworm gut is very strong, very fine, and not affected by urine or water. It is therefore preferable where bougies of moderate length and great tenuity are required. Bougies made of a new material, 'celluloid,' have been recently patented. They are non-absorbent, very smooth, and pliant when heated, but resume their rigidity too quickly to be generally useful for bougies. When cold the celluloid is sometimes very brittle. These qualities render this material of limited use for bougies, but for catheters for tying in the urethra celluloid is well fitted. It remains perfectly unaffected, however long it is worn, and unirritating, because at the temperature of the body it yields to the curves of the passage in which it lies. *See* CATHETERS. BERKELEY HILL.

BOUTONNIÈRE, the Operation of.—This term has been applied to an incision made in the perineum in the treatment of urethral strictures, which has been known by many appellations. As the name '*boutonnière*' suggests, the incision is a small one made in the mesial line of the perineum, and resembles a button-hole. The operation is an ancient one, and has been practised in various ways both in England and France for centuries. In modern surgery there are three modifications of it, or, rather, it is practised to serve three purposes:—1st. To expose the anterior end of the stricture of the urethra through which an instrument cannot be passed by way of the meatus, in order to divide the stricture from before backwards. 2nd. Also in cases of impassable stricture, to open the urethra behind the stricture, either to relieve retention of urine, or to give the bladder and stricture rest from the irritation caused by the straining necessary to force urine along a very narrow passage. The stricture, of course, would be dealt with by subsequent operation. 3rd. When disease of the bladder is present, for which digital exploration of the mucous surface is required, or when it is necessary to maintain free drainage of the bladder and the presence of an instrument cannot be borne.

1. The first variety of the operation—to get at the anterior orifice of, and thereby pass along the stricture a guide upon which the knife may divide the fibrous tissue that causes the contraction—is best performed by the method known as Wheelhouse's. The patient being anæsthetised and in the position for lithotomy, the operator passes along the urethra, from the meatus to the stricture, a straight steel staff 4 or 5 millimetres in circumference, 11 inches long, and grooved on one side. The beak is turned into a blunt knob or hook towards the side opposite the groove. With the groove directed towards the surface the staff is pressed forwards in the perineum until it can be readily felt from without. While the staff is held steady by an assistant, a vertical cut is made in the mesial line by the surgeon, large enough to allow the beak of the staff being thrust through the wound. The staff is then turned, that its knob may catch in the anterior end of the incision, which is tightened and fixed by the assistant, who pulls it steadily upward. The operator continues his incision in the mesial line backwards towards or over the stricture for about one inch, dividing the urethra freely opposite the anterior end of the stricture. By a hooked forceps applied on either side, the margins of the incision are drawn apart, and the interior of the urethra is exposed opposite the mouth of the stricture. This opening is carefully sought for, and, when found, a grooved director, with a fine tapering point, is insinuated through the stricture to the bladder. The point of the knife being then entered in the groove of the director, its edge is carried backwards till the stricture is thoroughly divided. The knife is laid aside, and a small tapering gorget, with a beak that will run along the groove of the director, is passed to the bladder. When the gorget has reached the bladder the director is withdrawn, and a flexible catheter, introduced by the meatus into the anterior part, is guided along the deeper part of the urethra by the gorget. The catheter being fixed in the bladder, the gorget is withdrawn, and the operation is completed.

2. By the second method—known as 'Cock's operation,' from its having been frequently practised and its value demonstrated by the eminent surgeon of that name—the urethra is reached in its membranous portion behind the stricture, at a point where it is usually dilated and more easily recognised than in the healthy state. Like the first form of boutonnière just described, this operation is adopted only when an instrument cannot be guided along the urethra to the bladder. The part of the urethra

attacked in the operation is that between the bulb and the prostate. The finger, with its tip just within the margin of the anus, feels the anterior or lower surface of the prostate, and informs the operator of the posterior limit of the membranous portion of the urethra. The central point of the perineum, being just behind the bulb of the corpus spongiosum, gives, for the purposes of the operation, the anterior limit. The knife, held with its cutting edge forward, is entered in the *raphé* of the perineum three-fourths of an inch in front of the anus, and a cut made through the integuments about half an inch long and half an inch deep. The tip of the finger inserted into the wound enters the small conical interval between the anterior wall of the rectum and the membranous part of the urethra. In cases of retention of urine the urethra, dilated at this point, can often be distinguished, and projects in a condition which facilitates the remainder of the operation. The operator, using the finger as a guide, pushes the knife cautiously upwards and backwards into the urethra. The gush of urine that escapes proves the urethra to have been opened, and the finger may then enter it and pass to the neck of the bladder, serving as a guide for introducing a catheter. This completes the operation.

3. In the third variety the operation is extremely simple. A curved lithotomy staff, having the groove on the centre of the convexity, not on the left side, is passed to the bladder and held steadily while the surgeon, pushing the knife on to the staff just behind the bulb, cuts for one inch or three-quarters of an inch towards the anus. This affords an aperture large enough for the finger to enter and pass into the bladder and search the whole of the interior, and ascertain the position, size, and shape of tumours or other affections of that organ. BERKELEY HILL.

BOW-LEG may make its appearance before a child's feet have been put to the ground, in which case it is simply an exaggeration of the natural curve of the tibia under the influence of muscular contraction. Or it may be the effect of that peculiar habit which the rickety child possesses of folding its legs across each other and sitting upon them tailor-wise. Often this condition of leg is associated with an exaggeration of the natural outward bowing of the femur, in which circumstances genu extrorsum (q.v.) is the result. Sometimes one leg is bandy whilst the other is in-kneed. This is caused by the mother or nurse carrying a soft-boned child always upon the same arm, whilst with the other she clasps the child's legs across the front of her body. Thus, if she carry the child always upon her left arm, the right knee will become valgous, whilst the tibia of the other leg will become moulded against the valgous knee, and consequently bandy.

Treatment should be begun as soon as the existence of the deformity is recognised. If the child be badly nourished or rickety, he should be carefully tended as regards feeding and clothing; warm stockings or woollen gaiters should be advised, with the view of keeping up an even circulation in the legs. If, when the child is being carried or wheeled out in the open air, the feet and legs become chilled, the nutrition of the bones must necessarily be seriously interfered with. Frictions in the direction of the venous and lymphatic return should be employed morning and evening after the warm bath, and if the patient be flabby, weakly, or ill-nourished, not only his legs but his entire body may be rubbed with cod-liver oil. A large proportion of those with bent legs have been brought up upon the bottle, and many of them reared upon condensed milk or a farinaceous diet; fresh milk, eggs, and meat will be wanted, but no tea, beer, or wine. If the treatment thus briefly sketched out be adopted, and the child be taken entirely off its feet, a slow but steady improvement will set in; but if the deformity be already considerable, it will be well to adopt accessory measures. Thus, a light wooden splint, padded on each side, may be fixed between the limbs, and the legs be bandaged to it. The splint should be long enough to reach some inches below the level of the feet, so that the child may be unable to stand, for, whatever be the treatment adopted, no weight must be transmitted through the leg-bones. To apply splints of wood or iron, and then allow the child to walk about, is manifestly wrong.

Children do not fret when they are made to keep off their feet, nor does their health suffer from the enforced rest. If only one leg be bowed, it should be bandaged to a long inside splint, so as to insure rest. The improved condition of the bone is obtained more by rest being insured, than by the mechanical effect of the bandaging. Some years ago the writer had under his care a little girl with extremely marked bowing of both legs; one leg he treated by forcible straightening under chloroform, the other he let alone. The child was taken completely off her feet, and at the end of a year the

bandiness had almost entirely disappeared from both legs; the rest which had been necessary for the limb which had been forcibly straightened, had induced an equal improvement in the other. It may be well to note that the use of a Martin's bandage with the splint is apt to cause cellulitis, ulcerations, or even sloughing; and that in forcible straightening of the limb care is required, lest the epiphysial cartilages be torn through. Osteotomy for the bandy legs of little children must be very rarely necessary. EDMUND OWEN.

BOZEMAN'S OPERATION is an operation for ruptured female perineum, in which metal plates and wires are employed. *See* PERINEUM, Rupture of the.

BRACHIAL ARTERY, The, commences at the lower border of the teres major, and passes downwards and forwards along the inner bicipital groove until it reaches its bifurcation, one inch below the elbow.

In front are—the skin: the superficial fascia with cutaneous nerves therein: the basilic vein: the median basilic vein at the elbow: the deep fascia: the bicipital fascia at the elbow: the median nerve, crossing it half-way down the arm. Behind it are—the long and inner heads of the triceps, the insertion of the coraco-brachialis, the brachialis anticus, and the musculo-spiral nerve. Internally it has the ulnar nerve at its upper part, the median below. Externally the coraco-brachialis muscle, the external cutaneous nerve, and the outer head of the median at the upper part, the biceps below.

Ligation.—(1) In the upper third the steps of the operation are as for ligature of the axillary artery in the third stage, the basilic vein appearing in the wound in place of the axillary. (2) In the middle of the arm, place the patient on his back, with the arm abducted at a right angle and rotated outward. Make an incision in the line of the artery two inches long. Cut through the cutaneous structures, expose the inner edge of the biceps, and then draw the muscle gently outwards, when the median nerve will be seen lying on the artery. Detach the nerve and pull it inwards or outwards, the former the better; open the sheath, avoid the venæ comites, and pass the needle from without inwards, having the arm slightly flexed at the time. (3) In the lower third—i.e. at the bend of the elbow—the artery lies between the tendon of the biceps, externally, and the pronator radii teres internally. It has the median basilic vein and the bicipital fascia in front, and the median nerve to the inner side. With the arm abducted and rotated outwards, make an incision 1½ inches long over the course of the artery, and immediately (⅛th of an inch) internal to the tendon of the biceps. Pull the median basilic vein and the internal cutaneous nerve inwards: cut through the bicipital fascia, when the artery is found surrounded by venæ comites, having the biceps one-third of an inch to its outer side, the median nerve one-third of an inch to its inner side, and the brachialis anticus behind. JAMES CANTLIE.

BRACHYMETROPIA. *See* MYOPIA.

BRAIN, Abscess of the. *See* ENCEPHALITIS.

BRAIN, Compression of the.—Compression arises from pressure on the brain. It may be brought about in many ways, such as by depressed bone, intracranial hæmorrhage, accumulation of inflammatory products, tumours, syphilitic and tubercular deposits, cerebrospinal fluid in undue quantity, &c. Intracranial hæmorrhage is by far the most common cause of compression; especially is this the case if idiopathic apoplexy, which is generally central, be included along with that occurring from traumatism, which is usually peripheral. Paralysis is its most definite indication.

Diagnosis.—The symptoms are dependent upon the amount of the pressure, and the rapidity and rate at which it occurs. Small effusions of blood, and slight osseous depressions, may take place without giving rise to any distinct symptoms. It is believed that blood may be slowly effused upon the surface of the brain without giving rise to any definite indications of its presence. Rapid extravasation, on the other hand, produces symptoms of marked compression. In a typical case of compression, the following are the general symptoms:—The patient is comatose, breathing is slow and laboured, often stertorous, and in some cases this is accompanied by a peculiar puffing arising from complete facial paralysis; there is retention of urine, which, if unrelieved, ends in incontinence from overflow. The pupils may either be contracted or dilated; they are often unequal, and they are usually fixed, not responding to light. The surface of the body, though it be at first cool, soon becomes hot, and often it is bathed in perspiration.

Though these are the symptoms recognised as typical of compression, it must not be understood that they are present in all cases. In localised compression the paralysis is only partial, and corresponds to the affected region. There may be paralysis of one side of the body, with loss of consciousness; or of one limb, or only of the muscles supplied by certain nerves, without loss of consciousness. There may also be mental confusion or delirium. One pupil alone may be affected, the other remaining quite normal.

The order of the symptoms is important, helping to differentiate the various causes of compression. When depressed bone is the cause, the symptoms follow immediately after the accident. When due to intracranial hæmorrhage, especially when this takes place outside the membranes, there is generally an interval before the symptoms set in. When inflammatory effusion takes place, the symptoms are gradually developed, and are ushered in by a series of phenomena, such as increased temperature and general febrile disturbance. When pus forms between the dura mater and the bone, as the result of traumatism, it takes place one or more weeks after the injury. In tumours the symptoms are generally very slowly developed. When the effusion of blood is so great as to exercise pressure on the brain generally, there will be in most cases no symptoms indicating the locality of the effusion. But when sufficient pressure affects a part of the brain only, localising symptoms may be looked for.

Intracranial effusions of blood may take place outside the dura mater; into the cavity of the arachnoid; into the pia mater; and into the substance of the brain, or one of its ventricles. When the out-pouring of blood into any of these positions arises from traumatic causes, the symptoms occur slowly, and an interval of time generally elapses between the accident and the occurrence of the symptoms, though this may not be evident when insensibility ensues from concussion, or when compression is induced by depressed fracture. By reference to the symptoms alone, it is difficult and frequently impossible to differentiate between blood poured out on the exterior of the dura mater and on the surface of the brain, especially when the amount of the effusion is great. But when there is an external injury of limited extent, the probability is that the blood is superficial. When there is evidence of contusion or laceration of the cerebral substance, extravasation of blood into the brain-tissue will have occurred at that point.

Extravasation on the *outside of the dura mater* may take place from the rupture of minute vessels which pass between the skull and that membrane; or from large vessels which lie in the osseous grooves in the interior of the skull. When it arises from the former, the extravasation is not extensive, and seldom causes marked symptoms; if from the latter, the amount of blood effused is great, and separates the dura mater from the skull, often to a considerable extent; at the same time it causes, by its pressure, marked depression of the cerebral substance. The vessel most frequently found ruptured from traumatic causes is the middle meningeal, or one of its branches. In fractures of the middle fossa, this vessel may be ruptured at any part of its course from the foramen spinosum to the anterior inferior angle of the parietal. The blood may, however, come from one of the sinuses, the lateral being the one most frequently ruptured. So that the parietal region is the one in which blood is most frequently effused between the dura mater and the skull. It has to be borne in mind that considerable effusions of blood may occur without giving rise to marked symptoms, if the effusion takes place slowly.

Traumatic effusion of blood frequently occurs *in the cavity of the arachnoid*. Its existence in this particular position cannot be diagnosed from that on the outside of the dura mater. But if the surgeon, led by the symptoms of localisation, has trephined on account of blood causing pressure on the brain, and finds none between the dura mater and the skull, he will be able to discern, by the dark blue appearance of this membrane, the presence of blood in the arachnoid. Blood effused into this region undergoes changes of a somewhat peculiar kind. The clot generally becomes attached to the parietal layer of the arachnoid, and later it becomes vascular, by penetration of the loops of capillaries. It ultimately may be converted into fibrous, and it is said even into cartilaginous, structures. Frequently these are cystic in form, and may be either attached to one of the layers of the arachnoid membrane, or remain free in its cavity.

Extravasations of blood *beneath the arachnoid* spread all over the brain-surface, and are not confined to the area in which they originate. They are generally associated with lacerations of brain-tissue. Unless very extensive, they do not readily

lead to distinct manifestations of brain-symptoms.

Effusions of blood *into the brain* are common accompaniments of laceration and contusion of cerebral substance, and the symptoms are apoplectic in their character. Compression of the anterior part of the brain is much less serious to life than when it implicates the middle or posterior lobes. The symptoms of compression of the anterior lobes are very slow in appearing, and are frequently of such a slight character as not to be observable, unless on very close attention. Compression of any part of the motor area is generally easily recognised.

The prognosis of compression, due to extravasated blood, depends greatly on the seat of the pressure, and also as to whether there has been pouring out of blood into the brain-tissue, as, in the latter case, there is frequently irreparable destruction of the parts into which the blood has been poured. When effusion of blood takes place into the central parts of the brain, pons varolii, or medulla oblongata, or if there be great effusion into the ventricles, the condition is much more serious than when it is superficial, or exists between the skull and the dura mater.

Treatment of compression.—The cause of the compression ought, if possible, to be removed. The treatment of compression arising from depressed fracture and inflammatory action within the skull, is fully dealt with under SKULL, Fracture of the; ENCEPHALITIS; suffice it to say here, that the bone ought to be elevated in the former, while exit to inflammatory effusion ought to be afforded in the latter. Cerebral tumours, which have been localised and which are situated in any accessible region of the brain, especially in the cortex, should be removed. Regarding effusions of blood, they present the most readily removable of all the causes of compression, more especially as the majority of them, arising from traumatism, are found on the periphery of the intracranial structures; and also, as they are free from the complication of inflammatory products (at least soon after the occurrence), which so often accompany other lesions occasioning compression. In trephining for the relief of pressure caused by blood, a large disc of bone should be elevated. If the blood be situated immediately beneath the skull, it will present itself whenever the bone has been withdrawn. The surgeon should then examine the aperture carefully, passing the probe between the dura mater and the skull, and by this means removing adherent blood-clots.

If the blood be in the cavity of the arachnoid, it will be recognised by the dark blue colour shown through the superficial membranes. The dura mater should then be freely opened, and the blood withdrawn. In some instances blood will present itself as a dark body in the pia mater or in the periphery of the brain-substance. This should be taken away. After all the effused blood has been removed from the interior of the skull as far as practicable, the bone should be replaced, an exit for drainage being kept patent. The scalp should then be brought carefully together, and the wound dressed antiseptically. If these operations are done aseptically, there is no fear of the procedure itself increasing the danger of the case. The statistics of such operations in the writer's practice are very favourable.

The patient ought to be kept quietly at rest in bed, the head shaven, the bowels freely acted on, and the diet restricted to milk or beef-tea. *See* HEAD-INJURIES, Diagnosis of. WILLIAM MACEWEN.

BRAIN, Concussion of the.—Concussion is a form of shock. Shock may arise from either mental or physical impressions. Physical impressions may produce shock, either directly by acting on the brain through the skull, or indirectly by the depressing influences conveyed to the central nervous system by the nerves of the part of the body which has been injured. In either case, a functional paralysis results. Peripheral shock arises from sudden, extensive, and severe injuries to any part of the body, but it is most prone to follow injuries of the abdominal viscera, the genitals, the bones, and the joints. Central shock or concussion originates from violent blows or falls, which produce shaking of the whole brain. These may act directly on the head, or they may do so through the trunk, the person falling from a height on the feet or buttocks.

Concussion may therefore be defined as that form of shock which arises from direct commotion of the cerebral substance, resulting in functional paralysis. In some post-mortem examinations of cases of this description, no cerebral structural lesions of any kind have been discovered, even with the use of the microscope. It is true that in many such cases the spine has not been examined. In others, minute hæmorrhagic extravasations have been found in the pia mater or in the substance of the brain. When lacerations existed, it is probable that these

would have indicated their presence during life, by distinctive symptoms, had time been afforded for their development, the concussion meantime having masked the other symptoms. The morbid physiology of this cerebral loss of function is obscure. Various theories have been advanced; the most popular is the assumption of a molecular disturbance of the protoplasm of the brain-tissue. Uncomplicated cases (of concussion) are comparatively seldom seen by hospital surgeons. The majority of cases of concussion are associated with some head lesion, which forms a complication, such as fracture of the skull, laceration, contusion, and compression of the brain. In many instances the concussion is at first paramount, but, as it begins to pass off, the indications of the other lesions manifest themselves. In other instances, compression, when localised, is apparent at an early period, along with a certain amount of concussion.

The *symptoms* of concussion are generally described as occurring in four stages—collapse, rallying, reaction, and gradual convalescence. The stage of collapse may be indicated by very varied symptoms. In slight cases there may only be vertigo and mental confusion, with faintness. In others, the patient is insensible, like a person in a deep faint—stunned. The skin is cold and pallid; the features blanched and contracted; the respirations superficial and shallow, and sometimes sighing; the pulse feeble or imperceptible; the reflex actions abolished; but there is no true paralysis. In this stage of insensibility, the pupils are always dilated. When they are otherwise, it indicates the existence of some complication. The period of rallying is generally ushered in by vomiting, and sometimes by an epileptiform attack. The reflex actions can now be excited, the pallor leaves the face, the pulse becomes stronger, the respirations more distinct, consciousness returns, and the whole condition of the patient begins to improve. This period of rallying may occur a few minutes after the injury, or the patient may remain in a collapsed condition for days prior to the rallying.

Reaction follows, with increased temperature, hot skin, flushed face, quick bounding pulse, and scanty urine. In severe cases the patient may die comatose, with symptoms of inflammation of the brain. In slight cases the period of reaction may be almost imperceptible, and the patient may pass gradually into convalescence. It is during the period of reaction that many lesions of the brain, previously masked, show themselves, such as localised compression, contusion, or laceration; and it is in these cases that the reactionary period is most likely to be marked by inflammatory symptoms. In uncomplicated cases of concussion the period of reaction is comparatively short, but when encephalitis arises it may last for weeks. The convalescent stage may be short or protracted, according to the condition established during the period of reaction. During convalescence many complain of languor, headache, and inability to work.

In uncomplicated cases of concussion, a fatal issue may occur during the period of collapse; but when reaction is fairly established comparatively few succumb, unless inflammation of the brain supervene. Though the majority of cases of simple concussion recover perfectly, in some there remains impairment of mental powers and of sensory functions, and these defects are at times permanent.

Treatment.—During the period of collapse, the patient ought to be enveloped in warm blankets, and have hot bottles or bags applied to the feet. A rectal injection of warm water, or diluted beef-tea, has often the desired effect of promoting reaction. Stimulants ought seldom to be employed, and when they are, they should be used with the greatest circumspection. The patient ought to be kept in bed in a quiet room, and his stay in bed ought not to be less than a fortnight, in the mildest cases. His diet ought to consist of little else than milk, until the convalescence has been fully developed. During the reactionary period, the head should be shaven, the room darkened, and the bowels acted on by mild purges. *See* HEAD-INJURIES, Diagnosis of. WILLIAM MACEWEN.

BRAIN, Hernia of the.—When a portion of brain-matter protrudes through an opening in the skull and its membranes, while its base is still continuous with the brain, a *hernia cerebri* has been established. In certain injuries brain-matter escapes, and is found on the outside of the skull, quite detached, and separated from the general mass of the brain. Such an escape of brain-matter ought not to be included under the title of hernia of the brain, though it is very commonly regarded as one.

Cerebral herniæ are divided into two classes—true and false. The former indicates a protrusion, containing the characteristic structures of cerebral substance, as may be verified under the microscope; the latter consisting of inflammatory new

formation, often of masses of granulation-cells, the products of inflammatory action in the brain. Occasionally also these false herniæ consist of red cells, a little fibrin, and a few white corpuscles.

Hernia cerebri may be produced at the moment of injury. The writer has seen such cases. In one a portion of the frontal bone was driven into the brain; the hollow which was left by the depressed bone was filled to the level of the scalp by a pulsating mass of brain-matter, which had escaped at the moment of the accident. More frequently, however, the escape of brain-matter at the time of the accident takes place in the form of detached and separated pieces, which do not constitute herniæ. All cerebral herniæ and cerebral protrusions, occurring at the time of the injury, retain the white appearance of brain-matter, which they exhibit on being washed from the blood so apt to surround them. Herniæ of the brain usually occur some time after injury, and then are always mixed with inflammatory exudation in varying proportions; commonly the exudation forms the greater bulk. They rarely appear before the second or third day after the opening of the skull, and their appearance may be greatly delayed, weeks elapsing in some cases. While cerebral protrusions, occurring at the moment of injury, retain their natural appearance, those which take place some days afterwards present a greyish-red colour, and have a fungating aspect.

Herniæ generally occur on the upper and lateral aspects of the brain; they seldom protrude from the base. The frontal and parietal regions are their most common site. They are rarely or never found in the occipital region. There are cases on record where considerable quantities of brain-matter have been protruded through the base of the frontal and cribriform plate of the ethmoid, and have escaped through the nose. The writer has seen two cases where brain-matter was seen issuing from the ear, in fracture of the petrous bone. In one it was in small and detached pieces, in the other there was a considerable hernial protrusion of a fungating form presenting at the external orifice of the ear.

Formerly hernia cerebri was looked upon as the necessary sequence of wounds and injuries which penetrated the skull and brain-membranes, exposing the brain. Under altered conditions of treatment it rarely follows such wounds, and only arises when excessive inflammatory action of the brain-tissue has been set up. It is also erroneous to suppose that such inflammatory conditions can only arise as a consequence of wounds. It is true that the herniæ cannot exist without an aperture, but when there has been idiopathic inflammatory action of an excessive kind, the moment the skull is opened, the inflammatory products protrude and form the hernia cerebri.

Regarding prognosis, these herniæ may be divided into two kinds, primary and secondary. The primary herniæ are such as occur as the immediate results of an accident, when fresh healthy brain-matter has been protruded. In such instances the hernia, though it must be regarded as a serious lesion, does not often lead to a fatal issue. Quite a number of such cases have recovered. The good results obtainable depend greatly upon the treatment. The secondary herniæ are the sequents of inflammatory action in the brain, and are therefore to be regarded in a much more serious light. The majority of cases in which they occur prove fatal, not so much from the herniæ themselves as from the fact that they are mere indications of the extent of the inflammatory action in the interior of the brain. Still recovery does take place, in young people especially.

Treatment.—In all cases, scrupulous antiseptic precautions, with due regard to the prevention of irritation, ought to be adopted. Such measures are the most reliable prophylactics when the brain is exposed, and the best treatment when the inflammatory action is established. This is especially the case with herniæ, as they are very prone to undergo decomposition, and to give rise to a very fœtid odour. 1–1000 bichloride solution may be used as a wash, and the part may be covered with sublimated wood wool.

WILLIAM MACEWEN.

BRASDOR'S OPERATION. — The term commonly used by French writers for the operation of applying a distal ligature. Wardrop was, however, the first to perform the operation. *See* ANEURISM.

BREAST, Diseases of the.—ABNORMALITIES OF SECRETION.—1. *Appearance of Milk unconnected with Pregnancy* is very rare. It has occurred as the result of allowing an infant to suck at the nipple.

2. *Agalactea or total Absence of Milk after Child-birth* is also rare, except in cases of premature delivery. Should there be delay in the appearance of the secretion, hot fomentations may be applied and the child put to the breast. By perseverance

in these means the secretion will usually be induced by the second day at latest. Deficient secretion is common in feeble and anæmic women. In such cases it is better to wean the child at once, as the imperfect supply is evidence that the mother is not fit to suckle.

3. *Galactorrhœa or Excessive Secretion of Milk.*—This may occur at an early period of lactation, and consist of a constant dribbling of milk from the swollen and distended breasts, or it may consist merely in a prolonged secretion in spite of efforts to arrest it by weaning the child. The former condition is an individual peculiarity, and its causes are doubtful; the latter is sometimes the result of prolonged suckling, or of uterine disease.

Treatment.—Galactorrhœa can usually be arrested by the external application of a paint composed of equal parts of glycerine and extract of belladonna, and by the internal administration of saline purgatives. In those cases which occur at an early period of lactation, iodide of potassium has been known to arrest the secretion.

Hypertrophy of the Breast.—True hypertrophy is a rare disease. It consists simply in an enormous over-growth of the mammary tissue.

Causes.—It has been attributed to menstrual irregularity, excessive sexual excitement, blows, &c. It commences usually about puberty. Of 26 cases collected by Labarraque, only 5 were over twenty-six years of age. In some few cases the enlargement has been an exaggeration of the normal evolution of the breast in pregnancy.

Symptoms.—The chief symptom is the steady and often rapid enlargement, affecting both mammæ in most cases. There is little pain, the chief inconvenience arising from the size of the breasts. This may be enormous, the breasts sometimes resting on the thighs when the patient is in a sitting posture. Cases have been recorded in which the patient was unable to bear the weight of the mammæ when in the erect position, and their pressure has been such as to interfere with respiration when lying down. The enlarged glands are usually somewhat hard and knotty, but not tender. In those exceptional cases which occur during pregnancy, there may be galactorrhœa; in others there is no secretion of milk. The general health suffers when the enlargement is considerable, the patient becoming anæmic; amenorrhœa is commonly present. After reaching a certain size the growth ceases.

Diagnosis.—The only disease resembling hypertrophy is a large cysto-sarcoma. The affection of both breasts, the central position of the nipple, and the absence of cysts serve easily to distinguish hypertrophy.

Treatment.—Various preparations of iodine have been used internally and externally without effect; they may, however, be tried. The external application of belladonna might relieve pain. Pressure has been tried without success. If the encumbrance becomes great, the only efficient treatment is removal of the enlarged breasts.

Neuralgia of the Breast, or Mastodynia.—The term neuralgia of the breast is properly applied to those cases in which pain is the only symptom, and in which no tumour or inflammatory induration is present. It is a rare affection.

Causes.—It is met with during the period of functional activity of the reproductive organs, and in all classes of society. It usually occurs in hysterical women, and is often associated with some uterine affection, with anæmia and habitual constipation. It has been attributed to blows or to the pressure of badly fitting stays.

Symptoms.—The pain is severe and paroxysmal, radiating from the breast to the neck, shoulder, or arm. It may be distinctly periodic in character, and is usually worse during menstruation. It is usually referred to the whole breast and not to any localised spot. There may be slight fulness of the affected gland.

Treatment.—Any uterine disturbance must be relieved, if possible. Constipation must be relieved by purgatives; anæmia by iron, animal food, and change of air to a bracing climate. Locally, the most useful treatment is the application of strips of belladonna plaster spread on leather in such a way as to support the breast and draw it slightly inwards. Opium in any form must be forbidden.

Inflammatory Affections of the Breast.—*Acute Mastitis, Acute Parenchymatous Inflammation, Mammary Abscess, Milk Abscess.*—Acute inflammation of the breast may occur in both sexes and at all ages, but it is rare in adults except in connection with lactation. A form of inflammation occurs in new-born infants, and is termed mastitis neonatorum, and a similar condition is sometimes met with at puberty.

Causes.—The inflammation most commonly appears during the first month after delivery, and is usually supposed to be due to retention of milk from obstruction of a duct, but the evidence of this is not very

good. In many cases it is preceded by a sore nipple, and possibly extension of the inflammation into the deeper structures may then be the true cause. Blows and exposure to cold during lactation are occasional causes. Mammary abscess is most common in women who nurse their own children, and in primiparæ. It is not a common consequence of enforced arrest of the secretion, as after the death of the child. The pus of an acute mammary abscess always contains micrococci, but how they get there, and what part they play in the causation of puerperal mastitis, are points not definitely determined.

Symptoms.—The first symptom is often some swelling and engorgement; there is pain, aggravated when the child is put to the breast. There is a feeling of weight, relieved by supporting the gland with a bandage or handkerchief. On examining the breast an ill-defined hardness is felt, most commonly towards the lower and outer side. Sometimes several such patches may be present. There is acute tenderness on pressure, and some œdema of the subcutaneous tissue. The thermometer shows some elevation of temperature. As the inflammation progresses, the thermometer rises to 102° F. or 103° F. or even higher, and there may be a rigor. The œdema increases over the indurated part, the skin reddens and fluctuation becomes distinct. If left unrelieved, the abscess may reach such a size as to contain many ounces of pus before it bursts. Both breasts are rarely affected. Under proper treatment the inflammation may subside without reaching the stage of suppuration, in fact this probably occurs in about half the cases.

Pathological Anatomy.—The observations on these cases are very few, and have been chiefly made in women dying of puerperal septicæmia or pyæmia. The ordinary signs of inflammation are found, the chief exudation being at first around the acini, but this does not prove that the source of iritation arises from within them, for similar appearances can be produced in animals by passing a seton through the gland. It is due merely to the vessels and lymphatics being most abundant in that situation.

Treatment.—This must at first be directed to the prevention of suppuration. The child must be removed from the affected breast, and the milk gently drawn with a breast pump. If the patient be weak the infant must be weaned. The arm must be fixed to the side to secure rest. The breast must be supported by a handkerchief or bandage passing over the opposite shoulder, and the patient should be kept as much as possible in the recumbent position. The part should then be painted with extract of belladonna and glycerine (equal parts) and hot fomentations constantly applied. Leeches are of little or no use and cold applications only do harm. Linseed-meal poultices are too heavy. If it be intended to arrest the secretion of milk, the bowels must be kept gently relaxed by means of saline purgatives.

If, in spite of this treatment, pus forms, when should it be let out? Some surgeons recommend opening as late as possible, or even leaving the abscess to burst. There seems no reason why the patient's pain and fever should thus be needlessly prolonged. To cut deeply into so vascular an organ as the actively secreting mamma in search of doubtful pus would certainly be wrong; but as soon as its presence is proved by the aspirator, or by fluctuation, it should be let out. The abscess should be opened with efficient antiseptic precautions (*see* Antiseptic Surgery), and no cases better repay the little extra trouble involved in so doing. The incision must be so placed as to radiate from the nipple in order to avoid damage to the ducts. It need not be larger than is necessary to admit a drainage-tube of $\frac{3}{8}$ inch in diameter, or even smaller if the abscess be not of great size. Great care must be taken, however, to ensure efficient drainage.

Consequences of Puerperal Mastitis.—Inflammation, which has stopped short of suppuration, leaves more or less induration of the inflamed area, lasting for many months or even permanently. This condition may very closely resemble scirrhous cancer. *See* Breast, Tumours of the, Diagnosis of. When an abscess has existed the induration is usually more marked, but the nature of the case is made more evident by the scar. These indurations sometimes become the starting-point of cancer. In the cases of carcinoma of the breast collected by Gross the disease arose in this way in 8·21 per cent.

Fistulous tracks or sinuses occasionally remain after a mammary abscess has been opened. These discharge a thin fluid not unlike human milk, but a true lacteal fistula is a very rare occurrence. Most commonly the sinus leads to a cavity surrounded by indurated tissue and imperfectly drained. A true lacteal fistula will not heal till the secretion of milk is arrested. A sinus leading to a cavity is best treated by enlarging the orifice. If the discharges are decomposing, the cavity should be scraped with a sharp spoon, and then cleaned with a small piece

of sponge held in a pair of forceps and soaked in a solution of chloride of zinc (40 gr. to f ʒj). This treatment is almost invariably followed by rapid healing.

Mastitis Neonatorum. — In new-born children of both sexes the rudimentary mamma becomes slightly swollen about the third or fourth day of life, and if at this time it be gently squeezed a small quantity of alkaline fluid containing colostrum corpuscles can be squeezed from it. The swelling and secretion reach their maximum on the tenth day and then gradually subside.

Acute submammary abscess.—A submammary abscess is a collection of pus in the areolar tissue between the gland and the pectoralis major. It is met with, almost exclusively, in puerperal women, and is, most probably, due to suppuration commencing in a deep lobule of the gland.

Symptoms.—The earliest symptoms are deep-seated pain, increased when the child is at the breast, tenderness, and febrile disturbance. As soon as the inflammation extends to the submammary areolar tissue, the symptoms are intensified. The breast becomes tense and full, and is pushed forwards bodily. There is severe pain, greatly increased by moving the arm. The febrile disturbance in this stage is very great. At first no fluctuation can be detected, but, after a time, redness and œdema, followed by distinct evidence of fluid, appear at some point of the circumference of the gland, most commonly the outer and lower border. Sometimes pus may point in more than one place. If left to itself the abscess bursts, sometimes at several points in the circumference of the gland, leaving sinuses which are very slow to heal.

Diagnosis.—The diagnosis is made by observing that the pain is increased by movements of the arm, or by moving the gland over the pectoralis major. The general prominence of the swollen breast is another important sign.

Treatment.— In the early stages the same treatment must be adopted as in ordinary puerperal mastitis, in the hope of preventing suppuration. The arm must, at the same time, be firmly fixed by bandages to the side. As soon as it is evident that pus is present, a free opening must be made in the place at which it is pointing. The incision should be parallel to the border of the gland and not directed towards the nipple, otherwise the gland is needlessly wounded. A large drainage-tube should be inserted, and some efficient antiseptic dressing applied. The troublesome sinuses which not uncommonly form are due, in most cases, to insufficient drainage and the presence of a cavity beneath the mamma containing decomposing pus. Under these circumstances, the orifices of the sinuses must be enlarged, so as to admit the finger. The cavity and sinuses are then to be scraped with a sharp spoon and cleaned by means of a sponge soaked in a solution of chloride of zinc (40 gr. to f ʒj.). Drainage-tubes may then be inserted and gradually withdrawn as the cavity closes, some antiseptic dressing being applied. A counter-opening must be made at the most dependent part if necessary.

Chronic Inflammatory Affections of the Breast.—*Chronic lobular interstitial mastitis* of one, or of several lobules, of the breast, is not uncommon in women past middle life, and is occasionally met with at an earlier period. The *causes* of this affection are very uncertain. It seems, in some cases, to be associated with uterine disease, but this is by no means constant. It is most common at the period of the cessation of menstruation, but is also occasionally met with in young women. Women who have borne children are more liable to it.

Symptoms.—The patient's attention is usually attracted to the breast by some pain and tenderness. Sometimes this is very severe, neuralgic in character, and aggravated at the menstrual period. On examining the breast an indurated nodule will be felt, varying in size from a filbert to a walnut, but seldom reaching the latter size. The patient often states that there is some increase of size at the menstrual period. The nodule does not slip about in the gland, but is evidently part of the gland itself. The outline of the indurated lobule is ill-defined and it gives a sensation rather of leathery toughness than stony hardness. Small projections of great hardness are sometimes to be felt in it. These are small and very tense cysts. When the nodule is of considerable size and very superficial, the skin may dimple slightly over it when pinched up between the finger and thumb. After the affected lobule has reached a certain size the disease tends to become stationary, and often the pain subsides and the patient suffers no further trouble. Several such lobules are occasionally met with in one breast, and both glands are not infrequently affected.

Pathology.— The indurated lobule is dense and leathery in consistence, opaque white in colour, and can often be seen by the naked eye to be composed chiefly of bundles of fibrous tissue. Small cysts, seldom as large as a pea, tensely distended

with fluid, either clear, or turbid and brownish in colour, are often scattered through it. The outlines of the diseased lobule are not clearly defined. It differs from scirrhous cancer in its leathery consistence and its flatness on section, and in not yielding a milky juice on scraping. Microscopic examination shows that it is a genuine interstitial inflammation. In the advancing margin the interacinous connective tissue is infiltrated with small round cells. In the more advanced stages these are found to have developed into dense fibrous tissue, the process being accompanied by contraction, as in the analogous conditions of cirrhosis of the liver or kidney. By this contraction the ducts are pressed on, and, as at the same time there is some slight excess of secretion in the acini, small retention cysts are formed.

Prognosis.—The disease tends to become stationary after reaching a certain point. It is possible that occasionally the indurated lobule may be the starting-point of a cancer, but this is certainly rare.

Diagnosis.—Chronic lobular interstitial mastitis may be mistaken for a chronic abscess, an adeno-fibroma, a cyst or scirrhous cancer. From an adeno-fibroma it is distinguished by its want of mobility in the gland and its ill-defined outline; from a cyst by its want of elasticity and its irregular outline; from a chronic abscess by its not arising in connection with pregnancy or lactation, and by the absence of œdema over it. In cases of doubt a grooved needle may be inserted, which will at once show the true nature of a chronic abscess or cyst. From scirrhous cancer the diagnosis is often so difficult that it can only be made by means of an incision into the nodule. *See* Breast, Tumours of the, Diagnosis of.

Treatment.—The treatment of this disease is not very satisfactory. Blistering, tincture of iodine, and other counter-irritants have usually little effect. The inunction of mercurial ointment is often recommended, but is of doubtful utility. The pain is best relieved by the application of a belladonna plaster. Should there be any concomitant uterine disorder, it must be attended to. If the patient is anæmic, the pain is usually more severe, and relief is then obtained by the administration of iron. Sir James Paget speaks of the following mixture as, in some cases, promoting absorption of the induration: ℞ Liq. potassæ f℥j., Pot. iodidi gr. ij. To be taken three times a day, after meals, in not less than f℥iv. of any simple liquid. If everything else fails, and the patient's mind is much disturbed by the fear of cancer, a single lobule may be excised.

Chronic Abscess of the Breast. Encysted Abscess.—This somewhat rare affection derives its interest from the close resemblance that it bears to scirrhous cancer.

Causes.—Chronic encysted abscess almost invariably arises in connection with pregnancy, and very frequently with miscarriage or abortion. Gross states that he has seen it in scrofulous subjects independent of impregnation.

Symptoms.—The symptoms closely resemble those of chronic lobular interstitial mastitis. There is a hard lump in the breast, seldom reaching the size of a walnut; it is tender, but not markedly so, and may be the seat of some pain. Its outline is ill-defined; it evidently implicates the mammary tissue and cannot be separated from it. There is some œdema of the tissues covering it, and if the skin be pinched up there is usually slight dimpling. In this state it may remain for many months without marked change. If it reaches any considerable size there may be a sense of elasticity in its central part. Finally it may become definitely adherent to the skin. There may be slight enlargement of the nearest axillary gland.

Pathology.—If a chronic abscess be examined by a section carried through it, it is found to be situated in a lobule of the mamma. In the centre is a small cavity lined with granulation-tissue containing thick pus. The tissue surrounding this cavity is composed of dense fibroid tissue, in the midst of which remains of the glandular structure may be recognised.

Diagnosis.—From an adeno-fibroma it is distinguished by its ill-defined outline and its implication of the glandular tissue. The presence of œdema, the dimpling of the skin, and its ill-defined outline will usually serve to distinguish it from a cyst. The distinction from chronic interstitial inflammation without suppuration is very difficult, but the œdema may serve to show its real nature. From scirrhous cancer it may be almost indistinguishable, except by puncture or incision. *See* Breast, Tumours of the, Diagnosis of. Many breasts have been removed needlessly for want of taking the precaution of cutting into a doubtful induration before proceeding to the operation.

Treatment.—The only treatment is to open the cavity. Healing will be promoted by scraping it with a sharp spoon.

Tubercle of the Breast.—The mamma is very rarely the seat of tubercle. Grey

granulations have never been observed in it. Billroth records a case in which numerous caseous nodules were found in the breast of a young woman who died of pulmonary tuberculosis. Duret and Dubar have described some cases in which chronic abscesses with curdy contents slowly formed in the breast, but the evidence that they were tubercular is not perfect.

Syphilitic Diseases of the Breast.—Primary sores and mucous tubercles on the nipple are occasionally met with. Chronic diffuse induration of the gland and the formation of gummata in it have also been described, but there can be no doubt that these conditions are exceedingly rare. Ambrosoli describes cases of diffuse induration which disappeared under iodide of potassium. Gummata have been described by various authors, as forming painless swellings commencing in the mammary tissue and gradually increasing till they reach the surface. Softening then takes place, and finally the skin gives way, exposing the characteristic slough, resembling wet washleather in appearance. This separates slowly, leaving a deep excavated ulcer. Further observations, however, are required before syphilitic diseases of the breast can be described with any certainty.

Tumours of the Breast.—*Cysts.*—Excluding cysts in solid tumours, three forms are met with in the breast:—1. Retention Cysts; 2. Serous Cysts; and, 3. Hydatid Cysts.

1. *Retention Cysts.*—These are formed by dilatation of the acini or ducts of the gland. The conditions essential to their formation are, obstruction to a duct and some excess of secretion from the part where the cyst is formed. Galactocele, which properly belongs to the class of retention cysts, has been already described with errors of secretion. Excluding galactocele the following varieties of retention cyst are met with:—

(*a*) *Involution Cysts.*—These are formed in the indurated and atrophied breasts of old women. They are usually numerous, and scattered throughout different parts of the gland. They seldom reach any considerable size, and are of little importance.

(*b*) Cysts, as already stated, are common in the indurated part *in chronic lobular interstitial mastitis.* They seldom reach any size.

(*c*) Retention cysts arising independently of these conditions are usually termed *glandular* or *duct cysts.* They may be single or multiple. They may be seated deeply in the gland or superficially near the nipple. They are composed of a fibrous vascular wall lined with epithelium, which is either cubical or inclining towards columnar in form. Their contents are thick, sometimes resembling mucus in consistence, turbid, brownish, or yellowish in colour, and frequently stained with recent blood. Intracystic growths are not uncommon. They are composed of delicate vascular papillæ, covered with epithelium springing up from the walls of the cyst and sometimes almost filling its cavity. It is possible that in some cases this condition may end in the peculiar form of cancer termed villous or duct cancer. See *Cancer of the Breast,* below. The obstruction of the duct leading to the cavity is in many cases not complete, and the contents can be made to flow from the nipple by firm pressure on the cyst. The *causes* of these cysts are uncertain; they are most common in women under forty, and are often attributed to a blow.

2. *Serous Cysts.*—These are supposed to be formed, as in other parts of the body, by dilatation of the lymph-spaces of the connective tissue. The walls are composed of fibrous tissue, lined internally by an imperfect layer of flattened endothelial cells. Their contents are usually clear serous fluid rich in albumen, but they may be altered by an admixture of blood. Serous cysts are usually single and often multilocular, but may be multiple. They may reach a considerable size, containing some ounces of fluid. Nothing is definitely known as to their cause.

3. *Hydatid Cysts of the Breast* are very rare in this country. When they occur they present no special peculiarities. *See* Hydatids.

Symptoms of Cysts of the Breast.—A cyst of the breast forms a slowly-growing, rounded, tense, or elastic tumour, sometimes smooth, often lobulated, on the surface. Its outline is in some cases tolerably clearly defined; in others it is obscured by indurated glandular tissue around it. It is attached to the gland, and not movable independently of the mammary tissue. It is free from pain and tenderness.

Treatment.—Glandular or serous cysts, if single, may be cured by making an opening large enough to admit a small sponge moistened with chloride of zinc (gr. 40 to f℥j). With this the inside may be thoroughly scrubbed. A drainage-tube is then to be inserted, and an antiseptic dressing of some sort applied. Under this treatment the cavity will usually close. If the case be one of a glandular cyst with intracystic growth, or if there be much induration of

the surrounding mammary tissue, the whole of the affected lobe of the breast should be removed.

Adenoma, Adeno-fibroma, Adeno-sarcoma, and Cysto-sarcoma.—These tumours are so closely allied pathologically that they may be considered merely modifications of a single form of morbid growth. They are all composed of a vascular connective tissue, modified according to the form assumed by the growth, surrounding spaces lined with cubical epithelium, and containing a variable quantity of clear fluid. They are enclosed in a capsule of fibrous tissue, and do not infiltrate the surrounding parts. By most German pathologists the connective tissue is regarded as the essential feature of the growth, and the spaces as more or less accidental remains of ducts or acini, and the term adenoma has consequently not been applied to them by those who hold this view. English pathologists and clinical surgeons have, however, regarded the epithelium-lined spaces as of equal importance with the surrounding connective tissue, and have consequently classed these growths with adenomata.

The following are the modifications met with:—(*a*) A dense, well-developed, fibrous stroma surrounding large spaces, containing little fluid, and consequently flattened or slit-like. This forms the common *adenoma*, or *chronic mammary tumour*.

(*b*) A less perfectly developed fibrous stroma, composed of fibrous tissue abundantly infiltrated with small round cells, or a small amount of fibrous tissue mixed with oat-shaped cells, or of spindle-shaped cells with scarcely any fibrous tissue between them, surrounding spaces containing more fluid, and consequently rounded or oval. This forms the *adeno-sarcoma*.

(*c*) Sometimes the half-developed connective tissue contains numerous stellate cells, and some mucous intercellular substance. This forms the *myxo-sarcoma* or *adeno-myxo-sarcoma*.

(*d*) A tolerably well-developed fibrous stroma, surrounding large spaces filled with fluid, and forming intracystic growths projecting into the cavities, sometimes nearly filling them. This is the *cysto-sarcoma* or *proliferous cyst of the mamma*.

For clinical purposes these tumours may be divided into three groups:—The adeno-fibroma or simple adenoma, the adeno-sarcoma, and the cysto-sarcoma.

Adeno-fibroma. — *Causes.* — These tumours are sometimes attributed to a blow, but we have no real knowledge of their mode of origin. They occur most frequently in young women under thirty.

Symptoms.—The tumour is small when first observed, and situated near the circumference of the gland, usually at the upper or outer part. It is hard, clearly defined, freely movable in the mamma, and has no adhesions to the skin, the deep parts, or the gland. The surface is smooth or smoothly lobulated. It may be painless and free from tenderness, but in hysterical women it is often the seat of intense pain, so much so that the term 'painful mammary tumour' has sometimes been applied to it. Its growth is slow and it may often remain stationary for years; but in other cases it steadily increases, and may attain the size of a small orange without materially altering in its other features.

Pathological Anatomy.—The tumour on section is of a bluish or greyish white colour, becoming pink on exposure to the air; the flattened spaces give it a peculiar foliated structure somewhat resembling the section of a cabbage, which becomes more apparent after the tumour has been immersed in spirit for a short time. It yields no juice on scraping.

Adeno-sarcoma. — An adeno-sarcoma may arise as such, and grow rapidly from the first, or may develop by the rapid increase of a tumour which has presented for many years the appearances of a simple adeno-fibroma. It is met with most commonly in women between thirty and forty. The tumour is lobulated, elastic, painless, and free from tenderness. Its outline is clearly defined, and it is separable from the mammary tissue till it attains a considerable size. Finally, from the tension it causes, the surrounding parts become irritated and adherent to it. The mammary gland may sometimes seem to be involved in the growth, when it is really atrophied from pressure. If the tumour be allowed to grow unchecked, the skin gives way, and a fungating vascular growth protrudes, death taking place from loss of blood and exhaustion. The lymphatic glands are not affected, and recurrence in internal organs is very rare.

Pathological Anatomy.—The tumour on section is usually seen to be perfectly free from adhesion to surrounding parts. It yields in many cases an abundant slimy juice, but on scraping no milk fluid is obtained. Rounded cysts of considerable size are frequently scattered through it.

Cysto-sarcoma, Proliferous Cysts. — These tumours closely resemble in their history and mode of growth the adeno-

sarcoma just described, but as a rule they develop more slowly. They occur more commonly after thirty than before. They form elastic lobulated tumours, with fluctuating points scattered through them. They may reach an enormous size without forming any adhesions to the deeper parts. The skin covering them is usually traversed by large veins, but does not become adherent or ulcerate till a late period. If left to grow, ulceration at last takes place and a fungating growth protrudes, and death occurs from exhaustion. The lymphatic glands are never affected and internal recurrences do not occur.

Pathological Anatomy. — A section through the tumour shows it to contain innumerable cysts, varying in size from a pin's head to an orange. The fluid contents are usually thick and viscid. In many of the cysts are intracystic growths. These are usually pedunculated, springing from one side of the cavity and projecting into it like the head of a cauliflower. The solid substance is white or pink in colour, and usually of firm consistence.

Prognosis.—All these tumours are simple in character, and do not return if removed completely.

Treatment.—Small adeno-fibromata are said to have been absorbed under the application of iodine, mercurial ointment, or pressure. It is, however, probable that in every case in which this has been supposed to occur, the tumour was in reality merely an indurated lobule of the gland, resulting from chronic inflammation. The only efficient treatment is removal of the tumour. Even when an adeno-fibroma is stationary, it is wiser to excise it, as it is impossible to say when it may not assume rapid growth and endanger life. In the larger tumours the absence of adhesion to the skin and deep parts renders the removal easy, even when the growth may have attained the size of a cocoa-nut. The breast should not be taken away if it can be avoided, but when the tumour is of great size the gland is so spread out over it and atrophied that it is often impossible to save it.

The removal of the smaller growths is done by a single incision radiating from the nipple. As soon as the capsule is opened, the shining surface of the growth comes into view and the tumour may then often be shelled out by the fingers with the greatest ease. A small pedicle is sometimes found containing the vessels. The operation should be performed with antiseptic precautions, and drainage must be very carefully attended to, lest pus form and burrow deeply beneath the mamma. The safe closure of the cavity is much facilitated by combining elastic pressure with drainage, and for this purpose an absorbent wool dressing will be found of great use.

When the breast cannot be saved, the operation is similar to that for removal of the mamma for cancer, but there is no necessity to remove any skin save that which is actually adherent to the growth.

Fibroma of the Breast.—Pure fibroma of the breast is very rare. It can only be distinguished from the adeno-fibroma by microscopic examination after removal.

Lipoma.—Fatty tumours occur in the immediate neighbourhood of the mamma, and may simulate disease of the breast. Their real seat of origin is the subcutaneous tissue over the gland.

Sarcomata of the Breast. — Various forms of sarcoma are met with in the breast, or its immediate neighbourhood. They differ from the adeno-sarcomata just described in the total absence of any glandular element. Should cysts be present they are due to hæmorrhage or softening of the growth, and not to the presence of epithelium-lined spaces. The most common form of sarcoma met with is the spindle-celled variety, but myxo-sarcoma is not uncommon, and round-celled and giant-celled sarcomata have been occasionally observed.

Causes.—Nothing is known as to the causes of these growths. They are most common in women above thirty.

Symptoms.—In many cases it is quite impossible to distinguish between a soft adeno-sarcoma and a sarcoma, before the growth is removed and submitted to microscopic examination. In other cases the less defined outline, the rapid growth, the uniform semi-elastic or almost fluctuating feel, and the absence of lobulation may lead to a strong suspicion that the tumour is a sarcoma. The lymphatic glands are not affected. If not arrested by treatment these tumours sooner or later implicate the skin, ulceration takes place, a fungating growth protrudes, and death follows from exhaustion.

Pathological Anatomy.—The tumour is soft and pink, and yields a bloody or viscid fluid with shreds of the tumour on scraping. The outline of the tumour will usually be found less clearly defined than that of an adeno-sarcoma, though there is often a fibrous capsule round the growth, yet the tumour cannot be shelled out of it or dissected from the surrounding parts without considerable trouble.

Prognosis.—The prognosis of a pure sarcoma of the breast is always much more grave than that of an adeno-sarcoma. It is in this region that the curious tendency, shown especially by spindle-celled sarcoma, to return locally after removal without affecting internal organs or lymphatic glands, has been most frequently met with. In some fortunate cases the repeated removal of the local recurrences has at last cured the patient, but more commonly the disease soon gets beyond the reach of surgical interference. Recurrence in internal organs is also met with in some cases.

Treatment.—The complete removal of the growth is the only treatment. From the impossibility of accurately distinguishing a pure sarcoma from an adeno-sarcoma, an attempt is usually made in these cases to dissect out the growth. If it be found, on removal, to present the appearances of a pure sarcoma, the capsule surrounding it should be freely dissected away, and it would doubtless be safer, if the patient's consent had been previously obtained, to remove the whole gland. Should local recurrences take place, they may be removed as long as there is any possibility of doing so; and even after no further complete operation is possible, relief may be given by scraping away the fungating mass and freely cauterising its base.

Cancer of the Breast.—All forms of carcinoma are met with in the female breast. The typical variety, forming at least 99 per cent. of all cases, is glandular cancer, usually occurring as scirrhus, rarely as encephaloid, and still more rarely as colloid. Columnar epithelioma has been observed, springing from the ducts, and squamous epithelioma is occasionally met with at the nipple, belonging rather to the skin than to the mammary gland.

Hereditary tendency.—According to Gross an hereditary tendency to the disease existed in one case in 9·72. But Sir James Paget, from the experience of private practice, puts the proportion as high as 1 in 4.

Age.—Cancer of the breast is never met with before puberty. In 642 cases collected and analysed by Gross, 18 appeared between twenty and thirty years of age, 128 between thirty and forty, 245 between forty and fifty, 165 between fifty and sixty, 78 between sixty and seventy, and 8 between seventy and eighty. Thus by far the greater number occur at that period of life at which the reproductive function is ceasing, only 22·74 per cent. arising during the period of greatest activity. The diminution after fifty is not merely due to the fact that in each successive decade fewer women are alive. The proportion of women living between forty and fifty to those between sixty and seventy is about 25 to 16, whereas the proportion of cases of cancer arising in these decades may be roughly given as 25 to 8. The youngest authentic case of cancer of the breast is that recorded by Henry, of Breslau, occurring in a woman aged twenty-one.

The *cessation of menstruation* seems to exert no marked influence. About 61 per cent. of all cases occur before the menopause. In only 6·41 per cent. of cases was the menstrual function irregular.

Social Condition.—It is difficult to say whether the disease is relatively more frequent in married or single women. According to Gross in 88·82 per cent. the patients were, or had been, married, and in 83·91 per cent. they had borne children, and 73·74 per cent. of these had suckled their infants. The disease arose during pregnancy or lactation in about 5 per cent.

The *previous general health* apparently exerts no influence. The great majority of patients enjoy excellent health at the time of the appearance of the disease, and in most cases for some months afterwards.

Local causes.—It is a popular notion that cancer very commonly arises as the result of a blow. According to Gross, 11·7 per cent. of the patients attributed the disease to an injury; but this history must always be regarded with some suspicion, as few women are willing to acknowledge that the tumour arose independently of an external cause. In eight per cent. of Gross's cases the disease attacked a gland which had previously been the seat of puerperal mastitis. Sir James Paget is also of the opinion that chronic indurations not infrequently become the starting-point of cancer after a longer or shorter period. Psoriasis, or eczema of the nipple (*see* Nipple, Diseases of the), is a precursor of cancer in not more than one per cent. of the cases.

Varieties of Cancer of the Breast.—For the purposes of clinical description, cancer of the breast may be thus divided:—A. Scirrhous or hard cancer. *a.* Nodular or circumscribed scirrhus; *b.* infiltrating or diffused scirrhus; *c*, atrophying or atrophic scirrhus; *d*, cancer '*en cuirasse.*' B. Encephaloid, or soft cancer. C. Colloid cancer. D. Cystic cancer. E. Duct or villous cancer. Of these forms, scirrhous, encephaloid, and colloid cancer are varieties of glandular carcinoma; that is to say, they are composed of cells of the type of glan

dular or spheroidal epithelium, filling the spaces of an alveolar fibrous stroma. In scirrhus the stroma is abundant, and consequently the tumour is dense and hard; in encephaloid the proportion of cells to stroma is such that the mass is comparatively soft; while in colloid the structure is modified by the colloid degeneration of the cells. Intermediate forms between scirrhus and encephaloid are not uncommonly met with, and, in cases of colloid cancer, parts of the tumour usually have escaped degeneration and present the appearance of ordinary cancer. Cystic cancer is very rare; it arises apparently from the softening and disintegration of the central parts of a soft cancer. Villous or duct cancer arises from the galactopherous ducts, and is characterised by the presence of columnar epithelium. It differs so much from the other forms as to require a separate description. It is difficult to state with accuracy the relative frequency of the various forms. Colloid, cystic, and villous cancer together would probably not form 1 per cent. of all cases. Of the remainder, about 85 per cent. would be ordinary scirrhus; 5 per cent. encephaloid; and the remainder atrophying scirrhus, cancer *en cuirasse*, &c.

Scirrhus.—*Symptoms.*—The *nodular* or *circumscribed* variety forms the type of cancer of the breast. The course of an ordinary cancer of the breast, unrelieved by treatment, may be divided into three stages. First, when the disease is limited to the gland; secondly, the stage of implication of the skin and the axillary lymphatic glands; and thirdly, the stage of ulceration and general infection.

First stage.—During the first stage the symptoms are entirely local. The patient may possibly lose flesh towards the end, but there is no constitutional condition characteristic of cancer. The chief symptom is the appearance of a hard lump in the breast, which slowly but steadily increases in size. In the majority of cases the tumour is discovered accidentally, as while washing, or the attention may be directed to it by a blow. Pain is not a marked symptom during the early periods of the disease, and may be entirely wanting till the second stage. Inspection of the breast shows nothing till towards the end of the first stage. Slight enlargement may then be perceptible; but as, in cancer, the new growth replaces the original structures, this is not so marked as in simple tumours of the same size. Retraction of the nipple is a common symptom towards the end of the first stage. The period at which it occurs depends considerably upon the situation of the tumour. If the cancer is in an outlying lobule, it occurs late or may be absent. If the disease is immediately under the nipple, retraction takes place early. By manipulation a hard nodule is recognised in the gland, most commonly situated either in the upper and outer segment or near the nipple. The nodule is single and tolerably clearly defined in outline, but a careful examination shows that it forms part of the gland itself. By the time the surgeon is called to see the case the tumour is seldom smaller than a filbert. It cannot be slipped about independently of the gland, and, if it be pushed away by the fingers of one hand while the nipple and areola are steadied by those of the other, the distinct connection of the tumour with the nipple by means of the ducts can be clearly recognised. The surface of the tumour is usually coarsely nodulated or irregular. Quite early in the disease, if the finger and thumb be placed about two inches apart so as to include the tumour between them, and the skin be then pinched up, a tendency to dimpling will be noticed over the nodule. In very exceptional cases there is a thin serous discharge from the nipple.

A combination of the above symptoms in a patient above thirty years of age justifies a further examination of the growth by incision. The duration of the first stage of cancer of the breast, according to Gross, averages 14·1 months.

Second stage.—As the tumour increases in size it gradually invades more and more of the gland, but, as it replaces the mammary tissue and contracts in its central parts while growing at its circumference, the actual increase in the bulk of the mamma is rarely very great. As the cancer approaches the surface, the skin becomes increasingly fixed over it, and finally infiltrated by it. When this has taken place the affected skin becomes smooth and leathery in consistence. It usually assumes a dusky red or brownish colour. If examined with a lens, small vessels are usually seen ramifying in it. The area of skin implicated varies in different cases, but it seldom reaches more than an inch in diameter before ulceration sets in. The tumour, although increased in size, retains its characteristic hardness, the central parts being the most dense. The retraction of the nipple becomes more marked. Pain is now almost a constant symptom, scarcely 10 per cent. escaping. It is acute, lancinating or burning, often severe at night, disturbing rest,

and thus causing impairment of the general health. Sometimes it radiates for some distance from the breast, often to the shoulder. It is usually increased by handling the diseased breast, but there is rarely acute tenderness.

Enlargement of the axillary glands commences to be perceptible on an average about the fifteenth month. The frequency with which recurrence in the glands takes place after excision of the breast in the first stage of the disease is, however, clear proof that the actual infection takes place at a much earlier period, and that the absence of enlargement perceptible to the finger is no proof that the glands are sound. The glands first affected are usually those at the lower and anterior part of the axilla. In feeling for them the arm must not be raised, as, by so doing, the axillary fascia is put on the stretch, and thorough examination of the armpit becomes impossible. The general health suffers but little during this stage of the disease. Loss of flesh is almost a constant symptom, but in other respects there is little change.

Third stage.—The average period at which ulceration sets in is 20·2 months. It may commence in two ways. In the great majority of cases a small fissure forms in the affected skin, from which a sanious discharge escapes. This dries and forms a scab. After a time the scab falls off, and leaves an ulcer exposed. The edges of the ulcer are hard and raised, the surface is pinkish in colour, sometimes irregular, but more often smooth, and without granulations. In other cases it may be covered with a yellowish slough. The ulcer may remain superficial, or may extend into the tumour, forming a deep, foul cavity. The discharge is peculiarly offensive, the smell being that always met with whenever epithelial structures are decomposing. The pain is usually constant and severe.

In exceptional cases the ulceration is preceded by softening of a portion of the growth beneath the affected skin; this subsequently gives way, and a deep cavity is formed from the beginning. Hæmorrhage from the ulcerated surface is not uncommon, and is occasionally the immediate cause of death. By the time ulceration sets in, or soon after, the tumour frequently becomes adherent to, or implicates, the pectoralis major. This is recognised by its becoming fixed when the muscle is thrown into forced contraction. The glandular enlargement, which commenced during the second stage, extends during the third. The enlarged glands are more clearly felt, and often cause fulness beneath the clavicle. The supraclavicular glands, and even those behind the sterno-mastoid, may become affected. The pressure of the glands on the axillary vein at this time often causes great swelling of the arm, and severe neuralgic pain shooting down the limb may arise from pressure on the cords of the brachial plexus.

Should the patient not perish from the effects of the local disease and that of the axillary glands, infection of distant organs now takes place. This occurs in about half of those who are allowed to die unrelieved by operation. The organ most commonly affected is the liver. The enlargement of the liver may be ascertained by percussion, and the secondary tumours felt on the surface, below the costal margin. Jaundice, more or less marked, is a common symptom, but there is seldom much pain. The lungs are affected with half the frequency of the liver. The pleura, on the side corresponding to the diseased breast, is implicated more frequently than the lung, effusion often taking place, which is occasionally the immediate cause of death. Next in order to these organs, but far behind them, come the bones. Spontaneous fracture of long bones, or disease of the vertebræ, with the rapid occurrence of angular curvature, are the most common manifestations of secondary growths in the bones. Secondary tumours may occur in any other part of the body, but are rare except in the situations just mentioned.

During the whole of the third stage the general health suffers severely. The patient emaciates, and loses strength and appetite, the complexion becomes sallow, and the appearance—commonly described as that of the cancerous cachexia—becomes marked.

Death takes place on an average 27·1 months from the first appearance of the disease. The immediate causes of death may be exhaustion from pain and discharge, chronic septicæmia from absorption of the decomposing discharge, hæmorrhage, or secondary visceral disease.

The foregoing may be taken as a summary of the typical symptoms of cancer of the breast, as observed in an ordinary circumscribed scirrhus. In describing the course of the other varieties of the disease, it will only be necessary to indicate the points in which they deviate from the type.

(*a*) *Infiltrating or Diffused Scirrhus.*—This is far less common than the nodular form. It may commence as several small nodules, which coalesce as the disease advances, thus forming a large, hard, ill-de-

fined tumour occupying the whole mamma. This diffused form of the disease grows more rapidly than the circumscribed, and causes considerable enlargement of the breast. The nipple is deeply depressed, as much by the projection of the growth round it as by retraction. The whole mass is hard, scarcely elastic, and lobulated on the surface. The skin may be extensively adherent from an early period. The pain is variable, rarely severe. Glandular affection occurs early. When ulceration takes place it extends deeply into the mass, forming a foul cavity of great size.

(*b*) *Atrophic, Atrophying, Withering, or Cicatricial Scirrhus.*—This form may occur at any age, but is more common in old than in young women. The tumour is of slow growth, and shows in an extraordinary degree the tendency to contraction, which is to a less extent met with in all forms of scirrhus. The affected breast is thus, in spite of the presence of the new growth, actually smaller than its fellow. The nipple is deeply retracted, and when the skin is implicated, the affected part may be drawn together like the scar of a burn. There is usually but little pain. The ultimate course of the disease is the same as in ordinary scirrhus, ending in implication of the lymphatics and infection of distant parts; but the average duration of life in cases not operated on is eighty-two months, patients having been known to survive fifteen, or even twenty, years.

(*c*) *Cancer 'en cuirasse.'*—This is a rare form of the disease. It commences in the mammary gland, usually as the ordinary nodular form, but more rarely as the atrophying. The peculiarity consists in the rapid extension in the skin as soon as the disease reaches the surface. This may take place by continuous extension, or numerous small flat tubercles may appear dotted round the central point at which the skin is implicated, and these gradually increase and coalesce. In one of these ways the whole skin of the front and side of the chest may be affected, from the clavicle to the level of the umbilicus. The skin becomes of leathery hardness and toughness, and of a dusky, brownish-red colour, and is tightly stretched over the parts beneath. Ulceration may occur in several points at the same time. This form of cancer is accompanied almost invariably by intense burning pain, and is usually speedily fatal.

Pathological Anatomy.—A typical scirrhus when removed is characterised by the hardness of its structure, the knife even creaking as it passes through it. The cut surface immediately becomes concave, in this respect differing from all other tumours. This is due to the degeneration of the cells and consequent shrinking of the central parts, while the contraction is limited by the density of the surrounding parts of the growth. The section is greyish-white in colour, and streaked by whitish or yellowish-white lines and dots, thus presenting the appearance of a section of an unripe pear. Its circumference is seen to be implicating the surrounding tissues, portions of undestroyed fat being frequently imbedded in the fully-formed cancer-tissue. On scraping or squeezing, it yields an abundant milky juice. In the infiltrating form the structure is more uniform, often lobulated, and of a white or pinkish-white colour. Its surface becomes less markedly concave when the breast is cut across, and it yields a more abundant milky juice. In the atrophic form the tumour is small, very dense, its surface becomes very markedly concave, and it yields but little juice on scraping.

The microscopic characters are fully described under cancer. *See* Carcinoma. It is sufficient to say here that the cells are arranged most commonly in lines or tubes in the denser forms, and in rounded spaces in the less dense varieties, especially in the infiltrating scirrhus, in which the structure is often spoken of as acinous. In the central part the cells are found to be undergoing fatty degeneration, and it is to this change that the shrinking is chiefly due.

Prognosis of Scirrhous Cancer.—The prognosis of scirrhous cancer is hopelessly bad, unless the patient be relieved by operation. The more active the growth, the more rapidly does secondary infection take place; thus, in ordinary nodular scirrhus, the average duration of life is only 27·1 months, while, in the shrinking or atrophic form it is as much as 82 months. Cancer '*en cuirasse*' is always very rapidly fatal. As a rule, the younger the subject the more active is the growth, and the shorter the duration of life; but this rule is not without exceptions. Pregnancy always adds greatly to the gravity of the case, for, as the mamma enlarges, the tumour increases with fearful rapidity. The effect of operation on prognosis will be discussed later on.

Encephaloid Cancer.—True soft cancer—that is to say, so soft as to justify the term brainlike—is very rare in the breast, as elsewhere. The so-called soft cancers of the breast are usually firm and elastic, lobulated, and of rapid growth; and every intermediate

form is met with between them and the less dense varieties of scirrhus. Soft cancer occurs at the same age, and under the same conditions, as scirrhus. It most commonly infiltrates the whole gland rapidly, but occasionally remains limited to one part. The tumour reaches a considerable size in a few months, causing, from an early period, an evident enlargement of the gland. Retraction of the nipple is an occasional symptom, and is often more apparent than real, being due rather to the projection of the implicated tissues round it. Dilated veins are commonly seen over the distended gland, and there may be some abnormal redness of the skin. Manipulation shows the mass to be tense and elastic; not unfrequently there is considerable œdema of the subcutaneous tissue. In exceptional cases the central parts of the tumour may be broken down by hæmorrhage, and there may thus be distinct fluctuation. The progress of the case is the same as that of scirrhus, but greatly exaggerated and accelerated. The glands are early affected, the skin becomes implicated, ulceration takes place, with the formation of a deep foul cavity, from which hæmorrhage is very prone to occur. The tumour soon forms deep attachments, and secondary growths appear in the viscera and elsewhere. The general health suffers early and severely.

Prognosis.—The average duration of life in soft cancer of the breast is under one year. Even after removal of the breast it is said to be only sixteen and a half months, death being due either to local recurrence or secondary growths in the viscera or elsewhere.

Pathological Anatomy.—The tumour on section is of a uniform white or pinkish-white colour, sometimes stained in parts brownish or reddish-brown from hæmorrhage. The growth is often markedly lobulated; its cut surface is convex or flat. It yields a very abundant milky juice on scraping. Microscopic section shows the characteristic alveolar stroma filled with cells of an epithelial type. These may be of great size, or may differ but little from those of scirrhus, the essential difference being in the relative proportion of stroma to cells rather than in those structures themselves. In rare cases the stroma is excessively vascular, and vascular processes project from the walls of the alveoli into the spaces. It is in cases of this kind that the structure may be extensively broken down by hæmorrhage.

Colloid Cancer in the breast is very rare. It is merely a modification of scirrhus, due to colloid degeneration of the epithelial cells contained in the alveoli. In its early stages it differs in no respect from ordinary scirrhus, but the degeneration of the cells seems to retard the growth of the tumour. Gross states that the average duration of life, in cases not operated on, is 144 months. As colloid degeneration tends to increase the bulk of the growth, the tumour does not show the tendency to retraction which forms the marked feature of ordinary scirrhus. The nipple is not drawn in; the tumour, as it grows, assumes considerable proportions, and when it implicates the skin it forms a projecting nodule, often of considerable size, before ulceration takes place. When ulceration commences, it proceeds slowly, the surface being sometimes covered with a crust or scab formed of the dried colloid matter. Infection of the lymphatic glands and internal organs follows in due course, and the secondary tumours may have the structure of ordinary scirrhus or assume the form of colloid cancer.

Pathological Anatomy.—The whole tumour has very rarely been found to have undergone colloid degeneration. More commonly the peripheral parts present the ordinary appearance of scirrhus. In the degenerated part the alveolar spaces are distended with colloid matter, so as to be clearly visible to the naked eye. We thus get an evident alveolar stroma, filled with a transparent gelatinous material of a delicate or yellowish-pink colour. *See* Carcinoma.

Prognosis.—The prognosis of colloid cancer is ultimately bad, but life is prolonged, in cases not operated on, for a longer period than in any of the other forms of disease.

Duct Cancer or Villous Cancer.—This rare form of cancer of the breast was first accurately described by Cornil and Ranvier. It resembles ordinary cancer in infecting neighbouring parts, lymphatic glands, and distant organs. To the naked eye it somewhat resembles soft cancer, and yields an abundant milky juice. On closer inspection, small cysts are seen, partly filled by dendritic filaments projecting into the cavity, the remaining space being occupied by a milky fluid. Sometimes the milky fluid is replaced by extravasated blood. Microscopic examination shows that the spaces are surrounded by a fibrous wall, from which the branching papillæ spring. These are very vascular, and covered with epithelium arranged in several layers. It is either cylindrical or cubical, with a tendency to assume the cylindrical form. The milky

juice contains the degenerated cells which have been cast off. From the resemblance of the epithelium to that lining the milk-ducts, it is highly probable that these spaces arise primarily from those structures, and hence the name 'duct cancer.' Billroth describes a growth apparently similar under the name of 'soft cysto-adenoma.' He says: 'If one looked at the specimen without knowing whence it came, one would think it might be from a polypus of the rectum or uterus.' When the growth is broken down by hæmorrhage, it closely resembles a soft sarcoma in appearance. The *clinical features* of the disease cannot yet be accurately defined. Some of the cases recorded have been taken for ordinary scirrhus, and some for sarcomata, before removal. The disease may be preceded by a bloody discharge from the nipple, as in duct-cysts. The prognosis is uncertain. Billroth's case occurred in a woman of twenty-four, and did not recur after removal. Other cases have run a malignant course, like that of ordinary cancer.

Treatment of Cancer of the Breast. No drug has as yet been discovered that exerts the slightest influence on the progress of cancer of the breast. The sole treatment which need be considered is the removal of the tumour, and this can only be effected by the knife or by caustics. Pressure, applied by means of various ingenious instruments, was at one time said to have caused the absorption of cancerous growths, but there is no trustworthy evidence that such a result has ever been obtained. Caustics have been extensively used by quacks and but little by surgeons. They are uncertain in their effect, it being impossible to be sure that the whole growth, and much less the whole gland, is removed. They are, moreover, extremely painful, and are quite inapplicable to cases in which the axillary glands are diseased. The removal of the disease by the knife is almost painless, is more speedy, and more certain, and no surgeon is justified in recommending the use of caustics as a substitute for it. It has been said that caustics are occasionally useful when the patient is either unfit to bear an anæsthetic, or too weak to stand a cutting operation. Such cases are equally unfit for caustics, and had better be let alone. The operation by the knife is therefore the only treatment we need consider.

Excision of the breast may be undertaken in all cases of cancer, while the disease is apparently limited to the mamma, unless contraindicated by diabetes, Bright's disease, extreme old age, or some other condition unfavourable to any surgical operation. Extreme fatness, although not alone a barrier to the operation, is an unfavourable condition, and, if combined with old age, is sufficient to render it inadvisable.

In the second stage of the disease, when the lymphatics and skin are affected, the operation may still be undertaken, if the diseased glands be limited to the axilla, and if the general health be good. The liver and other organs should always be carefully examined for secondary growths. In the third stage the mere fact of ulceration is of little importance. The question of operating must be determined by the general health, by the extent of the implication of the skin and lymphatic glands, and by the evidence of visceral infection.

The operation is contraindicated when both breasts are affected, when the glands above the clavicle are distinctly enlarged, when the glandular enlargement has caused œdema of the arm, when the deep adhesions of the tumour are such that there is reason to believe the chest-walls are implicated, and when the so-called cancerous cachexia is so manifest as to give rise to a suspicion of visceral implication.

The form of cancer also exerts some influence in determining the propriety of operating. The simple nodular scirrhus is always favourable for removal in its early stages; infiltrating scirrhus must be removed early, if at all, or it will most likely return locally; cancer '*en cuirasse*' is never suited for operation. Atrophying scirrhus and colloid cancer, being of slow growth, are favourable cases for operation. Encephaloid cancer, unless taken very early, may as well be let alone, as local recurrence is very prone to occur.

Should an operation be determined on, it is a universally received rule that the whole gland, including the nipple, should be removed. It is an equally well-recognised rule that, if the skin is implicated, the incisions must be carried very wide of the diseased part, and that, if the glands are enlarged, they must be removed at the same time as the breast. During the last few years many surgeons, amongst whom may be mentioned Küster, Banks, and Billroth, have strongly advocated the removal of the axillary glands in every case, whether any enlargement can be felt or not. The results of this practice have been such that there can be little doubt that it will before long become an established rule of surgery. Küster states that in one quarter of the cases treated in this way the patient has remained well three years after the operation,

which he considers a sufficient time to justify the belief that the cure was permanent.

Before commencing the operation the skin of the axilla should be shaved. The patient must be placed on a table of convenient height, and the arm must be raised and retained in that position, either by a bandage or by the hand of an assistant.

The incisions must necessarily be varied according to the situation of the tumour and the degree of implication of the skin. The operation is most commonly done by two curved incisions, including between them the whole of the skin covering the tumour. These incisions are so placed that the long diameter of the oval piece of skin included between them is parallel to the fibres of the pectoralis major. It will be found, however, that better drainage is obtained if they are so arranged that the long diameter is transverse, the angle of union of the two incisions being on the inner side near the sternum, and on the outer side at the lower part of the anterior fold of the axilla. If the oblique incision is adopted, the lower flap must be raised first, so that blood flowing from the upper may not inconvenience or obscure the view of the surgeon. In raising the flaps enough fat must be taken to ensure their vitality, and no more. It is advisable to remove the greater part of the fat about the gland with the breast. The dissection must be continued till the border of the gland is passed, and then carried more deeply till the fibres of the pectoralis major come into view. The other flap is then raised in the same way. Finally the whole breast is removed, the knife being carried along the fibres of the muscle so as to remove the fascia covering it with the breast. The whole operation should be done by clean dissection, with as little tearing as possible. Every bleeding vessel should be immediately seized when cut, by forci-pressure forceps, so as to diminish the loss of blood. The mass removed must then be carefully examined, and, if any lobule of the mamma has been left behind, it must be dissected out. If the tumour is adherent to the pectoralis major, it is better to remove the muscular tissue freely, either with the breast or afterwards.

Should it be intended to remove the glands, the axillary space must now be freely opened up. During this stage of the operation the arm must be held by an assistant, as the surgeon often requires to vary its position as the dissection is carried on. If the oblique incision has been adopted the axilla may be opened by carrying the knife upwards from the upper angle of the wound to the arm. If the transverse incision has been chosen, a cut must be made from near its outer end upwards to the arm, along the anterior border of the axilla. The glands should then be removed, with the fat of the axilla, by a process of careful dissection. It should be commenced at the anterior border and carried upwards, a blunt instrument being used as the axillary vein is approached. Any doubtful bands appearing to contain vessels should be tied with catgut ligatures before being divided. In this way the axillary vein is reached and exposed, and the upper part of the contents of the axilla freed. The dissection can then be carried downwards and backwards, care being taken to avoid the subscapular artery and vein, if possible. Unless a sharp look-out is kept for these vessels, they may be cut so close to the main trunks that a ligature can scarcely be applied, and it might thus become necessary to ligature the axillary artery. The intercosto-humeral nerve is divided, and usually the external mammary artery. A small gland, often found between the edges of the two pectoral muscles, should be sought for and removed. The thorough cleaning out of the axilla requires care and patience, but is not specially dangerous. The danger of entrance of air in an accidental wound of the axillary vein, or of a large branch entering it, must not be forgotten. *See* Air in Veins. The plan sometimes adopted of opening the axillary fascia and hooking out such glands as may be felt with the finger, is far less efficient than that just described. When it is adopted, more glands are usually left behind than are removed.

The after-treatment of the wound presents nothing peculiar. Drainage must be carefully provided for by the insertion of tubes. Button sutures must be used to bring the edges of the main wound together if there is much tension. Antiseptic treatment of some kind should be adopted whenever possible. The spray is perhaps the most efficient means of irrigation during the operation; but, if the surgeon prefers not to use it, the wound may be washed out with carbolic acid lotion (1 in 40), tr. iodi and water (f ʒij. to Oj.), bichloride of mercury (1 in 1,000), or chloride of zinc (20 gr. to f ʒj.) before the stitches are inserted. The dressing should also be antiseptic, but the form adopted must vary with the preference of the surgeon. Carbolic gauze is well adapted to most cases. Very good results are also obtained by permanent dressings of salicylic

wool or iodoform wool. *See* Antiseptic Surgery; Wounds.

Results.—The mortality from the operation is very small. When death does occur it is most commonly from pyæmia, septicæmia, or erysipelas. There are no dangers peculiar to the operation.

But few patients, however, are cured. It is generally recognised that life is lengthened, and that in many cases an easier death is substituted for that from ulceration and exhaustion. The statistics at present before the profession show that life is prolonged by the operation—in scirrhus by about twelve months, and in encephaloid by about eight months. These are, however, of little value. In order to draw any just conclusions, those cases which are operated on merely to give relief should be excluded. A separation should also be made between those in which the axilla is cleared out, and those in which the breast only is removed. There is no doubt that the more extensive operations performed at the present time give much better results, but the numbers recorded are not at present sufficient to draw any accurate conclusions from them.

When recurrence takes place, it may be in the scar, in the glands, or in distant parts. If the axillary glands have not been removed before, they may be taken away when the recurrence appears. If they have been removed and the recurrence is above the clavicle nothing can be done. Recurrences in the scar are best avoided by the freest possible removal of skin at the operation. Should they occur, great relief is often given by their removal, but any permanent cure is out of the question.

The *treatment of cancer not operated on* is very unsatisfactory. Antiseptics should be applied as soon as ulceration sets in, to correct the offensive odour. Among the best of these is an ointment composed of eucalyptus oil, ♏xx., iodoform gr. v., and vaseline ʒj. Carbolic acid is often too irritating; boracic-acid lint, terebene and oil, and washing with Condy's fluid are often useful. Conium poultices have been said to relieve the pain. Possibly cocaine might be of service. Sooner or later it is usually necessary to fall back on opium, given internally. It is most efficiently administered as hypodermic injections of morphia.

Diseases of the Male Breast.—The male breast is but little subject to disease. Mastitis neonatorum (see *Mastitis*) is equally common in the two sexes, and at puberty some swelling of the rudimentary gland is not uncommon. In adult life the breast is occasionally chronically inflamed, enlarged, and indurated. This is best treated by the application of belladonna. If this fails, tincture of iodine may be tried, and, as a last resource, if the tenderness and inconvenience are considerable, the whole gland may be excised.

Cancer of the Male Breast is occasionally met with. It appears almost invariably as scirrhus, and runs the same course and requires the same treatment as in the female.

Marcus Beck.

BREAST, Tumours of the, Diagnosis of. — In examining the breast for any disease the whole gland must be fully exposed. Neglect of this precaution is a common cause of errors of diagnosis. The patient should be in the recumbent position, so that the breast may be well supported by the ribs; in the erect position elasticity or fluctuation are readily overlooked. The diagnostic signs of the various growths differ so much in the early and late stages, that it is convenient to divide the tumours into (A) large, or those exceeding a large orange in size; (B) medium-sized or those between an orange and a walnut; and (C) small. Of course all tumours are originally small, and in this stage diagnosis is most difficult; but many never reach any great size, and others cause so little inconvenience that the patient allows them to attain a considerable bulk before consulting the surgeon. Unfortunately also, many are still allowed to increase to the medium or even large size by the pernicious practice of waiting till the nature of the growth becomes evident. If the surgeon is in any doubt, it is his duty to advise the patient to have the tumour examined by incision. When the nature of a malignant tumour becomes so clear that a mistake is impossible, it is usually too late to operate with any hope of permanent cure.

(A). Large Tumours of the Breast.

1. *The tumour arises in connection with lactation.*—Galactocele. Milk can be withdrawn by the aspirator. *See* Galactocele.

2. *The tumour does not arise as a consequence of lactation.*

(*a*) *It is of more than twelve months' growth, and the axillary glands are not enlarged.*—(*a*) Adeno-sarcoma, and (*β*) cysto-sarcoma.

a. Adeno-sarcoma—Does not implicate the mammary tissue; is smooth, elastic, lobulated, clearly defined in outline; not adherent to the skin, unless of great size; may fluctuate in parts and is painless. The

nipple is spread out, but not retracted or buried. It often arises by a sudden increase of growth in a very chronic tumour; it is most common between thirty and forty.

β. Cysto-sarcoma. — Closely resembles the adeno-sarcoma, but is more lobulated, and the fluctuating cysts are more distinct and numerous. It is of slower growth, and occurs most commonly between thirty and fifty.

(*b*) *The tumour is of about twelve months' growth, and the glands are not enlarged.*—Sarcoma.

Sarcoma.—Does not usually infiltrate the gland; is clearly defined, but less so than adeno-sarcoma or cysto-sarcoma; is elastic or semi-fluctuating, smooth or coarsely lobulated on the surface. It is of rapid growth and painless. The nipple is not retracted or buried. The skin is not implicated till late. It is most common between thirty and forty.

(*c*) *The tumour is of less than twelve months' growth, and the axillary glands are enlarged.*—Encephaloid cancer.

Encephaloid cancer infiltrates the gland. It has an ill-defined outline; its surface is lobulated; its consistence varies from semi-cartilaginous, elastic hardness to almost fluctuating softness; the skin covering it is early fixed to it and often œdematous, sometimes red; it is of very rapid growth and usually painful; the nipple is early buried by the swelling rather than retracted; the growth is adherent to the deep parts. It is most common between forty and fifty, but may occur at any age after thirty.

Dilated veins over the surface of the breast occur in all large tumours, and are of no diagnostic value. Ulceration may occur in all, but it takes place soonest in encephaloid cancer. The formation of a vascular, prominent, fungous mass is evidence of the sarcomatous nature of the growth. Cancer sloughs rather than fungates, forming a deep, foul excavation.

(B). Medium-sized Tumours.

1. *The tumour does not implicate the mammary tissue, and can be moved without dragging on the nipple.*—(*a*) Adeno-fibroma, (*b*) adeno-sarcoma, (*c*) cysto-sarcoma, (*d*) fibroma, (*e*) sarcoma.

(*a*) *Adeno-fibroma.*—It is of slow growth, rounded or slightly lobulated, dense and hard, inelastic; may be painless, but is often painful. It is most common under thirty.

(*b*) *Adeno-sarcoma* closely resembles an adeno-fibroma, but is of more rapid growth, perhaps following a long period of slow growth and being less dense. It is more common between thirty and forty.

(*c*) *Cysto-sarcoma* cannot be distinguished from an adeno-sarcoma at this stage, unless the cysts cause very distinct lobulation and can be recognised by fluctuation.

(*d*) *Fibroma.*—A pure fibroma cannot be distinguished from an adeno-fibroma.

(*e*) *Sarcoma.*—A sarcoma is less clearly defined than the foregoing tumours; it is softer, sometimes elastic or semi-fluctuating, seldom lobulated, painless, and of rapid growth. It occurs commonly between thirty and forty.

At this stage none of the foregoing tumours form deep adhesions, they do not cause enlargement of the glands, and produce no deformity of the nipple. They are not adherent to the skin.

2. *The tumour implicates the mammary tissue, so that the nipple is dragged on when the growth is moved away from it, and connection by means of the ducts can be felt.*—(*a*) Cysts; (*b*) Cancer.

(*a*) *Cysts.*—These are painless, of slow growth, fluctuating or elastic, or sometimes so tense as to be of almost stony hardness. They are smooth on the surface or coarsely lobulated. The skin does not dimple over them, nor is there œdema. If one part can be felt to be softer or more elastic than the rest it is the centre. They are most common between thirty and forty.

The chief kinds of cysts are—*α. Glandular or duct cysts* are often multiple; their contents can sometimes be emptied from the nipple by pressure, or there may be a history of a bloody discharge at some time.

β. Serous cysts cannot be emptied by pressure, and are usually single.

γ. Hydatid cysts cannot be recognised without puncture.

If there is any suspicion that the tumour is cystic it should be punctured with a fine trocar. If the contents are brown and bloody, it is, probably, a glandular or duct cyst; if clear and rich in albumen, it is, probably, a serous cyst; if clear and nearly free from albumen, a hydatid cyst. The fluid must then be searched for hooklets. Hydatid cysts are very rare.

(*b*) *Cancer.*—Cancer, in this stage, is adherent to the skin, as shown by dimpling when the integuments are pinched up, or may be actually implicating the skin, or even ulcerating. It is very painful, the pain being lancinating and burning. It is but slightly tender. It is of rapid growth. The nipple is very frequently retracted. The tumour may be fixed to the deep parts and the axillary glands are enlarged.

The different forms of cancer are thus distinguished.

α. *Scirrhus* is very hard, the centre being the hardest part; its outline is tolerably clearly defined, but not sharply circumscribed; its surface is usually nodulated; it very rarely forms a medium-sized tumour without implicating the skin and glands. The nipple is almost invariably deeply retracted, especially if the tumour be near the centre of the gland. The duration of the growth is usually about a year before this size is reached. It is very painful.

β. *Soft cancer* is elastic, very ill-defined; its surface is smooth or lobulated; it is often less painful than scirrhus; the nipple is less frequently retracted. It may reach a medium size without actually implicating the skin, but there is dimpling over it if the integuments are pinched up. The axillary glands are early implicated. It rarely lasts six months without reaching a medium size.

γ. *Colloid cancer* is almost painless, and of much slower growth. It is lobulated and elastic, the outer parts being sometimes harder than the centre. It causes the same dimpling of the integuments when pinched up, and, when implicating the skin, may form a considerable projection without ulcerating. The nipple is rarely retracted; the lymphatic glands are enlarged. It may take two years or more to reach a medium size.

In medium-sized tumours, if there is any doubt as to the nature of the growth, an incision must be made into it, but this is less frequently required than in small growths.

(C). Small Tumours.—In addition to all the tumours before mentioned, which must at some time be small, there are three which never pass beyond this, the small size: chronic induration from mastitis, chronic encysted abscess, and atrophic scirrhus. The diagnosis of the small tumours is conducted on the same principles as that of the medium-sized.

1. *The tumour does not implicate the mammary tissue. Adeno-fibroma, adeno-sarcoma, cysto-sarcoma, fibroma, and sarcoma.*—These cannot be distinguished from each other in this stage, unless the points already mentioned can be made out.

2. *The tumour implicates the mammary tissue.* (*a*) Cyst. (*b*) Chronic inflammatory induration of a lobule. (*c*) Chronic encysted abscess. (*d*) Cancer.

(*a*) *Cysts* present the same features as when they are larger, but the difficulty in recognising them is far greater.

(*b*) *Chronic induration of a lobule.*—The indurated lobule is ill-defined, of leathery hardness, often nodulated from the pressure of small retention-cysts; the integuments do not dimple over it when pinched up, except when the lobule is very near the surface, in a thin subject. The skin is never implicated, nor is the nipple retracted. The tumour is of very slow growth and after a time becomes stationary. It is sometimes painful and often tender, especially at the menstrual period. There is no enlargement of the axillary glands. It occurs most commonly in women who have borne children, but may be met with in others. It may occur at any age, but becomes less common after forty-five. Several such lobules may be found in the same breast, and both sides may be affected.

(*c*) *Chronic Encysted Abscess* closely resembles the indurated lobule just described, but it arises almost invariably after lactation or after a miscarriage, and there is usually some slight œdema of the skin over it. Dimpling of the integuments on pinching them up is common. The induration is usually leathery, but if the contents of the cavity are at some degree of tension it may be of stony hardness.

(*d*) *Cancer*, when very small, is recognised by the very early dimpling and the stony hardness. It may occur at any age over thirty. There is usually no actual implication of the skin, no retraction of the nipple, no enlargement of the glands, no deep fixity of the tumour, and most frequently no pain—in fact, few of the signs which are certainly diagnostic of cancer. Should any of them be present with a small tumour their importance is greatly increased.

The early stages of a soft cancer or a diffused scirrhus are still more difficult to recognise, as they so closely resemble inflammatory induration. Primary cancerous tumours are almost invariably single. Atrophic scirrhus is usually easily recognised by the slow progress of the disease, the great retraction of the nipple, the scar-like shrinking of the affected skin, and the stony hardness of the growth.

The diagnosis of small tumours is thus very uncertain, and yet if the disease is malignant the only hope of cure lies in early recognition of its nature. In these cases, therefore, an exploratory incision should always be made. If the tumour is one of the simple growths, its smooth surface will be seen as soon as the capsule is opened and the mass can be turned out without difficulty. If it is a sarcoma its soft structure and less perfect outline will be recognised. If it is a cyst or an abscess the

contents escape; and if it is an indurated lobule, its leathery toughness and perhaps the small retention-cysts will be recognised. If it is a scirrhus, the creaking of the knife as it enters it, and the sensation like cutting an unripe pear, and its sharp hard edge, not separable from the surrounding tissues, clearly show its nature.

If the case is a very doubtful one a freezing microtome and a microscope should be at hand, and a section should be mounted from a small slice taken from the growth. In this way all doubts are set at rest. 'Waiting till symptoms develop' in the case of cancer means waiting till all hope of cure is gone.

The difficulties of diagnosis are so great that it is a good rule, even if the cancerous nature of the growth seems almost certain, to cut into it before removing the whole breast. Many accidents might have been prevented by adopting this simple precaution. *See* BREAST, Diseases of the.

MARCUS BECK.

BROAD LIGAMENTS, Diseases of the.—The broad ligaments may be the seat of inflammatory deposits (cellulitis), of abscess, of hæmatocele, of solid neoplasms, and of a variety of cystic tumours. The inflammatory deposits, abscesses, and hæmatoceles will be dealt with in the special articles—PELVIC ABSCESS; PELVIC CELLULITIS; PELVIC HÆMATOCELE.

THE SOLID TUMOURS are very rare, and are so closely incorporated with either uterus or ovary that they are usually confounded with growths of those organs. It is, however, quite certain that fibroma, fibro-myoma, sarcoma, myxoma, and lymphadenoid tumours may grow in the broad ligament, independently of both uterus and ovary. The myxomatous and lymphadenoid growths may attain an enormous size and closely simulate like tumours of the uterus. Their causes, symptoms, diagnosis, and treatment cannot be at present separated from those of the latter growths, except that it may be possible to enucleate them without removing either the uterus or ovary.

CYSTS.—These are very important, not only from their growth frequently demanding surgical interference, but also from their great pathological interest.

Causes.—These are as obscure as are those which produce ovarian cysts. The great majority, if not all, probably receive their first impetus from the congestions and inflammations to which the ligaments are exposed.

Pathology.—There are several varieties of broad ligament cysts.

1. *Cysts arising from distension of pre-existing structures.*—The hydatid of Morgagni, found as a small, clear cyst depending from one of the fimbriæ of the Fallopian tube, arises from the remains of Müller's duct. A similar small cyst, which may be either sessile or pediculate, is frequently found at the outer end of the horizontal tubule of the parovarium. Small cysts also grow frequently from the vertical tubules of the parovarium, and these, with the sessile variety from the horizontal tube, may attain considerable size and require surgical treatment.

2. *Cysts arising in the cellular tissue, possibly due to blocking and distension of lymphatics, but not arising in definite pre-existing structures.*—These are the simple serous cysts of the broad ligament, and are identical with the sub-peritoneal cysts in other situations, often spoken of as 'inflammatory cysts of the peritoneum.' They may be unilocular, multilocular, or multiple. The unilocular may be so from its earliest growth, or may become so from coalescence of multilocular or multiple cysts. The latter may be found side by side, but quite independent, so that each is really a unilocular cyst. The part of the broad ligament between the ovary and uterus is liable to a general cystic degeneration, apparently the result of œdema; it is not a condition of much practical importance, except in so far as it sometimes interferes with the application of the ligatures in the removal of ovarian or uterine tumours.

3. *Papilloma-bearing cysts.*—These are of great importance, because the possibility of the presence of such growth in any broad ligament cyst governs the whole surgical treatment of these cysts. Doran has recently thrown much light upon the origin of these cysts, and has shown that they commonly arise from the vertical tubules of the parovarium, and especially where these tubules penetrate deeply into the hilum of the ovary. It is still, however, an undecided question whether papilloma is only found in cysts with this origin, or whether it may arise from the lining membrane of any cyst. And it is equally uncertain why one kind of papilloma-bearing cyst produces an innocent warty growth, which, though it may spread and infect other surfaces, often dies away entirely after a successful removal of its parent cyst, and another form is distinctly malignant. The hard, white, warty papilloma is commonly found in these parovarian and hilum cysts from their earliest growth; but the more fleshy pink papilloma appears in flat patches

on the lining membrane of cysts which have been allowed to remain undisturbed for long periods, or have been repeatedly tapped. Possibly in this difference as to the time of their first appearance may ultimately be found the reason of their clear clinical divergence.

The cysts which arise at the terminal ends of ducts, and the simple serous cysts have a simple lining of flat endothelium, and their fluid contents vary in colour from pale straw to orange and dark coffee colour, the latter being due to the admixture of blood. The ordinary parovarian cysts, and those which contain the warty papilloma, have a clear limpid fluid like water.

Diagnosis and Treatment.—An imperfect knowledge of these broad ligament cysts has led to two considerable errors as to their diagnosis and treatment. The first of these is the common one of speaking of the whole class as parovarian cysts, whereas the simple serous cysts are commoner than the true parovarian; the second is the commonly received opinion that they all may be cured by simple tapping. There are probably two causes for this second error: first, the fact that any of these cysts may fill very slowly after tapping, and, in the long interval, pass altogether out of the knowledge of the surgeon who performed the operation; and, secondly, that simple serous cysts are occasionally cured by a single tapping.

The only points which aid the diagnosis of these cysts from those of the ovary are their slow growth and occasional flaccidity, or this latter condition alternating with a more tense one. As it is impossible to be absolutely certain whether any given cyst is a simple serous one, or contains the infecting papilloma, they should never be tapped either for diagnostic purposes by examination of the fluid, or with a view to possible cure. They are generally free from adhesions, and can be removed with but little risk. Occasionally a broad base may necessitate a difficult enucleation, but these cases also do remarkably well, if care be taken to check all hæmorrhage, and the sides of the capsule be allowed simply to fall together at the bottom of the pelvis—i.e. if the operation be thoroughly aseptic; if it be not so, a glass drainage-tube should be left in the capsule for the first day or two, as there is often a good deal of serum effused from its torn cellular tissue.

It is sometimes possible to remove the cyst and leave the ovary and tube; but this is rarely advisable, as both are apt to be altered by the stretching during the growth of the cyst, and are liable to become diseased. The preparation of the patient, the arrangements for the operation, the instruments required, and the treatment after operation, are in nowise different from those for Ovariotomy, and will be found described in detail in the article on that operation. J. Knowsley Thornton.

BROMIDROSIS.—*Syn.*: Osmidrosis; stinking sweat.—A functional disturbance of the sweat-glands, causing the sweat to be so altered in character as to give rise to an abnormal odour. It is sometimes accompanied by hyperidrosis.

Symptoms.—The condition may involve the whole of the surface, or be of a local character. When universal, the individual emits with perspiration an odour which may be like that of a goat, or like that of onions or assafœtida, or it may be simply disgusting and indescribable. Sometimes a rather pleasant odour is noticed, like that of violets.

Bromidrosis is frequently the accompaniment of systemic diseases—smallpox, typhus, rheumatism, pyæmia.

The local varieties of bromidrosis are met with chiefly in the parts which sweat freely—the axillæ, groins, perineum, genitals, soles of the feet; here it is probable that decomposition of the sweat and sebaceous secretion is mainly instrumental in producing the result. The confinement of the sweat by waterproof clothing, dress-preservers, &c., tends to make matters worse. Bromidrosis of the feet is that form which most often calls for treatment. When associated with hyperidrosis, the treatment by Hebra's ung. diachyli, described under Hyperidrosis, may be adopted.

A mode of treatment has been suggested by Thin which seems to be very efficacious. It consists in soaking the stockings or socks every night in a saturated solution of boracic acid. Cork soles should be worn in the boots, and treated in a similar manner.

A solution of chloral to bathe the feet, 10 to 40 grains to the ounce, is also recommended. Alfred Sangster.

BROMINE. *See* Caustics.

BRONCHOCELE. *See* Thyroid Gland, Diseases of the.

BRONCHOTOMY. *See* Tracheotomy.

BRUISES or CONTUSIONS.—These result from injury to the tissues caused by blows or squeezes. Structures may thus be so damaged as entirely to lose their vitality, so that sloughing or gangrene re-

sults. It much more commonly happens that the injury is of a less severe nature, being confined to the rupture of some small superficial vessels, leading to an extravasation of blood. The slighter cases are only here considered, the severer ones being found under the heading of gangrene. The blood oozing out from the ruptured vessels finds its way into the interstices of the connective tissue, both of the skin and subcutaneous fascia. In addition to the blood there is considerable effusion of serum stained with the colouring-matter of the corpuscles. Soon after the receipt of the injury the part becomes swollen, and assumes a semi-transparent, pinkish appearance.

Occasionally, after a while, large bullæ are formed beneath the cuticle, containing blood-stained fluid. As the serum is re-absorbed the swelling decreases, but the colour of the part becomes darker, passing, in the course of a few days, from a dull red to a dark brown or chocolate, and then, slowly fading away, it assumes a greenish-yellow colour. The extravasation of blood generally ceases to extend after a few minutes; sometimes, however, the effusion slowly continues for some hours, extending over an area considerably larger than the part actually injured. The bruised part may inflame, giving rise to suppuration; but this is rarely the case, unless the skin has been broken, thus making a compound contusion.

In some instances, instead of the blood forming an infiltration into the connective tissue, it forms a circumscribed collection beneath the skin. This is known as a hæmatoma. The contained blood does not coagulate, so that a soft fluctuating swelling results. The tendency to the formation of bruises or blood-extravasations varies widely in different individuals, and the extent of the discoloration is no certain indication of the amount of violence employed. Some persons with thin, delicate skins, or with a tendency to the hæmorrhagic diathesis, will have their tissues bruised and discoloured from the most trifling injuries, a fact which should be borne in mind in certain medico-legal enquiries.

Treatment.—This should be of the simplest kind. To suppose that the effects of a contusion can be at once removed by the application of stimulating or any other lotion is absurd, for time is required for nature to absorb the extravasated blood and repair the injured tissue. Irritating lotions, and either very hot or cold applications are especially injurious, for it must be remembered that the vitality of the skin is already lowered, and it will be liable to slough, or become gangrenous if subjected to irritation. Just at first, whilst there is a tendency for the swelling and extravasation to increase, cold fomentation or spirit lotion may be advantageously employed; afterwards, the part should be kept warm and protected from pressure. With this object it may be lightly covered with cotton wool, and kept in position with a flannel bandage. Should blebs form, they may be pricked, and a piece of oiled lint applied beneath the cotton wool.

Arnica lotion has enjoyed some reputation in removing the discoloration; possibly, by stimulating the blood-supply, it may occasionally have this effect, but it generally does more harm than good, often producing excoriations and eczema.

Should the damaged skin slough, a light poultice may be applied, to protect the injured part and hasten its separation. If the extravasation should take the form of hæmatoma, this may be treated by moderate pressure applied with a bandage. Under this treatment, the collected blood frequently becomes reabsorbed. Should it not do so after some weeks, the swelling, with antiseptic precautions, may be aspirated.

HARRISON CRIPPS.

BRUSH-BURN.—This name has been given to a peculiar and complex injury caused by rapid and forcible friction of the surface of the body. It may be produced either by some rapidly revolving body, as a strap connected with machinery, coming in contact with the skin, or by the surfaces of the trunk and limbs gliding with much velocity down a long descent, such as an Alpine snow-slope. The skin is abraded, much bruised, separated from the subjacent soft parts, and sometimes actually burnt by the action of the heat developed by the friction. The subcutaneous connective tissue and the fasciæ and muscles are often much contused. In consequence sometimes of the burning, but more frequently of the cutting-off of its blood-supply, the injured portion of skin becomes gangrenous and is converted into a slough. The injury when extensive is a very painful one and attended with much collapse.

The treatment should consist in applying anodyne fomentations over the contused skin and, if this undergo sloughing, in dressing the eschar frequently with some stimulating lotion or ointment. The granulating surface exposed on separation of the eschar is to be dealt with in the same way as any largo healthy ulcer. W. JOHNSON SMITH.

BRYANT'S SPLINT, for excision of the hip and fractures of the thigh, is a compound of two long splints, one for each lower limb, fixed together at the upper and lower ends—at the upper by an iron bar which arches across the chest, and at the lower by an iron rod which passes straight across below the foot-pieces. The foot-pieces slide in slots at the lower end of the splints, and to each is attached a cord passing over a pulley, by means of which it is directed along the outer side of the splint, where it is attached to an elastic accumulator. By means of a piece of wood with a hole at each end, similar to those used for tightening tent-ropes, which is placed on the cord, it is possible to put the accumulator on the stretch and so cause traction on the foot-piece, and the use of the double splint is thought to ensure perfect symmetry of the two limbs. BILTON POLLARD.

BUBO.—A bubo, in the original use of the word, was any glandular swelling occurring in the groin. The term has, however, been extended to include gland-swellings in other parts, and it has been restricted to those which are secondary to sores existing elsewhere. Conventionally, a further limitation is often made, and we employ the word to denote only gland-enlargements which are secondary to venereal sores. In popular use, and probably with nine-tenths of the profession, the word now has only the latter meaning, and it might avoid confusion if it were in the future so restricted. The classical 'buboes of the plague' will probably long retain their name, but it is rapidly becoming pedantic to call enlarged glands 'buboes,' unless we mean that they are due to venereal disease.

The character of the venereal bubo is determined by the nature of the sore itself. If the latter be inflamed and suppurating the bubo will probably partake of the same features; the glands will swell largely and the cellular tissue around them will be implicated. Thus the glands will be glued together, and an ill-circumscribed painful mass will result. Such buboes have a tendency to suppurate. The matter frequently forms first around the inflamed glands but not in them, and the latter may be laid bare by the destruction of the intervening tissue. In other cases, however, suppuration undoubtedly takes place in the glands themselves, which, one after the other, may soften and break down. Individuals differ very much as regards their liability to lymphatic implication, but with our modern improvements in the treatment of chancre and of syphilis we may now boast that suppurating buboes are very rarely seen. They occur for the most part when the primary sore has been neglected.

If the primary sore be indurated and not inflamed, then we must expect induration only of the affected glands. The hardening will probably implicate several of them, but it will not involve the intervening cellular tissue. The glands will remain isolated from each other, and will be probably scarcely at all painful. They may be rounded and very hard—the 'bullet bubo'—or elongated and only moderately firm—the 'amygdaloid bubo.' In the case of the infective chancre it is rare to have the glands inflame and suppurate, and this never occurs unless the sore has itself inflamed. It is said that when suppuration occurs in a bubo consequent on an infecting sore, the pus is not contagious, but it is obviously not possible that we should possess much knowledge on this point. The induration of the glands consequent on the infecting sore is often very prolonged, and lasts, in a minor degree, long after other symptoms of syphilis have disappeared. It has been suggested that in such cases the glands serve as reservoirs for the virus and take an important share in the production of relapses. Although this is mere conjecture, yet it may be fully admitted that it is a wise precaution to continue treatment until the gland-enlargements have quite disappeared. It must be remembered, however, that a certain degree of enlargement of the glands in the groin is the normal condition with some persons.

Occasionally, at long intervals—a year or even more—after the primary sore, glands which were at the time slightly enlarged, will take on fresh engorgement and suppurate. In these cases the buboes are in part of constitutional origin, and further mercurial treatment is generally required.

Although it is certain that the bubo in connection with an indurated chancre will occasionally suppurate, yet this is very exceptional. It occurs solely when the chancre is on the genitals and the bubo in the groin. In the case of erratic chancres, as on the lip from kissing, or on the finger from inoculation in midwifery practice, although the gland-enlargement may be very considerable, it very seldom, or perhaps never, ends in abscess. In the groin the glands are very superficially placed, and are especially liable to be bruised or irritated by external causes, and hence probably the increased risk of abscess there.

The *treatment* of the bullet bubo of the infective chancre resolves itself into the treatment of syphilis. Mercury must be freely given and cannot be begun too soon. The patient must be told to carry nothing in his trousers' pockets, and if the glands are more than usually large, he must not walk much. The treatment of the bubo which attends the non-infecting sore is a matter of much more difficulty. The main point is of course the treatment of the sore itself. This must be rendered healthy as soon as possible. Next, every possible cause of external irritation must be carefully avoided and rest enjoined. Since the tendency to suppuration is often a constitutional matter, the patient's health must be sustained by tonics and a liberal diet, or in critical cases by sea air. To the groin it may be well, so long as there is hope of repression, to use ice or evaporating lotions very freely, but in many cases warmth will be attended by better results. A hot poultice, by relieving pain and tension, will often favour the subsidence of inflammation, whilst if suppuration have occurred it will hasten its progress towards the surface. If, therefore, suppuration appear inevitable, it is better to poultice at once. The question will now arise as to the propriety of excising the affected glands. If they are large and isolated, or if they have been exposed by suppuration around them, it is certainly good practice to give an anæsthetic and to proceed systematically to their removal. If they are left they will often be very slow to subside and may give much trouble. Their enucleation, however, is by no means always an easy matter, and it is indeed seldom practicable to make the operation a complete one. It is always, however, well in opening a bubo to make the incision a free one and to scrape away as much of the gland implicated as possible. Sometimes the glands within the brim of the pelvis are also enlarged. In such cases sea air and the free use of tonics in combination with mercury are indicated.

As regards the precise position of the glands implicated, this is to be explained entirely by anatomical knowledge. It is to be remembered, however, that the lymphatics inosculate freely and are by no means always regular in their course. We must, therefore, allow for buboes which appear to deviate somewhat from rule. Thus a sore on the right side of the glans penis may produce a bubo in the left groin, or *vice versâ*, because the lymphatics often cross in the dorsum of the penis.

The term 'double bubo' is used when the gland-enlargement is on both sides. That of 'bubon d'emblée,' or primary bubo, is applied to cases in which a bubo appears without any chancre being discovered. A 'sympathetic' bubo is a misnomer for a gland-enlargement which is supposed not to be in direct connection with the peripheral cause, i.e. not due to absorption. As a matter of fact all true buboes are due to absorption of some kind. The terms acute, indolent, indurated, constitutional, &c., as applied to buboes, sufficiently explain themselves.

In certain constitutions it is quite possible for a bubo to arise from common non-specific balanitis. So also we occasionally have buboes in connection with gonorrhœa. In such cases the general rules of treatment will be the same as for those which occur in connection with non-indurated sores.

JONATHAN HUTCHINSON.

BUBON D'EMBLEE. — A term implying 'primary' or 'non-consecutive' bubo, was given formerly, by some French writers on syphilis, to a supposed form of suppurating bubo with inoculable secretion, arising quite independently of any primary venereal or syphilitic sore, and followed by manifestations of general syphilis. The existence of such a lesion as this is now almost universally denied, as it is opposed to the widely-accepted views that the syphilitic virus never penetrates an unbroken surface, and that the suppurating bubo with inoculable discharge is always associated with a non-infecting sore, and never in itself causes constitutional infection.

BUBONOCELE.—This term, now seldom used, has been applied to an oblique inguinal hernia whilst still retained within the inguinal canal.

BUCHANAN'S RECTANGULAR STAFF.—This staff, bent at right angles three inches from the point and deeply grooved along the short limb, was devised by Dr. Buchanan, of Glasgow, for use in his modification of median lithotomy. With this staff, it is held, the prostate may be reached by the knife more readily and rapidly, the membranous portion of the urethra need not be wounded, and there is less risk of injuring the rectum. The rectangular staff having been introduced, and its angle corresponding in position with the apex of the prostate being made to project into the perineum, a long and narrow knife with a straight blade is thrust along the groove in the short limb as far as the interior

of the bladder, the rectum being protected by the forefinger of the left hand. The wound in the prostate is enlarged in an outward and downward direction as the knife is withdrawn.

BULLÆ or BLEBS, are blister-like elevations of the epidermis, varying in size from a split pea to half a turkey's egg, and containing fluid. In recently formed blebs the fluid contained is usually serous and of a clear pale straw colour; later on it becomes turbid, and sometimes dark red from the admixture of blood, or thick and yellow from the formation of pus. The fluid is always albuminous and generally alkaline in its reaction. Good examples of blebs are met with in pemphigus, and they may be artificially produced by the application of powerful irritants, such as cantharides or boiling water, to the skin.

ROBERT LIVEING.

BUNION.—This term is applied to the enlarged and thickened bursa often met with over the inner side of the metatarso-phalangeal joint of the great toe, in consequence of the distortion which takes place there. By the constant wearing of narrow-pointed and short boots the toes, especially in women, are crumpled together, and the pressure on the inner side has the effect of dislocating outwards the two phalanges of the great toe. As these are driven outwards under or over the second or third toes, the head of the first metatarsal bone forms an increasing projection, and enlargement of the bursa naturally met with there takes place. *Pari passu*, the head of the metatarsal bone itself gradually enlarges, and presents small bony outgrowths similar to those met with in joints the site of osteo-arthritis; the cartilage is absorbed, and the underlying bone becomes eburnated and sclerosed, the internal lateral ligament being elongated, while the external lateral is much shortened.

The chief troubles resulting from bunion are, first, the recurrent attacks of inflammation of the bursa, which cripple the patient while they last. After a while suppuration takes place, and the bursa, discharging, is liable to leave an ulcer, the healing of which is most tedious, owing to the liability to irritation, and the feeble circulation often met with after middle life, the period at which bunion comes chiefly under the notice of the practitioner.

Inflamed bunion, and still more the ulcer resulting from one which has suppurated, is very liable to render the patient subject to recurrent attacks of cellulitis and erysipelas, or even to become the starting-point of senile gangrene in aged or broken-down patients. If the ulcer open into the joint one variety of 'perforating ulcer' will present itself, leading to disorganisation of the joint and caries of the bones which enter into it.

Treatment.—One of the first things for the practitioner to insist on, a step which will, of itself, give sufficient relief in the early stages, is the wearing of proper boots, with straight inside border, rounded toes, giving sufficient room and play for the foot. The patient may be instructed to draw the phalanges inwards by passing a piece of Leslie's strapping between the first and second toes, around the phalanges of the first, and then carrying it along the inner border of the foot and round the heel as far as the centre of the outer side, this strip being secured by some others passed transversely round the foot and a bandage. A pledget of cotton-wool or 'elephant plaster' should be worn between the first two toes. Dr. Sayre recommends the use of a glove of buckskin or linen; this is fitted over the phalanges, and a few inches of elastic webbing attached to it, this webbing being itself fastened to a piece of strapping which goes round the heel, and is kept *in situ* as explained above.

If the case is too advanced for such simple treatment, some mechanical contrivance must be made use of. This consists of a metal sole-plate, which carries a delicate steel spring, by which the everted phalanges are gradually drawn inwards. Crumpled or hammer toes may at the same time be straightened by bandaging them with tapes to the sole-plate through slots in it. More conveniently worn than the above is the bunion-spring, made by various instrument-makers. The above should be worn by night as well as day. Where the phalanges are found too set or stiff to yield to gradual mechanical replacement, the surgeon may follow one of two courses. Aided by an anæsthetic, and with strict antiseptic precautions, he may divide the shortened external lateral ligament and any tendons, such as the extensor longus, which require it, and then forcibly but steadily replace the phalanges. If this be done too quickly the contracted skin on the outer side will very likely give way. Another, and probably better course is to perform osteotomy of the first phalanx, and thus bring the line of the great toe straight. But, in most cases of disorganisation of the joint, amputation by the oval method will

be the wiser course, care being taken to secure ample flaps, and not to disturb the head of the metatarsal bone or the sesamoid bones, if sound.

The bunion itself will require various treatment, according to its stages and condition. When simple thickening of the bursa or effusion into it exist, counter-irritation by flying blisters, iodine, nitrate of silver (ʒj. to fʒj.), strapping with Scott's ointment or the oleate of mercury, may be tried. When the bursa is inflamed, lead lotion, conium, and bread poultices are indicated, together with the frequent and prolonged use of hot foot-baths, the treatment above given for the more chronic stage being later on resorted to. Where suppuration takes place an incision should be made early, otherwise the patient incurs the dangers of erysipelas, cellulitis, and troublesome burrowing. Furthermore, the ulceration which results from a suppurating bunion is, at this time of life, most tedious. Any undermined skin is to be snipped away, the cavity of the bursa laid freely open, and obliteration by granulations encouraged by absolute cleanliness and stimulating applications. With these objects in view, Ol. acidi carbolici (1 in 40), an ointment containing ʒj. of iodoform and eucalyptus oil to ʒj. of vaseline, and, later, more stimulating ones of Ung. resinæ and Tr. benzoini co., or Hyd. biniodi gr. x. to vaseline ʒj. (T. Smith), may be made use of. The weak circulation should be encouraged by warmth and elevation, and the healing promoted by occasional applications of weak nitrate of silver lotions to the granulations, which often become stationary for a while. Skin-grafting may, in some cases, be resorted to with benefit. In patients advanced in life small doses of opium will often be found beneficial, and in these cases warmth by means of cotton-wool, as little exposure as possible, and the raised position, are points of cardinal importance.

W. H. A. Jacobson.

BURNS.—Under this heading it is proposed to include all lesions that may be caused by the prolonged action of caloric on the surface of the body, and by the direct application to the living tissues of flame, steam, and intensely heated bodies, whether in a solid or fluid form. The injuries produced by the chemical action of caustics, and those known as lightning-strokes, will be dealt with in separate articles. *See* Lightning, Accidents from; Caustics.

The term *Scald* is popularly applied to such injuries from caloric as are caused by heated fluids or steam. Between such injuries, however, and those caused by flame or heated solid bodies, no distinction can be made with regard to the nature of the changes produced in the tissues, or to their results and treatment.

The causes of burns and the ways in which caloric is applied to the body so as to produce injury vary much at different periods and in different countries, according to the habits and pursuits of the working classes of each people. The most frequent causes in this country are: the action of flame, the contact—more or less prolonged—of intensely heated solid bodies and fluids, and of fused metals, explosions of gas, and the impact of steam. In the United States and some parts of Germany burns are caused, in many instances, by the ignited vapour of certain mineral oils.

The injuries produced by the action of flame and highly-heated solid bodies are usually deep and destructive, whilst, in severe cases of scalding by heated water or steam, the gravity of the injury depends generally rather on the extent of surface involved than on the depth of the disorganisation. Scalds, however, that are caused by thick, oily, gummy, and saccharine fluids which adhere to the surface of the skin, and by boiling saline solutions are, as a rule, very destructive. The injuries caused by steam in 'boiler explosions' are usually very serious, in consequence of the extent of surface that is attacked, and of scalding of the mucous membrane of the respiratory tract. Of the more frequent forms of injuries from caloric, the most dangerous are those produced by the flame of burning clothes and by ignited gas. Rapid and deep disorganisation is the usual result of the contact of red-hot and fused metals, and of phosphorus and sulphur in a state of ignition; but injuries of this kind are usually confined to a small extent of the surface of the body. The least severe of burns, with regard to both extent of surface and degree of disorganisation are those caused by the action of radiated heat.

Of the many classifications of burns that have been proposed, chiefly by French surgeons, since the beginning of the seventeenth century, the most approved, and clearly the most convenient, are those of Boyer and Dupuytren. The arrangement of Boyer, which has been adopted by most German surgeons, is strictly a pathological one. It divides burns into three degrees, according to the conditions of redness, vesication, and destruction of tissue, these conditions corresponding to the three processes of *hyper-*

æmia, inflammation, and *mortification*. In the frequently cited classification of Dupuytren, burns are arranged on a histological basis, in six degrees. The first of these is characterised by erythema or superficial phlogosis of the skin, and the second degree by cutaneous inflammation with elevation of the epidermis and development of vesicles filled by serous fluid; in the third degree, there is destruction of some portion, not the whole, of the thickness of the papillary body; in the fourth degree, disorganisation of the whole of the dermis down to the subcutaneous connective tissue; in the fifth degree, destruction of all the superficial parts, and more or less of the muscular layer; and, in the sixth and last degree, 'carbonization' of the whole thickness of a limb.

Burns will be classified here in three degrees: the first, of congestion; the second, of vesication; the third, of more or less disorganisation of soft parts.

The lesion of the first degree is one of simple scorching. The burnt surface presents an erythematous redness, which disappears readily on digital pressure. The intensity of this redness varies in different cases, and the borders of the rash are ill-defined. The skin is dry and slightly swollen, and the patient suffers from a diffused burning pain which, though sometimes severe, is never so intolerable as in the second and third degrees. In mild cases the redness and pain disappear in the course of a few hours, but in most instances requiring surgical treatment, the pain declines very gradually, the epidermis desquamates, and the surface of the skin remains discoloured for many days. Simple burns of the first degree are most commonly caused by radiated heat, by a very temporary application of the flame of conflagrated gas, or of some inflammable vapour, or by the contact of a solid body or of some fluid moderately heated. This is probably the only form of burn which may exist on the surface of the body unaccompanied by any of the characteristic lesions of one or more of the other degrees, whereas in some severe burns the main lesion, whether it be vesication, or eschar, or deeply reaching slough, is always surrounded by a zone of reddened and hyperæmic skin. In the majority of cases of burn of the first degree the prognosis is very favourable, the injury being a mild one, and needing scarcely any treatment save the application of cold. But following the law that the severity of a burn depends more on the extent than on the depth of soft parts involved, the simple hyperæmic form contributes a very dangerous lesion when spread over a considerable surface. It has been asserted that a burn of the first degree, when it involves two-thirds or more of the surface of the body, will inevitably prove fatal. According to Dupuytren, when the head is the seat of a burn of this, as of any other degree, the irritation may extend to the brain and cause insomnia, delirium, convulsions, and even fatal coma. In a person having a very delicate skin, exposure to the rays of a bright sun, whether transmitted directly or reflected from some extensive white or glistening surface, will often cause intense and painful scorching, which may result in a sharp attack of erysipelatous inflammation.

In a burn of the second degree, the skin is marked by one or, usually, several patches of erythema, each of which is studded with numerous bullæ containing clear and yellow serous fluid. These bullæ vary much in size in different cases and in different parts of an extensive burn. In some instances the vesicles are very small, whilst in the more severe cases an extremity—as the foot or hand—may be covered by one large blister. In this degree there is always pain, which at first is very severe, and, subsequently, as vesicles appear and enlarge, becomes dull and heavy. In the most favourable cases the heat and redness of the surface subside speedily, the vesicles burst and discharge their fluid, and, as the dry and shrivelled epidermis is thrown off, a smooth surface is left which, in the course of a few days, presents the usual appearance of sound skin. If, however, the vesicles be prematurely ruptured and the elevated epidermis be torn away, or if the patient be feeble, the burnt surface may become inflamed, and suppuration and also some superficial sloughing may result. But even in the most prolonged and severe cases, if the burn be one strictly of the second degree, the epidermis will almost always be restored and permanent scars will very rarely be observed. It is often very difficult, however, to determine whether a vesicating burn be a well-marked form of the second degree or a mild form of the third degree; for, as has been pointed out by Billroth, there are many grades between elevation of the horny layer of the epidermis and complete destruction of the cutis.

The characteristic lesions of the second degree are observed most frequently in scalds, and after a very transient application of heated metal. They are, in the primary stage of the burn, more painful than those of any other degree. When much of the

surface of the body is involved, especially the front of the chest and abdomen, they are very serious, and in cases of almost complete immersion of the body in some highly heated fluid, are speedily fatal.

In the mildest burns of the third degree, besides the epidermis, a portion also of the thickness of the cutis is destroyed. This degree is characterised by the presence of yellow, grey, or dark-brown sloughs, which in some instances are soft and moist, in others tough and desiccated. These patches are occasionally associated with vesicles containing a turbid and often blood-stained fluid. The disorganised portion of skin is surrounded by a broad zone of erythema, dotted over by small vesicles, such as are met with in the second degree. As was pointed out by Sir Robert Christison, in the more severe burns of this degree, caused during life, the patch of destroyed skin is surrounded by a narrow band of a deep red colour, due to extravasation of blood or very minute capillary injection, which narrow band is separated from the charred part by a stripe of dead-whiteness, and passes at its outer edge by insensible degrees into a diffused blush, involving a considerable extent of the surface around the centre of the burn. It has been proved by experiment that the application of heat to the body, even a few minutes only after death, fails to produce any sign of this reaction. In favourable cases of burn of the third degree the sloughs gradually separate from the living parts, and during or soon after the third week are usually thrown off, leaving the well-known yellowish-white or pale grey surface, thickly studded with bright red points. This surface, after the removal of all dead and foreign material, heals rapidly by the formation of a thin, smooth, and white scar. This scar, though it can never be effaced, is always freely movable over the subjacent parts, and in consequence of its tenuity, and the presence beneath it of healthy cutis, does not tend by retraction to cause any tension or distortion of the surrounding parts.

A more severe burn of the third degree consists in destruction of the epidermis, of the whole thickness of the cutis, and of more or less of the subcutaneous layer of connective tissue. As a rule, however, in burns causing destruction of skin, the surgeon at first is unable to determine the depth to which the disorganisation has been carried, and often finds it difficult to distinguish at first sight a burn of this kind from a severe one of the former kind, or from a relatively mild one of that in which muscle, in addition to skin and connective tissue, has been involved. Again, with regard to prognosis as to the risk of subsequent cicatricial deformity, it is possible that, in the progress of any case of severe burn, excessive inflammatory action and consequent sloughing may cause still deeper destruction of the soft parts, so that in its anatomical conditions a burn of merely the cutis may be converted into one of the whole skin and of subjacent cellular tissue. The importance of the distinction between burns of the third and of the fourth degrees, in Dupuytren's classification, consists mainly in the manner in which the latter heal and in the structure and properties of the resulting cicatrices. In every burn causing disorganisation of the whole cutis, and more or less of the subjacent connective tissue, the open surface heals partly by the formation of dense and very retractile cicatricial tissue, partly by stretching and centripetal displacement of the surrounding skin; and thus it is only in burns which are deep and extensive that the healing is likely to result in the well-known deformity. Great stress has been laid by some authors on much-reduced sensibility as a distinguishing characteristic of burns of the third degree, as compared with those of the two former degrees. The eschars formed by the disorganisation of skin are certainly quite painless, but usually the patient suffers very much at the time the injury is received, and again after the separation of the dead parts and on the exposure of very sensitive granulating surfaces. Besides, as has already been stated, in extensive burns the lesions of two or more degrees are almost always found side by side, the charred surface being surrounded by blisters and a broad zone of hyperæmic and tender skin.

The most frequent causes of burns of the third degree are the action of the flame of burning clothes, and the prolonged application of heated metals and other solid bodies.

In its most severe form the burn has extended below the skin and cellular tissue and involved the muscular and other deep-seated soft parts of the injured region. In these burns, which are much less frequent than those of the preceding forms, a hard, dry, inodorous eschar of a deep brown or a black colour is formed, which on separating exposes fasciæ, muscles, and sometimes large vessels and nerves. In cases of this kind the detachment of the eschar may be followed by profuse bleeding. The deep ulcer formed by the destruction of so great a thickness of the soft parts, heals very slowly and with prolonged and exhausting suppuration.

In considering the general disturbances which may result from the action of concentrated caloric on the surface of the body, it will be found convenient to follow the course of a severe burn through the three stages of *prostration*, *reaction*, and *suppuration*.

The first stage, that of prostration or congestion, lasts from eighteen to twenty-four hours. The most prominent symptom is pain, which varies in its intensity according to the extent of the burnt surface and the degree of the burn. In extensive injuries of the second degree, such as scalds caused by the action of boiling water or steam on a considerable surface of the body, the agony is very great, and, according to Dupuytren, may by itself cause death. The suffering in cases of this kind is often increased through careless removal of the patient's clothes, so that the vesicles are ruptured and the elevated epidermis torn away, leaving large patches of denuded cutis. The general condition, in the first stage of a severe burn, is one either of deep collapse or of extreme restlessness and excitement. The patient often complains of alternate fits of general heat and chilliness. Death often occurs in this stage from shock, the patient either sinking rapidly without the least sign of a rally, or yielding to gradually increasing prostration, after muttering delirium, slight convulsions, and perhaps vomiting, at last succumbs. In children the more common fatal symptoms are convulsions and coma. In the stage of prostration, particularly in cases of very extensive burns of the second or third degree, extreme and obstinate thirst is a frequent symptom. It was pointed out by Nélaton, that many of the subjects of extensive burns complain soon after the injury of a very urgent desire to micturate, although the bladder may be quite empty.

The duration of the second period, which begins with reaction, varies much according to the degree and extent of the burn. In mild injuries of the first and second degrees this period is brief, lasting only for two or three days, but in severe burns of the third degree it does not pass into the final stage until the sloughs have separated and suppuration has become established. Most authors consider two weeks as the average duration of the period of inflammatory reaction. During this period the pain caused by vesicating burns of the second degree gradually diminishes, whilst the subjects of more severe burns in which the cutis has been destroyed, suffer much just before and during the separation of the sloughs. The patient is usually feverish during the early part of this stage, but there is rarely persistent fever or a very high temperature, save when the burn is severe and complicated in its course with local irritation or visceral inflammation. In severe burns involving the surface of the chest, cough is a frequent symptom during this period, and indicates some thoracic complication, as congestion of the lungs, pleurisy, or broncho-pneumonia. The most frequent and troublesome symptoms are vomiting and diarrhœa. The former, when obstinate and associated with the presence of blood in the stools, is suggestive of ulceration of the duodenum. During separation of any large and deep sloughs there may be serious loss of blood, which, in most instances, is due rather to oozing from several small vessels than to free arterial hæmorrhage from one point.

The third period, that of suppuration and exhaustion, lasts from the separation of the sloughs to the healing of the exposed granulating surfaces. The principal symptoms of this period are those due to exhaustion from profuse discharge. The patient, if the burn be wide and deep, may suffer now from hectic fever and marasmus, and be attacked at any time by any of the general or local complications of a large, open and suppurating wound; such, for instance, as erysipelas, cellulitis, sloughing, and diphtheria of the granulating surface, pyæmia and septicæmia, and tetanus. The more special internal complications which may occur during the third period are asthenic inflammation of the lungs and duodenal ulceration. In children convulsions may occur at any time in the course of the suppurating stage of a large burn.

Although the prognosis is much influenced by the degree of a burn, the superficial extent of the lesion is a more important element than its depth. As has already been stated, a very extensive burn of the second, or even of the first degree, is much more serious than a deep burn involving but a small portion of skin. With regard to cicatricial deformity, the more severe burns of the third degree are to be regarded as serious, especially when they are situated on the face, the flexure surface of a limb, the front of the neck, or on the hand. Scalds of the face and mouth are of serious import, as indicating a very probable complication of œdema of the glottis. Burns of the scalp, even when slight, are always liable to be complicated with erysipelas, and extensive burns of the front of the chest very often give rise to inflammation of the

lungs or pleura. Burns are more fatal in young children and in old people than in adults, in consequence of the susceptibility to pain and nervous irritation in the former, and of the feeble resistance, in the latter, to the exhausting effects of suppuration during the third stage. Moreover, children are very liable to be attacked by acute inflammation of the lungs or encephalon, whilst old people are seriously affected by any relatively slight complication, by exposure to cold, or any sudden change in the weather.

Of the fatal cases of burn it may be roughly stated that fifty per cent. terminate during the period of shock, thirty per cent. during the period of reaction, and twenty per cent. during the period of suppuration.

There is much variety in the modes of death from burn. Early death, when the injury is severe, is usually due to shock, the patient presenting a general condition similar to that observed after a suddenly produced contusion or laceration of a limb, or a violent injury to the abdomen. In many cases of fatal burn the condition of collapse is doubtless rendered more intense by mental emotion and terror, and also by acute pain, although it may be questioned whether pain *per se* can, as Dupuytren suggested, be the cause of death. In patients who, after having rallied to some extent from the immediate effect of the injury, yet die during the first period, death is usually the result of a condition characterised pathologically by congestion and commencing inflammation of the brain and its membranes, of the lungs and air-passages, and of the abdominal viscera. Dupuytren, who was one of the first to investigate and explain the general conditions which cause death after a burn, showed by post-mortem examinations that in subjects who have perished very soon after a severe burn or scald, and before internal inflammation has had time to develop itself, the brain is much injected with blood and the mucous membranes of the bronchi and intestinal canal are much congested. Moreover, not only are these mucous membranes swollen and studded with large patches of congestion, but the intestines contain effused blood and the bronchi are obstructed by blood-stained mucous fluid. After death, at a later stage—between the third and ninth days—the autopsy usually reveals all the indications of well-marked gastro-enteritis and often of inflammatory changes in the lungs. Dupuytren's statements have since been confirmed by the more extensive pathological investigations of Mr. Erichsen and Mr. Holmes. These surgeons have shown that, after death from burn during the first period, the brain and its membranes are almost always found congested, and the thoracic viscera and the gastro-intestinal mucous membrane very frequently so. After death during the second period, indications of cerebral congestion are still occasionally to be found, but the most frequent and characteristic pathological appearances are those of inflammation, and inflammatory congestion of the lungs and pleuræ, and of more or less congestion of the intestinal tract, frequently associated with ulceration of the duodenum.

Mr. Erichsen, in his observations of fatal burns, found that the brain was affected in thirty-three out of thirty-seven cases, the thoracic viscera in thirty out of forty, and the abdominal viscera in thirty-one out of forty-two cases.

Several views have been proposed to account for this almost constant tendency to visceral congestion and inflammation in cases of severe burn. In 1863, M. Baraduc, a French surgeon, brought forward the purely physical theory that, in consequence of the effusion of serum at the seat of the burn, the blood becomes thickened and plastic, so that it can no longer circulate freely. To this view there are strong and apparent objections. Except in cases of very extensive scalding, very little serum is effused on the surface of the body, and, as is well known, the blood may be deprived of large quantities of fluid, as in rapidly renewed ascites after tapping, without any evident bad result. A viscid condition of the blood after fatal burn has recently been found by Tapperner, of Munich, but as, in each of the four cases which were observed, the injury was very severe, and as much as two-thirds of the surface of the body was involved, death was very probably due rather to shock than to any undetermined result of loss of blood-plasma.

It has been suggested by Billroth that the visceral complications found in the early stages of burn may be due to an accumulation in the blood of nitrogenous compounds, retained as a result of wide destruction of the skin and consequent diminution of the cutaneous respiration. The subject of an extensive burn is, it is thought, placed in a condition somewhat similar to that of an animal completely enveloped in some impermeable material, which, after a time, presents symptoms of intense and fatal blood-poisoning. Well-marked, and even fatal, visceral congestion, however, is frequently observed when but a small extent of surface has been burnt.

Again, in the most extensive burn compatible in the human subject with vitality, there is always much sound skin left, and in burns of the first, and probably in most of those of the second degree, the cutaneous expiration is accelerated rather than obstructed.

Ponfick holds that in severe burns capillary embolism of internal organs is caused through a profound alteration and destruction of the red blood-corpuscles, and it is thought that the congestion of the lungs and the pneumonia so frequently observed in such cases of injury may have some connection with this blood-change. According to Falk, however, the theory that visceral inflammation is due to destruction of red blood-corpuscles in the vessels of the burnt part is not supported by a sufficient number of positive facts. Hoppe-Seyler, on microscopical examination of the blood in cases of severe burn, found the destructive changes in the corpuscles far too slight to give rise to any general disturbance.

It seems very probable that the visceral congestion so invariably associated with severe burn, is caused in great measure, as was argued by Brown-Séquard, by reflex action of the spinal cord; and that the visceral inflammations so frequently observed during the later stages of the treatment are the results either of septic poisoning or, with old and much enfeebled subjects, of prolonged confinement to bed and increased susceptibility to external influences.

There can be but little doubt that ulceration of the duodenum is an occasional result of burn on the surface of the body. Mr. Curling, in 1842, directed attention to twelve instances of this association, and Mr. Holmes found it recorded in 16 out of 125 miscellaneous fatal cases of burn. Simple or non-traumatic ulceration of the duodenum occurs much more frequently in males than in females, and is very rarely observed in patients below the age of puberty. Krauss found, on analysing 42 collected cases of simple ulcer, that the proportion of affected males to females was as 10 to 1, and that 2 per cent. only of the patients were under the age of ten years, and 6 per cent. under the age of twenty. Of 25 cases of intestinal ulceration associated with burn, that have been collected by the writer of this article, in 17, at least, the patients were females. In 6 out of the 25 cases the patients were under the age of five, and in 15 under the age of ten, and in one case only was the age above thirty. In most of these cases the burn had been severe, and had involved a large extent, usually the front of the neck, chest, and abdomen, and one limb or more. In three of these cases death occurred in the first week of the burn, in eight cases in the second week, in six cases in the third week, in a single case in the fourth week, and in two cases in the fifth week. In one case that has been recorded by Mr. Erichsen decided symptoms of intestinal ulceration were observed on the second day after the burn, and death occurred on the sixth day.

The duodenal ulceration is usually situated in the first and ascending portion of this intestine, and near the pylorus. The lesion, which is found most frequently on the front wall of the intestine, consists in one or, as generally happens, two or more small circular ulcers, or one large oval patch of ulceration formed by the junction of two ulcers. The margins of the ulcer are sharply cut, and the ulcerated surface is, as a rule, deeper in the centre than at the periphery, the inner coats of the intestine being destroyed over a greater extent than the serous coat. In acute cases the ulceration has a tendency to involve the whole thickness of the intestinal wall, in some cases extending to the surface of some neighbouring organ, as the pancreas, liver, or gall-bladder; in others, opening freely and directly into the peritoneal cavity, and giving rise to perforative peritonitis. Occasionally the progressive ulceration erodes some large vessel.

Duodenal ulceration is very probably caused, not, as Mr. Curling has suggested, by inflammation and ulceration of one or more of Brünner's glands, but by the action of the acid gastric juice on a patch of mucous membrane in which the circulation of the alkaline blood has been arrested through embolism. In support of this view it has been pointed out that a duodenal ulcer, whether simple or traumatic, has very rarely been observed below the orifice of the common bile-duct.

The diagnosis of duodenal ulcer in cases of burn is very obscure. In some instances it is indicated by epigastric pain, vomiting of dark brown fluid and diarrhœa, with occasional discharge of blood in the stools. In some recorded cases of this lesion, however, all these symptoms were absent, and no indications were observed until after death. If a large vessel has been opened there will be profuse melæna and hæmatemesis, and in cases of perforation symptoms of localised or general peritonitis. Ulcer of the duodenum, though a serious complication, is not universally fatal, as some few instances have been put on record, in which cicatrices of old ulceration were found in

the intestine after death from some other or more indirect result of severe burn.

During the third period of a severe burn the patient is exposed to all the risks which attend profuse and exhausting suppuration. In young and feeble subjects the progress towards recovery may be interrupted from time to time by attacks of fever and prostration. The most fatal complication in this final period of suppuration is pleuro-pneumonia. Congestive affections of the abdominal and intracranial viscera are not so frequent in this as in the second period; but in a scrofulous child tubercular disease of the meninges or of the mesenteric glands may be developed during the slow healing of the burnt part. In the third period sudden death occasionally takes place from some obscure cause, which cannot be determined on careful post-mortem examination.

As casual causes of death in the course of the treatment of a severe burn may be mentioned: erysipelas, which is often met with in cases of burn of the scalp; cellulitis, which sometimes occurs in association with an extensive burn of the second degree in the second or third period; pyæmia, not, however, of frequent occurrence; and tetanus.

Treatment.—In the general treatment of a severe burn in its first stage, the main indications are to overcome shock, to relieve pain, to calm restlessness and agitation, and guard against coma. In dealing with intense collapse, the ordinary means for bringing about reaction should be applied. Blankets should be wrapped around the patient, hot-water bottles be placed at the feet and along the sides of the trunk, and brandy with hot water be frequently administered. The intense pain may be best relieved by a full dose of laudanum or liquor opii sedativus, or by a hypodermic injection of morphia. As reaction becomes established, it will be advisable to reduce gradually the supply of alcoholic stimulant, and to give frequently and in small quantities hot beef-tea or soup. If there be much thirst, the patient should take milk mixed with soda-water, weak lemon drink, or barley-water containing a small quantity of dilute sulphuric or phosphoric acid. During the course of the reaction, bromide of potassium may be administered every three or four hours if the patient complains much of pain.

In the second period it is necessary to support the strength of the patient, and to husband his forces, so that he may withstand the exhausting influences of the final period of suppuration. At the same time, however, undue stimulation should be avoided, and a careful watch be maintained for indications of visceral inflammation. The diet should be nourishing, but consist, as far as possible, of fluids—as milk, beef-tea, soup; and where there is a decided tendency to diarrhœa and vomiting, similar precautions in feeding should be taken to those observed in the management of a case of typhoid fever. Symptoms of pulmonary congestion and broncho-pneumonia are best treated, if the patient be not very weak, by liquor ammoniæ citratis and small doses of tartar-emetic; and diarrhœa should be treated by chalk and opium, or small doses of castor-oil and laudanum, or, if very obstinate, by sulphate of zinc and opium.

In the treatment, during the third period of a deep burn, of a large, open, and suppurating wound, it becomes necessary to support the patient's vital powers by giving a free and generous diet with wine and malt liquors; and to overcome, so far as may be convenient, the adverse influences of a long-occupied sick chamber by occasional changes of air and scene.

In exposing the region of a recent burn, extreme care should be taken to avoid rough handling of any destroyed and partially detached portions of skin. This precaution is especially necessary in burns or scalds of the second degree. It is advisable, particularly in cases of burning by caustic agents or through explosion of gunpowder, to remove by gentle syringing with warm water all foreign material that adheres to the injured surface. In the choice of local applications suitable to the different stages of burn, the surgeon has to attend to the following indications:—he should endeavour, in the first place, to cool the burnt surface and to relieve pain, and, after reaction has been established, to moderate local hyperæmia and prevent inflammation by excluding from the seat of injury such external influences as might set up irritation. When eschars have been formed, it becomes necessary, by attention to cleanliness, by the use of antiseptic agents, and by rest of the burnt part, to ward off attacks of cellulitis, and to neutralise any conditions that might be likely to induce septic infection. After the separation of all disorganised tissues, it is requisite to promote speedy cicatrisation, and at the same time to prevent, as far as possible, any subsequent cicatricial deformity.

In the local treatment of burns of the first degree, the main indications are to relieve the smarting pain by applying cold, and to

bring about speedy resolution. If the scorched region extend over more or less of the surface of a limb, it should be covered with cold compresses, or the whole extremity be retained for one hour or longer in a cold bath, layers of cotton wool being subsequently applied when the pain and irritation have passed off. In the treatment of a superficial burn of the face, or of a small extent of the surface of the trunk, the immediate application either of iced water, or of lead lotion, or of diluted eau de Cologne, will be found beneficial. In a case of a burn of the first degree, involving one-half or more of the surface of the body, the patient, if an adult and well-nourished, will be much relieved by prolonged immersion in a bath of slightly warmed water; but if very young and collapsed, would be better treated by the local application of some cooling and oily fluid, and, over this, of a thick layer of cotton-wool.

The principal object in dealing with a burn of the second degree is to exclude as far as possible the external air from the seat of injury. If there be any very large vesicles, a few minute punctures should be made in the wall of each at the most dependent parts, so as to allow slow discharge of the contained serous fluid. It is very necessary to avoid laceration of the elevated epidermis, and undue and early exposure of the cutis. The burnt surface should then be covered by some thick dressing, so as to be protected against irritating agents until the complete reproduction of the destroyed epidermis. Mr. Erichsen recommends, in the local treatment of this as of other degrees of burn, the use of the finest wheaten flour, which, when laid on thickly but uniformly and gradually, forms a soft and soothing application to the surface. In cases of extensive vesication, strips of lint or linen which have been dipped in some thick or oily fluid will be found a more convenient and cleanly dressing. Of these fluids the best probably are carron oil (linseed-oil and lime-water in equal parts), carbolic oil (one part of carbolic acid to ten parts of olive oil), a mixture of olive oil and yelk of egg in equal parts. Chalk or zinc ointment, or one of carbonate of lead, spread very thickly on strips of soft lint, will each be found a suitable application to this form of burn. Cotton wadding, absorbent cotton wool and cotton tissue, treated with some antiseptic agent, constitute valuable material for dressings in every degree of burn, and may be applied in thick layers either directly to the injured surface or over any of the above-mentioned lotions or ointments. If cotton wool be applied directly to a vesicated surface, it will be advisable to retain the dressing until the burn has healed or the injured skin has become dry, as the flakes of cotton adhere closely to the loose epidermis, and if removed carelessly and too soon, might tear this away and expose a raw and irritable surface. In burns of this degree seated on the face or one of the limbs, if there be but slight vesication, the application either of castor-oil and collodion (one part to two parts), or of a super-saturated solution of bicarbonate of soda, is to be recommended. In cases of very painful scorching of the whole face, it will be found useful to brush over the reddened surface with some olive-oil or a diluted mixture of glycerine and boracic acid, and then to apply a thick mask of cotton-wool or wadding. In vesicated burns of limited extent, seated on the trunk or one of the extremities, nitrate of silver has often been found very useful when applied either in strong solution (one scruple of the salt to one ounce of water), or as the solid stick.

In treating burns of the third degree, the surgeon should act with the aim of accelerating the separation and removal of the eschars, of controlling putrefaction, and subsequently of promoting the cicatrisation of the open wound. The usual treatment, in cases where a portion of the skin has been destroyed and converted into sloughs, consists in covering the burnt surface with some stimulating dressing, and in applying over this a thick layer of antiseptic wadding.

The following are some of the most useful of the many preparations which have been commended as local stimulants: carron oil, turpentine liniment, carbolic oil, resin-ointment, Kentish's liniment of ceratum resinæ softened with spirit of turpentine, and the compound elemi ointment of the St. George's Hospital Pharmacopœia. The dressing should not be changed except when it is found necessary for the sake of cleanliness. At every exposure of the seat of burn, the sloughing surface should be irrigated and cleansed for some minutes with a tepid solution of carbolic acid (one part to thirty), or a weak iodine lotion, or a solution of chloride of zinc (ten grains to the ounce of water). After removal of the disorganised tissues, the exposed granulating surface is to be treated like any other form of healthy wound or ulcer.

Hebra, who objected to the use of ointments in the treatment of burns of the third degree, advocated the practice of

continuous irrigation in cases in which the situation of the burn permitted its employment. He also advocated, as a mode of treating very severe burns, prolonged immersion in a bath of water maintained for many days, and, if necessary, even for months, at a temperature of from 90° to 100° F. This treatment seems to have been hitherto tried but in few cases, and not with any superior results. In order to carry out such a plan, the surgeon would require a special and very complicated apparatus, needing constant attention, and, if used for a very young patient, obviously not free from danger.

In the management of a large granulating surface formed in the more severe burns of the third degree, the surgeon's efforts should be mainly directed to overcoming the effects of cicatricial retraction, and to favouring, as far as can be done, the formation of a thin, smooth, and lax scar. After a deep burn of the face, of the front of the neck, or along the flexure surface of a large joint, more or less deformity must result; but the extent of such deformity, and the nature of the cicatrix may be much influenced for good by careful attention to both local and general treatment during the process of healing. By supporting the strength of the patient and warding off local inflammatory attacks, the granulating surface may be maintained in a healthy condition, so that it will heal steadily and with the formation of a thin yet sound scar.

If the burn involve the flexure of a large joint, as the front of the elbow or the surface of the popliteal region, any muscular contraction which tends to keep up flexion should be steadily resisted, and the affected limb be kept straight on a splint. In the treatment of a granulating wound in front of the neck and of the upper part of the chest, constant endeavour should be made to prevent depression of the chin. In burns about the mouth, external auditory meatus, or any other natural orifice, tents, or solid plugs or tubes with solid walls, should be inserted, with a view of preventing contraction. Much difficulty will be experienced, in deep burns of the hand, in preventing adhesion of two or more fingers. The best means of preventing deformity by reducing hypertrophy and controlling the retractile action of a large scar, are extension of the distorted parts and compression by elastic bandaging. Extension can be readily applied to the lower limb by using strapping and weights, whilst in the upper limb, and probably in some cases of depression of the lower jaw, some good in this respect may be done by ingenious applications of elastic accumulators. Compression may be best effected by firm strapping and the application of a Martin's bandage. In order that any real benefit may be derived from these plans of treatment, they must be carried out with much care and perseverance, and be continued long after the granulating surface has healed.

The eschars formed by very deep burns require similar local treatment to that recommended for other burns of the third degree. An injury of this severity, however, is usually fatal when seated on the trunk, and demands amputation when a portion of a limb is involved.

Primary amputation, the general condition of the patient not forbidding, is indicated when an extremity has been destroyed by a very severe burn. The operation should be performed without delay in any uncomplicated case of hopeless disorganisation of a foot or hand. Amputation has been performed with success even in cases where a portion of the trunk also was severely burnt, and instances have been recorded by Larrey of successful double amputations for burn: one of a thigh and an arm on the same patient, another of a leg and fore-arm, and one even of both thighs. If the extremity be wholly destroyed, the surgeon need not hesitate to take flaps from skin already involved in burns of the second or third degree. The following are the conditions in which it may be found advisable to perform secondary amputation:—Profuse and exhausting discharge from a large granulating surface on a limb, formed on the separation of a deep eschar in a severe burn of the third degree; when much of the integument of a limb has been destroyed, and the retraction of the resulting cicatrix renders the member quite useless, and also interferes with the movements of adjacent sound parts; when a large open surface cannot be healed, or when a large cicatrix has a constant tendency to ulcerate on movement of the affected limb; when a large joint has been opened during the detachment of a deep eschar, and is undergoing disorganisation; in cases of extensive exposure and necrosis of a long bone resulting from burn.

W. Johnson Smith.

BURSÆ, Affections of.—Bursæ may be divided into *subcutaneous* and *deep*. The deep bursæ intervene usually between tendons, muscles, and bones, but sometimes between muscles or tendons. The

subcutaneous lie between the skin and exposed bony prominences. Most of the muscular bursæ are hereditary and fairly constant; but the majority of the subcutaneous are developed after birth.

Situations of Bursæ (*Head and Neck*). A large one (sublingual) exists between the genioglossi, back of the symphysis, and the mucous membrane on each side of the frænum, passing back behind the sublingual gland and Wharton's duct to the level of the first or second molar, and constricted in the mid-line by the frænum. *See* Ranula. Occasionally bursæ are seen on the symphysis and angles of jaw: between the back of the hyoid bone and thyro-hyoid muscle, and the thyro-hyoid membrane (thyro-hyoid): rarely on the pomum adami (ante-thyroid).

Upper Limb. — On the subcutaneous surface of the olecranon always; occasionally on the acromion, epicondyles, styloid processes, knuckles and backs of inter-phalangeal joints, bursæ are found. A large, generally loculated sac (sub-deltoid, sub-acromial) always exists between the deltoid and acromion and the head of the humerus. Beneath the tendon of the subscapularis, and along the tendon of the biceps, are protrusions of the synovial sac of the shoulder; fluid may run along the latter from the shoulder, and point beneath the great pectoral tendon. Bursæ are also found between the latissimus and teres major tendons, and between the latter and the bone: between the biceps tendon and the tubercle of the radius: between the triceps and the olecranon above its insertion: and around the tendon of the flexor carpi radialis where it grooves the trapezium.

Around the tendons of the superficial and deep flexors beneath the anterior annular ligament, extending from the level of the wrist-joint to rather below the bases of the metacarpals, is a large bursa divided into two parts—which may communicate—by a mesial septum; the inner surrounds the tendons of the fourth and fifth fingers, the outer those of the second and third fingers and the long thumb-flexor, and communicates with the special sheath of the latter round the flexor tendons in each digit, any one of which *may* join the bursa in front of the wrist. Six sheaths lie beneath the posterior annular ligament, beneath each of which there is a small bursa. Hernial protrusions of the intercarpal synovial membrane on the dorsal aspect are not uncommon.

Lower Limb.—The bursa patellæ consists of two or three distinct or intercommunicating superposed chambers, one at least being subfascial: and there is often another lower down in front of the ligament and tubercle of the tibia. Beneath the gluteus maximus, over the tuber ischii and origin of hamstrings, is a large bursa: another, large and loculated, is over the great trochanter and origin of the vastus externus; small ones exist beneath the tendons of the two smaller glutei, and still smaller in relation with the tendons of the pyriformis and obturator internus. Between the ilio-psoas and hip-joint is a large bursa, which may communicate with the joint: a small one beneath the crureus above the knee, with which it occasionally communicates.

Behind the knee on the inner side, beneath the inner head of the gastrocnemius, and also intervening between this muscle and the semi-membranosus, is an extensive bursa often communicating with the knee-joint. Lower down, between the insertion of the semi-membranosus and the tibia, is a small sac, and on the outer side, between the biceps and external lateral ligament, another, small and inconstant. In front of the upper end of the tibia, beneath the insertion of the ligamentum patellæ is a bursa: and another beneath and between the insertions of the sartorius, gracilis, and semi-tendinosus. Beneath the insertion of the tendo Achillis is a small bursa, and synovial membranes line the flexor sheaths in the toes, the peronei behind the ankle, the three compartments in the anterior annular ligament, and the sheaths in the internal annular ligament.

Injuries.—*Wounds* are recognised by their anatomical position, perhaps the escape of synovia, and the detection of an opened bursa by the eye or probe. Incised and punctured wounds, as a rule, heal easily, but may cause bursitis of all degrees of acuteness; whilst contused wounds, when septic, are often followed by suppuration of the bursa, and cellulitis leading from it. *Contusions*, without breach of surface, are not uncommonly followed by similar results, especially about the elbow; but simple hæmorrhage into the sac is common.

Treatment.—In the case of a wound, render the part aseptic, provide drainage if the wound is large enough to require it; apply some antiseptic dressing, and immobolise the part if practicable. Inflammatory complications must be treated as hereafter advised.

Diseases of Bursæ.—These are all inflammatory—acute or chronic.

Acute Inflammation may be serous or purulent.

Causes.—Wounds, contusions, extension of inflammation from surrounding parts; rarely, the extension of a slough of a boil into a superficial sac, and also, rarely, pyæmia. Often none is discoverable. Acute not uncommonly supervenes upon chronic inflammation. The common seats of acute inflammation are—the bursa patellæ (subcutaneous or subfascial, or both), and those over the olecranon, ligamentum patellæ, and tubercle of the tibia; much less commonly, the bursa beneath the insertion of the ligamentum patellæ.

Symptoms. — Redness, heat, swelling with more or less distinct fluctuation, and pain, localised to the situation of a bursa, or, attaining their maximum there, accompanied by more or less fever. In cases of acute suppuration these symptoms are well-marked, redness and œdema may extend some distance around, and the temperature is 101°–3° or even 104° F. If pus in a bursa is not evacuated, it may burst through the thick skin over it; but much more often subcutaneous or subfascial rupture and diffuse cellulitis result, perhaps running on even to sloughing of the subcutaneous tissue. Or the pus may burst into a joint, and, wherever there is danger of this, early relief is specially necessary, as in the case of the bursa beneath the ligamentum patellæ. Lastly, inflammation may spread from a bursa to the bone in which it lies, so that when the abscess is opened carious bone is found at the bottom; or a chronic septic discharge across a bone from a bursa may lead to the same result. This is sometimes found in suppuration of the bursa between the gluteus maximus and the great trochanter,—an affection which may present many of the symptoms of hip-joint disease. *See* Hip-disease. Lymphangitis and lymphadenitis are not uncommon complications.

Treatment.—In the earliest stage, rest upon a splint, and ice. Later on, but still before suppuration has occurred, rest, belladonna and glycerine freely applied, and fomentations changed every two hours. So soon as it is certain that pus is present, it should be let out by incision, a drain inserted, and an antiseptic dressing applied, preferably a large wool one, bandaged with moderate firmness.

If the pus has burst through the skin, and cellulitis is present, the best treatment is to render the drainage free, give rest, and apply fomentations of boracic lint.

If the sac has burst beneath the fascia, and suppuration is extending up and down the limb, free, and possibly numerous, incisions will be required to evacuate the pus, tubes must be inserted, and an antiseptic dressing applied. Frequent boracic fomentations act well. The sinuses are likely to be long in healing.

With regard to the bursa patellæ, an incision into its outer side gives better drainage than a central one, and the scar is less exposed to pressure afterwards.

Chronic Inflammation. — Several results are met with. Distension with serous fluid, the wall becoming rather thick and opaque (hygroma or simple dropsy). The fluid is sometimes deeply blood-stained, or may be thick and viscid, and bridle-like bands often project into the interior. Sometimes the wall continues to thicken, the fluid disappearing as it does so; in other cases fluid is never present in quantity, the swelling being due chiefly to thickening of the wall, which may not be uniform. The central cavity may be very small, but is rarely, if ever, obliterated. The thickening is produced either by fibrous tissue of inflammatory origin, or by fibrin, almost laminated and undergoing organisation towards the wall, deposited from blood or coagulable fluid effused into the cavity. Rarely, in old cases, the wall calcifies. Sometimes the interior presents a few or many warty, pedunculated growths; it is thought that these may become detached, and form one variety of loose body found in bursæ. Usually, however, these do not consist of connective tissue, but simply of fibrin, and they have very much the shape and appearance of melon-seeds. They may be dark brown from presence of blood colouring matter, and it is thought that they originate from fibrin derived from blood. It is not known to what they owe their peculiar form. In bursæ actually connected with joints, cartilaginous bodies have been found.

Causes.—Chronic irritation, generally of the nature of friction or contusion.

Seats. — The most common are—the bursa patellæ and others lower down, over the ligament (housemaid's knee); the bursa over the olecranon (student's or miner's bursa); that over the tuber ischii (weaver's bottom); those over the external malleoli (tailor's bursa). These frequently show all the pathological changes described above; whilst deeper bursæ in the neighbourhood of joints are generally affected by simple dropsy only. The bursa between the semi-membranosus and inner head of the gastrocnemius is that most commonly affected.

Symptoms.—A more or less rounded swelling in the situation of a normal bursa, or occurring upon a spot exposed to unusual pressure, varying from the size of a fœtal head downwards—the larger sizes being rare nowadays; enlarging, perhaps rapidly at first, but without acute symptoms, then increasing slowly, if at all; sometimes very lax, again tense, elastic and fluctuating (in simple dropsy); the skin either thickened or, less commonly, stretched so as to be even translucent. With thickening of the wall the swelling becomes firmer, and fluctuation less and less distinct, reaching stony hardness with calcification. Irregular thickening and warty growths are felt if the sac is not so tense as to prevent its walls being pressed into contact. Loose bodies may yield soft crepitus on palpation, and in lax sacs they may be felt and chased from spot to spot; but in tense bursæ they are often first discovered upon opening or aspirating.

Treatment.—When only a few weeks old, counter-irritation with Lin. iodi or blisters, *applied freely*, may cause absorption of the fluid, but it often fails. Aspiration, repeated in three or four days, if necessary, together with fixation upon a splint to which the limb is strapped or bandaged, so as to make firm pressure on the bursa, is more successful. In similar cases, the bursa may be tapped, and injected with a solution of iodine (Tr. iodi and water, equal parts—Billroth), the fluid being allowed to escape after two minutes, and absolute rest for some days being insisted upon. Lastly, strong pressure may be made upon the bursa with a flannel bandage, a splint being placed on the other side of the limb (Volkmann). Reabsorption occurs in two to eight days, according to the size and chronicity of the swelling. In the case of the bursa patellæ sufficient pressure is used to cause œdema of the foot.

When loose bodies are present, they must be completely removed. The best plan is a sufficiently free incision to secure this, and then drainage and an antiseptic dressing. If either local or general thickening of the walls exist in any marked degree, the only treatment certain to cure is excision of the whole bursa. The incision should be placed to one side of the point of chief pressure. Should excision be impossible, removal of a portion of the wall and prolonged drainage may be tried.

The most difficult cases to treat are those of deep bursæ, possibly communicating with a joint, such as are commonly met with in the popliteal space. If the bursa can be emptied into the joint, communication is clear; but, even when this could not be done, inflammation, excited with a view to curing the bursa, has spread to the joint. After the failure of counter-irritation and pressure, which is difficult to apply, it is right to consider whether it is necessary to do more. If it is, cure will be effected almost certainly, and with the least risk to the patient, by antiseptic drainage. This has failed, however, and the sac has been dissected out.

Sometimes a very chronic sinus remains after the bursting or laying open of a bursa. This is best treated by a free incision and the application of the sharp-spoon.

STANLEY BOYD.

BUTCHER'S SAW, consists of a narrow steel blade with fine teeth, set in a framework of metal, in which it can be turned so as to work in any direction, and from which it may be readily detached. This saw has been found very useful in excisions and in the removal of small exostoses and of thin sections of bone. The blade, Mr. Butcher states, cannot be locked, cuts more evenly and rapidly than that of the ordinary form of saw, and does not cause splintering. It readily cuts in a curve, and its shallowness and mobility permit of its being applied to the deep surface of a bone, so that it may in sawing be directed towards the surface of the wound, the tibia in excision of the knee being thus divided from behind forwards, and the radius and ulna, in excision of the elbow, from before backwards.

BUTTON-SUTURES.—This term was first applied to an apparatus used by Bozeman in operations for closing urinary vaginal fistulæ. The pared edges of the fistula having been brought together by silver wire, an oval and perforated plate of lead is passed along the free portions of the wires, and is retained over the wound by means of split shots. Another and double form of button-suture is used by Sir Joseph Lister in closing deep and wide wounds after operations on the trunk or limbs. Each suture is composed of two thin perforated discs of lead and some stout silver wire. The lead plates are applied each at some little distance from the edge of the wound, and are connected and approximated by the silver wire being drawn tight enough to allow the edges of the wound to come easily together. The edges of the wound may then be brought together by the ordinary interrupted suture without stretching or irritation. *See* ANTISEPTIC SURGERY.

C

CACHEXIA. *See* MALIGNANT DISEASE.

CADAVERIC WARTS.—A chronic, inflammatory thickening of the integuments, due to the local absorption of decomposing animal matter.

This affection is not infrequent on the hands of those who have to make many post-mortem examinations. Sometimes it begins with a small crack or pustule, but more often, without any evident breach of the surface, the skin at some point of the knuckles is observed to become thick and rough. The thickening spreads, and the skin assumes a livid, purplish colour, and, after a time, there is a deposition of pigment, which gives the elevation a brownish appearance. The epidermis may become cracked and scaly, and a condition is then produced which resembles ichthyosis. In many cases the thickening develops into a low warty growth, half an inch or more in diameter, and elevated nearly an eighth of an inch above the adjacent skin. In other cases the papillary structures do not appear to be so much affected, and the disease has more of the aspect of a chronic eczema. Several fingers are often simultaneously affected in both hands, usually on the knuckles of the metacarpo-phalangeal, but sometimes upon those of the first phalangeal joints. According to Dr. Wilks, who first described it, those who are subject to this affection may continue their avocation with impunity as regards putrid absorption or inflammation of the lymphatics, for, as far as he has seen, neither these nor any constitutional symptoms result. The low warty growths may bear some resemblance to an early stage of epithelioma, but their multiple occurrence, the absence of glandular implication, and the employment of the patient, will generally suffice for their recognition.

The disease may persist for many years after the irritation which has caused it has ceased. It is advisable to keep the hands from contact with decomposing animal fluids, by desisting from pathological work, or by adopting the protection of india-rubber gloves. In the earlier stage of the disease it will be sufficient to apply the strong tincture of iodine. If this fails, the surface should be cauterised with nitric acid, or the liquor hydrargyri nitratis. When the swellings have a distinctly warty character, it may be necessary to resort to excision.

N. DAVIES-COLLEY.

CÆSAREAN SECTION is the operation for the removal of the child and placenta from the uterus at term, by abdominal and uterine section. It is performed when delivery is impossible by the natural method, even if the child be sacrificed and embryulcio performed.

Some difference of opinion exists as to the indications for the operation, and especially between British and Continental authorities, but a discussion of this subject will be found in any of the best obstetrical works, and is beyond our limits here. The necessity for the operation may arise either from pelvic deformity, (rachitis and mollities ossium are the diseases which most often cause such pelvic deformity), or from the presence of a tumour fixed in the pelvis, most often a fibro-myoma, or from cancer of uterus, cervix, or rectum, or exostosis of the sacrum. The late Sir James Simpson taught that when the brim of the pelvis is below $1\frac{1}{2}$ or $1\frac{3}{4}$ inches in the conjugate by three inches in the transverse diameter, or when the cavity or outlet is much contracted, Cæsarean section should be performed. The operation should be performed before the mother's strength is exhausted. It is well to wait till labour be sufficiently advanced for the os to be well dilated, on account of the drainage of the uterus. It is an alternative to craniotomy, cranioclasm, and cephalotripsy. In some cases it may be performed even though the mother be dead, in order to save the life of the child.

Operation.—The bladder having been emptied by the catheter, the vagina and vulva carefully cleansed with an antiseptic solution, and the rectum cleared by enema, the patient should be laid on her back on a convenient table, and with exactly the same preparations as for ovariotomy. *See* OVARIOTOMY. An incision should be made in the linea alba about five inches long, and, when the peritoneum is reached, great care should be exercised in dividing it, for fear of wounding the highly vascular pregnant uterus. When all bleeding from the parietal incision has ceased, and the uterus has been fully exposed, the placental site should if possible be determined in order to avoid it in incising the uterus. A longitudinal incision from four to five inches long should then be made in the uterine wall (a small opening with the knife rapidly extended with scissors); the hand introduced and the child extracted, head first, as quickly as possible, and handed to an assistant, who

ties the umbilical cord. The placenta should also be extracted, being peeled from the uterine wall if necessary; then the index finger should be pushed through the cervical canal into the vagina, to insure this canal being left patent, and it may be well to pass through it a soft rubber drainage-tube, with large side holes, just long enough to extend from above the internal os into the vagina; the hand should then be quickly withdrawn, and the uterus grasped till it contracts firmly.

The very greatest care should be taken, during the incision of the uterus and the extraction of the child and placenta, to prevent escape of blood or liquor amnii into the peritoneal cavity, and this may be most safely done by placing large, soft, flat, carbolised sponges all round between the parietal peritoneum and the uterus, and causing an assistant to press the parietes firmly upon these sponges during the extraction. The uterus should be grasped to cause it to contract, and when it has contracted firmly, a row of fine carbolised silk sutures should be inserted through the whole thickness of its wall, by means of a fine curved needle. Each suture should include about a quarter of an inch of the peritoneal edge, and slant through the uterine wall, merely catching the mucous membrane and not going right through it into the cavity. These interrupted sutures should be about a quarter of an inch apart in the contracted wall, and after they have been securely tied and cut short, a fine continuous carbolised silk suture should be run along over them through the peritoneal coat only, the needle being made to transfix the peritoneum between these interrupted sutures.

The peritoneum should then be carefully sponged out, and the abdominal incision closed as in ovariotomy, a small gauze dressing being applied over the wound, and outside this a firm folded towel as a pad, and over this the usual adhesive straps; then outside the straps a large folded mass of cotton wool, over which a lined flannel bandage is pinned; this keeps up a firm elastic pressure on the uterus. The vagina should be syringed with warm 1 to 60 carbolic lotion, and lightly packed with iodoform gauze, which should be changed every twelve hours under the spray for the first few days. A subcutaneous injection of ergotin, and the early application of the child to the breast (if the mother be not too much exhausted), are advisable, as likely to keep the uterus firmly contracted.

In the event of the child being already dead and putrid, still greater care will be necessary to avoid fouling the wound, which should be completely covered all round the projecting uterus with napkins wrung out of warm 1 to 40 carbolic lotion. The uterine cavity should be well sponged out also with a strong solution of iodine, and a Keith's glass tube, with rubber sheet and carbolised sponges, should be used for draining the pelvis. This latter precaution may be advisable, not only in cases in which the child is putrid, but in any case in which escape of uterine contents into the peritoneal cavity has occurred during the operation.

The treatment of the patient after operation should be similar to that advised after ovariotomy. When syringing out the vagina and packing it after the operation, the rubber tube should be pierced by a safety pin placed across the os so as to prevent its being drawn into the cavity, and the tube may be removed altogether in about forty-eight hours when the peritoneal wound in the uterus is sealed.

J. Knowsley Thornton.

CALCIFICATION is an indication of diminished nutritive activity. This is true both as regards health and disease. Physiologically the deposition of lime-salts is the last of the series of changes concerned in the formation of bone where it is purposive, inasmuch as it gives the required durability, but at the same time it marks the loss of formative power of the osseous corpuscles. Pathologically it may occur as a primary change in previously healthy tissues, but more frequently it is consecutive to some other form of failure in nutrition—inflammatory or degenerative.

It is very widely distributed in the *vascular system*; thus it is found in the *heart*, affecting the valves and the walls of the coronary arteries; and large stony plates are occasionally met with in the pericardium.

The *arteries* are peculiarly prone to petrifaction. The muscular fibre-cells of the middle coat of the small and medium-sized vessels are often converted into calcareous rings, and the neoplasia of chronic endarteritis of the large arteries is very liable to infiltration with lime-salts.

The *veins* are subject to the change both as regards their walls and contents. In them, as in the smaller arteries, the tendency is for the middle coat to be first invaded. The rigidity of the vessels thus occasioned is a secondary cause of thrombosis. *Phleboliths* are mostly found where there has been passive venous congestion —a condition favourable both to chronic

plastic phlebitis and coagulation of blood. There is some doubt how far these calculi are petrified clots, or inflammatory buddings of the intima that have undergone calcification. They are most common in the prostatic venous plexus.

Disorderly calcification is one of the chief anatomical features of *rickets*, in which disease the epiphysial cartilage-cells are imprisoned, and their natural segmentation checked by the calcareous deposit in the secondary capsules.

Taken as a whole, calcification is most common in tissues that have succumbed to *chronic inflammation*. Examples of this in the vascular system have already been cited. The lesion is not rare in the membranes of the brain and cord; thus one meets with broad plates in the cranial dura mater, especially in old people. The author has observed patches of calcification as a sequel of traumatic, cerebral, and spinal meningitis. A like condition may be acquired by articular and synovial sheaths which have been chronically inflamed. But whilst calcification occurs in these cases of fibroid induration, it is much more likely to happen in connection with caseation of inflammatory products; thus it is met with in 'obsolescent tubercle' of the lungs and lymphatic glands. The inspissated pus of cold abscesses may contain such an excess of lime-salts as to simulate mortar of various degrees of consistence and grittiness. It is an interesting fact that passive congestion conduces alike to absorption of earthy salts from normal bone, and to their re-deposition in the contents of consecutive abscesses, as exemplified by the history of scrofulous caries.

Calcification sometimes affects the pyramidal blocks of degenerating tissue, the result of aseptic arterial embolism. There is scarcely an instance of fatty metamorphosis where calcareous infiltration may not be found in greater or less extent. It is a possible sequel to such widely different processes as 'ossification' of the choroid coat of the eyeball, extra-uterine gestation, and retrogression of the thymus gland. The interstitial tissue of the internal organs—the lungs and kidneys, e.g.—may be the seat of diffuse calcareous deposit secondary to absorption of the bone-salts from the osseous system generally.

Of the *new-formations*, those characterised by slowness of growth and other signs of benignancy are, by preference, selected by the process of calcification. The enchondromata are peculiarly prone to petrifaction with or without true ossification. In them, as in other tumours, the cells are invaded subsequently to the matrix. The *fibromata* may undergo interstitial or, much more rarely, capsular calcification. *Uterine fibroids* are now and again observed to be converted into stony masses.

The *psammomata* which, on anatomical grounds, are by Cornil and Ranvier classed with the sarcomata, are typical of calcified neoplasiæ. They are small, concentrically laminated, globular concretions found in the choroid plexuses and other parts of the pia mater. The deposit affects chiefly the walls of the capillaries.

Cysts are sometimes converted into a kind of shell or carapace. This is notably the case in hydatid and atheromatous or sebaceous tumours. Calcification may occur as a secondary change in *hypertrophy of the thyroid gland*, where it is usually seen in the form of cretaceous nodules.

Fragments of a calcified growth appear opaque when viewed by transmitted light. The constituent cells may be completely hidden, but their outline becomes apparent on the addition of a dilute mineral acid. The chinks or clefts present in these tumours must not be mistaken for the lacunæ of true bone. They do not contain corpuscular elements. Calcification is the essential process in the formation of salivary and many urinary calculi. In the majority of cases of calcareous infiltration the salts consist of calcic carbonate and tribasic phosphate.

AUGUSTUS J. PEPPER.

CALCULUS, Prostatic. *See* PROSTATE, Diseases of the.

CALCULUS, Renal. *See* NEPHROLITHIASIS.

CALCULUS, Urethral. *See* STONE IN THE URETHRA.

CALCULUS, Urinary.—Urinary concretions assume different forms, and exhibit great varieties both in their general appearance and chemical constitution.

The most common forms are simple calculi of uric acid or of oxalate of lime, and the compound calculi of phosphate of lime, with ammonio-magnesian phosphate, or of either of the above elements with mixed phosphates. Less frequently observed calculi are those of urate of ammonia, of triple phosphate, and of cystine. The most rare forms of urinary calculi are those composed of xanthic oxide, pure phosphate of lime, and of carbonate of lime. In this country uric acid calculi make up about 25 per cent. of the whole number, the

fusible or mixed phosphatic calculi about 10 per cent., and the oxalate of lime calculi about 15 per cent. The relative proportions of the forms of calculi would seem, according to the investigations of Indian collections by Dr. H. V. Carter, to vary in different countries.

The *uric acid calculus* has a smooth or slightly nodulated surface, is of a reddish-brown, yellow or fawn colour, is more or less ovoid in shape, and hard and compact. It is met with in greatly varying sizes, some stones weighing but a few grains, and others from six to eight ounces. The central portions are for the most part darker than the peripheral. On the application of heat it is found to be combustible, leaving very little residue. It is soluble in nitric acid with effervescence; and, on evaporation, with the addition of a few drops of ammonia, presents a blood-red hue. It is also soluble in a dilute solution of potash, and of carbonate of potash, but is insoluble in water, alcohol, and dilute hydrochloric acid.

The *oxalate of lime* or *mulberry calculus* is mostly darkish brown in colour, varying from this to a dark green, yellowish-brown, bright yellow or white. It usually presents sharp angular projections, or has a very rough and tuberculated surface. It is spherical in shape, is very hard and compact, and, on section, exhibits a laminated and finely granular texture. The oxalate of lime calculus, in its ordinary form, is usually single, but there is a variety of this concretion called 'the hemp-seed calculus,' consisting of very small, pale, and smooth bodies, which are sometimes found in large numbers in the kidney.

The white variety of mulberry calculus is crystalline, and consists of nearly pure oxalate of lime. This form is very rare. Oxalate of lime calculi are found to be soluble in hydrochloric acid, but insoluble in acetic acid and in water. They burn with a white glow under the blow-pipe, and the moistened residue gives an alkaline reaction.

The *ammonio-magnesian* or *triple phosphate calculus* is rare, and very few specimens are to be found, even in the largest collections. The calculus is usually large, and has been found mostly in men of advanced life. It is more or less oval in shape, white in colour, with a beautifully crystalline surface; on section it is found to be indistinctly lamellated. In some specimens the texture is compact, in others soft and friable.

The *ammonio-magnesian phosphate of lime*, or *fusible calculus* is of frequent occurrence, and often attains a considerable size; the largest specimens in collections of calculi being mostly of this variety. This calculus is of a white colour, usually globular or ovoid, but sometimes very irregular in shape, light as compared with other forms of stone, and brittle or quite soft. It is this material that forms the well-known incrustation on foreign bodies introduced into the bladder.

The *cystic oxide* or *cystine calculus* is small, and rounded or oval in shape, with a smooth or slightly tuberculated surface, and has a yellowish-white or pale green colour. It has a glistening appearance, and on section gives off a peculiar garlic-like odour. It is combustible and burns with a bluish flame and characteristic odour, and is soluble in nitric and other mineral acids. It contains above 25 per cent. of sulphur. This variety of calculus is formed in the kidney, and has a tendency to recur in the same patient. There seems to be some hereditary predisposition to its formation, as, according to Poland, out of twenty-two collected cases, ten occurred in four families.

The *xanthic oxide* is probably the rarest form of urinary calculus, four instances only having been recorded. The smallest of these weighed eight grains, and the largest 339 grains. It presents a smooth surface, and a cinnamon-brown or reddish-yellow colour, and is made up of concentric wavy laminæ. It leaves very little, if any, residue on combustion, and is soluble in the mineral acids.

The *phosphate of lime calculus* is very rare in the pure form. It is hard and compactly laminated, and has a smooth, porcellanous surface. When submitted to the blow-pipe, it whitens but does not fuse, and is soluble in hydrochloric acid without effervescence. Phosphate of lime, though very seldom met with as a true renal or vesical calculus, forms the bulk of the so-called 'bone-earth' calculi, or the soft amorphous masses of deposit so frequently found in cases of diseased bladder with decomposed urine.

Carbonate of lime enters into the composition of some few forms of prostatic concretion, and is occasionally met with in animals, but very rarely, if ever, forms a true urinary calculus in the human subject.

A mixed or *alternating calculus* is one made up of different layers of any of the foregoing varieties. This mixed composition is the result of changes in the condition of the urine at different stages of the

growth of the stone. Hence a change of residence, even from one part to another of the same country, or a material alteration in the habits of life of the patient, may be promoting causes. The most frequent combinations are: a nucleus of uric acid with a body of pure uric acid or of urates and a crust of phosphates; a nucleus and body of oxalate of lime, and a crust of irregular thickness, composed partly of phosphates, partly of uric acid; a nucleus of uric acid or of urate of ammonia, surrounded by alternating layers of uric acid and mixed phosphates.

The so-called fibrinous, sanguineous, and uro-stealith calculi being simply concretions of organic matter, and not crystalline formations, need not be considered here.

The development and growth of each of the ordinary forms of urinary calculus are associated with a somewhat characteristic condition of the urine. In the uric acid diathesis this secretion is scanty, highly-coloured, and deposits on cooling distinct coloured crystals of uric acid, forming the well-known 'gravel' or 'cayenne-pepper' deposit. A reddish-yellow 'brick-dust' sediment—probably urate of ammonia—which disappears on the application of heat, or on pouring water into the vessel containing the urine, is common in health and must not be confounded with the uric acid deposit. In cases of oxalate of lime calculus, the urine is pale and abundant without sediment, and generally contains traces of blood, and crystals of oxalate of lime may sometimes be detected on microscopic examination. In association with phosphatic calculi, the urine is pale and copious. It soon decomposes, and then becomes very offensive. It is very often alkaline, and contains much mucous deposit. *See* STONE IN THE MALE BLADDER. T. W. CROSSE.

CALCULUS, Vesical. *See* STONE IN THE MALE BLADDER; STONE IN THE FEMALE BLADDER.

CALLISEN'S OPERATION, *See* COLOTOMY.

CALLUS. *See* FRACTURES.

CALOMEL VAPOUR-BATH. — In the opinion of Mr. Henry Lee, who has long advocated calomel-fumigation in the treatment of constitutional syphilis, the most convenient apparatus to use in giving a calomel vapour-bath is one that sublimes the calomel and boils the water at the same time. Mr. Lee's apparatus consists of a metal receptacle with perforated walls, in which the lamp is placed, and immediately over the wick is a small circular plate, on which from ten to twenty grains of calomel are placed, and around this plate is a depression, into which is poured boiling water. The lamp having been lighted and the apparatus placed on the ground, the patient, covered from head to foot by a thick cloak of some impermeable material, sits over it on a cane-bottomed chair, and remains there for about a quarter of an hour, surrounded by a mixture of aqueous vapour and sublimed calomel. The surface of the body, during the bath, becomes covered by a black deposit of calomel, which should be disturbed as little as possible for some hours.

CANALISATION OF CLOT.—The process by which restitution of the lumen of a vessel is effected after occlusion by organisation of a thrombus.

This result is an outcome of the ordinary cicatricial changes occurring subsequently to the vascularisation of a thrombus. The channel may be a single one, as is occasionally seen after ligature in continuity of an artery, the vessel not being completely divided. The channel in this case is considerably smaller than the original one. In other cases the clot may become permeated by numerous channels, a condition sometimes noticed after thrombosis of the larger veins, such as the iliacs. In either case the permanent channel is due to the enlargement of one or more of the new blood-vessels formed during vascularisation of the clot. This enlargement is effected by the shrinking of the young connective tissue forming the organised thrombus, aided, in some degree perhaps, by the intravascular pressure. G. H. MAKINS.

CANALISATION OF THE PROSTATE (Perforation of Prostate. Forcible Catheterism).—This operation was formerly practised in prostatic retention of urine, when the catheter could not be passed. A No. 10 stout silver catheter with a conical point was passed down to the prostatic obstruction, kept steadily in the middle line, and the shaft forcibly depressed until the point penetrated the base of the middle lobe and entered the bladder. Sometimes the catheter was made with a terminal orifice, through which a sharp-pointed stylet could be protruded, to prepare a way for the catheter. When the bladder was reached, the catheter was retained for a day or two, and then immediately replaced by another, and so on, until the surgeon considered

that the false passage had become a permanent canal. Owing to the introduction of soft catheters of all shapes, the operation belongs entirely to the past. Patients so treated were exposed to grave risks. It can only be justifiable now, when the case is urgent and the surgeon beyond reach of soft catheters, or instruments for suprapubic tapping or aspiration.

G. Buckston Browne.

CANCER is a term used differently by different authorities. By some it is employed as equivalent to carcinoma; by others as a generic term for any truly malignant growth. *See* Carcinoma; Sarcoma; Malignant Tumours.

CANCRUM ORIS. *Synon.*: Noma of the mouth, Gangrenous stomatitis.—A rare form of gangrene of the lips and cheeks in weakly children, often after an acute fever: it is painless, rapid, and intractable, and causes death by blood-poisoning, or bronchitis, or pneumonia.

Although there are many intermediate forms of disease between cancrum oris and ulcerative stomatitis, yet a marked case of cancrum oris cannot be mistaken. The cheek is hard, hot, glossy, swollen, œdematous, invaded by a spreading patch of gangrene which is black edged with red; the whole thickness of the cheek is killed and putrid; the bones are bare, grey, and dead; the teeth come out. The disease may begin in the substance of the cheek, without visible disease of the mucous membrane; but usually the mucous membrane is affected early or primarily. The disease is at first insidious and often neglected, attacking as it does those children who are always weakly and ill-fed. Even after it has gone on to perforation, there is strange freedom from pain, strange indifference to the hole in the cheek, save for the difficulty in taking food; the child will even finger it inquisitively, and cover it with the hand while swallowing. Later, the child becomes exhausted and stupefied, or delirious and feebly restless, and dies either suddenly, as if from sheer exhaustion, or poisoned by the products of putrefaction, or from bronchitis or pneumonia due to inhalation of these products.

In one case at least, both cheeks have been attacked. It is almost confined to children of a few years old: in two cases of adults it is noted that there seemed to be more suffering than children feel.

Cancrum oris is something more than stomatitis, but it often begins in stomatitis, and has much in common with it. All forms of stomatitis, except the special ulcerations of syphilis and tubercular disease, are due in part to ill-health and severe depression; the mucous membranes being as much a register of the general health as the skin. The same causes predispose the child to cancrum oris; it is a disease of children depressed by all the evils of the worst poverty; it follows measles, typhoid, scarlet fever, ague, or some such cause. Bad drainage, the frequent cause of sore-throat and ulcerative stomatitis, probably also is at work in cancrum oris. It may follow the abuse of mercury (West), or the prolonged suppuration of a bad burn.

As regards successful treatment it is almost hopeless: the recorded deaths are 13 out of 18 (Hinder), 8 out of 10 (West), 20 out of 21 (Rilliet and Barthez), all out of 36 (Taupin of Paris). With more cheerful statistics comes a doubt whether those cases that recovered were all cases of real cancrum oris.

These three points, then, mark it off from ulcerative stomatitis: 1. Its destruction of the whole thickness of the cheek. 2. Its almost certain fatality. 3. Its advance, quite unchecked by chlorate of potash. Still, between it and ulcerative stomatitis there are intermediate forms, and there is no evidence that the difference is more than one of degree.

Pathology.—There are two views: one, that it is only a local expression of the general low vitality of the child—a local death preceding death itself, like the loss of hair or nails after a fever, or the sloughing of the penis after typhus (Holmes); the other, that it is due to a special poison. As regards the first view, the difficulty is to see why the cheek should be thus singled out. In other forms of gangrene from malnutrition, as in diabetes, and after loss of blood and exhaustion, the gangrene is of the extremities. The cheek is so richly supplied with blood, so quick to heal, that it would hardly be the first part of the body to give way under a general depression, but rather the last.

As regards the other view, it may be that in cancrum oris some other agent is added to those already at work upon the health of the child. This fresh factor is not the lingering effects of a fever through which the child may have recently passed, for cases of cancrum oris occur without this. Nor is it only the evils of poverty; for in that case cancrum oris would be much more common. Rather it is probable that this added something is imported from

without; that it is a fresh disease, a poison like the poison of syphilitic phagedæna and hospital gangrene, perhaps indeed the very same as these. These diseases are contagious; all they require is a proper soil and cultivation. And that cancrum oris has not yet been proved to be contagious, or to spread an epidemic of phagedæna, is due to its rarity, and to the prompt treatment given to it; and also, as Hutchinson suggests, to the fact that, as its process is very rapid and almost wholly one of gangrene, it destroys its own living pus-cells and nuclei, and thus limits its own power of spreading by contagion.

Thus, as phagedæna is a contagious disease, invading syphilitic sores—primary, secondary, and tertiary — commonly in young, fair, thin-skinned patients, whose secondaries are of an ulcerative type; attacking the patient, in many cases, more than once; laying hold on chancres of the glans more often than those of the foreskin, and on foul ones more often than clean ones; so cancrum oris also is phagedæna, invading the weakened or abraded or already ulcerated mucous membrane of the mouth in half-starved, fever-wasted children, or possibly first entering the circulation, and then finding in the cheek a suitable soil for development.

As yet, no organism has been isolated from cancrum oris, nor has the disease been inoculated. Dr. Sansom, examining the blood, urine, fæces, and discharge from a case on the third day, found in all of them small highly refractile bodies, like colourless crystals, about one-twentieth part of the size of a red corpuscle; their movement was spontaneous, rectilinear, influenced by chemical agents. They formed zooglœa-like masses, and became fewer with hæmorrhage and fall of temperature. The blood, injected into mice, produced septicæmia and death, with multiplication of the refractile bodies; the discharge, injected into a cat's abdominal cavity, produced fatal peritonitis, but no refractile bodies were found in the blood. (*Med.-Chir. Trans.* lvi.) In a second case of cancrum oris, Dr. Sansom did not find these refractile bodies. In the first case, he found the white cells irregular, diffluent, granular, and unduly numerous, the red cells unduly small. The nature and action of these refractile bodies remains uncertain; but the observation is of great value.

Lastly, it may be observed that Mr. Hutchinson's teaching as to cancrum oris is more in favour of this view than it was. In 1856 he says it differs from ulcerative stomatitis probably in degree only—that it is only an intense and rapid form of it; though he does not deny that possibly mere ulcerative stomatitis may be connected with a specific poison. In 1877 he classes together cancrum oris and noma as forms of sloughing phagedæna, and thus as allied to or identical with the contagious diseases called hospital gangrene and syphilitic phagedæna.

The *treatment* of cancrum oris is very discouraging. Every case of ulceration of the mouth of a child must be carefully watched. If it does not improve under large doses of chlorate of potash, with wine, tonics, good food and air, and local treatment, chloroform must be given, the cheek must be exposed, rubbed, and dried, and then carefully and slowly soaked with the strongest nitric acid. A saturated solution of bicarbonate of soda or potash should be at hand, to guard the action of the acid. The application may be necessary more than once.

If the child is not seen till the cheek is red, hard, and swollen, the acid must be applied at once, and poultices externally. If the black patch of gangrene has already appeared, it is useless to cauterise the inside of the cheek; it is best at once to punch out the rotten slough, to scrape and dry the hole all round as much as possible without making it bleed, removing as much dead tissue as will come away, and then to apply the acid freely. But in such a case, the sodden putrid tissues are apt to suck up the acid, and prevent its reaching the ever-advancing edge of the disease, and repeated applications only make bad worse. Since this is so, might it not be better, when once the whole thickness of the cheek has sloughed, to excise the whole slough with the knife? If the knife were carried clear round the disease, the first suspicious spot in the granulating wound would be immediately seen, and if only the angle of the lips were saved, the deformity might not after all be very bad. The use of the actual cautery, as Trousseau recommends it in advanced cases, 'by repeated application, including the whole thickness of the cheek, the gums, and the exposed bone,' is at least as severe. Both acid and cautery leave an eschar, which hides the spread of the disease and hinders their own further efficacy. It is possible that, in some cases, free excision might save life, where they would not.

STEPHEN PAGET.

CAPELLINE BANDAGE. *See* BANDAGES.

CANQUOIN'S PASTE. *See* CAUSTICS.

CARBOLIC ACID. *See* ANTISEPTIC SURGERY.

CARBUNCLE (*Syn.*: Anthrax) is a specific local inflammation of the superficial connective tissue, affecting to some extent the skin, and characterised by numerous openings which lead to a subcutaneous slough.

Its *Causes* are similar to those which produce boils. It is, however, usually found in those who are past middle life. Men are more subject to the disease than women. It attacks those who are debilitated by too good or too poor living. Thus, the plethoric and gouty suffer from it as well as convalescents from zymotic disease, and women who have been weakened by prolonged lactation. There is often a history of antecedent dyspepsia. The diabetic are especially liable to it, and according to Billroth, it is also frequent among uræmic patients. It has been known to follow the eating of diseased meat. The locality of the affection is often determined, in those who are already predisposed to it, by some friction or pressure. Hence it is apt to occur on the nape of the neck or on the nates.

Symptoms and Course.—Beginning as a red, hard, and very tender swelling of the skin, it rapidly spreads by the margins until a circumscribed, somewhat flattened elevation is formed, varying from an inch to six inches or more in diameter, and elevated one quarter to half an inch above the surrounding integuments. The colour which is at first red, soon becomes dusky, and even livid. In less than a week vesicles form over the middle of the swelling. These burst and leave a number of small openings, from which a thin sanious discharge exudes. As the openings widen, a greyish-yellow slough becomes visible. In the course of a few days they coalesce, and form a ragged aperture from which pus freely escapes, accompanied by large masses of slough. Soon a granulating cavity is left with undermined edges. By secondary union, and by the growth of the granulations, this is converted into a healing ulcer, which rapidly contracts and skins over. A puckered and somewhat discoloured scar remains.

The disease is usually single. Sometimes it shows a tendency to creep at the margins while the sloughs are being discharged at the centre. The duration may vary from two or three weeks to several months. It is apt to assume a chronic form in weakly patients, or where the thick skin retards the formation of the apertures by which the slough is discharged.

There is often considerable constitutional disturbance preceding the outbreak, such as chilliness, or even rigors, feverishness, irritability, and dyspepsia. While the swelling is growing, the fever may be of the sthenic type, and the pain is of an intense, throbbing character. In the aged, and in those in whom the affection has lasted two or three weeks, great prostration, with a typhoid condition, may supervene, and there is danger that death may occur from exhaustion or pyæmia. When the scalp is affected head-symptoms may ensue, and the patient may sink from coma preceded by delirium.

Pathology.—A carbuncle may be looked upon as a collection of boils, and it differs from them chiefly in the large destruction of skin by which it is attended. It is probable that the disease attacks first the sebaceous glands of the hair-follicles. Its chief site is in the connective tissue around them and immediately beneath the skin. The slough is composed of connective tissue infiltrated with fibrinous exudation and leucocytes. It is full of oil-globules from the disintegration of these structures, and its evascular condition is shown by the dirty yellowish-grey surface exposed when free incisions are used. The muscles are rarely attacked. It may sometimes give rise to plugging of the veins, and in this way lead to pyæmia.

Diagnosis.—Carbuncle may be distinguished from a boil by its size, by the numerous openings, by the livid colour, and by the fact that it is rarely multiple. From other phlegmonous inflammations it may be known by its circumscribed character, its brawny hardness, and the sieve-like perforations of the central covering. The peculiar character of the eschar will usually suffice for the recognition of MALIGNANT PUSTULE.

The *Treatment* by *local* means may be classed under four heads—

(1) Two free incisions may be made at right angles to each other through the slough into the living structures beneath and beyond. This method relieves pain and facilitates the discharge of the slough, but it is attended with so much bleeding that it should only be used in the young and robust.

(2) The same advantages can generally be obtained by the use of potassa fusa, small pieces of which should be thrust

through the openings into the slough beneath. If the openings are slow to form, or not large enough, small incisions may be made before inserting the caustic. By this plan the gangrenous mass is speedily and with little pain converted into a blackish gelatinous material, which is easily discharged. Care, however, should be taken to prevent the caustic from injuring the adjacent skin by the use of rags dipped in vinegar.

(3) Pressure by means of strapping carried over the swelling to the sound parts around has been strongly advocated. An opening should be left for the escape of the discharge.

(4) An expectant treatment with applications of linseed poultice or resin ointment.

After the employment of methods (1) and (2), a mixture of carbolic acid and olive oil (1 to 40), or boracic acid ointment, forms a good application. The pain may be allayed by the addition of the extracts of opium or belladonna to poultices or water-dressings. Plenty of nutritious food should be given, accompanied by alcoholic stimulants when the patient is in a debilitated condition. Dilute sulphuric acid with quinine and iron is beneficial.

Facial Carbuncle. — Ordinary carbuncles occur upon the face, which do not differ in their course from those situated in other regions. Occasionally, however, we see a very acute and fatal affection, which has some resemblance to the ordinary form, and has been described as *Malignant facial carbuncle*. This usually follows the accidental inoculation of some animal poison. Thus, the writer has seen it attack the lip of a woman who had been scratched by a child with severe scarlet fever, and the lip of a man who, after circumcision, had probably conveyed to it some matter from the sloughy wound which followed the operation.

It is generally seen at an earlier period of life than ordinary carbuncle,—e.g. between the ages of twenty and thirty. Beginning as an itching pimple, usually upon the upper or lower lip, the swelling rapidly affects the whole lip, which is soon four or five times the natural size. It is brawny, livid, and very painful. Numerous pustules or vesicles form, especially upon the red surface of the lip. The inflammation extends upwards towards the eye, or downwards towards the clavicle. The eyeball may protrude. Severe pyrexia with rigors accompanies the local disturbance. Pain in the side, bloody sputa, and other indications of lung-implication follow, and the patient may succumb to pyæmic phlebitis in a week from the onset of the malady. In a small number of cases, however, the constitutional symptoms are less severe, and the inflammation is not so diffuse. In these, after free suppuration from several points of the surface, the lip may return to its ordinary dimensions, and recovery may take place.

The disease appears to be essentially a phlegmonous inflammation of the lips following a poisoned wound, and setting up thrombosis in the facial or external jugular veins. The clots are apt to extend upwards into the cranial sinuses, and detached portions may give rise to purulent foci in the lungs. On section of the lip, numerous small abscesses are found, and not a homogeneous slough, as in true carbuncle.

The *Diagnosis* from ordinary carbuncle will depend upon the virulence of the constitutional symptoms, the youth of the patient, the position and appearance of the swelling, its tendency to spread along the veins, and the condition of the subcutaneous tissues when incisions are made. Many have confused the disease with malignant pustule; but in the latter affection the vesicles are close together, and grouped in a ring round a central blackish slough; the swelling is remarkably free from pain, and there is no suppuration. In malignant facial carbuncle the pustules are scattered over the surface of the swollen lip; there is acute pain, and the deeper structures are full of small abscesses.

The *Treatment* is to support the patient with generous diet and alcoholic stimulants, to give large doses of quinine, and to make free incisions into the swollen tissues. These should be subsequently dressed with carbolic acid or some other antiseptic material. N. Davies-Colley.

CARCINOMA.— *Structure.*— A carcinoma may be defined as a tumour composed of epithelial cells, generally contained in alveoli, the walls of which are formed of fibrous tissue. The cells vary in shape and size, and as a rule closely resemble the epithelium of the part in which the tumour has originated. Their shape depends also on the amount of pressure to which they are subjected by the surrounding tissues; they are often multi-nucleated, and increase both by endogenous cell-formation and also by fission. The cells lie closely packed in the alveoli and are not separated from each other by any matrix. The blood-vessels are well-formed and run in the trabeculæ, not between the individual cells, as in the sarcomata. Lymphatics accompany the

blood-vessels. The following are the chief groups of the carcinomata.

1. Epithelioma or squamous-celled carcinoma.
2. Rodent ulcer.
3. Spheroidal-celled carcinoma :—
   (*a*) Scirrhus.
   (*b*) Encephaloid.
   (*c*) Colloid.
4. Cylindrical-celled carcinoma; adenoid cancer; adeno-carcinoma.

1. Epithelioma.—*Clinical characters.* Epithelioma, or squamous-celled carcinoma, usually commences after forty years of age. It begins as a warty growth, raised to a varying extent above the surface, and at the same time growing to at least a proportionate extent into the subjacent tissues. It is this ingrowth that gives to epithelioma its typical induration. The growth generally becomes more or less papillated, and after a varying time the central part of the free surface tends to break down and ulcerate. In this manner it increases its area, spreading at the edges and ulcerating in the centre. Its progress is generally accompanied by much pain. The surrounding parts are infiltrated and destroyed by the new growth, which extends with much greater rapidity than does rodent ulcer; the neighbouring lymphatic glands are early affected, and the epitheliomatous mass in them runs a similar course to the original tumour. Not infrequently the glandular tumours increase even more rapidly than does the primary growth, and attain a greater size.

Secondary growths may occur in the viscera, but are comparatively rare. In untreated cases of epithelioma, the duration of life varies with the locality, and in some cases may extend over several years.

Symptoms.—When an epithelial ulcer is fully developed it is of a very irregular shape, with a deeply excavated and irregular base, greyish in colour, devoid of healthy granulations and secreting sanious pus; the edges are raised above the base of the ulcer and also above the surrounding parts; they are warty, sometimes ragged or fissured, and in places apparently undermined. On feeling the diseased part, it will generally be immediately discovered that there is a certain amount of new growth in the tissues, giving a sensation of induration around the ulcer to a varying extent; it will then be seen that it is the tumour itself which has ulcerated, and not the tissue in which it lies.

Diagnosis.—Epithelioma may be simulated by (1) innocent papillomas, (2) primary and tertiary syphilitic sores, (3) simple ulcers, (4) rodent ulcer.

(1) Simple warty growths and papillomas are generally easily separable from the epitheliomas; for in the former the tumour is essentially an outgrowth from the surface with little or no infiltration or hardness of the part from which it springs, with very slight tendency to destructive ulceration of any kind, and with but little vascularity, pain, or tenderness. Even in cases of long standing the lymphatic glands are not diseased. It is chiefly when inflamed or irritated that papillomas bear any strong resemblance to the malignant tumours, and it should be remembered that from the innocent papilloma an epithelioma may spring; if, therefore, there is any reasonable doubt, treatment by excision should not be delayed.

Venereal warts, especially when by pressure they have caused ulceration of the prepuce, occasionally grow in such a manner as to simulate epithelioma. The youth of the patient in most cases, and the history of previous urethritis in addition to the points just enumerated, will generally clear up any doubt.

(2) *Syphilitic Sores.*—Primary syphilitic sores, especially when occurring on the lip, may be mistaken for epithelioma. The youth of the patient in many cases, the very early and very extensive swelling of the glands, the amount of inflammation around, other evidences of syphilis, and the special characters of the sore, will in most instances enable the syphilitic chancre to be readily diagnosed.

Tertiary ulcers on the tongue and elsewhere are sometimes not readily distinguished from epitheliomas. Treatment often clears up the doubt, but it should be borne in mind that an ulcer, originally syphilitic, may become the seat of epitheliomatous new-growth. *See* Tongue.

(3) *Simple Ulcers.*—Simple fissures on the lips, chronic ulcers on the legs with thickened and raised edges, and, occasionally, simple ulcers on other parts of the body, occasion a slight difficulty in diagnosis, which readily clears up under adequate treatment. *See* Ulcers.

In all cases where there is doubt whether any given ulcer is epitheliomatous, a very small portion of débris from the ulcerated edge may be scraped away and put on a glass slide, in a little water, for microscopic examination. In most cases where the growth is epithelial, the cell-nests typical of this growth will be seen, either entire or in broken masses, in the field of the

microscope, affording positive evidence of the nature of the ulcer. If such nests are not seen, their absence does not necessarily prove the innocent nature of the sore.

(4) For diagnosis from rodent ulcer see *Rodent Ulcer* later on.

Structure.—Microscopically, these tumours are found to consist of ingrowths of epithelial cells arranged in the form of papillæ, columns, or cylinders. On any skin or mucous surface these ingrowths may readily be traced to an excessive development of the interpapillary processes of epithelium, which will be found gradually dipping further and further into the subjacent tissues. As these epithelial processes grow more deeply they throw out lateral branches, and, these latter uniting with similar cell-growths from neighbouring cylinders, form a rude epithelial network. At the same time that this ingrowth of cells occurs, a similar outgrowth takes place, and a warty excrescence of epithelium is formed on the cutaneous or mucous surface. As the tumour increases in size, the more superficial and central cells perish and fall away, thus leaving the deeper parts of the epithelioma exposed. Such a condition as this is usually spoken of as 'ulceration,' though there is not present any true granulating surface.

The epithelial cells of which the cylinders are composed are usually large, very irregular in shape, often possessing processes, multi-nucleated, and sometimes evidently in the process of proliferating by endogenous cell-formation. Embedded in these columns are a varying number of cell-nests, sometimes very numerous in any individual specimen, in other cases scarce, but rarely entirely absent. They appear to be composed of one or more central cells of a rounded shape, and often smaller than their neighbours; sometimes these central cells appear to have degenerated, and their place is taken by broken-down, granular débris. Immediately around the centre are small crescent-shaped cells, with their concavity inwards, and outside these again are layers on layers of similar-shaped, but larger, cells. It is probable that the nests are formed by the very rapid proliferation of cells at various foci in the tumour, that the cells first formed at any focus are pushed towards the periphery by the constant and rapid growth in the centre, and become flattened or crescentic through the resistance offered by the surrounding tissues. The chief significance of a nest is that it indicates rapid cell-growth, and therefore when occurring in the deeper parts of the skin is diagnostic of epithelioma, for no such formation occurs under other circumstances in this situation; although nests may be present normally, though rarely, immediately beneath the free surface of the epidermis. Around the ingrowing columns there is generally evidence of irritation of the tissues into which the tumour is making its way, and each column is more or less surrounded by numerous leucocytes.

Locality.—The most common situations for epitheliomata are at the junctions of mucous and cutaneous surfaces. They occur on the lips—almost always the lower lip—and other parts of the face, the tongue, the larynx, the œsophagus, the rectum and anus; on the penis, the scrotum—as 'sweep's cancer'—the vulva, the os uteri; more rarely on the skin of the extremities or trunk, especially in the site of old scar-tissue or of sinuses long discharging, and occasionally on the scalp and ear, in the antrum, and in the bladder. Epithelioma never occurs primarily in bone, but, as in the case of the jaw-bone, it may extend into osseous tissue from a contiguous mucous or skin surface. For *treatment, see* MALIGNANT TUMOURS.

2. RODENT ULCER. — *Clinical characters.*—Rodent ulcer occurs late in life, but may certainly appear as early as forty years of age or even earlier. Its common situation is the face, preferably the inner angle of the eyelids. Typically, it commences as a small wart, the centre of which ulcerates; the growth of the wart and the spread of the ulceration progress with about equal rapidity, so that at no time is there any large amount of new-growth; frequently the ulceration heals in one place while it spreads in another; the scar, when formed, is liable to again break down.

The growth of a rodent ulcer is essentially slow, yet the rate of its progress differs much in different cases. Sometimes, after an interrupted course of fourteen or fifteen years, the whole extent of the ulcer is not greater than could be covered by a half-crown piece, whilst, in other cases, large portions of the face may be destroyed within five or six years. The growth appears to extend most rapidly when it occurs at a relatively early age.

When fully developed, a rodent ulcer is a flattened growth of an irregular shape, with a grey, smooth, and glazed base, devoid of healthy granulations, discharging watery pus, cicatrised here and there, with edges raised above the level of the ulcer and of the surrounding parts. Rodent ulcer never

causes glandular infection, though the glands may become inflamed, and even suppurate. But, although the above description is true of typical cases of this disease, it is a fact that a rodent ulcer may, though very rarely, attain a considerable size without ulcerating at all, the surface remaining warty and tuberous.

At first a rodent ulcer tends to spread superficially, but, when it reaches bone, its progress is much more rapid, and the osseous tissue is quickly excavated and removed. Thus, in advanced cases, a great part of the skin of the face, the eyeballs, the nasal cartilages and bones, and portions of the calvaria may be entirely destroyed, so that the patient comes to present a most hideous appearance. Yet, even in this condition, life may be prolonged for years, for the distant viscera never become the seat of disseminated growths.

Diagnosis.—The diagnosis must be made from (1) Epithelioma; (2) Lupus; (3) Syphilitic ulcers.

(1) Rodent ulcer must be more especially separated from epithelioma. The first and great difference is found in the much slower progress of rodent ulcer; roughly speaking, epithelioma will grow as much in a month as a rodent ulcer in a year. Yet, here also care is necessary, for epitheliomas may originate in warts or pimples of long standing, so that a patient may, unless carefully questioned, unintentionally mislead the surgeon who asks him how long he has had the disease. In rodent ulcer, the ulcerated surface cicatrises in parts; epithelioma never cicatrises; but it must be remembered that in some rodent ulcers the surface is warty rather than ulcerated, though this is quite the exception. Rodent ulcer never affects the glands, epithelioma, after a longer or shorter period, almost invariably does. The amount of new-growth is generally much greater in epithelioma than in rodent ulcer, and the surface is more warty. Rodent ulcer does not occur in the most favourite sites of epithelioma.

(2) From ulcerative lupus rodent ulcer may be diagnosed as follows:—Lupus almost always *commences* before adult life, though it may *recur* in old age. It commonly occurs in strumous subjects. There is no evidence of warty new-growth; around the edge of the ulcer there are sometimes small tubercles which, by their breaking down, cause an increase in the extent of the sore; under constitutional treatment a healthy granulating surface may result, and a sound scar be formed.

(3) Tertiary syphilitic ulcers may be diagnosed from rodent ulcer by the early age of the patient in many cases; the evidences of syphilis; the presence of pigmented scars around; the much greater rapidity of the ulceration; the semicircular or serpiginous shape of the sore; the absence of all new-growth; and the success attending the employment of anti-syphilitic remedies.

Structure.—A rodent ulcer is a growth composed of embryonic epithelial cells, and must, therefore, be included amongst the carcinomata. Microscopically, it is found to consist of an overgrowth of epithelial cells in the deeper portions of the skin, often apparently commencing in the sebaceous glands. The growth invades the subcutaneous tissues in the form of large, flask-shaped ingrowths, frequently separated from each other by several normal papillæ and interpapillary processes of epithelium. The cells of which these ingrowths are composed are evidently epithelial, but, nevertheless, differ very markedly from those of the rete Malpighii and of the squamous epitheliomata, chiefly in being much smaller. In their further growth they differ again from the cells of epithelioma in their tendency to become vacuolated, and thus to form spaces in the centre of the ingrowing masses, and in that, with the most rare exceptions, they never form cell-nests in the epithelial columns, as do the cells of epithelioma. In rodent ulcer perfectly normal inter-papillary processes may often be found in the midst of the new-growth. This is never the case in epithelioma. The growth in rodent ulcer probably springs from the glandular epithelium in some of the appendages of the skin, and it is owing to this difference in origin that the tumour-growth differs from that of epithelioma, in which the growth always commences in the surface epithelium.

Locality.—Rodent ulcers are almost invariably met with on the face above the level of the mouth; perhaps their most common seat is the side of the nose and the inner angle of the orbit. They are sometimes found upon the ear and the scalp. For *treatment*, *see* MALIGNANT TUMOURS.

3. SPHEROIDAL-CELLED CARCINOMAS.—The spheroidal-celled carcinomas are subdivided into *a.* Scirrhus; *b.* Encephaloid; *c.* Colloid.

Clinical Characters.—Both scirrhous and encephaloid cancers are most commonly met with between the ages of forty and

sixty; they may occur, however, either earlier or later than these limits. Typically, a *scirrhous carcinoma* commences as a firm, nodular mass, which is at first painless, and so may attain considerable size before being noticed by the patient. An examination at an early stage of its growth reveals the following characters:—A tumour of variable size, surface irregular and nodulated, very hard indeed to the touch, often fairly movable in the tissue or gland in which it lies—e.g. in the breast—not very painful or tender; glands, if enlarged, very hard and freely movable. The rapidity of growth varies greatly, so that in some cases of so-called atrophying scirrhus the tumour may be no larger than a walnut after some three or four years' growth. Such cases are almost confined to the old, and are rare. After a varying time the tumour becomes fixed to the surrounding tissues; the skin becomes dimpled, puckered, and adherent; the patient suffers lancinating or stabbing pain, and the tumour is tender on pressure; the glands which are affected alter in character, just as does the original growth. *See* Breast, Diseases of the; Malignant Tumours.

Secondary growths in the viscera are common in cases of scirrhus, and the bones sometimes become brittle and fracture spontaneously. It is doubtful, however, whether the fragility of the bones exists except in connection with the development of cancer-elements in their structure. Sometimes scirrhous carcinomas are primarily multiple.

Medullary carcinomas grow much more rapidly than the scirrhous tumours, and early become adherent to the surrounding parts. They attain frequently a great size, and to the touch are soft or elastic, and sometimes fluctuating in places where they have undergone cystic degeneration. In their further development they run a course similar to that described as typical of the growth of malignant tumours in general. *See* Malignant Tumours. Metastatic growths are frequent, and the patient often succumbs within a year from the commencement of the disease.

The clinical characters of the *colloid cancers* are identical with those of the other spheroidal-celled carcinomas, the type varying in different cases, and resembling in some cases a scirrhous, in others a medullary, growth.

Diagnosis.—These tumours, when occurring in secreting glands, as is usually the case, must be distinguished from (1) the sarcomata; (2) cysts; (3) abscesses.

(1) From the sarcomata they may be diagnosed (*a*) by the greater age of the patient in whom they (the carcinomata) usually occur. Thus sarcoma of the testis occurs in the young, and even in infants; carcinoma in middle age or late in life. (*b*) By the presence of glandular affections in the carcinomas when the breast is the organ diseased, and by the absence of glandular affection in all sarcomas of the same part. (*c*) By the greater softness and more marked lobulation of the sarcomata, by the absence of puckering and retraction of the skin, and also of the nipple when the breast is the seat of sarcomatous growth. Carcinomas rarely grow in the parotid. In the testis it is often impossible to decide the true nature of a malignant growth.

(2) From deeply-seated cysts and (3) chronic abscesses of the breast the diagnosis is often difficult, and, in some cases, impossible. The age of the patient, a recent pregnancy or miscarriage, the greater softness and tenderness of any enlarged axillary lymphatic glands, œdema of the skin, with widely diffused tenderness, and, perhaps, an indistinct sense of elasticity or fluctuation, will all make probable the presence of a chronic abscess. In cases of doubt, exploratory puncture should always be resorted to.

Spheroidal-celled carcinomas sometimes commence in the skin, which rapidly gives way, and allows of the formation of a 'cancerous' ulcer with a fungating growth. Diagnosis must be made from inflammatory swellings and from the sarcomata. The rapidity with which the tumour increases, together with its hardness, the affection of glands, and the absence of suppuration, will generally admit of a diagnosis being readily made. *See* Ulcers.

Structure.—The spheroidal-celled carcinomata spring from the epithelium of the various secreting glands.

The tumour always commences by a proliferation of the glandular epithelium. The cells, increasing in number, first fill the acini and ducts, and then, continuing to proliferate, extend into the surrounding tissues. There, their presence causes a certain amount of irritation and consequent proliferation of the connective-tissue elements, and they thus become surrounded by leucocytes. In the usual course of events the leucocytes become developed and form connective-tissue bands around the growing epithelium cells, which in this way become shut up in spaces or alveoli. Later on, this newly-formed fibrous tissue tends to contract and become more dense, in exactly the same manner as does scar-tissue; and as

the oldest parts are always the most central, it is in the centre that the firmest portion of the tumour is to be found.

Considering that a certain amount of time is requisite in order to allow of the formation and contraction of this fibrous stroma, it will readily be understood that it is most abundant in the more slowly-growing tumours. It is, therefore, most plentiful in scirrhous carcinomata. On the other hand, in the rapidly increasing encephaloid growths, the walls of the alveoli are extremely thin.

(*a*) Scirrhous Carcinoma.—*Examined microscopically*, a scirrhous carcinoma is found to consist of epithelial cells lying in a connective-tissue stroma composed of interlacing bands of fibres. The spaces, or alveoli enclosed by these bands, are very irregular both in shape and size, and are smaller towards the centre of the tumour than at its periphery. Lying within the alveoli are numerous epithelial cells of different shapes, often undergoing fatty degeneration in the more central parts of the growth. Where the stroma is most loosely arranged, as at the edge, the cells are larger and more evidently epithelial than in the central and denser portions of the tumour; they often possess several nuclei and nucleoli.

In the larger alveoli as many as thirty or forty, or more, cells may be massed together; whilst in other parts they lie in single file, in groups of two or three, amidst bundles of connective tissue. Intimately mingled with the constituents of the tumour, as just described, are numbers of small round connective-tissue cells and young connective-tissue fibres; they are most abundant at the periphery of the growth.

To the naked eye a scirrhous cancer presents itself in its most typical form as an opaque, white, fibrous mass, very firm and dense, concave on section, and with an irregular margin. At the edge of the tumour there will often be seen small masses of the surrounding fat or other normal structures which are being infiltrated by the tumour, and which have, as it were, been entangled by the new-growth preparatory to being absorbed. There is no attempt at encapsulation. The surrounding tissues are puckered and drawn in towards the tumour mass, which sends into them irregular branching processes. On scraping, the tumour yields a milky juice.

In other cases the tumour is more succulent and lobulated, and not so definitely fibrous; whilst in rare instances there is a general infiltration of the tissue with new-growth and no very definite tumour is found. The appearance of a scirrhous cancer will further differ according to the amount of degeneration it has undergone, so that in some instances cysts containing a bloody fluid will be found in the centre of the growth. Where the tumour has developed in the breast, it is very common to find the remains of the ducts in the midst of the new-growth filled with inspissated secretion, which may be squeezed out in small masses somewhat similar to the secretions found in the sebaceous glands in acne.

Locality.—By far the most common seat of scirrhous carcinoma is the female breast; but this form of cancer is also found to occur primarily in the œsophagus, the stomach—especially at the pylorus—the bladder, the rectum, and the skin.

(*b*) Encephaloid Carcinoma.—*Microscopically examined*, an encephaloid carcinoma consists of an alveolar stroma containing masses of epithelial cells. In a typical case the alveolar walls are very thin, and are frequently composed of spindle cells and young, half-developed fibres. The general outline of the alveoli is more rounded, and their size more regular and much larger than in the case of scirrhus. The contained, numerous, closely-packed epithelial cells are large, with clear cell-bodies, many nuclei, and a large number of nucleoli. The bulk of the tumour is cellular.

To the naked eye, on section, an encephaloid carcinoma shows a soft, greyish or brownish-grey, brainlike mass, frequently containing cysts, very readily breaking down into a pulp, and nowhere bounded by a capsule.

Locality.—The female breast and, more rarely, the testis, stomach, bladder, rectum, and skin. Encephaloid carcinomata are much more rarely met with than the scirrhous variety. Their supposed frequency depended on their having been only of late years separated from the brainlike sarcomata.

(*c*) Colloid Carcinoma.—This is but a name given to a spheroidal-celled carcinoma, the cells and stroma of which have undergone degeneration. The alveolation is usually well-marked, but in places the fibres have become swollen and indistinct or hyaline; occasionally two alveoli run together through excessive degeneration of their walls. The cells are often indistinct and swollen, with the exception of their nuclei, which are generally well-marked and stain deeply. Frequently the nuclei alone can

be distinguished, but in other cases the cell-body may be seen distended with colourless, homogeneous, colloid matter.

To the naked eye a colloid carcinoma presents a very typical appearance, looking like an irregular meshwork, the spaces of which are filled by a clear, jelly-like, or slightly opalescent, gelatinous substance. Towards the periphery this appearance is less marked. These tumours are never encapsuled.

Locality.—Colloid carcinomas are most common in the stomach, but are found also in the intestines, the breast, and very rarely in other parts of the body.

4. Cylindrical-celled Carcinoma or Adenoid Carcinoma. — *Clinical characters.* — Cylindrical-celled carcinomas vary much in their clinical course and characters. In some cases they exist for many years without attaining any great size, without affecting the neighbouring glands, and without becoming disseminated. In other cases, they grow rapidly, fungate and bleed, affect both glands and distant organs, and rapidly destroy life. It is not possible to say, from a microscopical examination of such a growth, what course it will run.

The diagnosis of these growths will be found discussed in the article on the diseases of the Rectum.

Structure.—These tumours, like the spheroidal-celled carcinomata, originate in the secreting glands. Microscopically examined, they are seen to be composed of tubules lined with columnar epithelium, arranged so as to form a central lumen, after the manner of a simple tubular gland, and in addition to this growth, which possesses the appearance of a simple adenoma, there is generally present a considerable overgrowth of epithelium, not arranged after the glandular type, but occurring as masses of cells grouped in greater or less number in an alveolar stroma after the manner of a scirrhous cancer. Between the latter typical carcinomatous structure and the adenomatous growth all intermediate steps can be readily traced.

The structure of the alveoli does not materially differ from that already described as occurring in the spheroidal-celled carcinomas, but the cells are columnar or cylindrical in shape, and are generally numerous, large, and well-developed.

To the naked eye, the cylindrical-celled carcinomas present themselves as villous or papillary tumours of whitish hue, infiltrating the deeper tissues to a varying extent, and never encapsuled.

Locality. — Adenoid carcinomas occur most frequently in the rectum; much more rarely in the superior maxillary bone, the uterus, the bladder, and the stomach.

Melanotic Carcinomas. — Deposit of pigment in carcinomatous growths is rare, and may be said to be limited to a few cases of epitheliomata. Almost all melanotic growths are sarcomas. *See* Sarcoma.

For the Etiology and Clinical characters of malignant tumours, and the Treatment of the carcinomata, *see* Malignant Tumours.

W. Morrant Baker.
Anthony A. Bowlby.

CARDEN'S AMPUTATION. *See* Knee-joint, Amputation at the.

CARIES implies molecular death and disintegration of bone, attended with suppuration. The same kind of changes which occurs in ulceration of the soft tissues, is expressed by the term caries when bone is the part under consideration. The word has been used in very various ways, as, for example, in 'caries sicca,' to express inflammation of bone without suppuration, and it has thus led to considerable confusion. But it would be far better to call such cases ostitis, rarefying ostitis, tubercular ostitis, and so forth, using the term which seems most appropriate for each, and to limit the term 'caries' to those cases in which suppuration has occurred. It may be understood from this that ostitis not unfrequently terminates in caries.

Causes.—The same causes that give rise to inflammation of bone, and that are considered under Ostitis, may produce caries. Some slight injury is often the exciting cause. But struma or tubercle is generally present, and these two diseases may be looked upon as the special conditions—if indeed they are distinct from one another—which are mainly responsible for the commencement of caries. Caries is also sometimes caused by syphilis, and is then peculiarly intractable, being generally the result of a broken-down gumma in the periosteum and superficial layers of the compact bone. It would, in this superficial variety of the disease, be very properly described as ulceration.

Pathology.—Caries is met with chiefly in the short spongy bones, such as those of the carpus, tarsus, and the vertebral column, or in the cancellous tissue of the articular extremities of the long bones. The first stage of the process is probably 'rarefying ostitis,' although some patholo-

gists assert that it begins as a fatty degeneration of the bone-cells in the lacunæ. According to this theory, the trabeculæ being killed by the death of their cell-elements act as foreign bodies, and set up suppurative inflammation around them. But whatever be the primary condition—a condition which need not here detain us—inflammation of a low and chronic kind is eventually established. The periosteum becomes much thickened, highly vascular, and loosened from the bone. Its under surface is rough and covered with a layer resembling granulations which fit into the enlarged openings of the Haversian canals. The latter are dilated and their connective tissue infiltrated with inflammatory exudation, which develops slowly into granulation-tissue. The bone thus becomes more open and spongy, so that the cortical part resembles cancellous tissue. Pus, thick and curdy, is very slowly formed, and finally—perhaps after many months—makes its way to the surface as a chronic abscess. In this rarefying ostitis, some parts of the bone may not have melted away so quickly as others, and, being cut off from their nutritive supply, may perish. When this occurs, and sequestra are found in a carious cavity, the condition is called 'caries necrotica.' This is not uncommon in tubercle and syphilis. In some cases very little pus is formed, and the cancellous spaces enlarged by the absorption of their bony walls are filled with vascular granulation-tissue. This fungating form of caries ('caries fungosa') is especially common in the spongy bones, and in the epiphyses of the long bones, where it often opens into the neighbouring articulation, as is described in the article on joint-diseases. After a varying length of time, the fungating granulation-tissue undergoes fatty degeneration, which is then followed by softening and suppuration. Fatty degeneration and softening do not, however, necessarily ensue, and the cavities may remain filled for a variable length of time with the pink gelatinous granulation-tissue, which is again slowly absorbed, leaving the bone smaller and shorter than it was before. This variety, which is called 'caries sicca,' is seen occasionally in the articular extremities of a long bone, and produces considerable shortening of the extremity without suppuration. In the early stage of almost all these forms of caries, at a time when the disease corresponds chiefly to the rarefactive type of ostitis, some new bone is generally produced in the neighbourhood of the inflamed area, so that the bone appears enlarged.

Symptoms.—The symptoms in the early stage of the disease may be those only of ostitis, which will be found described under that heading; or the increased size of the part may be less evidently due to an enlargement of the bone itself than to a deep-seated swelling of the tissues in immediate contact with it. The presence of pain at night, the persistence of the tumefaction, and the tenderness on deep pressure, will then be the chief points indicating the presence of inflammation of bone which may terminate in caries. Often, however, a swelling which proves on examination to be a chronic abscess, is the first sign which the patient has himself recognised of the disease. The mere fact of the accidental discovery of such a chronic abscess will arouse the surgeon's suspicion of the case being one of caries.

Occasionally, the patient comes under observation for the first time with the sinus, which has resulted from the opening of the abscess already formed. Then the probe decides at once upon the nature of the case. It may sometimes be a little difficult to reach the bone, particularly in cases in which the sinus has existed for a long time, and the bone is not superficial. If, after a careful and fair trial with the probe, bent and moved in various directions, the bone has not been touched, and the impression is left on the mind that the end of the sinus has not been reached, then the fistulous opening may be enlarged to facilitate the movements of the probe, or Sayre's vertebrated probe may possibly be of service, but the writer has not much confidence in the use of this latter instrument. The character of the sinus and its discharge may also throw some light upon the nature of the case. The button-shaped, pouting granulations, which surround the opening, too surely indicate the presence of diseased bone at the bottom of the sinus, and in caries they are generally more fungating and œdematous than in necrosis. The discharge is also thin and watery, containing frequently small, gritty particles of bone; it may also be offensive if putrefaction be not prevented by suitable treatment. The probe, as it strikes upon the carious part, fails to elicit the clear, sharp, ringing sound which is generally noticeable in the case of necrosis, but conveys the impression that the bone is rough and bare. Being also spongy and fragile from the nature of the disease, it not uncommonly gives way before the pressure of the probe.

Treatment.—The general treatment in caries is more than usually important, for

the operations which are undertaken for its relief are not so uniformly successful as in other diseases of bone. If there be any grounds for suspecting syphilis to be the cause of the disease, iodide of potassium alone, or in combination with mercury if the former fail, must be given in gradually increasing doses, in the manner described under Periostitis.

Struma or tubercle being, however, the most frequent cause of caries requires more than a passing mention as to its treatment. Cod-liver oil probably holds the foremost place amongst the constitutional remedies in caries as in other strumous or tubercular affections. Iron and the iodides may also be of service. But, in the young, change of air, and especially to the seaside, will often bring about a successful result when no other treatment seems of any avail. It is truly astonishing to see the progress such cases make when they are sent from a London hospital to the Margate Infirmary.

As far as local treatment is concerned, rest and free openings for the discharge are the first and most important indications. Rest should be obtained, where it is possible, by a splint, and in the case of the foot by a knee-rest, so that the patient may not be confined to bed. Incisions should be made in dependent places when the discharge does not seem to escape with sufficient freedom. If the case come under observation before the abscess has opened, the incisions and subsequent dressing should be conducted with antiseptic precautions. A drainage-tube should be inserted, and some antiseptic absorbent wool will generally be found to be the most convenient form of dressing. Sufficient time having been allowed to elapse for these general and local remedies to take effect, the question arises what operation, if any, should be adopted; and here considerable latitude must be given to differences of opinion, according to the special features of the case. Some surgeons hold that there is very little to be gained by gouging away the diseased part; that if it becomes absolutely necessary to interfere on account of the exhaustion produced and the intractable nature of the disease, the choice of operation lies between excision of the whole bone affected, and amputation of the limb. Without going thus far, we may infer, from this opinion, that gouging away the diseased part of the bone is not held in very high favour. Such partial operations on bone were, in former days, peculiarly prone to be followed by pyæmia. The latter is not so frequent now that every surgeon makes thorough and effectual endeavours to prevent the occurrence of decomposition in the discharge which would otherwise necessarily ensue. The disease must, however, be chronic before such an operation is undertaken.

The limb should be rendered bloodless by Esmarch's bandage, so that the limits of the disease may be clearly defined. This is more essential in caries than in necrosis, for the diseased area is surrounded by rarefied bone, which is not easily distinguished from caries. The difference between the two is generally indicated by the crumbling non-vascular, almost white condition of the latter, whilst the healthy, although inflamed, bone, is firmer and more resistant to the gouge, and on removal will be found pink and vascular. Gouges of various shapes and sizes may be required, and Volkmann's sharp spoons may also be of great assistance, especially in the removal of granulations, which should be all cleared away. The cavity should then be sponged out with chloride of zinc from gr. xx. to gr. xl. ad f℥j., and some absorbent dry dressing, such as iodoform or salicylic wool, applied. This will not require changing for some days, and, after the first redressing, may generally be left untouched for a week.

Instead of using the gouge, some surgeons prefer the actual cautery, and Mr. Pollock has recommended the application of sulphuric acid, diluted at first with an equal quantity of water, and then more nearly pure. As soon as the eschar thus formed can be removed, the sulphuric acid is again applied, till a healthy surface of granulations is obtained. Mr. Holmes speaks favourably of this treatment, as also of that by the actual cautery.

Where the small bones are the parts diseased, such as those of the tarsus or carpus, excision, with or without the periosteum, is often the best operation, if the caries involves the greater part of the bone. This is especially the case in the os calcis; but if more than one bone is involved, amputation will probably be required.

The other small bones, entering into the formation of ankle- and wrist-joints, are more properly considered under Joints, Diseases of.

Amputation is very rarely required for caries, except in the case of joints, the diseases of which are considered in another article. H. H. Clutton.

CARIES OF THE SPINE (Pott's Disease).—This is especially a disease of childhood. It may begin in the first year of life, and even, it is stated, *in utero*. Most

cases are under sixteen years of age. It has been known to begin at seventy years (Ogle). Both sexes are said to be equally affected, though the writer's figures give a preponderance of twenty-five per cent. to males.

A remote constitutional cause can be generally traced in scrofula or tubercle; the exanthems, especially scarlatina and measles. In adults, syphilis in the form of gumma (Fournier), or following syphilitic pharyngitis. An immediate cause is often local injury, from falls, blows, strains; while certain occupations seem, at times, to account for it, e.g. those of well-sinkers, signalmen, compositors. Violence is almost necessarily applied indirectly to the vertebral bodies, which are more subject to strains than other forms of injury, at their unions with the discs.

Pathology and Course.—Caries of the spine begins usually at the junctions of the bodies of the vertebræ and the intervertebral discs. Even in advanced cases the laminæ and spinous processes escape. In atlanto-axoid disease it begins as a synovitis of the joint. The onset is insidious, the course chronic, occasionally only rapid and acute; but the pathological conditions in no way differ from those of caries of the other cuboid bones, or of the spongy ends of long bones. Since the flat surfaces of the vertebral bodies are epiphyses, caries may be regarded as commencing as an epiphysitis or articular ostitis.

Caries destroys the intervertebral discs and adjacent bone above and below, thus contrasting with the absorption due to pressure of aneurism—also a cause of angular deformity—in which the cartilages remain intact after the bone has disappeared. The bone-destruction may be quite superficial, and be only suspected when abscess has formed; it may, though rarely, begin in the spinal canal on the posterior surfaces of the bodies under the posterior common ligament. Any matter thus formed lies outside the theca vertebralis. At times there is necrosis as well as caries. Sequestra may be discharged externally, or be found at the autopsy in the cavity formed in the spine, and unsuspected during life.

Suppuration does not necessarily accompany spinal caries; but it may exist, yet never be seen, during life (e.g. it may form an abscess in the posterior mediastinum). Its extent is not proportionate to the apparent extent of disease, nor can it be predicted in any case. It may be the earliest objective sign, or it may be the last symptom in a case. The writer's figures show visible suppuration in about twenty-five per cent. of all cases.

Where suppuration is absent—*caries sicca*—the bodies of the vertebræ, in lieu of being destroyed so as to produce a larger or smaller continuous chasm in the front of the spine, are seen sometimes to be honeycombed by the carious process and filled with granulation-tissue, a condition known as *myelitis granulosa*. Extensive disease may then exist without deformity, the bodies being perforated rather than destroyed. But little practical good results from a distinction between suppurative and non-suppurative caries, for, as stated above, the absence of visible suppuration does not preclude the pathological probability of its existence. Most frequently there is but one focus of disease, and this involves one or many vertebræ, but two or more may be present in different parts of the spine. They may be contemporary or successive.

In proportion as the bodies and discs are destroyed, so will the second stage of the disease be reached—that of deformity or *angular curvature*—but deformity is absent where the caries is only superficial. The weight of the superincumbent trunk and limbs causes the bone above the cavity in the bodies, formed by the disease, to approach that below it until they meet; the spines of the intervening diseased vertebræ are protruded posteriorly as a knuckle or boss. Where a vertebral body is only partly destroyed or only softened by inflammation, the pressure described will cause it to become wedge-shaped, the base of the wedge being posteriorly, and its spine will unduly project.

The largest and most quickly formed bosses are to be seen in the dorsal region, simply because in the mid-cervical and lumbar regions there is a natural concavity of the spine backwards, which must be obliterated before a posterior projection can occur, but the dorsal spine is naturally convex posteriorly. In the cervical region disease of the third or fourth vertebra shows itself rather as a thickening than a distinct boss, and in the last three lumbar vertebræ a boss is rare. These vertebræ are so firmly interlocked, and are so broad, and their large transverse processes give such powerful muscular attachments, that the back can be held rigid and straight.

The most common seat of disease is between the first lumbar and twelfth dorsal vertebræ (Hueter). The writer's cases show the dorsi-lumbar region (second lumbar to tenth dorsal) as most frequently diseased, and, after that, the following is the order of

frequency: dorsal, lower lumbar, cervical vertebræ, cervico-dorsal (seventh cervical to third dorsal), atlanto-axoid articulation.

In the occipito-atlantoid, atlanto-axoid, and sacro-coccygeal regions disease begins as a synovitis of the respective joints. It is usually chronic, but death in two weeks from pyæmia, after acute synovitis of the atlanto-axoid articulation, is recorded. In the atlanto-axoid articulation the left side is more frequently affected than the right (Rust). From the joint the disease spreads to the arch of the atlas and body of axis, portions of which—or even the entire odontoid—may come away as sequestra through a post-pharyngeal abscess. The deformity in atlanto-axoid disease is peculiar. Where both joints are diseased the head and atlas slide bodily forward upon the axis, the spine of the axis forming an apparent boss, with a deep sulcus between it and the skull. Where one joint is affected that side only is projected forward, and hence the face looks to the opposite or sound side.

Narrowing of the spinal canal, as the result of deformity, is not seen in angular curvature. The anterior wall of the canal being gone, there is, even in extreme curvature, positively more room for the accommodation of the cord, whilst the chronicity of the change gives time for the cord to accommodate itself to the altered shape of its chamber. But in atlanto-axoid disease, where the atlas slides forwards upon the axis, the canal is narrowed, the posterior arch of the atlas gradually approaching the odontoid process, and as gradually are the functions of the cord interfered with, and death results. Yet extreme narrowing, if gradual, is not necessarily fatal; a man has lived years with only a quarter of an inch between the arch of the atlas and the odontoid, and that without any subjective symptoms; a lad, æt. fifteen, has lived some time, though with gradually increasing paralysis, in whom, at death, the canal at this point measured but three lines in the same direction (Paget).

Angular curvature in the cervical and cervico-dorsal regions causes dyspnœa from the forcing of the chin on to the sternum; in the mid-dorsal region it deforms the chest, reducing its vertical depth and interfering with the action of heart and lungs; in the lower dorsal region it bends the thorax upon the abdomen and interferes with the digestive organs, causing mechanical dyspepsia and frequently intercostal neuralgia.

The formation of pus causes fresh pathological states. It may appear externally as abscess (*see* Psoas, Lumbar, Retro-Pharyngeal Abscess), or it may remain concealed behind the peritoneum or in the posterior mediastinum, and may be unsuspected till it breaks into a viscus or serous cavity. It may occur at any period of the disease, or not at all; or, as a residual abscess, when apparently complete repair has taken place.

Interference with the functions of the spinal cord is specially correlated to the presence of pus. Chronic meningo-myelitis is the result of caries and suppuration in the proximity of the theca vertebralis, though pus may travel along the canal at times without doing any harm. The condition is one of thickening of the meninges with caseation, with inflammation of the cord, or even complete suppurative disorganisation. This is not confined to the level of the bone-disease; it spreads upwards and downwards; lumbar caries has been known thus to produce fatal cerebro-spinal meningitis. Acute cerebro-spinal meningitis in caries of the spine is always, or nearly so, due to miliary tubercle.

The paralysis of spinal disease is motor, and explained by the proximity of the disease to the anterior columns of the cord; in advanced cases anæsthesia may follow; paralysis of sensation is unusual as an early symptom; it then only amounts to numbness. Paralysis is due to inflammation in meningo-myelitis, or to pressure from confined pus or blood (e.g. ulceration into vertebral artery), and in atlanto-axoid disease, to the presence of displacement. It is rarely complete at first; it is ingravescent; it may affect one limb or be symmetrical, or in cervical disease may involve an arm and the opposite leg. In the paraplegic form the rectum and bladder usually escape; the patient, though unable to walk, retains power over his evacuations. Evidently recovery depends upon the cause of the paralysis. Cases due to pressure are the most favourable: paralytic attacks may be repeated, recovery occurring between each; when sensation is lost it is recovered before motion.

Death in spinal caries results often from exhaustion by suppuration or septicæmia, especially where abscesses have been opened non-aseptically; from hæmorrhage due to abscess opening into an artery, as the vertebral or iliac; from suppurative peritonitis or pleurisy; pneumonia; tuberculosis; amyloid disease; meningitis; and the sequelæ of paralysis. In atlanto-axoid disease, gradual or sudden pressure upon the cord from dislocation of the bones, and suffocation from the bursting of a post-

pharyngeal abscess, are special fatal results.

Symptoms.—It is of vital importance to recognise spinal disease before the advent of the later stage of angular curvature; yet many cases do not seek relief till a boss is developed, the premonitory signs having been so slight. Pain is generally an early symptom, of a dull, aching, gnawing character, situated in the back, with a sense of back-weakness. The pain is aggravated by movement, pressure, or jarring, and quickly relieved by complete rest. It is accompanied at times by muscular spasm and cramp; the former in cervical disease causing wryneck from rigidity of the sterno-mastoid muscle, the latter, when in the legs, producing a peculiarity in the gait. Neuralgic pains are referred along the course of the nerves near the roots of which the disease exists, hence sciatica and intercostal neuralgia; in mid-dorsal disease there is pain at the pit of the stomach, or a sense of constriction round the belly; in cervical disease, neuralgia of the brachial plexus, and in the scalp along the great occipital nerve (Hilton).

Children with early caries are seen lolling about, undesirous of play, uncompanionable, out of temper, and clearly show they wish to be left alone. When standing they hold on to the furniture, or even rest their hands and chins on the edge of the table. Their complaints of pain are very vague: it may be situated in the back, but as likely as not in the legs or belly, and from standing with one hand on the thigh to give support to the back, are usually suspected by parents of hip-disease, or all is explained as 'growing pains.' They strut instead of walking, which is due to holding the back stiff to prevent movement of the inflamed parts; but cramp or spasm of the calves sometimes gives a peculiarity in walking. When stooping to pick up an object, one hand is placed on the thigh, and the child reaches the ground with the other hand by bending the knees, or may at once kneel outright.

Firm pressure over the vertebral spines reveals a tender spot; and pain at the same place is manifested by pressing on the patient's head or shoulders, or by jarring the back; spasm of the erector spinæ is also present, and occasionally local heat and hyperæsthesia of the skin to heat and cold. By lifting the shoulders of the patient, and removing the weight of the trunk from the diseased bone, the pain is usually much relieved. When in later stages angular deformity is present, the case is easy to recognise; the boss is formed of one or of several spinous processes, and is accompanied by the thoracic and abdominal deformities already mentioned, when in the dorsal region.

In the cervical region special symptoms are present. Muscular spasm causes wryneck; from the forward position of the head the patient appears short-necked, and either a boss or thick convexity of the spine is felt posteriorly. Though commonly the chin approaches the sternum, sometimes in young children the head is thrown spasmodically backwards; the whole body is turned in lieu of rotating the head (but this is not confined to atlanto-axoid disease), and expiration is accompanied by a characteristic grunt; when dysphagia is also present, retro-pharyngeal abscess must be looked for. When standing or sitting the head will be supported by the hands. In disease of the atlanto-axoid articulation grating on forced rotation of the head may be at times felt, and the whole head is preternaturally forward, or the face looking to one side, for reasons given above. In advanced disease from gradual narrowing of the canal there is dyspnœa, with a sense of impending death, making the patient afraid to lie down; the supine position may even cause death by pressing the head forwards, were not a small pillow placed under the nape (Hilton). Equally dangerous is it to allow the patient to lean forwards.

The paralysis of spinal disease in children is often early overlooked or ascribed to clumsiness; hence, stumbling constantly in walking, and falling unduly at play, should excite suspicion. In adults the gait becomes shuffling, and numbness, neuralgia, and persistent cramp are at times the precursors of paralysis. Paralysis appears at all stages of the disease, and is, at times, the first symptom that attracts attention; there may be no objective sign of disease, but local tenderness in the spine will be present on careful examination.

When, accompanying paralysis, there is much rachalgia, with spasm of muscles, shooting pains and cramps, meningitis is likely to be present. When, later, the paralysis is complete, with loss of sensation and paralysis of the sphincters, profound changes in the cord from myelitis or pressure must be suspected. A sudden onset of complete paraplegia, with fever, delirium, cerebral symptoms, and optic neuritis, ending fatally, in the course of spinal caries, points to cerebro spinal meningitis due to acute tubercle.

Diagnosis.—In the later stage of angular curvature no difficulty occurs in diagnosis;

though the possibility of aneurism, or tumour (hydatid), must be remembered.

In the early stage, any one of the subjective symptoms before mentioned may be the first complained of. In adults, numbness of the limbs, unsteady gait, persistent cramp, sciatica, neuralgia, constricting pain round the belly, especially excite suspicion of spinal disease. In children, so-called 'growing pains,' aversion to exertion, fearfulness of sudden movement, a desire to lie down, or to lean when standing, any peculiarity in walking, persistent 'stomach-ache' without derangement of the bowels—in a word, acting the malingerer from school, should never be disregarded. Pathognomonic of atlanto-axoid disease are stiff-neck, forward or sideway position of face, and posterior hemicrania (neuralgia of great occipital nerve).

In seeking for local pain in suspected cervical disease, it must be remembered that pressure over the fifth vertebra is distinctly painful, as compared with that over the other vertebræ, even in healthy people; and the vertebra prominens must not be mistaken for a boss. Both these mistakes the writer has seen made.

Treatment—(*a*) of caries of the spine; (*b*) of angular curvature.

(*a*) When the disease is active, as mostly indicated by pain, either early in the case or as a relapse, and if fever is present or paralysis threatens, absolute rest, giving immobility to the diseased bone, and relieving it from the superincumbent body-weight, is essential. This is best attained by the supine position on a hard mattress, and, where feasible, this plan should be adopted. If a child, he can be removed, mattress and all, into the open air, and as much change given as possible, but the same posture must be rigidly maintained. In this stage, blisters over the seat of pain are valuable; they quickly relieve the pain and, presumably, inflammation; two or three in succession must be used. Where there is local heat, with hyperæsthesia, leeches are preferable; setons used to be employed, but their annoyance is disproportionate to their benefit. When acute symptoms are not present, and especially with older patients who cannot be carried into the open air, or with those who are unable to obtain the necessary nursing, mechanical appliances are to be used; with these the patient can move about, and the general health improves thereby. Yet there is no appliance that can give the physiological rest that bed does, hence all appliances are useless whilst lying down; but to keep up the health and spirits requires more nursing attention than can usually be afforded, so mechanical support is employed in most cases. The instrument best adapted to the purpose is *Sayre's plaster-of-Paris jacket.* It is a rigid corset, moulded to the extended portion of the trunk, closely fitting, firmly grasping the pelvis, and reaching breast-high. It acts as an all-round support, and if applied during extension, it keeps off the weight of the upper part of the body from the disease, and holds the trunk straight, simply because any endeavour of the trunk again to 'telescope,' when the patient stands, thus necessitating a proportionate increase of breadth, is prevented by the rigid jacket, in which there is no room for the latter to take place.

Method of Application.—A tight-fitting, specially-woven, merino, sleeveless vest (but any merino vest will do if without buttons), and fastened by its two tags over the shoulders, is put on; its lower edge—which must reach the trochanter at least—is attached to a petticoat or towel wrapped round the legs; it is thus held down, and strained tightly to fit. Between it and the belly, and reaching down from the ensiform cartilage, is placed a flat bedroom towel, folded as when clean; this is the 'dinner-pad,' and it allows room for distension of the abdomen. The pad is not necessary in children who have prominent bellies, but is generally requisite in older patients; the towel is large enough for an adult, in others, a folded napkin is sufficient. If too large, the pad, when removed, leaves too much room, and the jacket may slip round and be useless. Small pads to protect the breasts are used in female patients. The patient is now suspended by two padded straps under the arms, and a collar which supports the chin and occiput, all being attached to a steel cross-bar, which can be raised or lowered by pulleys attached to a tripod or the ceiling. The patient is then gently raised on to tiptoe, or else right off the ground, the guide being pain. If in pain before, such extension only should be used as to make the patient easier; if not, then the extension may be carried out to the full, or short of producing any feeling of strain in the back. If pain be the guide as to the degree of extension, there is no risk of doing harm. Manifestly the degree to which extension may be carried depends upon the stage of the disease and the patient's weight.

All bosses or bony prominences, especially the anterior iliac spines, are now protected with pledgets of wool laid on

outside the vest; if not so protected, sores from rubbing may result. The bandages are then applied. They are strips of the coarsest muslin (crinoline) 4½ yards long and 4 inches wide, previously prepared by being thickly dusted with *freshly-made* plaster of Paris before being rolled up. To moisten them they must be stood on end, two or three at a time, in a depth of water sufficient to cover them; when bubbles cease to rise they are ready to be applied. The first bandage is commenced round the hips, three-quarters of an inch below the anterior iliac spines, and holds in position the wool-pads that have been applied; after being firmly applied round the pelvis, it is carried obliquely upwards over the trunk, until it and the following bandages are equally distributed between the hips and chest. The lowest limit of the jacket is three-quarters of an inch below the iliac spines; the upper lies easily under the armpits, and should not make the patient high-shouldered. During the application an assistant keeps smoothing the bandages, and adapts them when requisite; turns are to be avoided as far as possible, nor should the bandages be drawn tightly, since they shrink on drying. The number of bandages varies from two to seven or eight. Children of ten years of age require three or four. With good plaster the jacket will have set before the patient is taken from the swing; but if the patient cannot remain the requisite time, he must be lifted down and laid on a mattress on his side until the jacket is set, and be then removed to bed, rolled up in a blanket. He should not, if possible, be allowed to walk until the following day. The dinner- and breast-pads are now drawn out; the woollen pledgets remain. If requisite, the jacket can be trimmed with shears or a knife; if it does not extend below the iliac spines it must be removed and a new one put on; a short jacket cannot be satisfactorily lengthened; when resting above the iliac spines it quickly rubs the skin into sores. Any jacket can be applied within five minutes.

With such a jacket the patient may go about; it will last six to twelve weeks, or longer, according to the progress of the disease and rapidity of growth. To remove it, it must be sawn up the middle with a tenon saw. The new jacket should be applied within twenty-four hours, the patient resting meanwhile. Some dispense with extension, but it ensures the jacket being applied when the chest is in the position of full inspiration, and relieves the diseased bones from downward pressure. There are two modifications in the application of the jacket.

Hammock method (Davy).—A piece of canvas wide enough just to meet round the patient, and twice his height, is suspended horizontally, hammock-fashion. In this the patient, wearing a merino vest, is laid face downwards, apertures being cut for the face and arms, so that the latter hang freely down through the canvas. Moistened plaster bandages are now applied round the body over the canvas, and the patient is then left till the jacket is set; the hammock is then taken down, and the ends cut away, top and bottom, to the level of the jacket; so the patient wears a layer of canvas in addition to his vest.

Recumbent method (Walker). — The same plaster bandages are used, but are moistened with gum and water; they are now cut in lengths exceeding the circumference of the patient's body by four inches; each length is laid flat on a table, one below the other, and overlapping for half its breadth; this is continued till a stratum of bandage equal in length to the vertical measurement of the trunk is completed. A second similar layer is now laid over this, strips of paper being placed at the edges to show the separation between the two layers. The patient is now laid on his back on the bandages, and the various strips are wrapped round him in order, and then left till the plaster has set.

The writer recommends and employs Sayre's original plan, as he fails to find any advantage in the modifications described. No rule can be laid down as to the length of time for the jacket treatment; it depends entirely upon the rate of repair. When all subjective signs have disappeared the after-treatment is begun: this mainly consists in substituting for the entire jacket one that is laced on, and so can be occasionally removed, whilst its not fitting so closely enables the cure to be tested.

Either the plaster jacket may be cut up and laced on, or, what is better, a felt jacket is put on. The 'poroplastic felt' usually employed is first roughly cut to the patient's figure, then steamed in an oven till soft, and then applied over a merino jacket; it sets when cold, and has then the requisite fastenings added. It is in this stage a good material to employ, but it cannot be so accurately applied as the plaster, and, being cut up, it gives less support; hence it is not advised in the earlier stages of the disease.

If there is a discharging lumbar sinus, a movable jacket, if any, must be used throughout. Windows cut in the plaster jacket do not answer.

In atlanto-axoid or occipito-atlantoid disease, as long as there are any subjective symptoms or dyspnœa, the supine position, with a small pillow under the nape, is the only safe one (Hilton). Sandbags on either side will keep the head from rotating. After probably two or three months the patient may get up, with a mechanical support. This may be either a leather or felt corset, bearing a stiff padded collar at the end of a steel rod, to support the head and prevent its rotating, or an adaptation of the plaster jacket. This consists of an ordinary Sayre's jacket, which forms the *point d'appui* of strips of plaster bandage, the centres of which are successively placed on the forehead, and the ends carried on each side over the ears, thence below the occiput, and finally across the scapulæ to beneath the axillæ, and there finished off; thus a rigid support to the head is provided (Furneaux Jordan).

In cervical disease below the axis, and in cervico-dorsal disease, the mechanical support may be the same, but Sayre's '*jury mast*' is better, as it permits rotation, and substitutes an elastic pull on the head for the stiff push up from below. It consists of a fishhook-shaped steel spring, which is attached below to a plaster jacket in the middle of the back, by being interwoven in the bandages as they are put on; the hooked part, passing up behind, arches over the head and carries a collar which supports the occiput and chin. The degree of extension exercised by the spring is regulated by straps to the collar. The upper part of the apparatus unscrews at the upper edge of the jacket, so as to be removed when the patient is in bed. A similar arrangement may be also attached to a movable (e.g. felt) jacket, though the plaster jacket is better for children.

Besides abscess, the special complication of spinal caries is paralysis. This, if due to pus pressure, must be treated by treating the abscess (*see* Psoas Abscess); but if due to inflammation of the cord or membrane, it is to be treated with iodide of potassium in 5-gr. doses, and the local use of counter-irritants; absolute rest being imposed.

The general medical treatment of caries is tonic. The writer prefers Syrupus ferri iodidi, or Ferri pot. tart., with Ol. morrhuæ in cold weather. Dialysed iron is not advised. The food and hygienic conditions must be the best obtainable.

(*b*) In treating angular curvature, it is presumed that all active disease has ceased, the deformity alone remaining. Extension and mechanical support are indicated—the former to expand the chest and relieve the compressed abdominal and thoracic viscera, the latter to maintain the gain by extension. In young subjects, who are still growing, the writer has seen the most marked improvement by the full use of the plaster jacket as above described; the boss, it is true, does not markedly diminish, but the total gain is great in a more erect posture and expanded chest. Where growth has ceased, the instruments mentioned under after-treatment above give enough support to make the patient useful in life; or one of the now old-fashioned 'spinals' (steel crutches arising from a leather and steel pelvic girdle) can be used; its only recommendation is that it lasts longer than felt. Of course many a 'hunchback' goes about without any mechanical aid whatever.

C. Hilton Golding-Bird.

CARIES OF THE TEETH.—As a result of original faulty development or of unfavourable subsequent conditions, the teeth are liable to a destructive process which consists in their decalcification and the disintegration of the organic matrix. It is, in the main, a chemical process, proceeding from without inwards; the theory which regards it as analogous to inflammatory softening of bones being untenable, because it occurs in dead equally with living teeth. During pregnancy, and after certain diseases, notably typhoid fever, the secretions of the mouth are in a state leading to wholesale destruction of the teeth, the destructive agents being probably acids generated by fermentations occurring in the mouth. Nooks and crannies, and the necks of teeth, where they are in close contact with the edge of the gums, are its chosen sites.

It therefore can best be combated by the most scrupulous cleanliness, by brushing the teeth after every meal, and by using alkaline washes copiously, a good formula being carbolic acid combined with a considerable excess of carbonate of soda or of liquor potassæ, and suitably diluted.

Bacteria are abundantly found in carious cavities, and penetrate the dentine to a considerable depth, but the precise share which they take is still *sub judice*; want of cleanliness offers them the most favourable opportunity for multiplication.

Of course all cavities as they arise should be at once filled; in health an annual careful inspection will obviate mischief proceeding to a disastrous extent before it is dealt with; but in cases where destruction is very rife, the teeth should be seen to twice, or even thrice a year, till the period

of rapid decay has gone by. It may almost be said that by the time the patient has become aware of the decay the most favourable time for dealing with it by stopping has already gone by.

Left to itself, caries proceeds to the exposure and ultimate inflammation and death of the pulp, then to alveolar abscess. In very exposed positions it sometimes comes to a spontaneous cure, the softened tissue getting worn away and the surface attaining a high polish; this result may in suitable cases be artificially brought about.

CHARLES TOMES.

CAROTID ARTERIES, Aneurism of the.—*Common Carotid.*—Aneurism of this arterial trunk, particularly when of traumatic origin, may be regarded as a rare affection. The spontaneous variety occurs much less frequently than femoral and popliteal aneurisms of like origin, about as often as subclavian aneurism, and with greater frequency than aneurism of the axillary artery. It has been asserted that carotid aneurism is met with occasionally in young subjects; but in one only, of fifteen cases collected by Mr. R. W. Parker of spontaneous aneurism in persons under twenty years of age, was the common carotid the affected vessel. The proportion of male to female subjects is certainly much smaller in a large series of cases of carotid aneurism than in those of aneurism of any other large artery. Whilst, in all other forms of external aneurism taken together, one female is affected to eight males, in carotid aneurism the numbers of each sex, according to Crisp, are almost equal. Any portion of the common carotid as it courses in the neck may be the seat of aneurism; but the most frequent locality of the affection is at or near the bifurcation. The vessel on the right side is sometimes affected with well-marked though not very progressive dilatation just above its origin at the root of the neck. Aneurismal dilatation of the intra-thoracic portion of the left carotid must be very rare. The right side of the neck is much more frequently the seat of carotid aneurism than the left side.

Carotid aneurism in most instances presents the ordinary objective signs of aneurism of any other large artery situated near the surface of the body. The tumour pulsates very forcibly, and is more or less ovoid in form. It usually increases very slowly in size, and in some cases seems to remain stationary for a time, although it undergoes spontaneous cure very rarely, and ultimately, if left to itself, causes death by rupture, either externally or into the digestive or respiratory tract. The effects produced by the gradual expansion of the aneurismal sac are very varied and of a serious character, in consequence of pressure on important structures in the neck and of disturbance of the cerebral circulation. Most of these symptoms, however, are common to carotid aneurism and to any other deep-seated cervical tumour. Pressure on the laryngeal nerves or directly on the larynx or trachea may cause hoarseness, very troublesome cough, attacks of dyspnœa and spasm of the larynx. There is often more or less difficulty in deglutition, and sometimes—though this is a symptom more frequently met with in aneurism of the internal carotid—the pharynx is occupied by a prominent and distinctly pulsating tumour. The usual cerebral symptoms are headache, occasional giddiness and syncope, and loud subjective ringing or buzzing sounds. The patient complains at times of neuralgic pains on the corresponding side of the head and also on the surface of the neck. Pressure of the aneurism on the sympathetic may cause contraction of the pupil on the same side, and there is often some visual disturbance.

The diagnosis of carotid aneurism may be attended with great and, indeed, insuperable difficulty, especially in a case of pulsating tumour at the root of the neck, which might be due to aneurism of the subclavian, of the innominate, of the vertebral, or of the arch of the aorta. It is necessary in instances of this kind to study carefully the form, situation, and relations of the tumour, the direction in which its bruit is chiefly propagated, and the condition of the circulation in the head, the upper part of the neck, and the upper extremity on the corresponding side. No very positive results, however, can always be obtained by such investigation, since a swelling of like form, and pressure-effects of like nature and intensity to those of carotid aneurism, may, under certain conditions, exist with aneurism of either of the other arteries.

The morbid conditions by which an aneurism on any part of the carotid artery may be simulated are: glandular enlargement and suppuration; deep-seated suppuration of simple inflammatory origin; a new-growth, whether solid or cystic; a vascular tumour or an aneurismal varix; simple or pulsating bronchocele; and a pulsating malignant tumour. The chief points to be observed in establishing the diagnosis are, the shape of the swelling, its condition on proximal or distal compression of the

carotid, its relation to and extent of connection with this vessel, the character of the pulsatile expansion, the intensity of the bruit, and the range of vertical movement of the swelling during deglutition.

The results of proximal ligature of the common carotid in the treatment of aneurism of this vessel have not been very satisfactory. Since 1805, when the operation was first performed by Sir A. Cooper, this plan of treatment has been repeatedly tried, and lengthy tables of such cases have been compiled by Pilz and Lefort. Of 47 cases collected by the latter surgeon 21 were fatal, whilst in 2 the operation was followed by relapse, and in some of the remaining cases reported as cured, the results, it is held, were doubtful. The most frequent causes of this tendency to failure of proximal ligature of the common carotid are inflammation of the sac, resulting in suppuration and hæmorrhage, serious cerebral symptoms, and hæmorrhage from the seat of ligature. Under the most favourable circumstances the operation is attended with much risk, and the records of the most successful cases show that recovery is seldom attained without the occurrence of some serious complication.

The results of distal ligature of the common carotid are also unfavourable. The operation, Lefort states, is almost always followed by diminution in the size of the aneurismal tumour, but, as with proximal ligature, there is much risk of subsequent suppuration and rupture of the sac, and also of cerebral mischief. Most of the few recorded cases, however, of distal ligature for carotid aneurism are probably very doubtful, as decided aneurismal dilatation, affecting only the root of the carotid, is not often met with, and its diagnosis must be attended with much difficulty.

The old method of opening the sac and applying a double ligature to the affected artery has been applied with success in cases of traumatic aneurism of the carotid by the second Hey, by Syme, and, more recently, by Frothingham, of Michigan. In 1880 Mr. Henry Morris, in some comments on a case of spontaneous aneurism of the external carotid, reported to the Royal Medical and Chirurgical Society, suggested that it would be best in carotid aneurisms near the bifurcation of the common trunk to ligature simultaneously the common carotid and such branches of the external carotid (facial, superior thyroid, and lingual) as are easily accessible.

Notwithstanding the difficulties in applying and keeping up pressure in the neck, compression, both digital and instrumental, below the tumour, has hitherto been attended with much success in some few cases of carotid aneurism. Mr. Holmes, who has collected seven cases, in two only of which this treatment failed, holds 'that there are forms of carotid aneurism easily curable by compression, and that compression of the carotid artery, though difficult and painful at first, may often be rendered successful by perseverance both on the part of the surgeon and the patient.' It has been proved, also, that a carotid aneurism at the root of the neck may be cured by distal pressure.

In a case of small carotid aneurism, if indirect compression fail after a fair trial, it may be found advisable to try direct compression before any cutting operation be performed. Of this method, however, very little is known beyond a successful case recorded in 1867 by Ciniselli, of Cremona.

Arterio-venous aneurism of the carotid artery and jugular vein has been met with in some few instances. This condition, which almost always, if not always, presents the form of aneurismal varix, is commonly the result of a sword injury. The symptoms are usually well-marked, and resemble those of a similar lesion to other large vessels, but are seldom of such severity as to justify any operative treatment.

External Carotid.—Aneurism of this vessel is usually of the traumatic variety, and implicates one or more of the branches. It presents no special characters. There must necessarily be some difficulty in determining the origin of an aneurismal tumour in this region; but the diagnosis of an aneurism of the external from one of the internal carotid may be assisted by observations of the state of the temporal pulse, and probably, also—as in a case recorded by Mr. Christopher Heath—by the existence of unilateral atrophy of the tongue.

Internal Carotid.— Aneurism of the extra-cranial portion of this vessel, like aneurism of the common carotid, may give rise to cerebral disturbances, but its most marked symptom is a pulsating tumour in the pharynx.

The treatment in cases of aneurism of the secondary carotid vessels should consist, at first, in a careful and persevering attempt at proximal compression, and subsequently, if this fail, in ligature of the common carotid; or, in the case of the external carotid, near its origin, ligature of some of the branches of this vessel together with that of the main trunk, as advised by Mr. Morris. W. Johnson Smith.

CAROTID ARTERY, The Common. *Course.* — From the upper part of the sterno-clavicular articulations both arteries ascend on the side of the trachea and œsophagus as high as the upper border of the thyroid cartilage. The left artery comes from the aortic arch close to the left of the innominate; the right results from the division of the innominate. The lower part of the left artery is surgically unimportant. The vessels are practically alike anatomically in the neck.

Whatever the position of the head, a line from the sterno-clavicular articulation to the lobule of the ear marks the course, as high as the upper border of the thyroid cartilage, where the artery ends. For descriptive purposes, it is divided into two parts by the crossing of the anterior belly of the omo-hyoid muscle. This muscle crosses on a level with the cricoid cartilage.

The common carotid artery *above* the omo-hyoid lies in what is known as the superior carotid triangle, bounded by the omo-hyoid below, the digastric and stylo-hyoid above, and the sterno-mastoid behind. The superficial coverings are similar to those over the lower part of the artery. The sterno-mastoid overlaps it; the descendens noni is usually on the sheath, but sometimes within; and the superior thyroid vein, with frequently the lingual and facial veins, crosses its upper end. *Behind* are the vertebræ covered by the longus colli and the rectus capitis anticus major, also the sympathetic cord; *externally*, the internal jugular vein and vagus nerve; *internally*, the larynx and pharynx, covered over by the inferior constrictor muscle. The superior thyroid artery passes down on the inner side of the vessel.

Ligation. — Place the patient on his back, with the shoulders raised, and the face turned to the opposite side. Make an incision, three inches long, from the level of the upper border of the thyroid cartilage downwards in the guiding line, or *vice versâ*; cut through the cutaneous structures, raise the deep fascia carefully—on a director is the best plan—and open it. Now flex the head slightly, to relax the sterno-mastoid, so that it can be pulled outwards. According to where it is wished to apply the ligature, the omo-hyoid muscle is pulled down or not; it is best to do so, and to tie the artery opposite the crico-thyroid membrane. Pick up and incise the common sheath on the inner side, avoiding the veins crossing its upper end. Open the immediate sheath, and pass the needle from the vein, avoiding the internal jugular vein externally, the pneumogastric behind, the superior thyroid artery internally, and the descendens noni nerve in front.

Below the omo-hyoid muscle the coverings are—the skin; superficial fascia having in it, the platysma, the anterior jugular vein, and the descending branch of the transverse cervical nerve; the deep fascia. The sterno-mastoid muscle overlaps it; the sterno-hyoid and sterno-thyroid muscles cover it and cross it; the descendens noni nerve lies on these muscles.

Behind are the transverse processes of the seventh, sixth, and fifth cervical vertebræ, covered by the longus colli muscle. *Internally*, the trachea. *Externally*, the internal jugular vein, and the pneumogastric nerve. The internal jugular vein on both sides tends to the right, hence it departs from the right artery below, but overlaps the left artery. The vessel consequently is more easily reached on the right side.

Ligation. — Make an incision in the guiding line from the sterno-clavicular articulation to the level of the cricoid cartilage. Cut through the cutaneous coverings described, so as to expose the inner border of the sterno-mastoid; now bend the head slightly forwards, and pull—outwards the sterno-mastoid, inwards the sterno-hyoid and sterno-thyroid muscles, upwards the omo-hyoid and the structures associated with it. Open the common vascular sheath, pull outwards the internal jugular vein and the pneumogastric nerve, and inwards the descendens noni; open the immediate sheath, and pass the needle from the vein inwards, keeping close to the vessel.

James Cantlie.

CAROTID ARTERY, The External. *Course.* — From the bifurcation of the common carotid at the upper border of the thyroid cartilage, the artery passes upwards to just behind the neck of the condyle of the lower jaw, where it divides.

The coverings are:—skin; superficial fascia, with the great auricular nerve and the external jugular vein; the platysma and the deep fascia. When the deep fascia is opened, it is seen that part of the artery below is in the superior carotid triangle, and that part of the artery above is in the parotid gland; the separation being marked by the crossing of the posterior belly of the digastric and the stylo-hyoid muscles over the artery. In the superior carotid triangle, the artery is crossed by the hypoglossal nerve, and the facial, lingual, and

superior thyroid veins; in the parotid gland, the facial nerve and the external jugular vein are superficial to it. Beneath, i.e. internal to the artery, is the pharynx below, with the superior laryngeal nerve crossing to reach the larynx; whilst higher up, between the internal and external carotid arteries are the styloid process, the stylo-pharyngeus muscle, the glosso-pharyngeal nerve, and a piece of the parotid gland. Externally is the internal jugular vein; the internal carotid is seen on the outer side for almost one inch of its course, when it disappears underneath.

Ligation.—Place the patient as for the common carotid operation. Make an incision from just behind the angle of the jaw, downwards along the line of the artery, to just below the upper border of the thyroid cartilage. Divide the cutaneous structures, advisedly using a director for the deep fascia. Draw aside the veins crossing the artery if possible; if not, tie each in two places, and cut between. Pull the digastric and stylo-hyoid muscles and the hypoglossal nerve upwards, the sterno-mastoid outwards. Open the sheath, and pass the needle from without—i.e. from between the artery and the internal jugular vein, with the internal carotid artery externally. The ligature is usually passed immediately above the origin of the superior thyroid artery. James Cantlie.

CAROTID ARTERY, The External, Wounds of branches of the.—The violence of all bleeding from the throat and neck, the suddenness of its occurrence, and the rapidity with which it proves fatal, render the question of the treatment of the following accidents of grave interest to the surgeon:—

1. Punctured wounds about the angle of the jaw or through the mouth. 2. Hæmorrhage after injury to the tonsils. 3. Hæmorrhage from cancer, or from the sloughing of the throat in scarlet fever or diphtheria. 4. Secondary hæmorrhage after wounds or operations.

In some of these cases the careful and accurate adjustment of pressure has occasionally succeeded, while in others cold, astringents, or the actual cautery has been employed with success. In one or two instances the ingenuity of the surgeon has suggested a remedy, as in a case of secondary hæmorrhage after operation for cleft palate, where the bleeding was permanently arrested by a wooden plug in the posterior palatine canal. However successful these palliative measures may occasionally prove, there will remain a certain proportion of cases in which their use is impracticable, or has been employed in vain. If there were a probability of finding the bleeding vessel by enlarging the wound this might be done; but in many instances such an operation would be anatomically impossible. In these circumstances, ligature of the main vessel in continuity has to be resorted to, as the only practicable means of stopping the bleeding.

The common carotid artery has been the vessel usually selected. The writer, however, considers that the external carotid is the better artery to tie, and has fully described the reason for this preference in a paper published in the *Medico-Chirurgical Transactions*, lxi.

Ligature of the common carotid for hæmorrhage is an operation of extreme danger to life, having a death-rate of more than 50 per cent., a large proportion of the fatal cases either dying from brain-symptoms, or a recurrence of hæmorrhage from the original wound. The brain-symptoms are the result of cutting off the blood-supply through the internal carotid, while the recurrence of hæmorrhage from the wound is due to the freedom of the anastomosing circulation. If hæmorrhage continues after deligation of the common trunk, the blood finds its way to the wound from one of the following sources: 1. As a regurgitant stream down the internal carotid. 2. By the communications of the superior with the inferior thyroid. 3. By branches anastomosing across the middle line. By ligature of the external carotid between the thyroid and lingual branches all risk of brain-symptoms is obviated, while the chance of recurrent hæmorrhage is diminished, inasmuch as the communications by the internal carotid and superior thyroid are cut off. The fact of the free anastomoses between the thyroids was markedly illustrated in a case of Guthrie's, in which the external carotid artery was wounded. Here the common carotid artery was tied, but it failed to arrest the bleeding. A ligature was then placed upon the external carotid above the wound, but blood still poured out. The external carotid was then again tied just above the superior thyroid, and the bleeding at once ceased.

An objection might naturally be raised to placing a ligature on the external rather than on the common carotid, on the ground that the surgeon assumes that it is a branch of the former that is wounded, and that, should the bleeding vessel prove to be the internal carotid, an operation worse than useless would have been performed. The

answer to this is, that in cases where the common carotid artery had been tied for hæmorrhage, and in which post-mortem examinations were subsequently obtained, it was extremely rarely found that the original wound had been one of the internal carotid—a circumstance to be explained by the fact that a wound of so important a vessel will generally prove fatal in a few minutes, thus affording no opportunity for any surgical interference. In the great majority of cases the bleeding vessel proved to have been one of the numerous branches of the external carotid, and could have been controlled by ligature of that vessel.

The same incision that is employed for ligature of the common carotid above the omohyoid would expose the external branch, which can be traced up from the bifurcation.

HARRISON CRIPPS.

CARPAL BONES, Dislocation of the. TRANSVERSE OR MIDCARPAL DISLOCATION of the hand, as a result of which the second row of carpal bones is separated from the first, only occurs as the effect of great violence, and is very rare. Malgaigne mentions two cases—one, *forwards* and compound, caused by machinery; the other (Maisonneuve's) *backwards*, caused by a fall from a height. In this case the hand was shortened and the fingers flexed; there was a prominence behind below the level of the styloid processes; in front another, with a depression below, *vis-à-vis le pli transversal du poignet.* Reduction has been found difficult or impossible during life, and easy after death. Both these cases died from other injuries. More recently Richmond has described a case in this country of midcarpal dislocation of the hand forwards. A man was drawn up by the strap of a machine nine or ten feet, and fell on his hand. The first row of carpal bones, with the radius and ulna, projected behind, and the second row, with the metacarpal bones, formed a prominence at the base of the hand in front.

Dislocation of any bone of the carpus alone is a rare accident, and generally the result of extreme violence. Of the first row there are instances of separate dislocation of the scaphoid, semilunar, and pisiform bones.

DISLOCATION OF THE PISIFORM BONE occasionally occurs as the result of forcible action of the flexor carpi ulnaris. Gras, Fergusson, and Erichsen have recorded cases produced in the act of lifting heavy weights. The bone is to be felt displaced upwards to the extent of about an inch. The treatment is to flex the hand on the forearm and the forearm on the arm, in order to relax the flexor muscles; to retain the hand in position by means of a curved dorsal splint, and to fix the bone by a pad and strapping.

DISLOCATION OF THE SEMILUNAR occurs more frequently than any other bone of the first row, and is often compound. It may be dislocated *forwards* or *backwards.* The forward dislocation is caused by a fall from a height with the hand extended, and the bone has on several occasions been driven completely through the skin in front of the wrist. This occurred in both hands of one case, the bones from which are preserved in the museum of St. George's Hospital. The effect of its displacement forward beneath the tendons may be to cause flexion of the middle and ring fingers, as in a case recorded by Cameron. Dislocation backward is caused by a fall on the back of the hand. In an instance observed by Erichsen, the bone projected behind, and could be reduced by pressure, but started up again upon flexion of the hand on the wrist.

The treatment, if reduction be effected, will be to retain the palm of the hand on a splint, with a pad over the bone, for two or three weeks. When the dislocation is compound, it is probably advisable to remove the bone at once; if simple and irreducible, it may be excised antiseptically. But without these precautions, considering the relation of the bone to the wrist and great carpal joints, as well as to the tendon-sheaths, an operation is scarcely to be recommended. A compound case operated upon, and reported during the present year by Buchanan, was followed by amputation of the hand; but excision was not performed till the fifth day, and not till after cellulitis had commenced.

DISLOCATION OF THE SCAPHOID.—Astley Cooper relates two cases of this injury: one a compound case caused by machinery, the other a simple dislocation backwards, together with a portion of the radius obliquely fractured into the joint, caused by a fall on the back of the hand. Malgaigne is inclined to throw doubt on the latter case.

DISLOCATION OF THE OS MAGNUM.—Dislocation of the head of the os magnum backwards appears to be the most frequent of the isolated displacements of the carpal bones. It is much more common in women than in men, and Malgaigne classes it as pathological rather than traumatic. It has been caused by falls on the back of the hand, and by muscular contraction during

the throes of labour. A rounded projection is seen, situated above and opposite to the base of the metacarpal bone of the middle finger, and a depression close to the base of this bone. In a case related by Cooper, the forefinger was abducted and could not be made to approach the middle until after the dislocation had been reduced. Reduction is effected by pulling on the first and second fingers, and at the same time pressing upon the displaced bone. There is great tendency to reluxation on strongly flexing the hand, to prevent which, a palmar splint, with a pad over the bone behind, should be worn for two or three weeks.

R. Clement Lucas.

CARPUS, Dislocation of the. *See* Wrist-joint, Dislocation of the.

CARR'S SPLINT, for Colles' fracture, consists of a strip of wood about 2 inches wide and 11 inches long, having an irregularly convex surface which is adapted to the shape of the lower end of the radius, and has an obliquely-placed cross-piece, 4 inches long and 1 inch in diameter, attached to its distal end. The splint is applied to the anterior aspect of the forearm, so that the cross-bar lies opposite the metacarpo-phalangeal joints when the hand is adducted. A light dorsal splint may also be applied, but it is not necessary.

Bilton Pollard.

CARTE'S COMPRESSOR. *See* Tourniquets.

CARTILAGE, Articular. *See* Articular Cartilage.

CARTILAGES, Aural. *See* Ear, External.

CASTRATION.—Preparatory to the operation, the pubes and scrotum should be carefully shaved and thoroughly cleansed. For the latter purpose, carbolic lotion, 5 p.c., may be used; but as the thin skin of this region may be irritated by this lotion, corrosive sublimate solution 1–500, or the solution of sulphurous acid B.P., may be substituted for it. Before commencing the operation, a careful examination for hernia should be made, and if present, its contents should be reduced and kept up by an assistant's finger placed over the abdominal ring. The patient being fully anæsthetised, the surgeon should grasp the back of the testicle in his left hand, so as to stretch its coverings over the front, and should then make an incision from the external abdominal ring to the bottom of the scrotum, and quickly cut through all the layers of fascia and muscle until the outer surface of the tunica vaginalis is reached. With a few touches of the knife, the testicle, in its serous covering, is severed from the scrotal tissues; the union between the two is most firm at the lower end of the scrotum. At this stage it is well to place pressure-forceps on all bleeding vessels in the scrotum, as oftentimes the hæmorrhage from this source is profuse. The surgeon should then carefully examine the cord to determine at what part to sever it, and he should proceed to transfix it, about half an inch above this point, with an aneurism needle armed with a double thread; and should tie it tightly in two halves, and then cut it across. The best material to use for this ligature is silk which has been soaked for some time in carbolic lotion, 5 per cent., or stout chromic catgut.

When the stump of the cord has been examined and found to be quite dry, and the surgeon is satisfied that his ligatures are secure, their ends should be cut off short, and the cord will retract into the inguinal canal. The forceps should then be taken off the scrotal vessels one by one, and those that are bleeding should be twisted or tied with fine catgut. After cleansing the wound with corrosive sublimate solution 1–1,000, a drainage-tube should be laid along it and brought out at its lower end, and the edges of the skin approximated by carbolised silk sutures. Owing to the contraction of the dartos, the skin is inverted, and this, unless corrected, delays the perfect healing of the wound. It may be overcome by making a very close continuous suture of the skin with very fine catgut in addition to the deep interrupted sutures. The whole operation may be conducted aseptically, and dressed accordingly. A very good form of dressing is to sprinkle finely-powdered iodoform over the line of incision, and to apply a thick mass of iodoform cotton-wool over the scrotum and pubes—the penis being brought out through it—and fasten it in position with a firm and carefully applied bandage. This dressing need not be disturbed for two days, when, if the tube be dry, it should be removed, the dressing renewed, and left undisturbed for several days, unless pyrexia, or pain, or some other disturbance, necessitate the examination of the wound.

Certain other details may be mentioned. If the testicle to be excised be adherent to the skin, that portion of the scrotal coverings should be removed with the organ by

means of two elliptical incisions. Where the surgeon is in any doubt as to the nature of the tumour he is operating for, he should open the tunica vaginalis and explore it—even cutting into the testicle itself if necessary—before detaching it from the scrotum. Owing to the extreme difficulty of diagnosing some cases of hæmatocele, it is a good rule to tap every scrotal tumour before excising it, or, still better, to cut into the tunica vaginalis before detaching it from the scrotum. When there is a large collection of fluid in the tunica vaginalis, it is an advantage to tap the sac before the operation, or to puncture it before dissecting it away. When the case is complicated with inguinal hernia on the same side, the surgeon should at the same time attempt the radical cure of this affection, by dissecting up the sac, stitching it together at the ring, removing the part beyond, and drawing together the pillars of the ring, if that aperture be large. When the cord is thickened high up, it may be necessary to slit up, on a director, the aponeurosis of the external oblique muscle where it covers the inguinal canal, and to ligature the cord close to the internal ring.

There are several other ways of treating the cord, but if the ligatures are tied tightly, the above is the best. Should hæmorrhage occur from the cord—primary or secondary—the inguinal canal must be laid open and the bleeding vessel tied. Where the gland to be removed lies in the groin, the parts covering it must be divided with a vertical incision, and the organ turned out of its bed, and the cord tied as above. As this condition is very often combined with hernia, great care must be taken to seek and, if found, to close any peritoneal prolongation or pouch.

On a few occasions a testicle, retained in the iliac fossa, has been removed on account of cancerous disease. This may be done either by laparotomy, the incision being made in the median line, or by an incision, similar to that for ligature of the external iliac artery, the parts being divided down to the subperitoneal fat, and the peritoneum stripped off the face of the tumour.

A. Pearce Gould.

CATARACT is opacity of the crystalline lens. *See* Crystalline Lens. It occurs in many forms, partial and complete, and is met with at all periods of life, but is more frequent in the old and in the young than in the middle-aged.

Causes and Pathology.—The lens is, by development, a cuticular structure, and is formed of successive layers of fibres derived from the epithelial cells which line its capsule. As in the cuticle, the older layers are firmer, drier, and more closely compacted than the younger; but, unlike what happens in the cuticle, they are not cast off at a free surface, but are constantly surrounded and driven inwards towards the centre by those more newly formed. Unless morbid processes intervene, the addition of fresh fibres at the periphery, and the progressive hardening of the older ones towards the centre, go on throughout the whole period of life, and as a consequence the volume of the lens continually increases, at the rate of about 1·5 cub. mm. each year. At the same time the refractive power undergoes a gradual change, and the fibres, colourless in early life, assume a yellowish tinge, but there is no loss of transparency. The following figures indicate the average weight, volume, and diameter of the lens at the ages of twenty-five and sixty-five respectively; they were obtained by the examination of more than twenty lenses in each decade of life. Weight, 174 and 240 milligrammes; volume, 163 and 225 cub. millimetres; transverse diameter 8·67 and 9·65 millimetres. The average specific gravity is about 1,070, and is not essentially different at different ages (*Trans. Ophth. Soc.* vol. iii. p. 79). The lens, having no direct vascular relations, depends for its nutrient supply on fluid secreted by the ciliary processes, which enters it chiefly, if not entirely, at its periphery, i.e. at the zone corresponding with the apices of the processes and Petit's canal. The causes of cataract are all those conditions which interfere with this normal growth and nutrition.

Classified according to cause, cataract is of three chief kinds:—(*a*) *Primary*, i.e. arising independently of discoverable disease in other parts of the eye. This group includes the great majority of the cases of cataract other than traumatic, which call for surgical treatment, namely all cases of ordinary senile cataract, and most of the varieties met with in infancy and childhood. (*b*) *Traumatic*, i.e. due to mechanical injury of the lens. (*c*) *Secondary*, i.e. resulting from obvious disease in other parts of the eye.

(*a*) *Primary Cataract.*—The nutrition of the lens is sometimes arrested during fœtal life. When this happens, the last-formed fibres, or sometimes the whole of those already formed, shrivel and degenerate and lose their transparency. If, after a while, the normal process is re-established, layers of healthy fibres are laid down upon the damaged ones, and growth continues. A

congenital cataract is the result, the lens presenting on examination after birth either an opaque nucleus surrounded by transparent layers, or simply a layer of opaque fibres enclosing a transparent nucleus, and itself enclosed by a transparent cortex. Or the opacity may be spindle-shaped, extending from the anterior to the posterior pole, and associated in some instances with the nuclear or lamellar forms above described. Such spindle-shaped opacities date probably from a very early period in the development of the lens; the opaque substance being adherent to the capsule, is stretched out more and more as the new fibres are laid down, and forms a permanent obstacle to their union in the axial line. Or, again, if the shock to the nutrition of the lens is extreme, a restitution of the process of growth may never take place, and at birth the lens may be opaque throughout, or may be represented merely by a small mass of degenerated fibres, enclosed within a shrivelled capsule. The causes of these intra-uterine disasters are not accurately known; they certainly include mechanical and nervous shocks to the mother, and probably some constitutional diseases productive of lowered vitality in the fœtus. Malformation of the lens at birth is sometimes a part of a general malformation of the eyeball.

Disturbance of the nutrition of the lens seems sometimes to occur rather suddenly during infancy and childhood, and to leave a lamellar opacity similar in kind to that already described as arising *in utero*. It is probable, however, that some cataracts which appear to be acquired in infancy are really of intra-uterine origin, the original disturbance damaging the fibres, then in process of formation, to an extent which is not sufficient to render them opaque, but which leaves them liable to further damage by comparatively slight causes, mechanical or other, after birth. A case is on record in which an infant's lenses, previously examined with the ophthalmoscope and found transparent, became opaque immediately after a convulsive seizure. There is, however, no reason to deny that nutritive disturbances may cause a lamellar opacity during extra-uterine growth in the same way as at an earlier stage. The amount of transparent matter between the opaque lamella and the capsule should be some guide as to the time which has elapsed since the initial disturbance. Children presenting lamellar or other varieties of primary cataract are very generally delicate in appearance and of nervous temperament. A history of convulsions in infancy is frequently forthcoming on inquiry, though this connection is not an invariable one. Signs of rickets are present in many cases, and in a very large majority the teeth show peculiar defects consisting in an abruptly limited deficiency or absence of enamel on the upper part of the tooth. The teeth affected are the first molars, canines, and incisors, of the permanent set. As the crystalline lens and the teeth are, alike, epithelial structures and develop at the same period, it is reasonable to suppose that the defects in question are due to a common cause affecting the nutrition of both.

During the middle period of life, primary cataract arises much less frequently than at either extreme, and when it does occur it is in most cases due to one specific cause—diabetes. In persons suffering from diabetes, cataract may occur at any age; it has been met with so early as the twelfth year. The amount of sugar in the urine is usually large, and the nutrition of the patient greatly impaired. When this is not the case, the patient is usually advanced in years. Sugar is present in these cases in the fluids of the eye, and has many times been found in the lens itself; but the precise way in which it induces the changes in the lens-fibres is still uncertain. The volume of the lens appears to be increased by excessive imbibition of fluid, a large portion of which enters, not in the normal direction, but by diffusion through the anterior and posterior capsule.

The third or last period of life, during which senile degeneration of many kinds is common, yields a large majority of all cases of primary cataract. The whitening and thinning of the hair, and the shrivelling of the skin, common in advanced life, find their physiological analogue in an increasing tendency to shrinkage and sclerosis of the lens-fibres; and this sclerosis, if it pass beyond a certain point, involves separation and disintegration of the fibres. Beyond the age of seventy, some slight opacification near to the equator of the lens is rather the rule than the exception. The writer's investigations on the growth of the crystalline lens (*loc. cit.*), besides establishing the fact of a continuous enlargement throughout life, have shown that previous to the formation of actual opacity in the lens there is usually a diminution in the rate of growth. The advancing sclerosis and shrinkage cause a separation of the fibre-layers just where the capsule and subjacent fibres are most affected by the traction of the suspensory ligament, viz. at the

equator, and this separation is usually the first step in the formation of senile cataract. By it a clear line of demarcation is established between the nucleus, or sclerosed portion, and the cortex, or non-sclerosed portion; the spaces caused by the separation of the layers fill with fluid; abnormal diffusion-processes ensue, which lead, more or less rapidly, to further splitting of the layers and breaking up of the individual fibres into a molecular mass, until the whole substance of the lens is more or less opacified, and sometimes, in the last stage, fatty and calcareous degenerations occur. Simultaneously with these retrograde changes, a rapid and abnormal production of new cells usually takes place in the capsular epithelium, due probably to a lessening of the intra-capsular pressure by which the cell-proliferation is ordinarily held in check.

Though the tissue-changes which constitute cataract are thus accurately known, the causes which determine their occurrence —earlier in some persons, later in others—are still uncertain. Albuminuria, and atheroma of the carotids have been supposed to play an important part in the causation of senile cataract, but careful inquiry shows this conjecture to have small foundation. The essential change is a failure of nutrition in the epithelial cells and fibres of the lens; it is likely that vascular degeneration in the region from which the nutrition proceeds, is the underlying cause. In a certain sense, senile cataract is hardly to be considered a morbid condition, but rather one of senile decay occurring prematurely, and one to which all eyes would come did their owners live long enough. The peculiar condition of the lens known as black cataract will be described later in discussing the symptoms of the various forms.

(*b*) *Traumatic Cataract* is due, in the great majority of cases, to perforating wounds of the globe which involve the lens-capsule. Contusions without perforation occasionally cause rupture of the capsule and thus lead to cataract; and in rare cases the lens-substance opacifies as the immediate result of an injury which neither perforates the tunics nor causes any break of continuity in the capsule. Injuries which involve damage to the uveal tract may, of course, impair the nutrition of the lens to such an extent as to lead, in course of time, to its degeneration; in such cases the cataract should be classed rather as secondary than as traumatic. When the capsule is wounded, the fibres in the immediate neighbourhood of the opening rapidly imbibe fluid from the aqueous or vitreous chamber, swell up and thereby become opaque, and finally disintegrate. This occurs more or less rapidly according to the size of the wound and the age of the person. In the young eye absorption of the entire lens-substance may take place. It is not very unusual, however, for the disturbance caused by a small wound to remain for a long time limited to the part injured; for example, a minute fragment of metal, or other foreign body, becoming embedded in the lens, may leave only a small localised opacity, connected with the capsular wound by a fine opaque line, marking the path along which it travelled. In such cases the opening in the capsule doubtless closes at once and completely. Such closure is promoted by adhesion of the iris at the point of injury, but may occur quite independently of it. The most frequent causes of traumatic cataract are punctures produced by scissors, forks, needles, awls, thorns, sharp fragments of metal, &c.: when wounds of larger size involve the lens, the injury is frequently so extensive as to cause total destruction of the eye.

(*c*) *Secondary Cataract.* — Many diseases of the eye, and especially those which involve the uveal tract, and which impair the secretory function of the ciliary processes, are apt secondarily to induce degeneration of the lens. Thus cataract is common as a late result of cyclitis, irido-cyclitis, choroiditis, retinitis pigmentosa, absolute glaucoma, retinal detachment, and intra-ocular tumour. In many of these conditions the lens acquires adhesions with false membranes and vascular tissues, and imbibes fluids in directions in which, normally, no fluid permeates the capsule. A special tendency to proliferation of the capsular epithelium, due probably to this morbid nutrient supply, is characteristic of many kinds of secondary cataract. The clinical importance of secondary cataract is usually not great, for at the stage in which it occurs the eye is often blind, or nearly so, from the original disease, but there is one variety in which this is not the case, and which, therefore, deserves special notice: anterior polar cataract. In some forms of secondary cataract—namely, in those which depend upon choroidal disease—the opacity begins at the posterior pole of the lens.

Anterior Polar Cataract may arise either before or after birth; in either case the cause is of the same kind—namely, contact of the lens-capsule in the pupillary area with an inflamed cornea, or with products of inflammation in the anterior chamber. Morbid fluid, and in some cases pus-

cells, traverse the exposed portion of the capsule and excite proliferation and disturbance in the subjacent epithelium and fibres. The capsule is eroded and thinned, and often somewhat elevated by the projecting mass of débris beneath it, forming a small prominent opacity, known as a pyramidal cataract; or the opacity may take the form of a circular group of dots corresponding with the margin of the pupil. The process is essentially the same, whether the resulting opacity is punctiform, flake-like, or pyramidal. A perforating ulcer, often the result of purulent ophthalmia immediately after birth, is the usual cause of anterior polar cataract, but perforation is not necessary to its production. During fœtal life, in which no anterior chamber exists, any inflammatory affection of the cornea, probably, may suffice to affect the capsular epithelium, and, as a matter of fact, in many cases of congenital anterior polar cataract no trace of a corneal cicatrix is discoverable. This form of cataract usually remains unaltered throughout life.

In an advanced stage secondary cataracts are apt to undergo calcification, especially if they are in abnormal and close relation with vascular membranes. The chalky deposit is found first in the layer of new tissue formed by the proliferation of the capsular epithelium, and in the pseudo-epithelium which forms within the posterior capsule. Later it invades the entire lens-substance, progressing from periphery to centre. Calcareous deposits of smaller size are found in primary senile cataracts in an advanced stage, in the form of thin films of strongly refracting granules near to the capsule. Total calcification of the lens is a matter of months, if not of years, for the intra-ocular fluid is poor in inorganic constituents, and the interchange of fluids is extremely slow in the degenerating lens. A mass of true bone may be formed in the position normally occupied by the lens, and may assume the contour of the lens, the process being an ossification of morbid tissue which has taken the place of the lens, and been moulded into its shape by pathological formations surrounding it; but ossification of the lens-substance itself, while still enclosed in its unbroken capsule, never occurs.

Symptoms and Diagnosis of Cataract. The *subjective symptoms* consist only of the visual troubles which naturally arise from a want of transparency in the lens. As a means of diagnosis they are no longer of much moment, for since the introduction of the ophthalmoscope the presence of cataract in any stage is determined by objective methods only; but it is important, none the less, to know the kind of complaints which are made by persons suffering from cataract in various stages, and in all cases in which operative measures have to be considered, a careful testing of the subjective condition is necessary in order to ascertain the presence or absence of retinal or other complications which would detract from the result of the operation or render it useless.

The extent to which vision is affected depends upon the amount of the opacity and upon its relation to the pupillary area. A few small opaque striæ at the margin of the lens, such as usually constitute the beginning of senile cataract, and, indeed, may remain unaltered for many years, are not incompatible with perfectly sharp vision. In like manner the small opaque white dot seated in the centre of the pupil, known as anterior polar cataract, causes little or no impairment of vision, though the eyes in which it is found often have defective sight by reason of the corneal cicatrices, which commonly accompany it and are due to the same original cause. Apart from these two forms, cataract always causes more or less impairment of vision. Simultaneously with its commencement there is often a change of refraction in the lens in the direction of myopia. *See* Refraction, Errors of. The patient states that the convex glasses which used to clear distant objects no longer give any assistance, indeed that he sees more clearly without them. Hypermetropia, formerly present, has disappeared. In many cases eyes previously emmetropic become myopic. At the same time, or very soon afterwards, the acuity of vision begins to fail, and continues to do so from month to month; reading has to be given up; after a while the patient can no longer safely walk alone; and finally only the power of discerning light from darkness remains. Unless cataract be complicated with disease of other parts of the eye perception of light is never lost, and the patient can indicate with considerable accuracy the position and movements of a luminous object, such as a candle, held before his face. In the earlier stages of the disease bright light—direct sunlight, for example—usually distresses the patient and increases his difficulty in seeing. This is due partly to the dazzling which is produced when the opaque particles in the lens are strongly illuminated by rays of light impinging directly upon them—a phenomenon easily realised when one sees how much more obscure a dusty window-pane becomes where it catches the sunlight than

where it is shaded by the window-frame—and partly to contraction of the pupil. The latter is of course most detrimental when the opacity is seated chiefly in the central region of the lens. In such cases vision is often distinctly better towards evening, or when the patient turns his back to the window and shades his eyes with his hand, by reason of the dilatation of the pupil which occurs under those circumstances.

In young children who are the subjects of lamellar cataract, the impairment of vision is sometimes so moderate in degree that it attracts no attention until, with the first attempts at schooling, it appears that the child is unable to learn his letters without great difficulty. In cases where the opaque lamina is very thin, the child may even learn to read and write without much difficulty, and go through a large part of his school life without coming under medical examination with regard to his sight. From his habit of bringing his book very near to his eyes such a child is often supposed to be myopic rather than the subject of cataract, and, as a fact, myopia is not infrequently present in addition to the lental opacity. Though the periphery of the lens is clear in these cases, the clear zone usually lies quite outside the area of the pupil, so that it is *through* the cataract, and not round it, that the child sees. In the denser forms of congenital and juvenile cataract the impairment of vision may be quite equal to that caused by the densest senile cataract, and it is often the essential cause of another peculiar symptom—viz. nystagmus, or continuous oscillations of the eyeballs.

The *objective symptoms* of cataract are the visible changes in the lens. In an advanced stage cataract usually manifests itself readily to ordinary daylight inspection, the pupil presenting, instead of its normal blackness, a grey, yellowish-grey, brownish-grey, or even solid white, appearance, which tells at once of opacity in the region of the lens. Simple inspection is, however, insufficient for a safe diagnosis. Those who venture by its means alone to pronounce an opinion as to the presence or absence of cataract will inevitably sometimes fall into serious error. The normal sclerosis of the lens-fibres increases their power of reflecting light, and at sixty or seventy years of age the normal lens, instead of being completely invisible, as in early life, gives to the pupil a distinctly greyish look, indistinguishable in some cases, on ordinary inspection, from commencing cataract. Under certain circumstances, notably in glaucoma, this reflex is still further increased, and sometimes to such an extent that a lens which is in reality quite transparent may simulate a cataract almost ready for extraction. This resemblance has often led to unfortunate mistakes; persons suffering from glaucoma have been told that their failure of vision was due to cataract, and have, on this account, postponed the question of an operation until their eyesight was nearly, if not entirely, extinguished—that is to say, until the glaucoma had passed into an incurable stage. Hence the importance of a precise investigation of every case.

The condition of the crystalline lens is investigated by two methods: firstly, by *focal illumination*, a method which strongly illuminates any portions of the lens-substance which are opaque, and, when the opacities are few and small as compared with the transparent matter, causes them to stand out against the latter as against a dark background; secondly, by the help of the *ophthalmoscope*. If any considerable portion of the lens remains transparent, the light from the mirror passes through it to the fundus of the eye, and this, being situated in the focus of the lens, is more strongly illuminated than the lens itself, and affords a bright background, against which opacities in the latter stand out as dark markings. When the opacity is general it, of course, intercepts the light of the mirror, and prevents the illumination of the fundus; the opaque parts then appear illuminated as in the focal method.

For focal illumination the patient is placed at a distance of about two feet from a lamp, and in such a position that the light falls upon his face somewhat from one side, rather than directly from in front. The observer holds a lens of two or three inches focus between his finger and thumb, as he would hold a burning glass, and placing it in a line between the lamp and the eye, and at about its own focal distance from the latter, focusses the light upon the pupil. Any opacities lying near to the anterior surface of the lens, and within the area of the pupil, are by this means at once brought into view, and by varying the position of the patient's eye in relation to the light, and looking into the pupil in different directions, a large part of the lens may be brought under examination. To examine the posterior pole of the lens, the eye must be directed nearly towards the lamp, so that the light enters the pupil nearly in the perpendicular direction, and the observer must look into it as nearly as possible in

the same direction. The peripheral parts of the lens can only be completely examined after dilatation of the pupil by atropine, or some other mydriatic.

In examining with the ophthalmoscope, the observer looks obliquely into the eye from different points of view rather than from directly in front. By this means the extreme contraction of the pupil which ensues when the patient is allowed to look towards the mirror is avoided, and as much as possible of the periphery of the lens is brought under examination. The light employed should be of only moderate intensity, or the fainter forms of opacity are likely to be overlooked. The eye of the observer should be focussed for the patient's lens rather than for the fundus, and to this end it is useful to place behind the mirror a convex lens of sixteen or twenty inches focus, and to approach to a point somewhat within this distance of the eye; or a convex lens may be held between the mirror and the patient's eye, or even placed close in front of the latter in the ordinary trial spectacle-frame. The depth at which an opacity lies in the substance of the lens is estimated most readily by the focal method, but it may also be determined by means of the ophthalmoscope. An opacity occupying the centre of the anterior capsule is seen as a dark, opaque spot in the centre of the illuminated pupil, and, since it is practically in the plane of the iris, does not move from this central position, however obliquely the observer may look at it. A similar opacity at the centre of the posterior capsule, on the other hand, is only to be seen in the centre of the pupil when the observer's eye stands exactly in line with the axis of the lens. If from this position he moves slightly to either side, the opacity appears to move towards the corresponding side of the pupil. The rate of this apparent movement, or, in other words, the readiness with which the opacity disappears behind the margin of the pupil, is a guide to its depth behind the plane of the iris. On the same principle, opacities which lie behind the lens, namely, in the vitreous body, are distinguished from lental opacities by the greater rapidity of their apparent movements. Vitreous opacities, moreover, often show more or less independent movement of their own, called forth by movements of the eye, but continuing after these have ceased.

Opacity of the cornea occasionally simulates cataract to a superficial observer; the distinction is made at once by focal illumination. A filmy opacity in the anterior stratum of the vitreous—that is, in actual contact with the posterior lens-capsule—is at times hardly distinguishable from an opacity within the capsule, and, indeed, the distinction is not very important, for cataract appearing in that form is usually secondary to changes in the vitreous fluid. A dense opacity in the region of the vitreous humour, such as is produced by glioma (*see* Optic Nerve and Retina), and by those infiltrations of the vitreous which resemble glioma (*see* Vitreous), sometimes presents an appearance which may be mistaken for cataract unless a careful focal examination be made with especial regard to the depth of the opaque body behind the iris. Again, small masses of pigment remaining adherent to the anterior lens-capsule after the subsidence of an iritis, are sometimes not to be distinguished with the ophthalmoscope alone from opacities beneath the capsule, or in the anterior layers of the lens-substance; their position, however, will usually suggest an iritic origin, and a careful focal examination will set the matter at rest. There are cases, however, in which an inflammatory exudation in the anterior chamber not only leaves opaque deposits on the outer surface of the capsule, but, by osmosis through it, sets up changes in the capsular epithelium, which lead to punctiform opacity within it.

Since the introduction of the ophthalmoscope the so-called catoptric test, by which the transparency of the lens is investigated by observing the images of a candle reflected from its anterior and posterior surfaces, has almost passed out of use; but it may still be sometimes employed with advantage, notably when the presence of a black cataract—a variety which neither focal illumination nor the ophthalmoscope can reveal with certainty—is suspected.

The earliest objective sign of *senile cataract* is usually the presence of a few linear or wedge-shaped opacities, beginning apparently near to the equator of the lens, and pointing towards its axis. They are at first to be seen only by looking very obliquely into the eye, and may be quite beyond the reach of inspection until the pupil is dilated with atropine. They indicate a splitting up of the fibre-layers at the junction of the sclerosed portion or nucleus, and the non-sclerosed portion or cortex, and may be found, on careful examination, to embrace the margin of the nucleus, passing inwards both over its anterior and posterior surfaces. Prior to the appearance of actual opacity visible under

focal illumination, the ophthalmoscope will sometimes detect the presence of radiating streaks or lines, which shift their position or disappear as the direction of the light is varied; these indicate the formation of minute interstices filled with clear fluid, and are usually near precursors of actual opacity. In the course of months or years the marginal striæ increase in number and size, and invade the area of the pupil. They coalesce to form sector-shaped and flake-like patches of opacity, and they extend towards the capsule. Gradually the whole pupillary area becomes opaque, and the red glare of the fundus is no longer visible with the ophthalmoscope. For a while longer the laminar structure of the lens may be indicated by glistening sectors or radiating lines, and then these also disappear, and the opacity assumes a more uniform, greyish, or yellowish-white look, and involves the whole of the cortical substance quite up to the capsule. At this stage the cataract is, from the surgical point of view, *mature*. The special signs by which maturity is estimated will be described farther on.

The appearances which cataracts present in a still later stage correspond with the further degeneration of the opaque cortex. More or less shrinking usually occurs, which gives to the capsule a shrivelled look; spots and patches of a denser white make their appearance, and the bulk of the cataract is noticeably diminished. Less commonly the capsule remains distended by fluid imbibed from without, and the disintegrated fibres break down into a semi-fluid pulp. Occasionally the liquefaction of the cortex is so complete that the nucleus, which always retains its consistency, floats freely about in it, when the head is bent forwards falling against the anterior capsule so as to become visible, disappearing when the head is thrown back. This condition is known as 'Morgagnian' cataract. The brilliant white spots and patches which make their appearance on the surface of over-mature cataracts are due to changes in the capsular epithelium, and constitute what is called capsular cataract. The opacity differs from that of the lens-substance, not only in being denser and whiter, but in being devoid of stellate marking, and in being limited to an area not exceeding that of the moderately dilated pupil. A final change occasionally to be witnessed in over-mature cataract is the spontaneous loosening of the lens from its attachments. In consequence, probably, of the shrinking of the lens, the suspensory ligament gives way at some part of the circle, and the shrivelled lens is drawn towards the opposite side, leaving a clear space, through which, with the help of a cataract-glass, the patient may enjoy useful vision, or the lens may fall back into the vitreous chamber and leave the pupil entirely free. This spontaneous cure of the blindness is a rare event, and occurs for the most part only after the cataract has been complete for many years, and in persons whose nutrition is greatly impaired.

The foregoing description of the development of the opacity in senile cataract is applicable to very many cases, but not to all. In some the opacity, instead of advancing from the periphery towards the pupillary area, makes its appearance in the central part first, and thence gradually extends outwards. This does not necessarily imply that the degeneration begins actually in the nucleus; in some cases, certainly, it is the cortical layers immediately overlying the surface of the nucleus which suffer first, and the cataract is really cortical throughout, as in the form already described. But in others the morbid process actually begins in the nucleus, and the cortical layers suffer later, the rate of progress being for the most part extremely slow. This is a true nuclear cataract. It appears, in some respects, to stand midway between the ordinary cortical cataract of the old, and the general soft cataract of the young. The opacity has a diffuse, cloudy look, and is devoid of the radiate marks which are common in cortical cataract, though there is sometimes in the cortex a Y-shaped line of opacity, causing a well-marked tripartite division. In colour it is milky or yellowish. In the nucleus the opacity may develop quickly, but its invasion of the cortex is very slow, and the patient must wait through a long period of partial blindness before the cataract is sufficiently ripe for extraction. These are the cases in which vision is decidedly improved by a moderate dilatation of the pupil, either as the result of shading the eyes, or by the use of atropine.

Diabetic Cataract presents no specially distinctive appearances. Its characters vary, like those of other forms, with the age of the subjects. Thus, in young people, the whole lens—there being no hardened nucleus—becomes opaque throughout, while in old people the cortex and nucleus are differentiated, as in ordinary senile cataract. Both lenses are commonly affected together, or very nearly together. In all cases of double cataract in young or middle-aged

adults the presence of diabetes should be suspected.

Black Cataract is a term applied to a peculiar and rare condition of the lens met with in the second half of life. To ordinary inspection the pupil appears black; focal illumination fails to reveal any decided opacity; but no reflex from the fundus is obtainable with the ophthalmoscope. Under the catoptric test the image of the candle which should be produced by reflection from the posterior surface of the lens is wanting, the lens is of a deep brown colour throughout, and though it presents none of the ordinary signs of opacity is practically impenetrable by light. Such lenses are in reality not cataractous at all, but owe their opacity to a great excess of the brown coloration which is present to some extent in all healthy lenses in later life. It has been asserted that the coloration is due to an infiltration of the lens-substance with hæmatin; but lately a careful spectroscopic examination has proved that it is not derived directly from any of the blood-pigments; the colouring matter belongs to the same class of pigments as melanin, and presents analogies with the colouring matters of hair and feathers; it is, in short, a cuticular pigment, a further point of analogy between the lens and the skin. (*Trans. Ophth. Soc.*, vol. ii. p. 10.)

Traumatic Cataract varies greatly in its course and symptoms according to the nature and extent of the injury and the age of the patient. Under focal illumination the opacity can generally be traced to a wound in the lens-capsule. From this it spreads, sometimes in the course of a few hours, sometimes much less rapidly, to the whole of the lens-substance, which swells considerably as it becomes opaque. In the soft lens of childhood the spread of the opacity and the swelling are much more rapid than in the hard lens of advanced life. A wound of some size in the anterior capsule of a child's lens is followed, in a few hours, by the escape of a considerable mass of grey lens-matter into the anterior chamber, and not only the extruded portion but the whole of the remainder, with the exception of a few films adhering closely to the capsule, may in the course of a few weeks undergo spontaneous solution and removal, so that a black pupil is restored. A smaller wound will lead more slowly to the development of a complete cataract, and the process of absorption may come to a standstill, so that surgical interference is required before disintegration and removal of the opaque matter occur. Very small wounds, as has been already stated, sometimes close at once, and cause nothing more than a small limited opacity in their immediate neighbourhood. Small fragments of metal or other foreign substance entering the lens may lead rapidly to total cataract, or may for a considerable time remain the centre of a small opacity which spreads no further. Or, passing completely through the lens from front to back, they may leave only an opaque line in their path. When the anterior and posterior capsule are both wounded, the opacity spreads more from the anterior than from the posterior wound, the vitreous humour taking less effect upon the exposed fibres than the aqueous. A fragment of iron, or other metal liable to undergo chemical changes, may in course of time cause discoloration of the opaque lens-substance in which it is embedded; such discoloration should therefore excite suspicion of a foreign body being present. Other things being equal, a wound of a senile lens is a more serious injury than a wound of a young lens; for in advanced life, the lens, being of large size, is in closer relations with the surrounding structures, and is therefore, when it swells, more likely to cause difficulties with the iris and ciliary processes than the smaller lens of a child or young adult. In the uncommon cases of traumatic cataract in which the capsule is not ruptured, the opacity generally makes its appearance first at the anterior or posterior cortex, and advances much less rapidly than when the capsule is opened.

Lamellar Cataract is less easily made out by ordinary inspection of the eye than many other forms. With an undilated pupil it is often quite invisible until focal illumination or the ophthalmoscope is used, Looking straight into the eye with the ophthalmoscope, the observer notes that the reflex from the fundus is imperfect, but the cause of the dimness is not revealed until he looks obliquely behind one or other border of the pupil. Then the periphery of the lens is seen to be quite clear and to stand out sharply against the central clouded area. The opacity appears to become more dense towards its outer margin, where it is limited by a well-defined dark outline; this however, is more apparent than real, and is due to the fact that at the margin the opaque lamina presents itself edgeways, while in the central area it lies perpendicular to the line of view. The apparent increase of density towards the margin of the opacity distinguishes the lamellar from the solid nuclear form of cataract. In the latter the

density is of course greatest in the axis of the lens, where the largest amount of opaque substance lies. Under focal illumination, with dilated pupil, a lamellar cataract presents the appearance of a bright semi-transparent filmy vesicle or shell, lying without visible attachments in the midst of a transparent medium. The amount of opaque matter varies from an almost invisible film in some cases to an almost solid-looking mass in others. The initial disturbance of the fibres is very probably in most cases an intra-uterine event, but a decided and sometimes sudden increase of the opacity is not infrequent during infancy or early childhood. Beyond this time of life an extension of the opacity is the exception, rather than the rule. From the margin of the opaque area radiating stripes or lines may sometimes be seen, extending outwards into the clear portion, and an increase of these at any time would indicate the probability of a general opacification; as a rule they are stationary. An inner shell of opacity may sometimes be seen within the outer one, the two being quite concentric and separated from each other by a layer of transparent substance; an instance of three distinct layers of opacity is on record. In nearly all cases lamellar cataract affects both eyes. The total nuclear, membranous, and other congenital varieties of cataract do not require detailed description; the appearances which they present may be best interpreted by considering the manner in which the fœtal lens is built up, and the effects which would result from disturbance of its growth at various periods.

Secondary Cataract may usually be recognised as such without difficulty. In many cases signs of a bygone iritis or irido-cyclitis are present, and if the opacity is not sufficient to completely hide the fundus, deeper-seated disease of the uveal tract may be discoverable. The loss of vision is generally greater than can be accounted for by the lental opacity only, and in very many cases amounts to total blindness; the character of the opacity itself is sometimes a sufficient evidence of its being the result of other mischief in the eye. Thus a stellate opacity seated in the posterior cortex of the lens is an almost certain sign of choroidal disease of one kind or another. It is frequently met with in the later stages of retinitis pigmentosa. It is to be distinguished from a rarer form of posterior polar cataract which is congenital, and which probably depends upon an abnormality in the fœtal hyaloid artery. This latter presents the appearance of a solid glistening plaque, and has not the diffuse and radiate character of the choroidal cataract. The radiate opacity is internal to the capsule and follows the anatomical arrangement of the fibres; the plaque is probably external, and owes its glistening look to its being lined, as it were, by the capsule. Anterior polar cataract—a small central opacity immediately beneath and involving the anterior capsule—is, as already stated, an evidence of bygone corneal suppuration. A dense irregular patch may sometimes be seen occupying the centre of the anterior capsule in what looks like an ordinary senile cataract; it tells of morbid secretions in the anterior chamber. Again, the more pronounced degenerative changes to which secondary cataracts are liable often give them a brilliant white or yellow appearance which declares at once that the lental disease is not the primary one.

Maturity.—From the surgical point of view, this is one of the most important questions involved in the examination of a cataract. A cataract is said to be mature when the adhesion of the cortex to the capsule is so far destroyed that the whole of the lens-substance can escape readily when the capsule is opened—in other words, when the cataract will leave its envelope as a ripe nut leaves its shell. To this end the whole cortex, and especially the layers in contact with the capsule, must be involved in the degeneration. Generally speaking, a cataract is not mature until the opacity has come close up to the capsule. In order to estimate maturity, the observer illuminates the eye by the focal method, causing the pencil of light to fall upon it obliquely from one side. If there be a layer of transparent matter between the opaque fibres and the capsule, the edge of the pupil nearest to the light will cast a shadow of crescent form into the substance of the lens, while if the opacity be immediately beneath the capsule, no such shadow will be cast upon it. In the second place he throws light upon the lens with the ophthalmoscope, when, if it be mature, no red glare from the fundus will be obtainable. The rule then is that a mature cataract receives no shadow into its substance on focal illumination, and permits no illumination of the fundus. But the rule is not absolute. There are cataracts which fulfil both these requirements, and yet are immature, and there are mature cataracts which fulfil neither. Thus, in some instances, the soft opaque cortical substance is entirely wanting, or very nearly so, the whole lens consisting apparently of a large brownish-yellow nucleus, which, although sufficiently clouded

to destroy useful vision, will still allow some illumination of the fundus, and receive a shadow on focal examination. Such cataracts grow darker in colour with age, but do not become truly opaque. They will often separate readily from the capsule, and are therefore, in a surgical sense, mature. Again there is a form in which the opacity appears first in the nucleus, and invades the cortex very slowly; ultimately a thin subcapsular layer becomes opaque, and then the cataract is ripe for removal, even though the iris may still cast a shadow into it. On the other hand, despite the ordinary signs of maturity, a cataract is not fully ripe if, under focal examination, its surface shows well-marked glittering sectors. These indicate that some thin flakes still remain transparent, and, so long as this is so, a complete separation of the cataract from the capsule cannot be relied on. The glittering appearance is usually not of long duration; the sectors soon break down and then the cataract is mature. (Förster.)

A thorough examination of the condition of the lens can only be made after the pupil has been dilated with atropine, or homatropine, the latter being sometimes preferable because of its more transient action; but, in using either of these drugs in elderly people, it is well to remember that, where any tendency to glaucoma exists, dilatation of the pupil is apt to intensify it. The tension of the eye should therefore be carefully ascertained beforehand.

PRIESTLEY SMITH.

CATARACT, Treatment of.—*Therapeutic Treatment* is powerless to remove an opacity of the lens, and very rarely has any decided effect in delaying its progress. Still, the possibility of doing some good by general treatment should not be entirely lost sight of. Slight opacities of the lens have been known to clear up, and in very many cases they remain stationary for long periods of time; it is, therefore, always right in the early stages of the progressive forms of cataract to inquire as to the habits of life and the constitutional condition of the patient, and to correct any faults, as far as may be possible, in the hope of lessening the tendency to further degenerative changes. Among other alleged remedies electricity has been put forward as a cure for cataract, but no satisfactory evidence of its utility has been given. It is very probable that some of the reported cures by this and other therapeutic measures have been due to the clearing up of cloudy conditions of the vitreous.

Palliative Treatment, which aims not at removing the opacity, but at diminishing its detrimental effect upon the sight, is very useful in certain forms and stages of cataract. Thus, tinted glasses to moderate the light, atropine to enlarge the pupil, iridectomy to uncover a transparent portion of the lens when the opacity is chiefly central, sometimes give much help. Their special application will be discussed in connection with the various forms of cataract. Apart from these palliative measures, the only treatment which is available is an operation for the removal of the opaque lens.

Operative Treatment.—Broadly speaking the operations now employed for the removal of cataract are of three kinds: 1. Those which by admitting the aqueous humour freely into the substance of the lens promote its solution in, and spontaneous removal by, the fluids of the eye. 2. Those by which it is removed piecemeal through a small opening in the wall of the eye. 3. Those by which it is removed more or less unbroken and entire through an opening of larger size. A fourth method, distinct in principle from the foregoing, was formerly much employed, but has now fallen into almost complete disuse—the operation known as couching or reclination, by which the opaque lens was dislocated backwards into the vitreous humour, so as to leave the area of the pupil free. The choice between these several methods in any given case is determined by the consistency of the cataract. From the operative point of view cataracts may be classed as hard or soft. A *soft* cataract is one which is either pulpy throughout, or will become so after the aqueous has been freely admitted into its substance, and which, therefore, can be removed through a small opening. A *hard* cataract is one which, having a firm nucleus, cannot be rendered pulpy throughout, and which therefore demands a much larger opening for its removal from the eye. Whether a cataract is hard or soft depends, not upon the nature of the morbid process, but upon the natural consistency of the healthy lens at the corresponding time of life. With few exceptions, in early life all cataracts are soft, in advanced life all are hard; there is no sharp line separating the one class from the other, the transition is gradual, like the process of sclerosis by which the hardened nucleus is formed. For practical purposes, the age of thirty or thereabouts may be taken as the point that separates the cataract which is soft throughout, from the one in which a firm nucleus must be expected. It is not

often that a doubt on the matter arises, for, except as the result of injury, cataract at this time of life is rare.

Before taking each of the chief varieties of cataract in turn, and pointing out how it should be dealt with, it will be well to deal generally with the question of *the use of anæsthetics in cataract operations.* Until lately it has been the custom of many operators to use ether, chloroform, or some other general anæsthetic, in most operations for cataract; others have employed them only for children and for nervous adults, in whom the necessary self-control could not be expected. In addition to the avoidance of pain, anæsthesia confers the advantage of passivity of the eye and eyelids; but it carries with it the drawbacks of nausea and constitutional upset for a time after the operation, and the chance of vomiting, which, in certain cases, may greatly imperil the eye. In operations which do not include a large wound, the risk from the latter cause is slight and need hardly be considered, and the question of an anæsthetic must depend on the amount of pain likely to be given and the steadiness of the patient. In needle operations, which involve only the cornea and lens, the pain is slight; in iridectomy it is more severe. In iridectomy for artificial pupil, in which a wound of the lens would be a serious disaster, the need for passivity is at its greatest. When a large wound is to be made, as in extraction of senile cataract, vomiting involves great risk, and on this account, as well as that the patient may be able to assist the operator by voluntarily directing his eyes in the required direction, some surgeons dispense with anæsthetics almost entirely in the removal of senile cataract. The matter has remained one for individual choice and experience. The writer, having found that the administration of fifteen or twenty grains of chloral-hydrate by the mouth about twenty minutes before ether-inhalation much diminishes the liability to sickness, has used this mode of anæsthesia largely with good results.

Koller's discovery in September, 1884, of the power of cocaine to induce local anæsthesia in the eye, has, in the course of a few months, changed the practice with regard to anæsthetics in ophthalmic operations, all over the world. A few instillations of a four per cent. solution of hydrochlorate of cocaine, render the whole of the conjunctiva and cornea sufficiently anæsthetic for operations which involve these structures only; the iris may be rendered subnormally sensitive by a further instillation after the anterior chamber has been opened; and, with care and a warning to the patient not to flinch at the moment when the iris is seized, operations involving this membrane also may usually be satisfactorily carried out. Hence, nearly all the operative measures which are required in treating cataract may now be undertaken with the help of local anæsthesia only. In cases in which severe congestion and inflammation of the eye are present—as, for example, in some cases of traumatic cataract—the effect of cocaine in lessening sensibility is very slight.

Lamellar and Nuclear Cataract in Young People.—In these forms the opacity is usually non-progressive, and the marginal zone of the lens remains permanently clear. In a few cases of the lamellar variety, vision is sufficiently good for all ordinary purposes, and it is best not to interfere in any way; usually we have to decide between the formation of an artificial pupil by iridectomy, and the removal of the lens by a needle operation. If, after wide dilatation of the pupil by atropine, and the correction of any refractive error, vision still remains very insufficient in both eyes, and if the eye appears to be sound as regards the condition of the retina and in other ways, the removal of the lens is indicated; but if, on the other hand, vision is found under these circumstances to be fairly good, it is better simply to uncover the margin of the lens at one part of the circle by an iridectomy. (For a description of the operation, *see* Iridectomy.) The latter proceeding has several advantages. It is a safe operation, and is very quickly recovered from; it permits of useful vision without the use of spectacles; it spares the accommodative function of the eye; it does not preclude, but rather facilitates, the subsequent removal of the lens, if this should prove necessary. On the other hand, it must be allowed that in a light-coloured iris an artificial pupil is disfiguring, but the wearing of cataract-glasses is hardly less so. Some surgeons remove the lens from one eye, and at the same time iridectomise the other. This practice is decidedly objectionable, for although the aphakial eye may be aided with a glass, the two eyes will not work well together; the patient probably soon lays aside the glass, and learns to depend almost entirely upon the eye which has the artificial pupil, thus proving that an iridectomy in both would have served his purpose better. The position of the *artificial pupil* must correspond with a clear part of the lens-margin, and must be

determined by careful examination beforehand with the ophthalmoscope. If possible it should be downwards and inwards.

In cases of lamellar cataract both eyes usually require operation. There is no objection to operating for artificial pupil on both at one time. The only accident which can easily happen, in making an artificial pupil in the cases now under consideration, is wounding the lens. Should it occur, the case must be dealt with as one of ordinary traumatic cataract in a young subject.

Two other methods of making an artificial pupil are occasionally employed—iridodesis and iridotomy. *Iridodesis*, or the entanglement of the iris in the cornea, was recommended by the late Mr. Critchett, but has been abandoned because it may lead to sympathetic ophthalmitis. *Iridotomy*, which signifies the cutting, merely—not the *cutting out*—of iris, is sometimes practised, but is dangerous for zonular cataract; though, as will be seen later, iridotomy is a most valuable operation for opening up the pupil when the lens is absent. *See* below and Iris.

Those cases of lamellar and nuclear cataract, for which an operation for artificial pupil is obviously unsuited, or in which it proves insufficient, must be treated by the needle operation (discision), followed, if necessary, by linear extraction, with or without the help of suction. These methods will be described in connection with the treatment of complete soft cataract—the form of the disease in which they are chiefly employed.

Complete Soft Cataract.—In infancy and childhood an opaque lens may usually be got rid of by one or more simple needle-operations. By this proceeding the anterior capsule is lacerated, and the fibre-layers are more or less broken up and exposed to the action of the aqueous humour. Any portions not previously opaque become so, and the whole lens-substance swells, softens, and gradually dissolves in the fluid which macerates it. The younger the patient, the more rapidly does the process of disintegration go on, and the less danger is there of inflammatory complications on the part of the iris. This is a reason for early operation in cases of congenital cataract. A stronger reason still lies in the fact, that the absence of visual impressions, in very early life, appears to act unfavourably on the development of the brain-centres which control the movements of the eyes. Children blind from birth, or blinded soon after birth, as, for instance, by purulent ophthalmia, frequently present the symptom known as nystagmus—a continual oscillation of the eyes indicative of disordered action in the cerebral centres for ocular movements. A needle operation, if it is required, may properly be undertaken in the third month after birth, before its results are likely to be interfered with by the troubles of dentition. An earlier interference than this is not desirable, for at birth the aqueous humour is scanty, and the anterior chamber extremely shallow.

Needle Operation (Discision) and Solution.—The pupil must be thoroughly under the influence of atropine. The instruments required are the speculum, the fixing forceps, and a cataract-needle. Some operators prefer, in the absence of an anæsthetic, to fix the lids and globe with the fingers rather than with instruments. The extremity of the needle is flattened and has two cutting edges; in the shaft it is cylindrical and slightly tapered, so that it completely fills the puncture which it makes, and prevents escape of the aqueous. A stop or shoulder on the shaft serves as a guide to the depth to which it enters the eye, and gives it additional strength. The speculum being in place and the globe fixed, the point of the needle is pushed rather obliquely through the cornea in its outer and lower quadrant, at a point about midway between the centre and the margin, and carried to the centre of the pupil; by a few gentle to-and-fro movements it is then made to divide the centre of the capsule with crossed cuts, and to break up the anterior layers of the lens. The needle is then carefully withdrawn, its flattened point coming out in the same plane as it went in. The iris must not be touched with the needle; the aperture made in the capsule must be smaller than the pupil; the lens must not be forcibly or deeply cut into; the movement of the needle must not be such as to drag upon the cornea, but must be made in lever fashion around the corneal puncture as a fixed point. After the operation, the pupil is kept dilated to the utmost by applications of atropine at intervals of not more than three hours; a fold of linen, dipped in cold or iced water, is kept lying across the lids for forty-eight hours, or longer if there is any reaction, and later the eyes are covered with a shade. Exposure to strong light is to be strictly avoided. In very young children any application over the eyelids sometimes causes much fretting, and does more harm than good; the eyes must then be allowed to remain uncovered, and the room darkened.

The result of the operation is that the lens-matter immediately adjacent to the wound in the capsule becomes opaque, if it was not so already, swells, protrudes, more or less, into the anterior chamber, and ultimately shrinks and disappears, the bulk of the lens being thereby reduced. In a few cases a single operation leads to complete solution and removal of the lens. More commonly the needling has to be repeated two, or three, or more, times, at intervals of several weeks. In the later operations, the needle may be used rather more freely than at first, for the lens is smaller, and a sudden and dangerous swelling of its substance is less likely to occur. During the whole period of the treatment, the eye is to be kept thoroughly under atropine and no fresh needling must be undertaken so long as the slightest sign of irritation remains over from the last. In the final stage there sometimes remains an opaque membrane upon which the process of solution takes no further effect. If this cannot be readily divided by the single needle, it is safer to employ two than to drag upon the ciliary processes in the effort to tear it through. One needle is passed through the inner half of the cornea and through the centre of the membrane, the other through the outer half of the cornea and to the same spot in the membrane; then, by approximating the handles, the points are separated, and an aperture is torn in the membrane without any dragging on its ciliary attachments (Bowman). Instead of repeating the needling when the process of solution appears to be at a standstill, it sometimes answers well merely to evacuate the anterior chamber by a small opening in the cornea; the fluid thus drawn off is highly charged with the débris of the lens; it is replaced by a fresh aqueous secretion, and solution begins again.

The needle operation, when properly performed and followed by careful after-treatment, is a safe procedure. The complications which we have to fear are iritis and even irido-cyclitis from irritation of the vascular structures in the neighbourhood of the lens, and increase of tension—secondary glaucoma—caused by the pressure of the swollen lens against these parts and consequent compression of the filtration channels at the angle of the anterior chamber. Slight congestion in the ciliary region without pain is not serious; but if the congestion be considerable, and the colour of the iris altered, a severe iritis is imminent, and must be promptly met by the application of two or three leeches to the temple or lower eyelid, very free instillation of atropine, persistent use of iced compresses, and, if the bowels be inactive, a purge. If the inflammatory symptoms persist, or if the eye become hard, either with or without pain and congestion, relief must be given immediately by removal of the swollen lens-matter by linear extraction or the suction method described below. The tendency to glaucomatous complication increases as the size of the lens increases; it has, therefore, a direct relation to the age of the patient. The needle operation alone is suited chiefly to the complete cataracts of children. In young adults, in whom the process of solution goes on more slowly, and to whom time is of more value, it is usually supplemented by linear extraction or suction. It is not well suited, even in children, to fluid cataracts, nor to those which have tough and thickened capsules.

Linear Extraction.—This operation affects the removal of the softened lens piecemeal through a small straight incision in the cornea. It is applicable to soft cataracts, for which the needle operation proves insufficient; to fluid and other completely softened cataracts, without previous needling; to traumatic cataracts below the age of twenty-five, when the swollen lens-matter sets up inflammation or excess of tension; to lamellar, nuclear, and other partial forms of cataract, after they have been made complete by previous needling. The instruments required are the speculum and fixing-forceps, a keratome, a cystotome, and a curette. Under the same conditions as before with regard to dilatation of the pupil, separation of the lids, and fixation of the globe, the keratome is passed through the cornea at a point 2 or 3 mm. within its outer margin, and carried onwards parallel with the iris until an incision from 4 to 6 mm. in length is effected. It is then slowly withdrawn. If the lens-capsule be not already opened the cystotome is introduced, care being taken not to entangle its point in the iris, and the capsule is lacerated as freely as the size of the pupil will allow; it is then withdrawn with the same precautions as before. Instead of using the cystotome some surgeons open the capsule with the point of the keratome at the moment of completing the incision. If the iris prolapse through the wound, the extruded portion is taken up with iris-forceps and cut off as in an ordinary iridectomy. The curette is then gently pressed upon the outer lip of the wound, so as to make it gape a little, and at the same time slight

pressure is made upon the globe with the fixing forceps. A considerable portion, if not the whole, of the lens-substance is by this means evacuated, and the pupil at once assumes a more or less black appearance. In order to effect the removal of any fragments which may remain, the speculum is now removed, the eyelids closed, and a few light rotatory stroking movements made over the cornea by means of a finger on the upper eyelid. Time is given for the anterior chamber to refill with aqueous. On re-opening the wound by pressure with the curette, a further clearance of the pupil will then take place. Pains and time must be devoted to removing in this way all particles of lens-matter which can be got away, but it is not advisable to put instruments of any kind into the anterior chamber for this purpose. It is better to leave some lens-matter in the eye than to irritate it by violence. Fragments which remain behind are usually absorbed. The after-treatment is the same as in the needle operation.

Suction.—This operation differs from the foregoing in the manner of obtaining the escape of the lens-matter. The incision need not be quite so large as in the former case. The instrument through which the soft lens-matter is drawn out of the eye is a smooth round-ended metal canula, mounted either on a small syringe worked on the principle of an aspirator by the hand of the operator (Bowman), or on an india-rubber tube with a mouthpiece, which is held and aspirated with the lips (Teale). The canula is passed into the chamber with its aperture towards the cornea, and gently dipped into the semifluid lens-matter. By very gentle suction this is gradually drawn up into the tube, as much being removed as possible. The nozzle of the instrument must be brought as little as possible into contact with the iris, and must not be passed behind it in search of fragments. The operation gives, in many cases, excellent results; it is followed, however, every now and then by suppuration and loss of the eye. Delicacy of manipulation and absolute purity of the suction instrument are essential to the avoidance of these disasters.

Hard Cataract.—In the earlier stages of senile cataract palliative measures sometimes give much help. For outdoor use 'globular' spectacles, combining the power which gives the best distant vision with a blue or neutral tint, to lessen the uncomfortable glare caused by bright light, should be ordered. If the opacity in the pupillary area is considerable, while the lens-margin is comparatively clear, a moderate dilatation of the pupil by atropine, such as may be attained by the use of a single drop of a very weak solution once a day, or on alternate days, is likely to give help. A tenth of a grain of the sulphate of atropia to an ounce of distilled water is quite strong enough for such a purpose. The possibility of inducing glaucoma by wide and prolonged dilatation of the pupil must not be forgotten. During the earlier stages of the disease the opportunity should be taken of examining and carefully noting the ophthalmoscopic appearance of the fundus; for there may be changes of importance here, such as patchy atrophy of the choroid, which at a later stage would be undiscoverable, but which would affect the result of an operation. When the opacity becomes general, the maturity, or ripeness, of the cataract is to be carefully estimated according to the tests already given. Complete maturity gives the best prospect of a successful operation, and should usually be waited for. When the cataract in the one eye is well in advance of that in the other, this commonly involves no great hardship, for the one eye is ready before the other has lost all useful sight; but when the opacity is equal in the two eyes, waiting for maturity may mean a long and trying time of partial blindness, during which the patient's means of livelihood may be cut off, and the health and spirits much depressed. In such cases the ripening may sometimes be hastened artificially in a way which will be described further on, and an operation may sometimes be ventured on before complete maturity is attained. If one eye only is affected and the patient is advanced in years, an operation should not, in the writer's opinion, be recommended; if perfectly successful it will rarely enable the two eyes to work well together, the one requiring a cataract-glass, the other none, and it is to be borne in mind that failure of the operation followed by sympathetic mischief in the good eye, though not a likely result, is still a possibility.

Before the removal of a cataract is undertaken, the soundness of the eye in other respects must be carefully tested. Cataract, however dense, never abolishes perception of light. If the retina be healthy, the patient, when placed with his face to the window, will perceive the shadow of a hand passed before his eyes; and in a dark room he will usually be able to indicate the position of a lighted candle, or of an ophthalmoscope throwing

light upon the eye at a distance of two or three feet. If all perception of light is wanting, an operation will be useless. A ready response of the pupil to light and to atropine is favourable; a small and rigid pupil, unless it be adherent, indicates degeneration of nerves or of vessels, and a somewhat greater liability to bleeding and to inflammation of the iris. In such cases it is best to prepare for the extraction of the lens by performing an iridectomy some weeks previously. It is never advisable to extract a cataract from both eyes at the same time, for, should both do badly, the disaster is absolute and final, whereas a failure in the case of a single eye not only leaves a second chance still open, but will not improbably suggest some modified proceeding, which will give a better prospect of success for the second eye.

In all cases of cataract the cornea should be carefully examined under focal illumination. A nebula, so slight as easily to escape notice while the opaque lens is behind it, may materially affect the acuity of vision after the operation. It need be no bar to operating, but the patient should be informed beforehand of its presence and of its probable effect on his sight after the cataract is removed. The state of the eyelids and tear-passages must also be noted; a chronic discharge from either, especially if purulent, exposes the eye to a risk of destructive inflammation after operation, and must be remedied beforehand as far as possible. When any complication of this kind persists, in spite of treatment, disinfectants of one kind or other must be assiduously used to the conjunctiva, both before and after the operation. Of the various disinfectants which have been recommended for use in ophthalmic surgery, boracic acid, either in powder or in saturated watery solution, and iodoform as a very fine powder, are among the best. Some authorities, especially among the Germans, advocate a rigid antiseptic treatment in all cases—e.g. washing out the conjunctival sac with carbolic solutions, immersion of all instruments in absolute alcohol, the spray during the operation, medicated dressings of various kinds after it, and so forth; but the evidence advanced in favour of these measures has not been sufficiently strong to lead to their routine adoption in this country. Finally, the bodily health of the patient must be considered before an operation for the extraction of cataract is recommended. Temperate habits, good digestion, and freedom from serious organic disease will strongly favour a good result, but it is not necessary to abstain from operating, even though there be pronounced cardiac or pulmonary mischief, provided the patient have the prospect of some years of life. Diabetes appears to add little, if at all, to the risks of a bad result. Chronic albuminuria, on the other hand, increases the danger very materially. Advanced age is of itself no contra-indication, provided there is no extreme feebleness. Many perfectly successful extractions have been done in persons more than eighty years old.

Operations for Hard Cataract.—A hard cataract can only be removed through an opening of considerable size. The aim of the surgeon is to incise the tunics in a manner which, while it permits the lens to escape readily, offers the best conditions for healing, and the least danger of destructive inflammation. Very many modes of operating, differing more or less as regards the size, the form, and the position of the incision, and the manner of dealing with the iris, have been practised and described. Two distinct types are represented by the operations known as the 'flap extraction' and the 'peripheral linear extraction.' Each of these goes to an extreme in avoiding the drawbacks which belong to the other, and experience has shown that the best operations lie somewhere between the two. The subject will be best explained, therefore, by describing first these two typical, but extreme, modes, and then the modifications which are in more general use.

Flap Extraction.—The incision is made at the margin of the cornea, or just within it, and forms a semicircular flap, either of the upper or the lower half of the cornea. The speculum and fixing-forceps may be used, or, as was formerly always done, the globe and one of the lids may be fixed by the operator's fingers, the other lid by those of his assistant. The triangular knife is entered at, or just within, the outer margin of the cornea, and carried across the anterior chamber in a plane parallel with the iris, until it emerges at a point diametrically opposite to the point of entrance; it is then pushed steadily onwards until, by reason of the increasing width of the blade, it cuts its way out and completes the semicircular flap. The cystotome is then passed into the anterior chamber, and the capsule is opened; the body of the lens, escaping from its sac, then comes forward through the pupil, rotating somewhat upon its transverse axis as it does so, the edge nearest to the wound appearing first, and escapes from the eye. If the escape does

not occur spontaneously, it is effected by making slight pressure on the globe.

When the wound heals favourably, and no inflammation follows, the result of extraction by the flap method is more perfect, as regards the appearance of the eye and the condition of the pupil, than can be attained by any other mode of extraction. But there are many dangers, and when the flap extraction was commonly practised failures were more numerous than they are now. The shape of the incision is unfavourable to ready coaptation of its lips, and allows of gaping upon the occurrence of the slightest pressure from within, as during coughing, vomiting, or straining of any kind; the extensive separation of the corneal tissue from its source of nourishment exposes it to great risk of non-union and destruction by suppuration; prolapse, and incarceration of the iris in the wound, occur readily, and may lead to iridocyclitis; the mechanical bruising of the iris during the exit of the cataract is apt to set up inflammation, and to lead to closure of the pupil.

Peripheral Linear Extraction (Von Graefe).—This operation embodies the principles by which the dangers attaching to the foregoing are to be avoided. The incision, instead of being a semicircle, is, as nearly as possible, a straight line, for the more the curvilinear form is got rid of, the less does the wound tend to gape, and the more likely is it to unite smoothly. Instead of being placed wholly in the non-vascular cornea, and cutting off the nutrient supply from one half of this membrane, it lies almost entirely in the sclera, and corresponds to not more than one-third of the circumference of the cornea. The portion of the iris adjacent to the wound is excised; this not only obviates the bruising which occurs when the pupil is entire, but enables the cataract to present more easily in the wound, removes in great part the tendency to prolapse, and lessens the likelihood of the pupil becoming occluded should iritis follow the operation. As will be seen, however, it is not free from special dangers of its own. The instruments required are the stop-speculum and fixing-forceps; a linear knife, 2 mm. broad, about 30 mm. long, and as thin as is consistent with strength; curved iris-forceps; iris-scissors; a cystotome, the best form being that which is bent at an angle so as to clear the brow, the bend being different for right and left eye; and a curette or spatula. There should also be placed ready to the hand a small but stiff pair of scissors, with which to enlarge the wound in case of need; a scoop to remove the lens with, should it fail to present in the ordinary way—the kind known as the vectis (B. Taylor), which is merely a wire loop, being the best, because it occupies the least space inside the eye; and a small, sharp lens-hook, sometimes required for a similar purpose.

The operator stands behind the patient's head, and makes the incision with his right hand for the right eye, with his left hand for the left. The lids being secured in the usual way, the conjunctiva is seized below the lower margin of the cornea, and the globe turned gently downwards far enough to expose the sclera above the cornea. The knife, with its edge turned upwards, is entered in the sclera at a point about 1·5 mm. external to the outer and upper margin of the cornea, and 2 mm. below the level of an imaginary line drawn horizontally through the highest point of the corneal margin. It is directed in the first place, not towards the intended counter-puncture, but towards the centre of the pupil, so as to make the internal dimension of the wound as large as possible. As soon as the point has passed well into the anterior chamber, the direction of the knife is changed, and it is carried across the upper part of the chamber and out through the sclera in such a way as to effect a counter-puncture exactly corresponding in position with the puncture. The edge of the blade is then turned slightly forwards, and gentle sawing movements are made, till it cuts its way out with a minimum amount of force, and without any sudden jerk, exactly at the junction of the cornea and sclera. The conjunctiva, which still remains to be divided, unless the apex of the incision lie just within the visible margin of the cornea, is severed in the form of a small flap by a few more to-and-fro movements of the knife. This completes the first act of the operation. The incision thus made, if measured externally in a straight line, will have a length about equal to the transverse diameter of the cornea; its extremities will lie in the sclera, its middle portion will pass almost entirely through corneal tissue; it will have a minimum amount of curvature, hence its name 'linear.' The second act is the iridectomy. If necessary, the fixing-forceps are given to the assistant, who rotates the eye gently downwards, while the operator passes the forceps closed into the chamber, if the iris be not already prolapsed, and seizing the pupillary bor-

der of the iris opposite to the centre of the wound, draws it gently out, and cuts it off. Some operators remove the iris-segment by separate snips at the two extremities of the wound; others by a single snip, with the scissor-blades lying parallel with the incision. Seeing that the object is to make a perfectly clean but not a very extensive excision, the single snip, which is quick and easy, is to be preferred; but the blades should lie across and not along the wound.

The third act is the laceration of the capsule. The operator resumes the fixing-forceps, and passes the cystotome into the chamber on the flat, taking care that its blunt side is in advance of the point, lest the latter should become engaged too soon. Arrived at the farther margin of the pupil, he turns the point towards the capsule, and, without sensible pressure upon the latter, crucially divides it as freely as possible. It is important not to make a triangular flap of capsule with its base at the wound, as such a flap would readily prolapse, and, becoming incarcerated at the cicatrix, might be the cause of serious mischief later on. The fourth act is the delivery of the cataract, or of so much of it as remains, for more or less of the softened cortex often escapes immediately after the capsule is opened. Gentle pressure is made immediately below the cornea with the back of the curette, or, if it be preferred, with a tortoiseshell or india-rubber spoon, which should cause the wound to gape a little, and the upper edge of the nucleus to present itself. The pressure is cautiously increased, and as the cataract moves upward, it is followed up by the curette over the surface of the cornea. The moment the largest part of the cataract has passed the opening, the pressure is diminished, and the delivery is completed with the utmost gentleness, the cataract being helped out, if necessary, with a touch of the curette. If it be necessary to retain a hold of the conjunctiva during the delivery of the cataract, the pressure may be made with the fixing-forceps, the curette being used at first upon the upper lip of the wound to make it gape, and then upon the cornea to stroke the cataract out of the eye. Some operators remove the speculum before delivering the lens, and, telling the patient to look towards his feet, make the necessary pressure by a finger on each lid.

The cataract being removed, the eyelids are closed for a few moments so as to rest the eye, and to allow the anterior chamber to refill with aqueous humour. They are then reopened, and the operation is completed by the removal of any cortical fragments which may still be visible in the pupil, and by cleansing the wound of any tags of iris which may be retained in it, and the surface of the eye of blood-films. A few rotatory movements of the finger on the upper lid will tend to bring cortical fragments into the pupil, and then, while the patient looks downwards, these are extruded by an upward stroking movement of the lower lid upon the cornea. Much pains must be bestowed on this cleansing of the pupil, but instruments should not be introduced into the eye. An incarceration of the iris will often disappear under a similar stroking with the lid over the angles of the wound; if not, a fine spatula must be used. Blood-clots should be picked from the conjunctiva with the iris-forceps. A drop of atropine is instilled, and the lids are finally closed. Some surgeons use eserine before the operation, and once or twice after it, with the idea of diminishing the risk of prolapse of the iris; against the advantage so aimed at must be set the fact that eserine increases the bleeding after the iridectomy, and probably the tendency to iritis afterwards. The dressing consists of a soft circular pad of absorbent cotton wool between layers of gauze laid over each eye, and held in place by several turns of a roller bandage made of flannel or some other slightly elastic material, the pressure being light and equable. The patient is instructed to lie in bed, either on his back or turning towards the side not operated on, and to avoid all straining movements. If no severe or lasting pain be complained of, the dressing need not be disturbed for forty-eight hours, and then if there be no swelling of the lids, it is sufficient to place a drop of atropine at the inner canthus, and to bandage as before. If all be well, the patient may sit up for an hour or two on the third day, and gradually resume his usual hours. A daily action of the bowels should be obtained by aperients if necessary. Light must be excluded from both eyes for three or four days, and from the operated eye for at least ten days. A deep shade, and, later, tinted glasses, are substituted for the pad and bandage as the eye gains strength. Spectacles should not, as a rule, be allowed under three months after the operation.

The peripheral linear operation, as above described, obviates the special drawbacks of the old flap, but is apt to err in the opposite direction. The incision, lying as it does almost wholly in the sclera, may easily pass

beyond safe limits and create a risk of sympathetic inflammation in the fellow eye. The divided vessels sometimes bleed freely into the anterior chamber. The exposure of the suspensory ligament predisposes to rupture and an escape of vitreous. With regard to details, therefore, the operation is at present modified in a good many different ways, of which the following are the most important.

The incision is now often made exactly at the sclero-corneal margin, and of such extent that its extremities lie 3 mm. below a horizontal line passing through the summit of the cornea. The points for the puncture and counter-puncture in this incision are found by laying the blade of the knife, which is 2 mm. broad, horizontally across the cornea, so that 1 mm. of clear cornea remains exposed above it (De Wecker). This is known as the short, or 3 mm. flap. An iridectomy must be performed, but need not be very extensive. The wound adapts itself well, but it sometimes proves a little smaller than is desirable. To avoid this, the puncture and counter-puncture may, when necessary, lie 1 mm. external to the corneal margin. In another form of incision at present a good deal practised, the puncture and counter-puncture lie in the sclera, while the remainder passes through the cornea at some distance from its edge.

The iridectomy is sometimes performed three weeks or longer before the extraction of the cataract. It is then called *preliminary iridectomy*. An incision not more than 4 or 5 mm. long, made with a keratome, suffices, and the cicatrix resulting from it may be disregarded when the extraction is undertaken. This division of the operation into two parts is probably the safest of all methods. A properly performed preliminary iridectomy is almost absolutely devoid of danger to the eye; should serious reaction occur, the surgeon may feel almost sure that an attempt to extract the cataract at the same time would have destroyed the eye. The extraction is facilitated by the previous iridectomy, for there is no bleeding from the iris, and the risk of employing an assistant to fix the globe in presence of a large incision is done away with, for at no stage is a third hand needed. Against the method may be urged the delay, and the chance of disappointment to the patient at the want of apparent result from the first operation. If the iridectomy be made many months before the extraction, there appears in some cases to be an increased liability to rupture of the suspensory ligament and escape of vitreous. A cataract previously immature will sometimes ripen rapidly after an iridectomy; and, with this end in view, a proceeding known as *artificial ripening* is sometimes practised (Förster). Immediately the iridectomy is completed, and while the anterior chamber is still nearly empty, the cornea is stroked with as much firmness as is judged safe with the smooth knee of a strabismus-hook; by this means the anterior cortex is kneaded, as it were, through the cornea, and its splitting up is expedited. The method is often effectual, but involves a distinct risk of setting up iritis by bruising the iris.

Difficulties, accidents, and complications.—The aperture of the lids is sometimes too small to allow of easy access to the sclero-corneal junction; division of the outer canthus is useful in such cases. Holding the lids away from the globe by means of the speculum, the operator transfixes the tissues with a cataract-knife or bistoury from the conjunctival surface, and bringing the point out through the skin divides them freely; bleeding follows, but soon ceases. The lids can then be opened more widely. If the knife be improperly directed within the anterior chamber and the counterpuncture made in a wrong place, it must be withdrawn until the point is disengaged and a second counterpuncture must be made. Should it be necessary through any carelessness to withdraw the blade entirely, no further incision must be made until the anterior chamber is refilled and the aperture closed. The aqueous may escape and distend the conjunctiva like a bladder the moment the counterpuncture is effected, and the iris may sometimes double itself upon the edge of the knife; these occurrences are not serious, and the incision is to be deliberately completed without regard to them. Downward rotation of the eye must be accomplished with the aid of the patient's own efforts, if he be not anæsthetised—never in opposition to them. Dragging upon the globe, especially after the incision is completed, is almost sure to rupture the zonula.

If, when the cystotome is applied to the capsule, the lens is seen to move as a whole with the pricker, dislocation of the cataract and escape of vitreous are imminent. If the cataract do not at once present, it must be removed by a traction instrument—the vectis or the sharp hook—passed carefully but quickly behind it. When the delivery of the cataract is attempted the wound may prove too small. Undue

force is dangerous, and bruising of the lips of the wound is likely to lead to suppuration. It must be lengthened at one end by a careful cut with the scissors. An opaque lens is always, or nearly always, smaller than a healthy lens at the same time of life, otherwise the difficulties of extraction would be greater than they are; but in the period of swelling which sometimes precedes complete maturity, the size is probably not far different from that of the normal lens. The so-called 'black cataract' is an exception to the rule; it is not really a cataract at all, and probably has the full size of the healthy lens. If the anterior chamber fill with blood after the iridectomy, light pressure on the outer lip of the wound will sometimes clear it; if this prove unsuccessful, the operation must be completed in spite of the cataract being hidden.

Escape of vitreous denotes rupture of the zonula or posterior capsule, and of the hyaloid membrane. It may arise from the wound being too peripheral, or from undue pressure on the globe. It is more likely to occur in stout, short-necked persons with turgid veins and prominent eyes, than in thin, hollow-eyed, aged people. Collapse of the cornea, on the completion of the incision, is a sign that the contents of the globe are not driven forwards either by the elastic shrinking of the sclera, or by pressure from without; it may be taken as a sign that escape of the vitreous is not likely to happen. In old people with greatly degenerated vessels, especially in drinkers, we may anticipate an unsound condition of the zonula and vitreous, which will almost inevitably lead to loss of the latter. If vitreous fluid escape before the lens, the danger of losing the latter altogether is great; the cataract must, if possible, be immediately removed by traction, as above explained. An escape of vitreous together with the cataract, or after it, is not necessarily detrimental, unless other harm have been done; but it probably predisposes to deep-seated changes both at the time and later, and should always be avoided if possible. In rare instances immediate and copious bleeding takes place from the deep vessels; the eye is thereby lost, and should be excised as soon as possible.

The pain after the operation is usually not severe; it should subside after a few hours. Severe and increasing pain after the first six or eight hours is a sign that things are going wrong, and the eye must be examined. The complication most to be dreaded is suppurative inflammation, beginning at the wound. If this occur, the lips of the wound will show a yellowish infiltration, and may be coated with shreds of muco-pus; the conjunctiva will be swollen, the aqueous more or less turbid. Unless the suppuration can be immediately checked it is likely to involve the whole of the cornea and to spread to the iris, ciliary processes, and cornea, ending in destruction of the eye by panophthalmitis and subsequent shrinking. In the most favourable case it is likely to damage the cornea, and to leave a closed pupil with dragging of the iris towards the cicatrix. The inflammation is probably of septic origin, and a vigorous disinfecting treatment should at once be adopted. But this is not the only indication; an eye which easily succumbs to septic influence is probably an eye of feeble vitality, and every possible effort must be made to improve its nutrition. The lids being carefully separated, the surface of the eye is to be cleansed from pus by means of warm water or boracic acid lotion several times during the day; after each cleansing, finely-powdered iodoform should be dusted on to the conjunctiva and outside the lids; and then a hot fomentation should be applied. The conjunctiva, if much swollen, should be incised lightly with a cataract-knife, or scissors, to give escape to blood and serum, and at the same time a good nourishing diet, with a liberal allowance of alcohol in the form most acceptable to the patient, should be given. If there be much pain, ease must be given by morphia. Some Continental authorities have lately advised still more vigorous measures, namely, opening up the wound and injecting the anterior chamber with a saturated solution of boracic acid, or a 5 per cent. solution of salicylic acid, at intervals of eight or twelve hours (Horner), and again, by applying the platinum wire galvano-cautery heated to a white heat to the whole length of the wound (Abadie).

Iritis, apart from that which occurs with suppurative inflammation, is a common complication. It is usually caused by the irritation of cortical substance remaining in the eye, but is greatly furthered by systemic disturbance, such as may arise from constipation, lithiasis, chill to the surface, loss of sleep, and emotional upset; it may also arise from incautious exposure of the eye to light too soon after the operation. One or two leeches to the temple or lower eyelid, a purge, atropine six or eight times during the twenty-four hours, with careful protection of the eye and head from draught, are the chief

remedies. The iritis is of the plastic variety, and often causes more or less occlusion of the pupil. If it be so severe as to involve the ciliary processes, and be accompanied by much loss of tension, the eye is in great danger, and there is the further danger of sympathetic ophthalmitis. Incarceration of the iris in the cicatrix is likely to cause iritis and prolonged irritability of the eye. Usually it leads to some irregularity in the surface of the cicatrix; the tissue which unites the lips of the wound bulges at one or more parts, and may become prominent along its whole length, a condition known as a cystoid cicatrix. The bulging part may be punctured with a needle a time or two, so as to evacuate the anterior chamber, and thus, by lowering the pressure on its inner surface, to give it a chance of contracting. If it persistently recur, the tension of the eye will probably be found to be in excess, and the cause of this may be looked for in a partial obliteration of the angle of the anterior chamber. The proper remedy is then either an iridectomy, or a sclerotomy. Moderate prominence of the cicatrix is not of itself dangerous to the eye, but it exposes it to risk of easy infection from without, and destruction by suppurative inflammation extending to the uveal tract. Inversion of the edge of the lower lid to such an extent as to irritate the eye sometimes occurs during recovery from cataract-extraction. It may usually be remedied by coating the outer surface of the lid quite up to its margin with collodion, so as to cause strong contraction of the skin; the application must be repeated from day to day.

After recovery from the operation the pupil is left, in the most successful cases, entirely free from opacity of any kind; in a considerable proportion of cases it is occupied by a more or less opaque membrane consisting of retained lens-matter, or inflammatory exudation adhering to the capsule and iris. Such obstructions are sometimes spoken of as secondary cataracts; it is better, however, to use the terms primary and secondary cataract only as they are used above, i.e. in the sense in which they are used also in relation to glaucoma, and for the conditions in question to use the terms secondary capsular membranes, capsular opacity, or closed pupil, or to designate them by the general term *after-cataract*, the equivalent of the German 'Nach Staar.' They are dealt with differently according to their density. The thinner films are readily divided with two discision needles. When the iris is adherent to the obstructing membrane, iridotomy gives the best results with the least risk. *See* Iris, Diseases of the. In all cases the cut should be across the fibres of the iris as far as may be, not in the direction of their length; their retraction on being severed then serves to widen the aperture. Instead of iridotomy the following method (Noyes) is sometimes available. A linear cataract-knife is passed through the cornea near to its outer margin and out again near to its inner margin by puncture and counter-puncture; before it is withdrawn from the chamber its point is made to perforate the opaque membrane. A blunt iris-hook is passed in through each of the corneal apertures and through the puncture in the membrane, and then, by drawing the two hooks apart, the latter is torn more widely open without dragging on the ciliary processes.

Traumatic Cataract.—In all cases of injury to the eye involving damage of the lens, the first object of treatment is not to deal with the cataract, but to save the eye from destructive inflammation. If there be a prolapse of the iris which cannot be reduced, it is usually best to excise the prolapsed portion as fully as possible, making an incision, if necessary, as for an ordinary iridectomy, in order to prevent its incarceration in the cicatrix. To prevent iritis, atropine should be used freely and frequently; iodoform in fine powder should be dusted upon the wound, to lessen the risk of septic inflammation; and iced compresses should be applied over the closed lids. If there be much injection, two or three leeches should be applied at once to the temple. Next to the danger of destructive inflammation is that of the onset of glaucomatous tension. The older the patient and the more rapid the swelling of the lens, the greater is this danger. In the absence of any serious complication of either kind, no operation for the removal of the cataract should be undertaken until the irritability of the eye has quite subsided; but if inflammatory symptoms set in, or if the eye becomes hard, the lens must be removed as soon as possible. The operative treatment of a traumatic cataract is the same as for an ordinary cataract at the same time of life. In many of the more severe injuries involving the lens, the most urgent question is whether the eye should not be at once removed in order to preserve its fellow from the danger of sympathetic ophthalmitis. For the indications to be followed in such cases *see* Sympathetic Ophthalmitis.

Priestley Smith.

CATARACT-GLASSES.—Aphakia, or absence of the crystalline lens, involves, in almost all eyes, a high degree of hypermetropia, and in all eyes an absolute want of accommodation. The final step in the treatment of a case of cataract is, therefore, to prescribe glasses which neutralise these deficiencies. An emmetropic eye will, after removal of its lens, in most cases require for distant vision a spectacle-lens equal to about 11 dioptres ($3\frac{1}{2}$ ins. focus), and for reading one of about 16 dioptres ($2\frac{1}{2}$ ins. focus). Theoretically it might appear that, in the absence of accommodative power, a different lens would be required for every different distance, but practically two are enough, for the effective power of each can be varied considerably by placing it further from or nearer to the eye; the further from the eye the greater the power obtained, and *vice versâ*. Thus, with his distance glass, the patient can accurately focus objects 3 or 4 feet away by placing the spectacles a little further down his nose, and with the reading glass, which is usually focussed for 10 or 12 inches, he can get clear vision at a shorter distance by the same means. Eyes previously hypermetropic will usually require stronger glasses than the foregoing; myopic eyes will require weaker ones; but the strength of the glass required to produce emmetropia after removal of the lens bears no very exact relation to the pre-existing condition of refraction, for the lowering of the refraction produced by loss of the lens is not the same in all cases; a pre-existing myopia may depend on elongation of the eyeball, or upon changes in the lens itself arising with the onset of the cataract. In cases of very high myopia (far point at about 3 ins.) the removal of the lens may bring the eye into the emmetropic condition. In many cases the operation produces another refractive change, viz. corneal astigmatism. This may arise either through imperfect coaptation of the lips of the wound or swelling of the corneal or scleral tissue, or through traction upon them from within by pupillary membranes. The maximum acuity of vision is not attained until the astigmatism is corrected by an appropriate glass, but such correction should not be made too soon, as the degree of the astigmatism is apt to alter during the first few months. In some cases it is sufficiently corrected by merely sloping the ordinary spherical glass.

The acuity of vision after a cataract operation as tested in the usual way may reach $\frac{20}{20}$, or may fall short of that standard by any amount; $\frac{20}{70}$ may be considered a good result, but a lower degree than this will be appreciated as a boon when previously the patient has been unable to make his way about without help. Even when $\frac{20}{20}$ is obtained the operation is not to be credited with having restored a retinal picture equal to that in the normal-sighted eye, for the aphakial eye armed with a cataract glass obtains a larger retinal picture of a given object at a given distance than the normal eye. PRIESTLEY SMITH.

CATARRH OF THE BLADDER. *See* BLADDER, Diseases of the.

CATARRH OF THE EAR. *See* EAR, MIDDLE, Diseases of the.

CATGUT LIGATURE. *See* LIGATURES.

CATHETERS are hollow instruments for emptying the urinary bladder. They are tubes constructed of silver or of flexible material. The silver instruments are about eleven inches long, of equal thickness throughout; closed and rounded at one end (the beak) to slide along the urethra, and furnished with two rings near the open end (the mouth) to which tapes may be attached when the catheter has to be retained by the patient. About a quarter of an inch behind the beak two slits are cut —the eyes—to allow the urine to enter the catheter when the beak has passed into the bladder. For eight inches from the mouth the instrument is straight; but the last three inches are bent round a fourth of a circle which has a diameter of four inches; so that the beak is placed at a right angle with the direction of the stem. As the rings near the mouth are fixed on each side of the stem, they indicate the direction of the beak, which is in a plane parallel to that of their openings. Each instrument has a wire stylet. The catheters range in size from No. $\frac{1}{4}$ English to No. 12; the first has a diameter of 0·06 inch; the latter, 0·25 inch. Larger ones than these are seldom employed. This, the English scale, does not advance in equal steps, and also varies with different makers. The French scale ranges from No. 1 to No. 40, and each numeral denotes the circumference of the catheter in millimètres.

The flexible catheters of woven silk have two principal forms. The English, so-called 'gum elastic,' are of the same thickness throughout, have an eye near the beak, and are mounted on a wire stylet. Highly flexible when warm, they stiffen when cold, and thus can be given any required curve, which they will retain

until again heated. The French flexible catheters taper for the last three inches to the beak, becoming very pliant and fine near the point. The beak itself is rendered blunt by ending in a small swelling or 'olive'; hence the name 'olivary' applied to these catheters. They retain their pliancy in all cases, and cannot be made to adopt a curve. A well-shaped one should be very smooth, have eyes with nicely-rounded edges; and when the point or beak meets an obstruction, the flexible neck behind it should yield at once in a sharp bend, not in a gradual curve.

Besides these two forms there is the so-called 'sonde coudé' or elbowed catheter. Made of the same flexible material, this is bent half-an-inch behind the beak to an angle of 45° with the stem, and this bend is sometimes again bent half-an-inch further back, when the catheter is termed 'bi-coudé,' or doubly-elbowed.

Catheters are also made of vulcanised india-rubber or of celluloid. The former are valuable from their extreme suppleness; the latter from their smoothness and insusceptibility to roughening by phosphatic incrustation. *See* Bougies.

Berkeley Hill.

CATHETERISM.—The art of passing catheters. This is practised in various ways, according to the different conditions of the urethra and neck of the bladder which render the artificial evacuation of the bladder needful. These conditions are described in the articles on Bladder; Prostatic Hypertrophy; Retention of Urine; Stricture of the Urethra, &c.

CATLIN.—An old form of amputating knife, having a narrow straight blade with a double cutting edge. It was used chiefly in amputations of the leg and forearm.

CAUSTICS, agents used for the destruction of tissue, may be classified in two divisions, viz. chemical and thermal. The latter includes the galvanic and actual cautery, which are treated of in the article Cautery. The chemical or 'potential' caustics may be arranged in three main classes, viz. alkaline, acid, and mineral.

I. The Alkaline Caustics include (1) Potassa fusa, hydrate of potash, caustic potash.

(2) Hydrate of soda, caustic soda.

(3) Lime, dehydrated, unslaked or quick.

Various combinations of these have been devised, such as 'Vienna paste,' which is made with quicklime, 2 parts; caustic potash, 1 part; mix just before use with sufficient alcohol to form a soft paste. 'Caustique Filhos,' lime, 1 part; caustic potash, 2 parts; prepared in moulds. 'London paste,' lime and caustic soda, equal parts.

(4) Ethylates of sodium and potassium.

All these act mainly by virtue of their great affinity for water, withdrawing it from the tissues with which they are brought in contact; they also readily decompose and dissolve the nitrogenous components. Potash and soda have a high diffusive power, and are not neutralised by the natural fluids of the tissues, which are themselves nearly all alkaline, therefore their action tends to spread. In their effects they are *deep*, as distinguished from *superficial* caustics; the slough produced is dark, moist, and leathery; the potash compound is more powerful than the soda.

The action of quicklime is less diffused and more superficial, and on the skin proper not very severe; but when applied to mucous membranes it causes much pain and an extensive slough. The addition of lime to the caustic alkalies, as in the pastes described, serves to render them less deliquescent, and so to keep their effect more under control.

The ethylates act in a similar but more limited manner, and with less pain, especially if opium be combined with them; a solution in spirit is commonly used, and on first contact causes only redness; but when the textures part with water, caustic soda (or potash) is immediately formed, and destruction of tissue commences.

II. The Acid Caustics include the mineral acids—nitric, hydrochloric, sulphuric, chromic, and manganic; and the organic acids—carbolic, glacial acetic, pyrogallic, and salicylic; with which may be grouped iodine and bromine. The mineral acids act only superficially if lightly applied, destroying the epidermis; but if kept in contact, they penetrate and destroy the tissues deeply, abstracting water from them, coagulating albumen, and combining with alkaline bases; the latter effect limits their caustic action.

Hydrochloric acid penetrates less deeply than nitric or sulphuric acid, and the slough produced by it is at first white; that of sulphuric acid is brown and firm. Nitric acid turns the part yellow, picric acid being formed in the tissues. Chromic and manganic acids and their compounds act almost wholly by oxidation; from the former, when applied over an extensive ulcerated surface, absorption, with serious symptoms of vomit-

ing, diarrhœa, and collapse, has occurred. The same may be said of strong solutions of pyrogallic acid.

Chromic acid is slow in action, but not extremely painful, though it penetrates deeply; it requires care in protecting neighbouring parts. Made into a paste with a little water, it turns the skin yellow, brown, and, later, black, and causes a slough which is detached in one or two days.

Glacial acetic acid is much more superficial in action, often producing only vesication; it is, however, a useful application to warts and callosities, destroying them in successive thin layers. A special formula containing it, used for syphilitic warts, bears the name of Plenck, and is as follows:—℞. Alcohol, acid acetici āā f℥ss., hydrarg. perchloridi, aluminis, camphoræ, plumbi carbonatis, āā ℈ss., to be applied carefully twice daily.

Carbolic acid, the action of which is also superficial, is not often used as an escharotic, but is employed pure or mixed with sufficient liquid for solution as a moderately caustic astringent to the cervix uteri, and, combined with one to three parts of spirit, is much esteemed by Hardy in superficial lupus; it penetrates the tissues, but not so deeply as potash; it is less painful and leaves a smoother scar. The pure acid injected into the slough of a furuncle or carbuncle allays pain, limits the inflammation, and hastens the separation of the slough.

Salicylic acid is much milder in effect. It is doubtful whether it forms a compound with albumen or not; but when applied in strong solution to previously cut warts and corns, the base of these separates in layers. It is more useful in post-mortem warts, though it causes some smarting pain for a short time after its application; it must be re-applied daily until the growth disappears. It is very irritant to mucous surfaces, but is well tolerated in some cases; ulceration of the throat has been caused by its internal administration.

Iodine in strong solution is occasionally used for its caustic properties, especially in snake-bite; and a solution in oil of tar—one or two drachms to the ounce (Coster's paste)—is an efficient, though painful, application for ringworm; it often vesicates.

Bromine is much more powerful, quickly oxidising and destroying organic tissues, coagulating and combining with albumen, and forming a brownish slough. Bromide of potassium, sprinkled in fine powder over an ulcerated surface, acts as a mild caustic with advantage (chlorate of potash is also used in the same manner).

III. The Mineral Caustics include the following:—

1. *Arsenious acid or oxide* (*white arsenic*), which is used either mixed with 3 or 4 parts of mucilage, or combined with mercury, as in the following pastes or powders, named after their inventors; but their ingredients may be varied somewhat according to the case. Cosme's: Cinnabar, 2 parts; arsenious acid, 1 part; powdered pterocarpus draco (dragon's blood), 2 parts; made into a paste with mucilage. This is similar in composition to the arsenical powder of Dubois, but contains proportionally more arsenic. Dupuytren's powder is made with arsenic 4 to 10 parts; and calomel 90 to 100 parts (by weight). Miss Plunkett's contains Ranunculus acris and flammula, of each 1 ounce; arsenious acid, 1 drachm; sulphur, 100 grains; worked into a paste and dried in the sun. There are many other empirical formulæ, of which Manec's is still used in France, and is made as follows:—Arsenic, 1 part; cinnabar, 5 parts; burnt sponge, 2½ parts; made into a thick paste with water. That of Frère Come contains the same ingredients, but has 1 part of arsenic to 4 of cinnabar and 10 of charcoal.

2. *Acid nitrate of mercury* is perhaps the best and most manageable liquid caustic.

3. *Mercuric chloride* (corrosive sublimate).

4. *Chloride of antimony* (butter of antimony) is not now much used; but has the advantage of penetrating well and of not producing much pain or inflammation, and after the separation of the eschar, a clean, healthy surface is left. A preparation of it, formerly celebrated, but now little, if at all, used in this country, is the paste of Landolfi, which was made with 1 drachm of chloride of bromine, 2 drachms of chloride of antimony, and 3 drachms of chloride of zinc, mixed with sufficient liquorice powder to form a paste. According to another, and probably original, formula, an equal part of chloride of gold is substituted for the zinc. Hebra, however, discards the metals, and his 'modified paste of Landolfi' contains only concentrated hydrochloric acid with sufficient liquorice powder to form a paste.

5. *Chloride of zinc.*—Canquoin's Paste, as used by Liston:—Chloride of zinc, 1 part; wheaten flour or plaster of Paris, 2 to 3 or 4 parts, according to the strength desired, and water sufficient to make a paste. This caustic destroys the part in a

direct ratio with the thickness of the layer applied.

Fell's Paste:—Chloride of zinc, 1 part; extract of sanguinaria, 1 part; extract of stramonium, 2 parts; to be thoroughly mixed.

In preparing the paste used at the Middlesex Hospital, 'Liquor zinci chloridi cum opio' is first made as follows:—Zinci chloridi ʒxvj.; pulveris opii ʒjss.; acidi hydrochlorici fʒvj.; aquam bullientem ad Oj. Macerate the opium in twelve ounces of boiling water for twelve hours; add the acid and filter, then dissolve the chloride of zinc in the filtered liquid, and make up to twenty ounces with distilled water. Two drachms of flour are added for every ounce of liquor, mixed smoothly in a mortar, and heated over a water-bath until of proper consistence.

6. *Sulphate, nitrate, and acetate of zinc.*

7. *Perchloride of iron.*

8. *Nitrate of silver* (lunar caustic).

9. *Sulphate, nitrate, and acetate of copper.*—The so-called 'lapis divinus' is made with equal parts of sulphate of copper, alum, and nitre, fused together with 4 parts of camphor.

The mineral caustics differ somewhat in their mode of action, but resemble each other, to a great extent, in coagulating albumen, and thus arresting vital processes. Arsenic especially illustrates such arrest, its result when applied in suitable form being a 'mummifying of tissue.' With this drug, as with mercury, antimony, and chromic acid, the possibility of systemic absorption has to be carefully considered, serious and even fatal results from general poisoning having followed the application of a 4 p.c. solution to a small ulcer. Hence these agents are not used so much now as formerly.

The chloride of zinc is probably the best solid caustic, and the one now in most frequent use, but it is deliquescent, and apt to penetrate too deeply if used pure; it should therefore be employed in the form of one of the above-mentioned pastes. The nitrate of zinc is commended by Mr. Marshall as penetrating deeper and with less pain; advantages which were claimed also by Sir J. Simpson for the sulphate, the slough produced by which he found to separate earlier than that formed by the chloride.

The stronger solution of perchloride of iron, though commonly used only as a styptic and astringent, acts as a caustic to mucous membranes, and will cause a slough.

Nitrate of silver, which popularly represents the type of *caustic*, acts only as such when thoroughly applied in a concentrated form—e.g. when a solid pointed stick is firmly pressed into a soft tissue until the latter is broken up. A similar remark may be made as to the use of sulphate of copper and its preparations.

Uses and Mode of Application of Caustics.—1. *To make an issue.*—Take a strip of soap plaster with a hole half an inch square in its centre, and apply it over the part to be treated. In the hole place a small piece of caustic potash about the size of a pea, and cover it over with a second strip of plaster, and in two to three hours a slough will have been formed.

2. *To open an abscess.*—The method of proceeding is the same as for an issue, although it is now rarely, if ever, resorted to. Previously to the introduction of the aspirator and antiseptic modes of treatment, this was a favourite method of effecting the discharge of an hepatic abscess, the slow action of the caustic leading to adhesions which prevented the escape of pus into the peritoneal cavity.

3. *Counter-irritation.*—Besides issues, the cautery is a powerful and useful counter-irritant in some chronic inflammations.

4. As a *hæmostatic*, a pointed stick of silver nitrate is serviceable in arresting the bleeding of a leech-bite or the base of an excised wart. For more extensive surfaces the actual cautery, at a dull red heat, is necessary.

5. *For destruction of unhealthy ulcerated surfaces, morbid growths, &c.*

In strumous ulcers with overhanging, thickened edges and slowly extending surface, the application of a caustic alkali to the edges and base is often beneficial, and equal parts of caustic potash and water, as used by Dr. Liveing, is one of the best applications for strumous lupus. The surrounding healthy skin should be protected by plaster or oil, and the cauterised part sponged with dilute acetic acid after the application. Fungating granulations may be rubbed down with solid silver nitrate or copper sulphate; the former is also thrust into the nodules of *lupus* to break down the morbid tissue. Chloride of zinc paste, in any of the forms mentioned, is also much used for *lupus* and *rodent ulcer*, the application being made on a piece of thin linen, and allowed to remain for twelve to twenty-four hours at a time; after separation of the slough by poultices a fresh application may be made. In *hospital gangrene*, and similar cases of rapid sloughing,

the part should be scraped with a blunt or wooden knife, and fuming nitric acid applied by means of a glass rod. The mineral acids mixed with charcoal are also suitable, but bromine seems to have special efficacy; after thorough cleansing of the wound a solution may be used containing one ounce of it with two drachms of bromide of potassium, and four ounces of water. The intensely irritant effect on the mucous membrane of the nose and air-passages is its chief drawback.

Hydrochloric acid is a useful application to *cancrum oris*, diphtheritic membrane, ulceration of the tongue, and phagedænic ulceration of the tonsils, and nitric acid to the non-infective chancre; the parts must be only lightly touched with the acid. Small ulcerated surfaces and spots of acne may be treated with the acid nitrate of mercury, which is conveniently applied with a wooden match; this is also very serviceable for outlying nodules of lupus. Morbid growths may be removed by a heated iron driven into and through them in various directions, or by Fell's paste, spread on thin linen, and applied repeatedly after the separation of each slough. When the surgeon wishes to use the paste after a cutting operation, he should staunch the bleeding by the firm application of a pad of lint for twenty-four hours, after which the caustic may be spread on the dry surface. This procedure ensures the efficient action of the paste.

In epithelioma of limited extent, as in other forms of malignant growth, the knife is usually preferred; but in cases where this is inadmissible, a paste of chloride of zinc is very serviceable. If the skin is unbroken it should be destroyed by nitric acid, and the paste introduced through incisions made in the eschar formed. Maisonneuve used a paste, dried in pointed pieces, which could be inserted into and round the tumour; and Paget applied small lancets of wood coated with the previously melted chloride. When the surface is already ulcerated, a zinc paste may be spread over it for a thickness of, say, half an inch, and kept in contact for six or twelve hours, when it will have destroyed tissue to the depth of about one inch. This slough will separate in a week, leaving either a fresh cancerous surface exposed for another application, or a healthy granulating sore. Simpson applied the sulphate of zinc, in powder or mixed with a small quantity of glycerine, one ounce of crystals to one drachm of the latter; he found that the slough usually separated in five or six days.

For quite superficial nævi, a careful application of fuming nitric acid on a glass rod is very successful. The surrounding skin should be protected with oil, and the superfluous acid neutralised with a solution of carbonate of soda. Other mineral acids may be used, or the part may be painted with an arsenical solution or the ethylate of sodium. The latter is very good for the smaller nævi: it causes little pain, and is efficient; no water must touch the surface during its application. The same caustics have been used to obliterate varices. The deep forms of nævi require the actual cautery. C. D. F. Phillips.

CAUTERY.—The cautery consists of a piece of metal, generally iron or platinum, raised to a variable temperature by the heat of a flame or fire, or by some special means, as in the galvanic or in Paquelin's cautery.

It is used for the following purposes: for dividing soft tissues, as in removing portions of the tongue and cervix uteri; for destroying vascular and fungating growths; for arresting hæmorrhage; and for purposes of counter-irritation. The degree of heat employed varies to some extent in each of these cases. Three degrees of heat are recognised—white, red, and black—and it is stated that when heated to the white degree the cautery gives little pain.

A bright red heat is employed for dividing tissues. In all cases this operation must be done slowly, and if hæmorrhage occur, the heat must be reduced and the bleeding points retouched. When the metal is covered with blood and charred tissue, it is difficult, as in Paquelin's cautery, to see the exact colour. The temperature can then be estimated by the rapidity of the cutting and the presence of blood.

For arresting hæmorrhage, a dull red or black heat is the most effective. When a little too cool, the tissues are apt to adhere to the metal, and bleeding to follow its forcible removal. If this occur with Paquelin's cautery, raising the temperature slightly will separate the metal; but with the actual cautery the tissues must be detached by a spatula or blunt director. The surface must during the whole time be kept as dry as possible, the sponge or lint being pressed on the surface, not drawn or rubbed over it, for fear of detaching the eschar.

For destroying growths, a red heat, slightly brighter than the dull red, is used. The tissue is gradually burnt down, the cautery being held in contact with the surface some time, and the part kept dry. In puncturing nævi, when the actual cautery is

used, it must be made as hot as possible at first, to penetrate the skin.

For purposes of counter-irritation a white heat is recommended, and is said to produce little pain. The cautery is drawn lightly over the skin in vertical lines. It is employed in disease of the joints, especially of the knee, and also in spinal caries. This mode of application will produce an eschar, the depth of which will depend on the amount of pressure used. A slighter effect may be obtained by holding the heated metal a short distance from the surface, and passing it over more slowly, thus producing a rubefacient action, or even blistering. It is well, in applying the cautery for this purpose, to avoid points where ulceration is likely to be troublesome, as over subcutaneous bones and superficial tendons.

The benzoline or thermo-cautery of Paquelin is now employed for most purposes, and the only precaution necessary in using it is to take care that the point is thoroughly heated in the spirit-lamp before any benzoline vapour is forced into it.

The Galvanic Cautery.—The heat in this cautery is produced by the passage of an electric current through platinum wire, fixed in a suitable insulated handle. This metal, on account of its high fusing point, can be kept at a white heat for some time.

The difficulty of obtaining a constant battery with sufficient power is the practical inconvenience connected with the galvanic cautery. It is also expensive, and requires frequent attention. Except where a cautery-écraseur is required, it is now almost entirely replaced by Paquelin's thermo-cautery.

The battery.—In every battery there should be a small number of cells (four to six), with large acting surfaces. The bichromate of potash battery is the one now most commonly used. The elements are carbon and zinc, the fluid an acidulated solution of the bichromate. When not in use the elements should be raised out of the fluid. This is accomplished in a battery made by Messrs. Meyer and Meltzer by closing the lid. One charge will last for several operations, but so quickly do the elements polarise that the current is uncertain, and liable at any moment to stop. Should such an event happen the working may be renewed by blowing air in with a bellows. This battery has the further advantage that it can be kept in a closed box, there being no acid fumes to destroy the connections.

The Bunsen arrangement supplies a reliable current, and where it can be attended to by an electrician, is no doubt the best. The elements are best arranged in vertical cylindrical jars. The block of carbon—preferably, on account of its porosity, retort carbon—is suspended in nitric acid contained in a porcelain jar. This is placed in a wide vulcanite jar containing water acidulated with sulphuric acid (1-8), and between the two is the zinc plate folded into a cylinder, a gap of about an inch intervening between the edges. The connections are of copper. The objection to this battery is the necessity for decanting the fluids when not in use, since the nitric fumes destroy the connections. If, however, this be done, and the elements carefully washed and the connections dried, the battery will not prove expensive and may be relied upon. Before long probably the necessary heat will be obtained at a moderate cost, from the 'accumulator.' Already Mr. Buchanan has used this electric reservoir, and the writer has maintained a platinum wire at a white heat, for some time, with two of Faure's accumulators. The great weight and the cost prevent the general adoption of this plan at present.

The connections and handle.—The current is conducted through thick copper wires, so as to diminish as much as possible the resistance, to a special handle. This is composed of two brass rods which are insulated by talc fitted in a wooden handle; at the lower end are clamps for connecting the wire, and to the other is soldered, by common solder, the platinum wire. A movable button in the handle works a metal cylinder by which the continuity of the current may be made or broken. This interrupter has been arranged so as also to be worked by the foot.

The shape of the terminal will depend upon the use to which it is to be put. That just described furnishes a point or small loop for puncturing, or cauterising, small surfaces; for larger surfaces the wire is coiled round a porcelain cone. The chief use now of this cautery is for removing growths by surrounding them with a wire. The platinum is made into a loop, the ends carried through two brass tubes and wound round ivory rods by turning a button, so that the tumour can be gradually constricted and burnt through. The current is conveyed through the brass tubes to the wire.

Application.—It is only necessary to describe the écraseur action, and here an advantage possessed by no other cautery is manifest—viz. that the wire can be placed *in situ* before the heat is applied. The loop is carried over the growth, tightened,

and the heat applied gradually; if too much heat be used the wire will cut through like a knife, and no time be given for hæmostatic action; therefore the wire must be tightened very slowly. When acting well there should only be heard a low frizzling sound with little smoke.

When the part to be removed cannot be surrounded—as, for example, the tongue—the wire must be carried through at the desired point or points, and the part removed by one or more cuts. The wire is made to traverse the part by a large needle with a sunk loop at one end, or it may be passed through a canula. It is specially used for removing intra-laryngeal, nasal, and uterine growths, and, as said above, for extirpating the whole or part of the tongue affected with malignant disease.

Paquelin's Cautery, invented and introduced by M. Paquelin in 1876, has now almost replaced both the actual and galvanic cauteries.

The essential principle is that platinum, when raised to a certain heat, becomes incandescent when brought into contact with a mixture of air and benzoline vapour. A stream of air is passed, by means of the ordinary spray-bellows, into a bottle containing benzoline, and the resulting mixture of air and benzoline vapour conducted through an indiarubber tube to the cautery. This is hollow, and consists of a wooden handle through which passes a metal tube. To the end of this is attached the indiarubber tube, and into the other is screwed, by a piece of the same metal, a hollow platinum cone. The tip of the platinum is heated in the flame of the spirit lamp until it begins to glow; this ignites the highly inflammable benzoline vapour forced into it by a few sharp compressions of the hand-ball, and the metal is raised in a few seconds to a red heat. The temperature can be maintained for any length of time by gently compressing the ball, and moreover can be regulated to a nicety. The cautery is sold in a compact box containing usually three platinum heads: one wedge-shaped, to act as a knife; a second furnished with a broad button for large surfaces; and a third with a point suitable for punctuning nævi and piles. Various other terminals have been made to suit particular localities; for example, the knife-end is curved and this renders it more useful in cavities, as in dividing the cervix uteri. A scissors-terminal is also made.

It is necessary to use rectified spirit in the lamp, for the double purpose of increasing the heat and preserving the platinum. The benzoline must be of the specific gravity of 0·709, and the bottle never more than half-full. After remaining some time in the bottle the benzoline will not ignite, so that it is well to use a small quantity at a time, keeping the reserve in a special flask.

Charters J. Symonds.

CELLULITIS, or Diffuse Cellular Inflammation, may clinically be looked upon as a form of erysipelas, and by many authors is classed as a variety of that disease. It is characterised by the same spreading inflammation and by the same atonic character. It affects, however, only the cellular tissue; occurring in those situations where there is no skin, as in the pelvic cellular tissue, or in the subcutaneous cellular tissue, the skin not being involved, or only secondarily affected, by the inflammation.

It presents itself in its most virulent form after the introduction of a septic poison, as in dissection wounds, or after the bite of one of the less poisonous snakes. It may occur also in the pelvic cellular tissue after wounds or surgical operations, in women, after parturition; and after scalp wounds or injuries of other parts involving the cellular tissue.

When it occurs as the result of a poisoned wound, it possesses the peculiarity that it may attack tissues remote from the wound, and between which and the puncture no direct communication can be traced. Moreover, the puncture may be quite healed or apparently healthy. Thus, in a dissection wound of one of the fingers, the cellular tissue in the pectoral region may be the seat of the disease. When it occurs as the result of a simple wound, it runs the same course as an attack of ordinary erysipelas, starting from the seat of injury, but implicating the cellular planes.

The disease appears as a diffused swelling of the part affected. The swelling, at first œdematous, speedily becomes brawny; or it may be œdematous in some parts, brawny in others. The skin is slightly reddened and presents a mottled appearance, but there is no well-defined limit to the redness. There is great pain, of a tensive, burning character, which is increased by pressure. There is often inflammation of the absorbent vessels and glands. After a time the swelling becomes soft and doughy, and there is an indistinct sensation of fluctuation. Occasionally crepitation may be perceived, from putrefactive changes. The skin later on becomes more involved and of a darker colour, and may, eventually, pass into gangrene, unless relieved by timely

interference. The constitutional symptoms are of an exceedingly grave character. There is great excitement and prostration of the nervous system, especially where the disease is the result of the introduction of a septic poison, and speedy collapse. The fever is of a marked asthenic type, with a high temperature, generally profuse sweating, a quick and feeble pulse, a brown and dry tongue, vomiting and diarrhœa, and low muttering delirium.

In extreme cases death results in two or three days, but in those in which the general symptoms are not so severe, it may be delayed for several weeks, or recovery may take place.

The *diagnosis* of the subcutaneous form of this disease is generally simple, but when the mischief is deep-seated it is by no means easy. The presence of an œdematous swelling, accompanied by severe constitutional symptoms and rapid prostration, should always put the surgeon on his guard, and if any reason exists for suspecting the presence of deep-seated cellulitis, an exploratory puncture should not be omitted.

Treatment.—In the treatment of cellulitis decisive measures are necessary, and the only effectual way of preserving the skin and preventing sloughing is by means of incisions. Hence they should be made early, before the parts have lost their vitality. The object of the incisions is to relieve tension and give exit to the effused inflammatory products; and, to attain this end, it is better to make a number of small incisions (say some two or three inches in length) rather than one long cut through the inflamed structures. The incisions should embrace the whole extent of the tense parts. It is desirable that they should be made parallel to each other, and that the extremity of one incision should overlap that of the second, as by this means the greatest relief is given to tension. They must be carried deeply into the infiltrated and gelatinous-looking cellular tissue, and if the disease has extended beneath the fascia, it must be freely incised. After the incisions have been made, warmth and moisture, in the shape of fomentations and poultices, must be applied in order to facilitate the escape of the effused fluids.

As regards general treatment, the free and early administration of tonics and stimulants is necessary. Wine and brandy, combined with bark and ammonia, or other tonics, form the only reliable treatment, and they must be given with no niggard hand.

The issue of a case of diffuse cellulitis will often depend upon whether the patient is able to take and digest large quantities of stimulants. So long as he can do this there is always good ground for hope, and the amount of brandy and wine which patients suffering from this disease can assimilate is sometimes astonishing. If, however, the stimulants upset the digestive organs and sickness comes on, or the patient begins to refuse them, speedy prostration supervenes and rapidly terminates the life of the patient. Opium, or other narcotics, are often required in this affection, in order to allay nervous irritability and diminish pain. T. Pickering Pick.

CERUMEN. *See* Ear, External.

CERVIX UTERI, Amputation of the. This operation is generally performed either for the removal of malignant disease, or for the cure of the troublesome results which may follow hypertrophic elongation of the cervix. Operations for malignant disease must be conducted, in the case of the uterus, upon the same principles as in any other form of cancer or sarcoma; but in this special case the difficulty of removing the entire morbid growth is often peculiarly great, and the surgeon can seldom feel sure that he has done so. As anything like a free use of the knife or cautery in the neighbourhood of the uterus entails great risks, it follows that, if the cervix be amputated and there be the least suspicion that some of the disease is left behind, the use of scraping instruments or strong caustics will be rendered necessary, any further cutting operation being out of the question, unless total removal of the uterus be meditated. All these questions are dealt with in standard works on diseases of the uterus, to which the reader is referred.

Turning to the consideration of the operation alone, it must be borne in mind that the surgeon aims at removing just as much of the cervix as he desires—not too little, so as to nullify all premeditated benefits, and not too much, so as to involve several serious risks. He also presumes that the canal of the uterus will not be obstructed after the operation. It happens that even a very small experience shows how very hard it is to remove precisely as much of the cervix as is required. The position of the cervix prevents that free use of the hand and perfect control of the part to be cut through, which can be brought into play when a limb is amputated. Even the most skilful operators have met with very bad results when employing the knife or any kind of écraseur. The wire or chain

not unfrequently drags down the posterior *cul-de-sac* of the vagina, and tears away a piece of peritoneum from Douglas's pouch. To avoid this disaster, which may be followed by severe hæmorrhage or peritonitis, some surgeons have been accustomed to free the uterine part of the cervix by cutting away the vaginal mucous membrane round its reflexion on to the cervix; but this proceeding is not to be recommended.

The least objectionable, most successful, and most generally recommended instrument for amputation of the cervix is undoubtedly the galvano-caustic wire. The patient being placed in the lithotomy position, and the vagina depressed by a Sims's speculum, the cervix is seized with a pair of vulsellum forceps, and drawn as low down as is needed, an assistant facilitating the process by pressing on the fundus uteri from above the pubes. The loop of platinum wire is then passed round the cervix as high up as is desired, and drawn tight. The next stage of the operation consists in the process of cutting through the cervix with the red-hot wire. If this be done in a hurry, the risk of hæmorrhage and of a slipping downwards of the wire, with consequent amputation of an insufficient portion of the cervix, will be very great. The advice given by Dr. Barnes should be followed. The wire being drawn so tight as to imbed itself in the groove which it forms in the tissues, it can then be made red-hot without any fear of its damaging the vagina. The loop must be made tighter as it burns through; time must be left after each tightening to allow it to get red-hot again, as the tissues must be burnt through, and on no account cut through by overtightening the knot. When the cervix is entirely burnt through, the stump must be cleaned by free syringing with ice-cold water; bleeding points may then be secured; and lastly, the vagina is plugged with lint soaked in some antiseptic solution. The cut surface will granulate and heal within a month. It is very necessary to pass a sound occasionally to avoid contraction of the uterine canal.

ALBAN DORAN.

CERVIX UTERI, Stenosis of the. Authorities upon gynæcological questions are much divided in opinion as to the relation of dysmenorrhœa to organic stricture of the cervix uteri. Although stenosis of the cervix is intimately associated, in the minds of many, with painful menstruation, the relations of the two still lie within the domain of theory; and stenosis will, therefore, be here considered in its definite forms, ranging from a distinct contraction to absolute atresia. In all these forms there may be no symptoms of dysmenorrhœa throughout the course of the case.

Stenosis of the cervix may be congenital or acquired. The congenital variety is often associated with the small, tough, strongly anteflexed and ill-developed uterus seen in sterile women who have never menstruated, or whose catamenial show is scanty and attended with pain. As in such cases, little, if any, fluid escapes through the cervical canal; as the flow of that fluid is never sudden or rapid; and, lastly, as the fact of distension of the uterine cavity with retained fluid has not been proved in cases of stenosis, it is, at least, probable that the pain is due to causes other than obstruction. Acquired stenosis has been repeatedly observed as a result of partial amputation of the cervix, of injury during parturition, and, though to a limited extent, of inflammatory diseases and neoplasms in the canal. Putting aside the contraction of the canal, very common after the menopause, there can be no doubt that stenosis has been produced by the abuse of caustics or of scraping with the curette, and this fact has been frankly admitted by some of the advocates of these practices.

When, from any of the above causes, the cervical canal is found to be extremely narrow, resisting the withdrawal of the sound, stenosis of the cervix may be diagnosed. Difficulty in the introduction of that instrument, however great, is not satisfactory evidence; for, in cases of spasmodic dysmenorrhœa, the sound slips out with ease, though its entrance, aided by a considerable amount of force, may have taken several minutes. In such a case, there is generally severe pain as the sound passes through the os internum. In true stenosis, this pain is often absent. In a case of stenosis, menorrhagia may exist; in complete atresia this symptom is impossible. The diagnosis of a uterus distended by retained fluid may, it must be remembered, be very difficult. Circumstances may render it unadvisable to use the sound, and the swelling may be taken for pregnancy or a uterine tumour.

Should the surgeon be able to detect true stenosis, not amounting to atresia and accompanied by severe dysmenorrhœa, then, especially in an acquired case, he may dilate the cervix by bougies or tents, preferably the former. When atresia exists, the case will require very grave consideration. The distended uterus may be associated with dilatation of the tubes and its concomitant

evils; and, again, operation may be followed by the disastrous results which have been known to occur after the puncture of an imperforate hymen. In such a case, it is advisable to draw down the cervix with a tenaculum forceps, after a Sims' or Neugebauer's speculum has been introduced into the vagina, and to puncture the obstruction very carefully with a very fine aspirating-needle. After aspiration, the best treatment is to keep the parts as aseptic as possible without active syringing. An iodoform pessary, of Ehrendorfer's composition, may be introduced into the vagina; it is an excellent means to this end, and sometimes takes three or four days to melt. The use of bougies will be required for after-treatment. ALBAN DORAN.

CHANCRE.—A chancre may be defined to be any primary sore connected with venereal disease. The association may be direct or indirect, and it is not necessary that the sore should be on the genitals. Neither is it necessary that a chancre should lead to syphilis. There are chancres which infect the system, and others which do not. All chancres are contagious, and are produced by contagion only. All chancres are liable to affect the lymphatic glands nearest to them, and thus to produce bubo. The characters of the bubo will usually resemble those of the chancre. If the latter is hard, well-defined, and not inflamed, the enlarged glands will be hard, loose, and almost free from inflammation, but if the chancre be inflamed and suppurating, the bubo will very probably suppurate also.

It is exceedingly difficult to determine correctly the relationship between infecting and non-infecting chancres. The difficulties are much increased by the circumstances that the characters of the two are often seen together in the same sore, and that the one is very often introductory to the other. We shall probably be near the truth if we believe, that non-infecting chancres are produced by the contagion of inflammatory secretions from venereal sores of all kinds, which do not contain at the moment the specific virus of syphilis; or in some cases it may be the fact that the recipient is not liable to the specific contagion, having been temporarily protected by a previous attack. In yet other cases, it may be that the acute inflammation induced by the pus-contagion makes the site of the chancre unfavourable for the development of the specific virus. The school of dualists believe that there are, and have always been, two wholly different kinds of virus, which have no relation to each other, but produce their effects side by side. There is no great difference of opinion as to the facts; it is simply as to their interpretation and the terms in which they are described. For the unicist, the non-infecting sores are usually an appanage of syphilis; for the dualist they are wholly distinct. Both will admit that the contagion of non-venereal pus—from boils, for instance—may produce, when inoculated on the genitals, ulcers, which may have a certain duration, and may simulate the non-infecting sore; but both will also probably assert that the venereal non-infecting sore usually presents peculiarities. The diagnosis between the chancre which will infect the system, and the one which proves to be a local ulcer only, is often exceedingly difficult. In many cases, if a month or five weeks have elapsed since the contagion, it is often—indeed, usually—quite easy to decide, but in a few it may be impossible.

The feature which is of chief importance in the decision is the very peculiar kind of hardness which the sore often assumes. In well-marked cases this induration may be such as might be produced by a disc of cartilage. It causes the affected portion of mucous tissue, if it be in the roll of the everted prepuce (its most common site), to stand up in a sort of collar, and it is not necessary to use the finger to recognise the induration. When in other parts, as the skin of the penis, or elsewhere, it produces, not a collar, but a round patch or button, which is usually well circumscribed and but little inflamed. The sclerosis of tissues and the absence of common inflammatory action are the chief features. Sometimes the sore will not show any ulceration from first to last, and it is very common for the ulceration to heal and leave the induration still present. The size and thickness of the hardened patch may vary very much. The disc may be no bigger than half a pea or as large as a half-crown. Whilst the absence of inflammation and the presence of induration are the common features, it is yet quite possible that the sore may deviate very widely from rule in either direction. It may be acutely inflamed, and it may be wholly without hardness. These deviations probably depend chiefly on the peculiarities of the recipient, but they may also in some cases be due to the nature of the secretion in which the virus was conveyed. If the pus-secretion be of an irritating character, the inflammation caused may obscure the features of the

specific induration. Thus chancres produced experimentally, and with secretions as little mixed as can be helped, run, usually, a more typical course than those which occur *au naturel*. In some cases the inflammation of a chancre becomes erosive, and assumes the features known as phagedæna. This process may entirely destroy the chancre and extend widely in the parts around. It seldom, however, occurs early enough to prevent the infection of the system.

Next in importance to the two conditions named, we have, as distinctive of the infecting or true chancre, its observance of stages. It has been well determined by experiments that, between the date of contagion and the full development of induration, a period of nearly five weeks will intervene. Observations on patients, when the infection has been accidental, are in accord with this. The first result of contagion is usually a little red point, which lasts only a few days and then wholly vanishes. During the fifth week the site of this point usually becomes irritable and again red, and very quickly develops slight hardness. Upon this hardness ulceration takes place, but, the induration continuing to widen, is still of much greater size than the ulcer. The ulcer usually secretes very sparingly, as has been already said. At the end of the sixth week the induration may be expected to be at its height, but in many cases it is very short-lived indeed, and may disappear in a few days, and the sore heal and be forgotten.

There is no fact more certain in medicine than that mercury can cause the sclerosis of a true chancre to disappear, and that it invariably does so in the most remarkable manner. We seldom see a chancre run its course without interference from this specific. If, however, the very largest indurations be left to themselves, there is reason to believe that they will not, as a rule, last long. The normal duration is, however, varied. They may, as first said, vanish before full development, or they may persist for many months. If mercury be prematurely interrupted, the chancre will indurate again, and in rare cases we encounter what are called 'relapsing chancres' in which the hardness returns over and over again in the exact site of the chancre, during several years. The periods specified are usually observed with great exactness in all cases of experimental chancres, and in all those which occur in vaccination. It is probable that the observations which assert that definite induration may develop in much shorter periods, or that its first occurrence may be delayed to much longer ones, are founded on error.

When the chancre has been produced by sexual contagion, the secretion causing the infection will almost always be mixed—that is, it will contain pus-elements, the products of inflammation, as well as the specific virus. From this it results that very often a pus sore is produced at once, or within a few days after the exposure. This sore may persist during the whole month which intervenes before induration sets in. In such cases a sore, which has had the characters of a non-infecting one during the first month or five weeks, finally develops those of the syphilitic kind and is followed by the usual results. Such a chancre may continue to suppurate after induration of its base has occurred, and may thus present 'mixed' features.

Another character which usually denotes an infecting sore is that it is single; or rather, perhaps, it should be said that the non-infecting are often multiple. The infecting sore is not always single, for there may be two, three, or more. If multiple, we may be sure that they all result from contagion at one and the same time, for it is impossible for a true chancre to produce others in the same person.

The characters assumed by chancres which do not prove infecting are very various. The sore is, however, invariably developed within a few days—it may be a few hours—of the exposure to contagion. As a rule only one sore is present at first, but there may be two or three. As a result of contagion from the pus secreted by the first sore, others may be produced, usually in its close proximity. If the part on which the sore has appeared is in apposition with another surface, this latter is almost always infected. The degree of inflammation, ulceration, &c., may vary very much. Many sores of this kind heal within a week of their formation, and never assume any peculiarities. In other cases the sores last long, have abrupt cut edges as if punched out, and show a grey surface destitute of granulations. Although they often spread at their edges to some slight extent, and closely approach the condition known as phagedæna, yet they very rarely pass into it. Phagedæna may, however, supervene, especially if the prepuce be phimosed, and the secretions pent up. With these sores there is almost invariably early enlargement of the glands in the groin. The bubo is often inflamed and the glands become matted together in one lump. There is

much risk of suppuration, and large and troublesome abscesses may result. *See* Bubo. The nearer the sore to the frænum, the more certain it is that bubo will occur.

The infecting chancre may be met with on any part of the body, and has been recognised on the scalp, on the face, in the palm of the hand, and sole of the foot, on the lips, tongue, and tonsils. It is now and then multiple on the surface of the body, as, for instance, in policemen and others who have been bitten and scratched by prisoners suffering from syphilis. The non-infecting chancre, on the other hand, has never been recognised as such on other parts than the genitals. This, however, may result simply from the fact that its features are ill-marked, and we have no proof of its nature to which to appeal. Probably, also, on any other part than under the foreskin a non-infecting sore would usually soon heal. Its production and its perpetuation seem both of them to be closely connected with retention of irritating secretions.

As regards the relative proportion of infecting and non-infecting chancres, it is difficult, if not impossible, to collect trustworthy statistics. A great number of those diagnosed as non-infecting at first, assume other features at a later stage. No observer has a right to put down a sore as non-infecting, unless he has watched the case during a long period and made sure that the sore never changed its character, and that nothing followed it. It is unsafe to rely upon any local characters or their absence. If we make allowance for errors of diagnosis, and also for a not inconsiderable number in which the sores are so trivial and of such short duration that it may be doubted whether they are specific at all, it will be found that a very large majority of venereal sores are infecting. This applies, of course, chiefly to those who contract sores for the first time. A certain number of so-called 'soft sores' are such because they occur in those who, having had the disease before, are not susceptible of syphilis.

The *treatment* of chancres has been much simplified of late years. In all stages and conditions attended with suppuration and without definite hardness, iodoform is to be applied, and it will cure quickly in four cases out of five. It may be used as a powder, dusted into the sore, and, when healing commences, as an ointment, in the proportion of a drachm to an ounce of vaseline. The sores which resist iodoform usually have more or less tendency to phagedæna, and often prove for a time very difficult of cure. Iodoform is, in the first instance, to have a fair trial, the free use of warm water being also enjoined. If the sore do not heal, black-wash may be tried, or, if it assume an unhealthy aspect, the acid nitrate of mercury may be applied as a caustic. There are sores, however, which will resist all these measures, and which become healthy only when mercury is given internally. When positive phagedæna supervenes it may be necessary, in addition to the measures just mentioned, to keep the patient in a hip-bath of warm water continuously for a period of several days. *See* Phagedæna.

If a chancre show specific hardness, it is advisable at once to begin the administration of mercury, and thus anticipate and usually prevent secondary symptoms. All non-secreting indurated sores should be dressed with black-wash in preference to iodoform.

The question of the abortive treatment of chancres does not often come within the domain of practical surgery. For the most part our patients consult us too late. Some facts appear to show that the poison is imbibed early, and it avails little to excise or destroy a chancre within even so short a period as four or five days. These facts ought not, however, to hinder us from giving the patient such chance of escape as excision affords in all suitable cases. Paquelin's cautery is the best instrument to use, and with it either the sore may be burnt up in the freest possible manner, or—what is still better—a liberal excision of the structures around the infected spot may be made. Any chancre coming under the observation of the surgeon within a week of contagion, and on a part where such treatment is practicable, ought to be so dealt with.

Jonathan Hutchinson.

CHARBON. *See* Malignant Pustule.

CHARCOT'S DISEASE.—*Synonyms:* Arthropathy of ataxia; neurarthritis in connection with tabes dorsalis or progressive locomotor ataxy (Duchenne's disease). A peculiar form of arthritis, usually affecting large joints, especially the shoulder, elbow, knee, and ankle, arising in the course of the disease known as locomotor ataxia. This was first discovered and described by M. Charcot in 1868.

Cause.—The disorder is only met with in a marked form in cases of spinal tabes, and must, therefore, be regarded as directly dependent either on definite lesion of the cord, or as a part of the whole morbid

state of which that sclerosing lesion forms the main or most obvious change. It is not very common, but since attention has been directed to the disorder, many cases have been brought forward in France, America, and in this country.

Pathology.—The exact nosological position of this malady is not yet determined. There is hardly any difference of opinion as to the fact that this peculiar arthritis forms part of the disorder recognised as tabes dorsalis, although some surgeons, who commonly see these cases in the first instance, are unable to detect any specific difference between them and certain cases of chronic rheumatic arthritis. It seems probable that some cases hitherto believed to be examples of hydrarthrosis have really been instances of Charcot's disease, in which the tabetic spinal symptoms were either little marked or overlooked. It must be allowed that many of the changes occurring in the affected joints are common to both morbid states. This being so, the writer holds strongly to the opinion that these changes in and by themselves, tell no complete or accurate story as to the clinical features which previously characterised the particular instance under examination. This disorder has been considered to be a new manifestation of joint-disease, chiefly for the reason that, till within recent years, no examples of its morbid anatomy have been collected and preserved in museums. The same might fairly have been affirmed of tabes dorsalis itself, and of other maladies also, till Romberg and Duchenne, by their investigations, led to its differentiation. The writer prefers to believe that it is not a new disease, but has simply been unrecognised as a specific form of neurarthritis, and that, probably, specimens illustrating it are already in museums, arranged as examples of chronic rheumatic arthritis.

Certain articular troubles have long been recognised as dependent on disease of the brain, cord, and nerves. Thus, effusion and inflammation in joints, with ankylosis, changes in the skin, œdema, &c., are regarded as sequential trophic alterations in relation to various paralyses and traumatic affections in the line of nerve-supply to the joints and affected parts. These trophic changes are attributed to damaged nerve-centres, and many of these are now known to be situated in the grey matter of the spinal cord, as, for instance, those presiding over the nutrition of muscles being placed in the anterior horns. The special centre, or centres, for the joints, if there be such, are not yet determined. The fact that in progressive locomotor ataxia the line of morbid action follows the postero-external columns (Burdach's), without, as a rule, implicating the anterior columns or grey matter, seems to militate against the view that, in this disease, the joint-affection, when it occurs, can be due to an affection of the latter. Moreover, the sclerosis may spread to other tracts of the cord, and even involve the anterior horns without inducing the specific articular affection. Some authorities, notably Buzzard, consider that a trophic centre for the joints is situated in the medulla oblongata, and some proof of this is gathered from the fact that troubles of the vagus are commonly associated, in cases of ataxia, with Charcot's joint-disease.

In most instances the affection occurs early in the course of spinal tabes, at a period between the prodromal and the ataxic symptoms. The disease may also supervene at a later stage, and is then almost constantly found in a joint of the upper limb. In relation to (1) an early and (2) a later form, it may be noted that the part of the cord affected is not always in the same region; thus, the sclerosis may begin in the higher centres, as in the medulla, and come later to affect the dorsal or lumbar portions, and *vice versâ*. Further, it is necessary to point out that tabetic patients may, like other persons, be the subject of chronic rheumatic arthritis, which runs its course as usual, presenting no special features of Charcot's disease. It has already been noted that in many of the cases examined *post mortem* all the changes recognised as the result of chronic rheumatic arthritis have been met with, and while this has been the case sometimes in certain joints, others in the same patient have presented the characters more particularly attributed to Charcot's disease. Thus, ulceration of cartilage, marginal overgrowth, dendritic, synovial, and bony growths, erosion of bone, and eburnation are found in one joint; and the results of riotous disorganisation, with fracture of bone and extreme absorption of epiphyses, are discovered in another. Hence, if morbid anatomy could testify to the pathogenic process which has been at work, there might be a fair inference as to identity in pathology of these conditions. The clinical features of the malady, however, forbid the acceptance of this view, and the furthest point of speculation here admissible, for the present, is to regard both the specific arthropathy of Charcot, and chronic rheumatic arthritis, as forms of neurarthritis.

T

It has been stated that no attempts at repair are seen in affected joints. This is not the case. The existence of osteophytes and of eburnation suffices to disprove this. Marginal hyperplasia is common. This is not peculiar to any form of arthritis, and is found both in gouty and rheumatic joints. Without question, the most characteristic features of Charcot's disease are the sudden onset, the extreme effusion, the rapidity of the whole process, the rapid wasting and wearing down of the bones with consequent tendency to fracture. The cases in which the disorder is of slower onset more closely resemble rheumatic arthritis. The 'benign' examples are unlike the latter in that a greater tendency exists to complete recovery from the primary local lesion which, unhappily, is too rarely witnessed in rheumatic cases.

It is important to note that other evidence of trophic disturbance sometimes occurs in the progress of tabes dorsalis. Thus, perforating ulcer of the foot is apt to occur in a small proportion of cases. Attention has also been directed to a form of arthritis involving the tarsus, sometimes with and sometimes without associated arthropathy elsewhere. To this form M. Charcot has applied the term *pied tabétique*. Disorganisation of the tarsal joints and destruction of the arch of the foot occur, certain bones may become ankylosed, and others so broken down as to be hardly recognisable, while many fragments may be found detached from them.

The relation, if there be any, between this disease and chronic rheumatic arthritis is not, at present, readily determined. An 'error of nervous force,' it has been suggested, may determine the lesion, but the method and manner of it are dependent on other causes, such as rheumatic, gouty, or syphilitic tendencies (Paget). In the writer's opinion, the phenomena of this disease throw light upon those of chronic rheumatic arthritis, the neurotic origin of which he is disposed to believe in. The life-history is essential to the determination of the nature of the morbid process in each case. In this disease the joint-changes may be the direct result of central (spinal) irritation; in rheumatic disease, there may be reflex dystrophies. The influence of the nervous system here is thought by some to be merely passive, and the changes but a result of injury inflicted upon parts whose sensibility is impaired. *See* Chronic Rheumatic Arthritis.

An important point is raised by the existence of certain cases of locomotor ataxy in which no central (spinal) lesions are found, but changes are confined to the peripheral nerves. It may be that future investigations will throw light upon the latter, and that such may be found both in cases of this special arthropathy and in those of chronic rheumatic arthritis, illustrating the trophic changes in each instance. It is conceivable that, with central spinal disease, the arthritic degenerations may proceed in different fashion from that commonly occurring where no coarse lesions are present in the cord. Certainly, it is found that the affected joints can be used without pain or great inconvenience in some instances. There have been no constant lesions found in the cord or peripheral nerves in these cases. The rule is to find the ordinary affection of the columns of Burdach, but atrophy and destruction of ganglion cells have been found in the anterior cornua and in the postero-lateral groups. In unilateral cases the changes have been found limited to the corresponding side of the cord; in the cervical region when the shoulder has been affected, and in the lumbar region when the knee was involved. Inflammatory changes—whether primary or secondary is not known—have also been observed in the peripheral nerves in cases of tropho-neurosis associated with locomotor ataxia. The most recent hypothesis on the whole subject has been put forward by Morrant Baker, who conceives that there may be a pathological connection between this special arthropathy, tabes dorsalis, and chronic rheumatic arthritis. He thinks that all these disorders may arise from 'some antecedent morbid state of which the result is expressed in pathological changes, sometimes in the cerebro-spinal system, sometimes in the joints, and sometimes in both.'

Symptoms.—Sudden and painless swelling in a joint, without any local premonitory symptoms, is significant of this disorder. The patient may present no sign of incoordination, but commonly has suffered from 'lightning' pains in the limbs. Pyrexia is absent. The knee is most often affected, then the shoulder, elbow, hip, and wrists, in order of frequency. The small joints are not exempted. The swelling is more or less firm, due to effusion into the synovial cavity. The integuments are not reddened, and there may, or may not, be local œdema. Some crackling may be noted at times before the extreme effusion. The '*benignant*' *variety* is characterised by subsidence of the swelling and return to a natural state after some weeks or months. The '*ma-*

lignant' variety leads on to rapidly degrading changes, rupture of ligaments, dislocation, fracture, and impaction of fragments of bones—a 'riotous' arthritis, in short; and all this may be set up in a few weeks. In spite of these profound changes the limb affected may retain a remarkable amount of power, movements may be freely executed and work carried on without any suffering. Portions of bone may become detached and adhere to the capsule of the joint, or osteophytes may form, and abundant dendritic outgrowths of cartilage or bone may occur within the joint. Spontaneous fracture may occur in sundry bones in some cases. The early tumefaction is not always sudden. Patients with gravely affected joints may live for many years, and retain remarkable powers of motion and capability. Thus, one man (under the writer's care) worked as a cooper's labourer for six years with hydrarthrosis and flail-like movements in both elbows, suffering no pain and little inconvenience, ataxic symptoms being well-marked at the end of that time.

The following table shows the prominent characteristics of Charcot's disease and chronic rheumatic arthritis in well-marked cases:—

Charcot's Disease.	*Chronic Rheumatic Arthritis.*
Patient not necessarily of rheumatic habit.	Patient of rheumatic habit.
Onset sudden, independent of injury, but not invariably so.	Onset gradual; often determined by injury.
First symptom: extreme tumefaction, rarely crackling.	First symptoms: slight swelling and crackling (extreme tumefaction rare and, perhaps, never sudden).
Pain absent; knee-jerks absent.	Pain severe; knee-jerks present.
Dislocation common.	Dislocation rare.
Progress: may retrograde, or disorder pass off.	Progress constant, often permanent.
Bones apt to wear away; osteophytes less marked than in rheumatism?	Much production of new bone and ostcophytes.
Fragility of bones.	Condensation of bones.
Ocular symptoms.	No ocular symptoms.

It is true that instances of this disease have been noted in which it has not been possible to draw the hard and fast lines indicated above, but enough remains to show that very specific characters pertain, for the most part, to the form of arthritis which occurs only, so far as is known, in that variety of spinal tabes which induces the symptoms of locomotor ataxia. The bones are apt to become porous and fragile.

These cases have been commonly seen in the first instance by surgeons, and, hence, the special nervous symptoms associated with them, unless present in marked degree, have been apt to be overlooked. More instances have been found since the attention of surgeons has been directed to them, and, in future, it will be well to look for tabetic symptoms in all cases of monarthritis involving the larger joints. The fact that locomotor ataxia has only been clearly differentiated of late years no doubt accounts for the absence of mention of these cases by earlier writers. It is certain that the arthropathy may occur independently, or before, any active symptoms of locomotor ataxy.

Diagnosis.—This is to be made by consideration of all the concomitant nervous symptoms which may be present. These are not far to seek in most cases. The joints may be affected early, and but few indications of ataxia be found; but these are apt to supervene. The disorder is most likely to be mistaken for chronic rheumatic arthritis, and a careful review of all the symptoms, the history, the question of heredity, with knowledge of the special features of this arthropathy, will commonly avail to render the diagnosis certain. Malignant disease may be suspected in cases where the progress is rapid in an instance of monarthropathy. These disorders will be found free from the severe pain, local and reflex, and the muscular spasm which commonly accompany other forms of acute arthritis.

Treatment.—The affected joints must be set at rest. Cotton-wool, covered with light and well-adjusted bandages, should be applied. Strips of buckskin, covered with mercurial and ammoniacum plaster, and carefully applied, are useful for hydrarthrosis in any stage. Splints will be necessary in some cases to secure immobility, and casings of leather, with suitable straps, will be proper to support and restrain joints whose movements, owing to suppleness and dislocation, are too free. Remedies for the central nervous lesion must be employed, as in ordinary cases of locomotor ataxia, benefit being sometimes secured by nitrate of silver, iodide of potassium, mercury, and by cod-liver oil. Monobromide of camphor in full doses is of value for 'lightning' pains and insomnia. The disorder may altogether subside in benign cases. In the others the prognosis is bad, and the local troubles become of secondary importance as other symptoms of the constitutional malady progress. DYCE DUCKWORTH.

CHEEK, Fissure of the.—Syn.: *Macrostoma congenitum.*—This very rare deformity consists of a unilateral fissure extending from the corner of the mouth

proper for some distance into the cheek, and usually continued as far as the anterior margin of the buccinator, but occasionally running upwards toward the outer angle of the orbit. The natural point of junction of the two lips is marked on each by a slight papillary elevation of the mucous membrane; but with that exception there is no difference in the condition of the parts forming the cleft from that of the lips, the inner surface being lined with a similar mucous membrane which joins the skin of the cheek, just as that which forms the red surface of the labium. The deformity is very unsightly, and gives the appearance on one side of the face of a very elongated mouth, whilst the non-union of the fibres of the orbicularis oris causes a want of expression, which is more marked when any attempt is made to smile or laugh. This unsightliness is, in many cases, increased by the presence of so-called auricular appendages or supernumerary auricles, which, however, are not always present. When they occur they are placed in front of the tragus or upon the cheek itself, in a line between the end of the fissure and the tragus of the ear, and they consist of fleshy elevations, generally containing cartilage, and covered with soft hairy skin similar to that over the helix. In shape they are small, oval, and sometimes as large as a horsebean, and are attached by a pedicle to healthy skin of the cheek, or the base of attachment may sometimes be as broad as the growth itself. They are usually bilateral, though not necessarily symmetrical in shape, or position, or number. The external ear is generally more or less misshapen on one or on both sides, and the external auditory meatus may be absent.

Causes.—The deformity is congenital, and results from a failure of union between that upper part of the first visceral arch from which is developed the superior maxilla, and the lower part of the same arch, from which Meckel's cartilage is derived, and upon which the lower jaw is formed. As the first visceral arch is visible in the human embryo at the third week, and is the earliest to unite with its fellow of the opposite side, this deformity may be regarded as a pure accident of development; and since it is found in children with elder brothers and sisters who are perfectly formed, and where no trace of similar deformity has occurred in the families of either parent, it is not hereditary, and, from the early period of pregnancy at which it must take place, maternal impressions are not likely to influence its origin.

Symptoms. — The appearances above described are unmistakeable (for portrait see paper by the writer in *Medico-Chir. Trans.*, vol. lxv. p. 20). It occurs more permanently in girls than in boys, and the subjects are often delicate. The lower jaw is frequently small and ill-developed, especially upon the side upon which the fissure exists. Besides the supernumerary auricles there are sometimes to be seen upon the cheeks of these patients small cicatrix-like striæ, or pore-like openings, ending in a *cul-de-sac.*

Treatment.—Since the condition does not cause any impediment to the power of sucking, there is no necessity to operate at a very early age, and it is wiser to allow the first year of life to pass, so that the child may be weaned and be brought into a better condition to bear the slight loss of blood incident to the operation. The child having been anæsthetised, all that is required is to make a clean incision extending just beyond the mucous surface of each lip, and to bring the cut surfaces together with two or three silver sutures, which should pass completely through the substance of the cheek and out again before being twisted together. This is preferable to the use of harelip pins, as being less likely to cause cicatrices. One stitch should be placed at the point where the two lips should naturally join, and another half-way between it and the angle of the cleft, whilst if necessary the edges of the skin may be more neatly adapted by fine sutures of horsehair or catgut. The sutures may be left for three or four days before being removed; and the wound should be dusted with a little iodoform powder, or painted with collodion to which iodoform has been added, and must be covered with a pad of lint, which should be firmly retained by strapping, so arranged as to prevent, as far as possible, any movement of the facial muscles. Every effort must be made to obtain primary union of the wound, and if this is successful the result will be found extremely satisfactory.

JOHN H. MORGAN.

CHEILOPLASTY.—Under this heading is included a great number of operative procedures of an autoplastic character, performed either for establishing an oral aperture of normal size and shape in cases of congenital malformation, or for the reconstruction of a lip that has been destroyed, to a greater or less extent, by the surgical removal of a new-growth, by malignant or syphilitic ulceration, or by the primary or

secondary and cicatricial results of injury. It is proposed to deal in this article only with the latter classes of cases, as the operations necessary in cases of congenital malformation will be described under HARE-LIP; CHEEK, Fissure of the.

The main object in a cheiloplastic operation is, whilst preserving a shapely and efficient oral aperture, to protect the teeth and gums, by one or more transplanted flaps of sound and healthy structures taken from the immediate neighbourhood of the defect. It is also a very important point to preserve, if possible, a free margin of mucous membrane. In most of the procedures that have been devised, each flap, after its dissection, is glided into its new position, and is not twisted. In his selection of one out of the very numerous and varied methods of cheiloplasty, the surgeon will be guided by the extent of the defect and the condition of the surrounding parts. Endeavour should be made so to contrive the dissection of the flaps that the resulting cicatrisation and retraction of the fresh wounds may tend rather to keep the flaps in their new position than to drag them away.

The simplest of cheiloplastic operations on the *lower lip* is that in which the edges of a V-shaped wound, formed by removal of a small tumour or ulcer, are immediately brought into contact by harelip pins or wire sutures.

The following are some of the best known of the very numerous operations that have been performed in cases of considerable destruction of the lower lip:—

In *Chopart's operation*, performed for covering a large rectangular defect after removal of extensive disease of the lip, a rectangular flap with its base below is taken from the chin and front of the neck, and drawn upwards over the lower jaw towards the mouth. The lateral margins of this flap are attached by sutures to the lateral margins of the primary wound, and its upper free margin forms the lower boundary of the oral aperture. This procedure is attended with several disadvantages, and its results in general have not been very satisfactory. There must be considerable tension of the flap, and it is necessary for the patient to keep the head bent forwards during the after-treatment. The flap may be dragged downwards even before the removal of the sutures. Its free labial margin, being formed of cicatricial tissue, is often very thin and uneven, and may be rolled inwards by retraction. The principle of this operation, however—that of taking the sound skin from the chin or front of the neck—has been followed, with modifications, by many surgeons, of whom may be named Lisfranc, Roux of St. Maximin, Zeis, and v. Langenbeck. Serres, of Montpellier, who was the first to propose saving the mucous membrane of the lower lip, in order to replace it on the free margin of the flap, has devised a method of inferior cheiloplasty, which, in a modified form, has been recommended by Mr. Erichsen. The object of this modified operation is, it is stated, to raise the lower lip to a level with the incisor teeth. 'An incision about three-quarters of an inch in length is made directly outwards from the angle of the mouth, on each side, into the cheek; from the extremity of this, a cut is carried obliquely downwards on to the upper margin of the lower lip so as to excise the included triangular piece; the lower lip is then dissected away from the jaw, and a V-shaped piece is taken out of its centre. By means of a harelip pin, and a point of suture on each side, the incisions in the angles of the mouth are brought accurately together; and, in the same way, the vertical one in the centre is united. If, on the removal of the diseased portion of the lip the mucous membrane has been left rather long, a good prolabium may be formed, and the restoration effected with but little deformity.' (Erichsen.)

Although a large and vascular flap may in most instances be readily obtained from the front of the neck, the tendency to retraction and sinking of this flap, and the accumulation of blood and wound-secretion in the large pouch formed below the seat of operation, render most modifications of Chopart's method less advantageous than those in which the defect is covered by lateral flaps taken from the sides of the face and brought together in the middle line. Procedures of this kind, however, can, as a rule, only be applied to cases in which the integument of the chin remains in a sound condition.

In *Syme's operation* for restoration of the lower lip, the principle of which is to leave the central part of the chin undisturbed, and to cover the defect by two lateral flaps, two incisions are made from the centre of the gap outwards and downwards to the extent of rather more than an inch, and are then carried outwards and downwards and at last a little upwards, so as to terminate on each side below the angle of the jaw. These flaps are then raised so that the two straight portions, formed in the first instance, meet together in the middle line and are united by silver

sutures. The remaining extent of cut edges are united to the edges of the ∧-shaped portion of skin over the chin, which serves to support and prevent downward gliding of the flaps which form the new lip.

Buchanan's operation is applicable in cases of extensive malignant disease affecting the upper part of the lip, and leaving the chin quite free. From the centre of the inferior curved margin of the wound, made on removing the disease, two straight incisions, one on each side of the median line, are carried downwards and a little outwards. From the lower end of each of these incisions a long and but slightly curved incision is made in a direction outwards and upwards. The two oblong flaps thus mapped out are dissected from the subjacent parts and then raised upwards, the upper curved margins forming the margin of the lip, and the short inner margins of its flaps coming into contact in the median line, where they are connected by sutures. The triangular wound left below each flap is allowed to heal by granulation.

In *Teale's operation* for severe cicatricial deformity of the lower lip from burn, the everted lip is divided into three parts by two vertical incisions, each three-quarters of an inch in length. The width of the middle portion found between these two incisions should equal half the width of the lip. From the lower extremity of each of the vertical incisions, a curved incision is next to be carried upwards and outwards to a point about one inch from the commissure of the lips. The two lateral flaps are then dissected up, and raised and united by sutures in the middle line above the middle flap, to the freshened upper margin of which their lower margins are also fixed by sutures.

Other operative procedures for the reconstruction of the lower lip by the formation and apposition of lateral flaps, have been devised by Malgaigne, Dieffenbach, Bruns, and Szymanowski.

In a case of very extensive destruction of the lower lip, and of the soft parts of the chin, it might be possible to perform a satisfactory cheiloplastic operation by applying Reid's method, taking, in the first place, a single flap from the skin of the neck, and subsequently bringing together, above this, two lateral flaps.

Cheiloplastic operations on the *upper lip*, performed mostly in cases either of congenital malformation or cicatricial deformity, consist in varied applications of the double lateral flap method. In *Bérard's operation* each flap is formed by one incision, carried from the upper extremity of the defect outwards through the soft parts of the cheek, and a second, parallel to this, commencing at the corresponding angle of the mouth. This procedure has been modified by Bruns, who, at the outer end of each upper incision, excised a triangular piece of skin with the apex upwards, and at the end of each lower incision a similar piece of skin with the apex downwards. Dieffenbach formed his lateral flaps by a curved incision on each side round the ala of the nose. Teale also performed a cheiloplastic operation on the upper lip by making two crucial incisions, the intersecting point of which was placed in the median line, just below the septum nasi. The two lateral triangular flaps thus formed were drawn inwards, one below the other, and retained in this position by twisted sutures. Other plans of superior cheiloplasty, on the same principle of lateral flaps, have been devised by Malgaigne, Mirault, and Sédillot.

W. Johnson Smith.

CHELOID. *See* Cicatrices, Pathological Conditions of.

CHEMOSIS. *See* Conjunctiva, Diseases of the.

CHEST, Deformities of the. *See* Caries of the Spine; Pigeon-breast.

CHEST, Injuries of the.—*General Diagnosis of.*—These injuries may be divided into:—(1) those presenting some external wound; (2) those without external wound.

1. This class may be again subdivided into wounds of the parietes alone, and penetrating wounds which affect the structures within the walls of the chest also.

The diagnosis of wounds of the external parietes alone will be mostly negative. The external wound may pass in a direction in which it is impossible that the chest contents should have been injured; and again there will be a total absence of the severer symptoms usually associated with injury to the contained viscera. The worst symptoms which such a wound presents are due to division of large parietal blood-vessels or nerves, or injury to muscle. Thus we may have a blood-tumour form beneath the integument or the muscle, as the immediate result of the wound; or, later on, suppuration may take place in the track of the injury, either under the muscles or directly beneath the skin and fascia.

When the structures within the thorax have been injured, the symptoms will be of

a severer character. The pleura may fill up more or less with blood, forming a HÆMOTHORAX. Or air may enter its cavity, either from the external wound or from the wounded lung, forming a PNEUMOTHORAX. Or, finally, suppuration may take place in the cavity, constituting an EMPYEMA.

If the lung itself be wounded there will be effusion of blood into its substance, followed by inflammation, which may spread extensively, so that a very considerable part of the wounded lung may pass into a state of acute PNEUMONIA. This state is indicated at first by the expectoration of florid blood (hæmoptysis), and afterwards by the signs of consolidation of the lung, as shown by dulness on percussion, by rust-coloured expectoration, bronchial breathing and bronchophony; these latter signs may be much concealed by blood or fluid in the pleura in those cases in which there is much present. In either case, the burden of respiration will be thrown principally upon the uninjured lung, and there will be great dyspnœa and impeded circulation, as may be evidenced by blueness of the face, lips, &c. Percussion will give a dull note over the injured side (except in cases of pneumothorax), and auscultation will show the absence of efficient breathing. The temperature at first is somewhat depressed from shock, but later on may become elevated, especially if suppuration sets in. The diagnosis may be somewhat aided by the direction of the wound. In these cases it is not wise to permit much probing, but the direction of a wound can often be ascertained by collateral circumstances; and if these are absent, light and careful probing, not prolonged, will often sufficiently indicate the general direction of the wound, and show that some of the internal structures must have been damaged.

If the HEART or PERICARDIUM be wounded (and the one rarely occurs without the other), the symptoms are of the gravest character. Immediate death not infrequently follows, and, in those cases in which life is prolonged, recovery comparatively seldom takes place. Should life be prolonged, however, the signs of such an injury will consist in trouble to the circulation, from the impeded heart's action, a quick, small, laboured, and intermitting pulse, dyspnœa, and blueness of the face and extremities. The wound itself is attended by a sharp burst of hæmorrhage, which, however, speedily ceases as the external aperture becomes closed. The bleeding then takes place into the cavity of the pericardium, giving rise to the impeded circulation spoken of above, or into one of the mediastinal spaces, the signs of which are much more obscure. Auscultation of the heart does not give so much assistance as might be expected, but the precordial dulness is often increased. The heart-sounds are inaudible or scarcely audible, from the blood in the pericardium obscuring their distinctness, or if the amount of blood be very small, as in those rare cases where the pericardium is alone wounded and the heart has escaped, the friction-sound of pericarditis may be audible.

Penetrating wounds belonging to this class are sometimes complicated by foreign material, carried into the interior by the agent inflicting the injury. This is palpably the case in gunshot wounds, where a bullet is left in the chest. The same lesion exists when a portion of clothing is carried into the wound by a bullet, or, less frequently, by a stab. The diagnosis of this state will always be made with great difficulty, unless the foreign material can be seen or felt, though its presence will militate immensely against the chance of the patient's recovery. Not less dangerous, though much less palpable, is the foreign material carried in from without by a dirty weapon. This not infrequently gives rise to a poisoned wound, leading to the death of the patient from septicæmia.

2. The injuries to the chest without external wound comprehend fractured ribs, sternum, &c., and lacerations of the muscles, and also those cases in which the thoracic viscera have been damaged, either by compression from the injury or by a fractured end of bone having been driven into them. These cases will be treated of in separate articles, but it may suffice to state here that the general symptoms are similar to those in Class 1. When, however, the LUNG is injured, general EMPHYSEMA is often superadded to the symptoms before enumerated, but PNEUMOTHORAX is of less frequency, the air escaping directly into the general cellular tissue more often than into the cavity of the pleura. The diagnosis of this state is at once made by the swollen puffy state of the integuments, and by the crackling sensation communicated to the fingers on pressing them over the swollen part; this crepitant feeling is due to the air being squeezed from one part of the areolar tissue to another.

When the pericardium is wounded by the fractured end of a rib or of the sternum, the heart more frequently escapes injury than where there is an external wound. This injury is therefore of a less severe

character, and may be recognised by the increased precordial dulness arising from the cavity of the pericardium being dilated with inflammatory effusion, or by the friction-sound which indicates the existence of pericarditis. H. G. Howse.

CHIGOE.—The parasite (*Pulex penetrans*, or sandflea) which causes this disease is one of the pests of the West Indies and some parts of S. America. While both male and female live in the sand, it is the latter which, when impregnated, makes its way under the nails or between the toes of the human foot, where its presence is made known by the appearance of a white pea-like vesicle, which leads to much itching and irritation.

Treatment.—The orifice of entrance is to be carefully found, and skilfully dilated with a needle, and the vesicle then turned out whole. Great care must be taken not to rupture the vesicle, otherwise the escape of the ova into the soft parts will lead to most troublesome suppuration.

W. H. A. Jacobson.

CHILBLAINS are localised erythematous congestions, usually met with on the toes and fingers of weakly subjects, and liable to inflammation and even ulceration from time to time. The patients affected are usually children, more frequently girls, who take insufficient exercise and who are allowed to hang much over the fire before going out, or return to it immediately on coming in. It is rare to meet with chilblains after adolescence, though occasionally they are seen in grown-up women. The usual sites are the feet, hands, and not uncommonly, to a lesser degree, the ears, or much more rarely, the nose.

Chilblains will be met with in the following conditions: (*a*) red swollen patches liable to congestion, especially after going to the fire, taking food, or when first taking exercise; and when congested, itching, pricking, or tingling most intensely. (*b*) After frequent attacks of congestion the chilblains become more swollen, tender, and covered with vesicles. (*c*) The vesicles break and leave raw excoriated surfaces, liable to pass into very troublesome ulcers. It is rare to see chilblains go beyond this third stage, though occasionally the ulcers they cause become sloughy or even gangrenous.

Treatment.—In the treatment of chilblains the chief aim of the practitioner must be to stimulate the weakly circulation both locally and generally. To begin with, tight garters or boots should be forbidden, and only those worn which admit of warm socks or stockings. Regular exercise daily, especially in cold weather, should be insisted on, patients liable to chilblains being too often kept indoors; hanging over the fire before and after going out is especially to be forbidden. A chilled sponge bath in the morning, followed by good friction, this being repeated before a fire at night, so as to send the patient to bed in a glow; improvement in the diet as well as the addition of meat or its equivalent at breakfast, a glass of port wine or half a pint of milk with f℥ss. of rum in it at 11 a.m. and a course of bark and acid if need be, are all points of importance. So, too, at night the bedroom should be warmed, and knitted 'bed boots' worn, scarcely anything being more likely to conduce to or maintain chilblains than the custom of sending weakly children from heated sitting rooms into chilly bedrooms.

Locally, as long as chilblains are unbroken the treatment should be directed to judicious stimulation of the part. Thus, frequent bathing should be made use of in cold or just chilled salt water, or in water to which mustard has been added, the bathing being followed by persevering friction with a soft towel or flannel. The following stimulating applications will be found useful in the earlier stages. One part of Tr. iodi to two of Lin. saponis gradually increased to equal parts; one part of Tr. cantharidis to six of Lin. saponis; camphor dissolved in eau de Cologne, or equal parts of turpentine and olive oil. Nothing relieves the intolerable itching better than the Linimentum belladonnæ painted on and allowed to dry, or the application of Papier Fayard. Another application, which is only to be used where the chilblains show no sign of breaking, is aconite, opium, and chloroform liniments āā f℥ss., to be well rubbed in night and morning with soft flannel. Where vesication has taken place, flexile collodion, or the anodyne amyl-collodion will be found useful. In the stages of ulceration or sloughing, treatment appropriate to those conditions must be adopted.

As regards internal remedies, probably small and repeated doses of opium are the most trustworthy. W. H. A. Jacobson.

CHILDHOOD, the Surgical Affections of, are special only in the sense that they occur in children; for with very few exceptions children are liable to the same diseases and accidents as adults. Any

peculiarities, which disease manifests when occurring in childhood, depend not on special types of disease, but on certain physiological differences which distinguish the juvenile and adult periods of life. Childhood extends from birth to the thirteenth or fourteenth year of life. The first twelvemonth of this period is the *period of infancy*; the last year or two border on the age when *childhood* gives place to *adolescence*. The former is characterised by an excess of animal over intellectual growth, the latter is the period when intellectual activity begins to assert itself over mere bodily growth, and when the organs undergo higher development and not merely increase in size. These facts not unnaturally influence the nature and course of any disease which occurs at the several periods named. The bodily Temperature of young children is rather higher than that of adults, and it is more easily disturbed. Thus in children's hospitals the temperature of the majority is found to rise after the parents have left on visiting days. Little articles of diet surreptitiously brought in no doubt must be credited for something, but it is chiefly the mental effect on the children which causes this rise. So, too, after accident or operation: the temperature, therefore, is not quite so reliable a guide as in adults, and variations mean less than with them. On the other hand, children are more susceptible to changes in the external temperature than adults, and great care is necessary with regard to this point; the temperature of the sick room should be kept at a uniform point night and day, and some five to ten degrees higher than for adults. Infants are peculiarly susceptible to cold, and not a little infantile mortality is due to too low a temperature, especially during the night, when the physiological functions are at their lowest ebb. Errors are more likely to be prejudicial if the temperature of the room has been kept up during the day.

The question of Shock is one of the first which occurs to the surgeon's mind, when he is called to a severe accident, or when he has to decide on an operation. It is usually asserted that children more readily succumb to shock than adults. In the writer's opinion this is not the case. The intense vitality of children, the integrity of their vascular and emunctory systems, the absence of unfavourable psychological influences which so beset adults, are factors of the greatest moment all in their favour; and the success which has attended even such severe operations as abdominal section, ovariotomy, extirpation of the kidney, and many others, are testimonies in favour not only of a child's endurance, but of its great recuperative power. A matter of great importance after operation or accident is the assuaging of pain. Pain is very exhausting, and children do not bear pain so well as adults. It is owing doubtless to the saving of pain by chloroform—which children take better than any other anæsthetic—that so little shock is observed after severe operations; and if opium in full (proportionate) doses be afterwards administered to save subsequent pain, shock can be largely banished from children's surgery. The writer gives one minim for each year of life, and one for the operation; thus for a child three years old, four minims of the tincture of opium would be given after a painful operation.

Heredity plays a very important part in the causation and type of disease in early childhood: the worst effects are usually found in organs which are most rapidly developing. As age progressively advances, and as a child's tissues, so to speak, become more and more independent of their ancestry, hereditary influences gradually weaken. Thus, an infant born with congenital syphilis almost invariably suffers within the first few weeks of birth—the stronger the hereditary taint, the more severe will the disease prove in the child, and the earlier will it manifest itself, and *vice versâ*. In regard to those changes which we call strumous, they tend gradually to pass away as age advances, under suitable treatment and surroundings; hence in the treatment of the lesser manifestations of this diathesis it is highly important to gain time; so, too, in prognosing as to strumous lesions, either of the glands or of the joints, or elsewhere, provided ordinary care be exercised, time itself will frequently bring about a cure. Many a joint may be saved from excision by expectant treatment, if directed to the general as well as to the local condition, and patiently persevered in.

Constitutional Peculiarities greatly modify the growth of a child. Rickets, for instance, may manifest itself by no other visible sign than that of retarded, stunted growth, so that 'backwardness' in children is often synonymous with rickets. It is important to recognise this fact, for cod-liver oil, and shampooing the limbs with sea-water, will often work marvels in a comparatively short time.

Much more than in adults, Injuries in children tend to bring out constitutional peculiarities; a syphilitic or rheumatic taint

will often remain latent until an injury calls it forth. Thus strumous affections are often traceable to a slight injury. Acute tuberculosis, especially of the brain, is often set up by a fall or blow on the head. Disease of joints follows slight wrenches or blows, such as would be inoperative in a strong constitution. After operations and accidental (open) injuries, children sometimes get scarlet fever, and occasionally other similar diseases. In the same manner a general eczema may be set up in children predisposed thereto by very slight external irritants—rough flannel, coarse soap, flea-bites, slight scalds, or the use of strong external applications. In certain but few cases vaccination is followed by a general and troublesome eczema, which is due to the irritation set up by rubbing the vesicles, or even of unskilfully taking out lymph.

In infants, those parts are chiefly liable to take on disease or disordered function which have been latest perfected, or those which are still in a condition of active development. Hence Hernia is exceedingly common in infants: the tunica vaginalis testis has been so recently shut off from the general peritoneal cavity, or but imperfectly shut off, that a very slight cause is sufficient to open it up again. The commonest cause is tight bandaging. Mothers and nurses think it supports a child's abdomen to keep it tightly swathed in a flannel binder. The practice is a bad one, for it does not allow for changes in size of the abdomen, due to flatulence or to the ingesta, and the intestines pass into the scrotum, reopening the hardly closed abdominal rings for the purpose. In a large percentage of cases, the removal of the tight bandage allows Nature to reassert herself, and spares the child the discomfort of wearing a truss. Another very troublesome affection of early life, connected with development and growth, is acute Epiphysial Disease. Its commonest cause is congenital syphilis, but it also occurs in other cachectic subjects; it results too from, or is apparently started by, slight injuries in children not manifestly the subject of specific disease. This liability to disease at the epiphysial junctions lasts all through childhood; but as age advances, the disease, when it occurs, assumes a more chronic form. Slight injuries, which would be otherwise harmless, suffice to set up disease in these parts, on account of the great physiological activity which is taking place. In estimating obscure injuries about the joints of young persons, the epiphysis and its possible participation in the condition should always be borne in mind. The Bursæ in connection with the muscles surrounding joints—the hip-joint especially—are liable on slight provocation to enlarge and suppurate. In opening these, it should be remembered that they are frequently connected with joints and may involve them in suppuration.

The developmental activity of childhood predisposes to Morbid Growths; hence the frequent occurrence of tumours, in the immediate causation of which injury seems to take a considerable share. Excluding the congenital tumours (which are generally either cystic or fatty), the most common is sarcoma; of this it may be said that the younger the patient, the greater its malignancy, and the greater the need for early and radical treatment.

In the *Treatment* of all affections of children, it is highly important to remember the possibility of a mixed diathesis; thus syphilis and struma may exist in the same child, and be about equally balanced; the writer has seen many such cases, in which, for instance, mercury alone has failed to cure a child of its congenital syphilis; but when combined with cod-liver oil has been quite successful. On the other hand, cod-liver oil in strumous children is often greatly aided by a judicious use of some mercurial. Syphilis and rickets also frequently coexist. Success in treatment will depend on the combined use of those drugs which are known to influence the diseases—more or less of the one or the other being given in proportion as one diathesis appears to predominate over the other. Treatment should always be continued for some time after the local injury or disease has subsided; for the constitutional element remains present, ready to assert itself on the slightest provocation.

As regards *drugs*, whether for internal or external use, it may be said that children are a little more susceptible to their influence than adults. Opium especially is thought to affect children more readily than adults; on the other hand, children tolerate both mercury and belladonna better than adults. Mercury especially they bear in full and long-continued doses without ill-effects, probably owing to the large amount of milk they take, which deprives it of its irritant effects. There is the same individual susceptibility to drugs which is met with in adults. In prescribing, therefore, it is wise to commence with small doses, and repeat them until the desired physiological effect is produced.

Robert William Parker.

CHIMNEY-SWEEP'S CANCER. *See* SCROTUM, Injuries and Diseases of the.

CHLOASMA.—This name is now given to circumscribed hypertrophy of pigment in the skin, occurring in large patches, and also to diffused increase of pigmentation due to a variety of causes; the term melasma or nigrities is applied when the increase is so excessive as to give the skin a very dark, nearly black, colour.

Causes.—Exposure to the sun produces the well-known hypertrophy called sunburn, and people who are fond of sitting much before the fire are apt to get reticulated pigmentation over the shins (*Chloasma caloricum*). The application of irritant substances to the skin, such as blisters and mustard plasters, is very frequently followed by an increase of pigmentation, which is sometimes permanent (*Chloasma toxicum*). Again, mechanical irritation of the skin by rubbing and scratching, as by the pressure and friction of tight bandages, and scratching to relieve intense itching, as in prurigo and phthiriasis, will give rise to pigmentation (*Chloasma traumaticum*). Further, any disease of the skin which is accompanied by long-continued hyperæmia, especially if itching be superadded, is commonly followed by pigmentation; thus scabies, eczema, psoriasis, lichen planus, are often succeeded by increased pigmentary deposit. It is obvious that all the above-enumerated forms have one important factor in common, and that is hyperæmia of the affected skin as an antecedent; whether this be due to heat and exposure, to chemical or mechanical irritation, or to disease. They may therefore be logically grouped together as varieties of pigmentation due to direct affection of the skin, or *Chloasma idiopathicum*.

Increased pigmentation of the skin also occurs in connection with physiological and pathological processes which affect the whole system, without directly implicating the skin; the affection is then called *Chloasma symptomaticum*. Pregnancy constantly gives rise to pigmentation of the face, neck, nipples, and linea alba (*Chloasma gravidarum*), while the most various diseases and functional disorders of the uterus and ovaries are accompanied in many cases by a similar affection (*Chloasma uterinum vel hepaticum*). This variety is met with chiefly on the face, especially the forehead and temples, as smooth patches of variable size and shape, circumscribed or diffused, and varying in colour from yellowish to a liver-coloured, deeper brown, or smoky tint; it sometimes extends to the neck, backs of hands, and trunk; it usually subsides on removal of the uterine or ovarian condition on which it depends. Strong mental emotion, especially fright, and various functional affections of the nervous system must be mentioned among the causes of increased pigmentation. It occurs also in various chronic exhausting diseases (*Chloasma cachecticorum*); it is often well-marked in the cachexia of cancer, inherited syphilis, malaria, phthisis, and scrofula, and in a lesser degree in Bright's disease and myxœdema.

But the most striking kind is the bronzing of the skin which occurs in Addison's disease (*Melasma suprarenale*); this is most strongly marked on exposed parts, as the face, neck, and hands, and varies in tint from the yellowish-brown of sunburn to a deep greenish-brown colour; the nipples, axillæ, and genitals are often so strongly pigmented as to be nearly black; the pigmentation is diffused, but patches of a deeper tint occur here and there on the brown skin, and pigmented spots are also found on the mucous membrane of the mouth and elsewhere.

In a few cases of generalised melanotic sarcoma, the skin, especially of the face and hands, has been noticed to assume a slaty colour. Syphilis occasionally gives rise to pigmentation of the skin apart from that which is so constantly met with as following syphilitic eruptions. This affection, which has been chiefly described by French authors under the name 'Syphilide pigmentaire,' is met with almost exclusively in women in the secondary stage, chiefly on the neck, where it forms a reticulated blotching of a light coffee-colour. It is sometimes more extensive, and has now and then been found in males. As it is met with when all other signs of syphilis are absent, and is quite uninfluenced by treatment, it is probably to be viewed as a form of chloasma. It should be noted, however, that several observers look upon the discoloration as due, in great measure, to atrophy of pigment in the parts enclosed in the brown meshes, and therefore class it with leucoderma.

The differential diagnosis of chloasma is not difficult; practically the only disease with which it may be confounded is tinea versicolor; but this occurs chiefly on the trunk, never on the face, is slightly scaly, especially on scratching with the finger-nail, and nearly always itches; whereas chloasma is commonest on the face, has a smooth surface, and does not itch. Microscopical examination of the detached scales

of tinea versicolor, after treatment with potash, shows the characteristic fungus, which is of course absent in chloasma. A simple method in a doubtful case is to paint the surface with a weak solution of iodine; this gives an intense reddish-brown tint in tinea versicolor, but no darkening in chloasma.

As chloasma depends upon the deposition of increased pigment in the epidermis, treatment can only be of service by removal of the affected cuticle; therefore all substances which cause desquamation are of value. The best of these is corrosive sublimate, which may be employed as a lotion of about one grain to the ounce; but an ointment of white precipitate or sulphur, or painting with iodine, will also be efficacious, although not so active. For congenital excess of pigment, *see* MOLE.

JOHN CAVAFY.

CHLOROFORM. *See* ANÆSTHETICS.

CHOLECYSTOTOMY is an operation which consists in opening a dilated gall-bladder through an abdominal incision, for the removal of impacted calculi.

The presence of *biliary concretions* does not, as a rule, give rise to any urgent symptoms beyond those due to occasional attacks of so-called biliary colic, caused by the passage of a gall-stone through the ducts. Cases are even met with *post mortem* where the gall-bladder is found completely packed with closely wedged calculi, of which no indication had existed during the patient's lifetime. Occasionally, however, the presence of such concretions may lead to inflammation of the gall-bladder, followed by suppuration and the ultimate discharge of its contents through an opening in the abdominal wall, resulting in the formation of a biliary fistula.

DILATATION OF THE GALL-BLADDER, consequent upon obstruction of its duct by an impacted calculus, is a somewhat rare affection, more commonly met with in women than in men. The retained fluid, consisting of bile mixed in greater or lesser proportion with mucoid secretion from the lining membrane of the gall-bladder, may occasionally become purulent as the result of inflammation of the sac. The distension, if long unrelieved, exposes the patient to the risk of sudden rupture of the dilated bladder —an accident almost inevitably followed by fatal peritonitis.

Symptoms.—1. *Recurrent paroxysmal attacks of colic*, referred to the right hypochondrium, and thence radiating through to the back and loin as well as downwards towards the thigh, are usually the first indications of the impaction of a gall-stone. The pain, which is commonly very severe, and accompanied by retching or vomiting, is from the first readily induced by exertion of any kind. As the dilatation progresses it becomes, however, more or less constant in character, while subject always to recurring paroxysms. 2. *Jaundice* is not a common symptom of gall-stone impaction obstructing the *cystic* duct. Its presence in any case would indicate closure of the *common* duct, a condition which, if unrelieved, usually proves fatal before the occurrence of any marked dilatation of the gall-bladder. 3. *Formation of a tumour in the right hypochondrium.*—The fundus of the normal gall-bladder projecting below the margin of the right lobe of the liver opposite the ninth costal cartilage, lies beneath the outer border of the right rectus muscle, and its tendency when enlarging is to project downwards and forwards towards the umbilicus. A *dilated gall-bladder* usually constitutes a somewhat pear-shaped or semi-globular tumour, overlapped by intestine along its lower and inner borders. When of moderate size, its shape and free mobility may occasionally lead to its being mistaken for a movable kidney. It is commonly smooth on the surface and of uniform contour, either firm or elastic on palpation, according to the degree of distension, and often the seat of much tenderness, especially after being handled.

Diagnosis of the affection during its early stages is often a matter of considerable difficulty, unless a well-marked history of the passage of gall-stones on previous occasions be obtainable. In any given case the following conditions may require elimination before arriving at a definite conclusion:—1. Malignant disease of the liver, of the gall-bladder, of the stomach, omentum, or pancreas; 2. Abscess in or about the liver; 3. Hydatid disease; 4. Renal tumours, solid or fluid; floating kidney; 5. Dermoid or ovarian cysts. *Aspiration* of a cystic tumour suspected of being a dilated gall-bladder, although useful as a means of diagnosis, especially with a view to detecting the presence of calculi, is not altogether devoid of risk, from the possibility of the subsequent escape of irritating fluid through the cyst-puncture—an accident which may well lead to disastrous consequences, should the swelling prove to be due to hydatid disease. A small *exploratory incision*, if carried out with all due antiseptic precautions, is a much more satisfactory and safe proceeding in doubtful cases.

The operation of Cholecystotomy is performed as follows:—A vertical incision two inches in length, commencing about an inch and a half below the costal margin, is made over the tumour along the outer border of the right rectus muscle. All hæmorrhage should be arrested by pressure-forceps before opening the peritoneum, which is to be freely divided to the same extent as the skin. The surface of the tumour having been thus exposed, the surgeon next introduces one or two fingers for the purpose of ascertaining its connections and detecting the cause of obstruction. Sponges are now inserted around the incision to protect the peritoneal cavity, and the gall-bladder is evacuated by means of the aspirator. Before the canula is withdrawn, the now flaccid cyst should be seized by pressure-forceps applied above and below the seat of puncture, and drawn well forward through the abdominal wound. Its wall is then incised vertically to the extent of one inch, and the sides of the opening are held apart by forceps while the interior of the sac is sponged out dry. Introducing his finger, the surgeon feels for an impacted calculus, and, if possible, removes it with the help of suitable forceps. Should he be unable to grasp the stone, an attempt may be made to dislodge it by external manipulation through the wall of the duct, or, failing this, it may be crushed from without by means of carefully-padded forceps, the fragments being afterwards squeezed onwards through the duct, or back into the gall-bladder and thence removed. Finally, the condition of the ducts should be thoroughly explored, in order to make sure that no obstruction remains.

A rubber drainage-tube is now inserted in the gall-bladder, and the abdominal incision is closed around it by sutures which must include the edges of the divided peritoneum, together with those of the opening in the gall-bladder. A carbolised sponge is placed over the end of the tube, and an antiseptic dressing is applied over all. The discharge of bile is usually very profuse for the first thirty-six or forty-eight hours, after which it gradually lessens in amount. The sutures may be taken out at the end of a week, but the tube should not be removed until all discharge has practically ceased. The fistulous opening left by it usually heals of itself in the course of a few weeks; but, failing this, it may be readily closed by operation.

Another plan of treatment, which was adopted in one case by the writer, consists in closing the gall-bladder incision, after removal of the calculi, by means of a continuous silk suture involving only the muscular and peritoneal coats; the sac is then dropped in, and the abdominal incision is closed in the usual way. The objection to this procedure *without drainage*, lies in the fact that it may not be always possible to make quite certain that all obstruction has been removed at the time of operation; for, if such be not the case, the rapid accumulation of bile or mucus might tend to force open the incision in the gall-bladder, and thus allow of the escape of its contents into the peritoneal cavity.

A further modification of the usual operation, proposed by Dr. Gaston of Atlanta, U.S.A., with a view to obviate the dangers of an unrelievable obstruction of the *common* duct, aims at the establishment of a permanent artificial communication between the gall-bladder and the duodenum. It is conceivable that the procedure suggested might prove useful in certain exceptional instances, but so far its value has not been tested in the human subject.

Cholecystectomy. — *Excision of the dilated gall-bladder* has been advocated by Prof. Langenbuch of Berlin. The operation, however, apart from the immediate risks entailed by its performance, does not necessarily ensure restoration of patency to the *common* duct, and cannot therefore be said to afford any advantage over the more usual method of treatment in these cases.

William Appleton Meredith.

CHOPART'S AMPUTATION. *See* Foot, Amputations in the.

CHORDEE. — In the acute stage of gonorrhœa the patient usually suffers at night, when in bed, from frequent attacks of very painful erection, with bending and slight twisting of the penis. The concavity of the arc is almost always directed downwards, but some few instances have been observed of lateral and also of upward bending. This condition is the result of acute inflammation along the urethra and of general congestion of the penis. The erections are excited by irritation of the prostate, and the associated pain is due to the congested and engorged condition of the penile spongy tissue. The walls of the urethra, together with the peri-urethral tissue, and more or less of the corpus spongiosum being stiffened in consequence of inflammatory deposit, become far less extensile than the other structures of the penis, and so, as the corpora cavernosa become distended, yield but in a slight degree.

This, which is the generally accepted view as to the causation of chordee, has been opposed by Mr. Milton, in whose opinion the bending of the penis is due to spasm of the special muscular elements of the urethra.

For the treatment of chordee, see GONORRHŒA.

CHOROID, Diseases of the. — The choroid is a vascular membrane which lines the posterior part of the eyeball, as far forward as to the margin of the ciliary body (q. v.), and is interposed between the retina and the sclera. It is perforated for the passage of the optic nerve, and is loosely attached to the sclera by a very slight connective tissue until it reaches the ciliary region, where, as well as in the immediate neighbourhood of the nerve-entrance, the connection between the two structures is closer and more intimate. The choroid consists essentially of a web of blood-vessels, which are coarser and larger on the side turned towards the sclera, and capillary on the side turned towards the retina. The principal veins of the choroid are arranged in a series of whorls, called *vortices*, five or six in number, the veins of each vortex running to a common centre, and there uniting in a single vein, which passes out of the eye through an oblique channel in the sclera. Internal to the vortices there is a layer of vessels of smaller size, and internal to these there is the so-called *chorio-capillaris*. The intervascular meshes of the membrane contain a variable amount of pigment, usually of a dark chocolate-brown colour, and between the chorio-capillaris and the perceptive layer of the retina there is a layer of pavement-epithelium, the cells of which, in dark eyes, are loaded with pigment to such an extent that the layer is rendered practically opaque, and conceals the choroidal structure from ophthalmoscopic examination. This layer of pigmented epithelium was formerly described as part of the choroid, but most modern histologists refer it to the retina. By its intermediation, the two membranes are in intimate union with each other, and the perceptive layer of the retina derives its nourishment from the chorio-capillaris. Besides connective tissue, blood-vessels, and pigment, the choroid contains many filaments derived from the short ciliary nerves, and the long ciliary nerves pass forward between it and the sclera until they approach the ciliary region. In man, the choroid has, presumably, no other function than to provide for the nutrition of the retina, and to convey vessels and nerves to the ciliary body and iris, but in some of the lower animals it is comparatively more voluminous, and in many birds it projects into the cavity of the eyeball in a large fold called the *pecten*. There is reason to believe that, in such conditions, it ministers to accommodation by permitting considerable variations in the quantity of blood which is contained within the eye at different times.

Ophthalmoscopy.—Our knowledge of the diseases of the choroid is derived chiefly from the ophthalmoscope, and hence the normal aspect of the membrane is the first point which requires description. This aspect depends entirely upon the amount of pigment which it contains. In the dark races, and even in dark Europeans, the choroid itself is invisible, being completely screened from view by the layer of pigmented epithelium, which presents a uniform dark brownish-red surface, broken by the comparatively white circle of the optic disc, and seen through the slight opalescence of the retina. In Europeans, with brown or hazel eyes, it is seldom possible to see choroidal vessels. In them the membrane forms a red, or orange-red, background, against which the retina itself is scarcely visible, although the arborescent ramifications of its blood-vessels are conspicuous. As seen in the direct method of ophthalmoscopic examination, the choroidal background assumes a finely granular appearance, and the optic disc is often bordered by a crescentic line, or even by a complete circle, of pigment, which appears almost black by contrast. In very light eyes, pigment is comparatively absent, both from the epithelial layer and from the choroidal tissue, and in such conditions the latter is conspicuous. The vessels of the choroid are distinguished from those of the retina not only by their situation on a deeper plane, but also by the manner of their arrangement. The retinal vessels are arborescent in their distribution; the larger vessels of the choroid, which form radii to the centres of the vortices, are almost parallel to one another. In very light eyes, the inner surface of the sclera is visible through the meshes of the choroidal vessels, which then evidently rest upon a white background.

In certain morbid conditions the pavement epithelium of even dark eyes loses its pigment, and exposes the choroidal tissue to view. When this occurs, the parallel vessels are seen to be separated by more or less linear interspaces, which are filled by the loose pigment of the choroidal stroma,

and hence appear dark by comparison with the vessels. The resulting striation, which is manifestly behind the retina, and over which the retinal vessels pursue, independently, their arborescent course, presents a very curious and interesting picture.

The vessels of the retina are chiefly contained in the anterior layer of that membrane, which consists essentially of nerve-fibres and connective tissue. Between this layer and the choroid other retinal layers are interposed, which consist essentially of nervous elements, with but little connective tissue, and which scarcely at all modify the ophthalmoscopic image. When the retina itself, or rather the connective tissue of the fibre-layer, becomes the seat of morbid changes, these must inevitably, in some degree, conceal the retinal vessels from view, and, conversely, when the retinal vessels are plainly visible, the retina itself must be free from disease. Hence, when there is any morbid appearance in the fundus of the eye, and when, across and in front of this morbid appearance, between it and the spectator, the retinal vessels pass in an unchanged condition, the inference is inevitable that the appearance is posterior to the retina, or, generally speaking, that it is in the choroid. The chief exception to this statement is furnished by the disease commonly described as 'pigmentary retinitis,' a disease which affects chiefly the contiguous layers of the retina and choroid at their surfaces of apposition, and which, in the writer's opinion, should be classed among choroidal affections rather than among those of the retina.

A patch of inflammation in the choroid is liable to produce two marked changes, obliteration and atrophy of the blood-vessels of the affected area, and displacement of its pigment. These changes produce transparency of the tissue, and hence render the sclera plainly visible. The seat of a localised choroiditis will usually be left as a white spot, surrounded by a narrow black border. The whiteness is that of the inner surface of the sclera, and it will sometimes be broken or diversified by remains of the original choroidal stroma. The black border consists of displaced pigment, which has infiltrated the ring of tissue immediately around the inflamed structure.

Pathology.—The anatomical position and relations of the choroid render it liable to become implicated in morbid changes which originate in other tissues. It not infrequently participates in inflammations of the sclera at the two regions where it is in close union with that structure, and we then have the conditions which have been described under the names of 'sclero-choroiditis anterior' (*see* Ciliary Body, Diseases of the), and 'sclero-choroiditis posterior' (*see* Refraction, Errors of). It is prone to participate in iritis, which may extend to it by direct contiguity, constituting irido-choroiditis. It is still more prone to participate in cyclitis. It is early involved in that general plastic inflammation of the eye which is called sympathetic ophthalmia, or in that still more rapidly destructive form of general inflammation leading on to suppuration, which sometimes follows surgical or accidental injury, and is sometimes produced by blood-poisoning. It suffers in all forms of glaucoma, whether primary or secondary. Its share in these various affections does but constitute a complication of them, and will be found described in the articles in which they hold the first place. The writer proposes here to confine his attention to those diseases of the choroid which, as far as can be ascertained, originate in the membrane itself.

The history of development proves the choroid to be essentially a dermal structure, and many of its diseases bear a marked analogy to those which affect the skin. They are of high importance to vision, but they owe this importance to the accident of locality. An inflammation of the choroid strikes at the root of the nutrition of the perceptive elements of the retina; and hence, when it occurs anywhere near the centre of the fundus, it is always attended by early and great disturbance of vision. Where the disease passes into atrophy, the perceptive elements of the retina participate in the change, and a permanent blind spot, of situation and magnitude corresponding to that of the atrophy, will be the result. In this respect, the inflammations of the choroid present a marked contrast to those of the retina. The latter are chiefly situated in the connective tissue of the fibre-layer, and hence, even when the morbid changes are very conspicuous, they may not affect vision at all.

Inflammation.—The various forms of primary choroiditis have been distinguished by names more or less descriptive of the aspects which they usually present, so that choroiditis has been called disseminated, areolar, wandering, circumscribed, and the like. The differences thus noted are sometimes rather accidental than essential; and the points of chief importance, in any case,

are to determine whether or not the disease is syphilitic, and whether it is confined to peripheral portions of the membrane, or is likely to extend to the neighbourhood of the yellow spot.

Disseminated choroiditis.—In the typical form the fundus of the eye is sprinkled over with spots, which may be compared to those of a cutaneous eruption. Each spot, in its origin, has been a sort of pimple, formed of an aggregation of cells in the choroidal tissue. The pimple becomes the seat of a localised inflammation, and ultimately shrinks, destroying in its shrinkage the adjacent tissues, so that its seat is marked by a sort of scar. This scar is surrounded by a line of pigment, and its central parts are white, the colour of the sclera showing through the thin layer of choroidal and retinal remains which the inflammatory process may have spared. The parts around each spot are not affected, and the spots themselves are usually most abundant near the equatorial region, and comparatively seldom approach the yellow spot. Practically, they are of little importance to vision, insomuch that the occurrence of the disease may have been unnoticed. In examining the eyes of children who are the subjects of inherited syphilis, it is frequently found that the more peripheral parts of the fundus are sprinkled over with small white dots, each encircled by a pigment line, and showing that disseminated choroiditis has occurred and has been recovered from. When the earlier stages of the process can be observed, each spot appears as a slightly yellowish point, surrounded by a narrow area of increased vascularity, and which, by very careful ophthalmoscopic inspection, may be distinctly seen to be an elevation. The yellowish centre gradually passes into the whiteness of atrophy, and the surrounding vascular area gradually passes into a line of pigmentation.

The *areolar choroiditis* of authors is a form of disease scarcely distinguishable, as far as its essential nature is concerned, from the foregoing; but, from the locality which it is more prone to attack, it is much more serious in its consequences. The process of inflammatory thickening in the choroid seems to be much of the same character, but the individual patches are larger, they are usually situated near to the macular region, on which they not infrequently encroach, and they are apt to coalesce with one another. Hence, even if the macula be spared, the ordinary result of areolar choroiditis is to obliterate a large and irregular portion of the visual field. The aspect presented by the fundus is that it is studded, around the optic disc and the macula, with oval or irregular patches, centrally white and bordered by pigment; the whiteness of the centres being often broken by a few remains of choroidal vessels. Besides these patches there will be small black spots, some of which are probably accidental aggregations of pigment, while others, according to some observers, are fresh patches in an incipient stage.

Wandering choroiditis.—In this form there are no sharply bordered spots, either of primary exudation or of secondary atrophy, but the choroidal surface is invaded, here and there, by irregularly shaped patches of effusion, comparable to the irregular patches of certain cutaneous eruptions. Over each of these patches there is a damping of the brightness of the tisssue, and this damping is succeeded, in time, by irregular pigmentation, and by changes which approach, but seldom quite amount to, absolute atrophy. It often happens that wandering choroiditis may exist for a long period without exciting attention, that it ultimately either actually invades the macular region, or approaches sufficiently near to it to produce disturbance of vision, and that, if then treated with sufficient energy, its progress may be wholly arrested, and central vision completely restored. In such cases, over the lateral areas, in which it had previously run its course, no improvement is usually to be expected.

Central choroiditis.—Besides the foregoing essentially chronic affections, we sometimes meet with choroiditis in a more acute form, and it is then apt to invade the region of the macula in the first instance. The disease appears to commence as a patch of effusion in the choroid, immediately beneath the macula. From the very first it produces distinct impairment of central vision, the point looked at appearing to be obscured as by a patch of fog; while, in consequence of the disturbance of the retinal elements by swelling underneath them, objects are distorted, and often appear to be smaller than natural. De Wecker has described this state as being almost invariably syphilitic, and as appearing between the ordinary secondary and tertiary periods, often many years after the primary infection. He attaches great importance, as a diagnostic sign of syphilis, to a very slight turbidity of the vitreous, situated chiefly in the layers nearest to the retina, and presenting an aspect as if the humour were beset with fine dust particles. This special form of turbidity usually ob-

tains, at first, only in front of the macula, and is only to be observed by the very careful use of the ophthalmoscope. It is probably the physical cause of an appearance frequently described by patients—a sort of quivering or shimmering in the fog by which the objects of direct vision are obscured. Such cases are always of great gravity; and the appearance of a central visual cloud, in a patient known to have suffered from syphilis, is a matter which calls for prompt action on the part of the surgeon. Under the most favourable conditions, syphilitic central choroiditis is likely to be a serious and protracted affection; which, if neglected at the outset, will almost inevitably extend to the retina, and may involve both this structure and the choroid in one common ruin, with consequent total destruction of vision.

Treatment.—In the treatment of choroiditis, the chief matters to be taken into account are the degree of acuteness of the disease, the extent in which it seems to threaten the region of the macula with invasion, and the evidence for or against its being of a syphilitic character.

In a certain proportion of cases, in patients who apply on account of some superficial ocular trouble, or of some error of refraction, we may find the more peripheral parts of the fundus studded over with the scars of disseminated choroiditis. If the central vision is good, and if the ophthalmoscope discovers nothing but scars, no spots of apparently recent disease, we may consider that we are looking at the relics of a past storm, and may dismiss the scars from consideration as completely as we should dismiss the scars of small-pox.

In cases of areolar choroiditis, or in cases of wandering choroiditis in which vision has recently become affected, we shall probably find, besides more or less atrophic or degenerative change, places in which some active mischief is in progress. Here and there, the brightness of the choroidal colour will be somewhat damped by effusion, and a careful use of the ophthalmoscope will perhaps show that, in these places, the retina is somewhat raised by subjacent swelling. The bending of the retinal vessels, as they pass over the margin of a suspicious spot, will often afford evidence of its being on a higher level than the parts immediately around it. When such appearances are presented it is necessary to recognise the existence of grave peril to the sight, and to insist upon the necessity of submission to careful and even rigorous treatment.

Having, in the first place determined, whenever the determination is possible, the presence or absence of a syphilitic taint, the next care of the surgeon must be to investigate thoroughly the general conditions of the patient, with regard both to function and to diathesis. The urine should be examined, not in a perfunctory manner, but thoroughly; with reference to quantity and specific gravity, and to amount of urea, as well as with reference to albumen and sugar, to lithates or phosphates. The liver should be examined by palpation in the erect posture; and, in a large proportion of cases, there will be good reason for commencing the treatment by the administration of two or three doses of a mercurial alterative, followed by moderate, but sufficient, purgation. The ordinary regimen and habits of life should also be inquired into, and corrected if found to be ill-regulated.

When these preliminaries have received attention, and when no syphilitic taint is discoverable, the medicine which the writer has found most efficacious is the mercurial perchloride, given to an adult in doses of the sixteenth of a grain three times a day, and usually combined with a small quantity, say three to five minims, of the tincture of perchloride of iron. Many practitioners direct such a combination to be taken immediately after food; but it will sometimes be found that this course is followed by dyspepsia, as if the iron interfered with the secretion of the gastric juice. Sir Henry Thompson has pointed out that, when this happens, the iron will often be perfectly well borne if its administration is deferred until three hours have elapsed after a meal.

An important adjunct to treatment will often be the abstraction of blood from the temple by Heurteloup's or some other artificial leech. The process is, in fact, a form of cupping, and it is more advantageous than the use of the natural leech, which abstracts the blood more slowly, and after prolonged suction which produces a congested state of all the neighbouring parts. About two fluid-ounces of blood should be taken quickly, and the bleeding may be repeated from time to time, according to the local and general conditions of the patient. It is desirable entirely to screen the eye from light for some hours after the bleeding; and, for this purpose the little operation is best performed at nightfall. The patient should remain in bed during the whole of the next day, in a completely darkened room, and should not be exposed to light until the morning of the third day.

Even then, the exposure should be careful and gradual; and, especially in the spring and summer seasons, dark spectacles should be worn in full daylight. All functional use of the eyes, even if one of them is quite sound, should be strictly forbidden, and a reader and amanuensis must be employed if there should be any business which imperatively requires attention.

The absorption of effused materials may often be much promoted by the use of pilocarpine diaphoresis, which serves to empty the blood-vessels without exhausting the patient. The best preparation for the purpose is the pilocarpine hydrochlorate, in the form of a ten per cent. solution in distilled water. For an adult, two minims of this solution may be injected hypodermically as a commencing dose, and it will generally be found that three or four minims may be given on subsequent occasions. The patient should go to bed, with warm coverings, and the dose should be given about an hour after breakfast. The place of injection is immaterial, although the first signs of perspiration will appear in the immediate neighbourhood of the puncture. In some people, the diaphoresis will be attended by free salivation. The whole effect terminates in about three hours, after which time the patient may rise, be rubbed dry, and return to his or her usual avocations.

By the adoption of such a course as this, the progress of the disease will often be arrested, and the central vision, if it were only beginning to suffer, will be restored. Even when good results are speedily obtained, it is desirable to continue the mercurial perchloride for several weeks, and at all events as long as any appearance of effusion or recent mischief is visible with the ophthalmoscope; and only to permit a very slow and careful return to the functional use of the affected organ or organs.

In the more acute cases of disturbance of central vision, with the appearance of a quivering cloud over the fixing point and with distortion of objects, the surgeon has to deal with an acute and highly perilous syphilitic affection. De Wecker advises that recourse should be had to rapid mercurialisation, preferably by inunction; but the writer is strongly of opinion that mercury, as a means of arresting the present symptom in the late forms of syphilis, whatever that present symptom may be, is decidedly less trustworthy than iodide of potassium, given energetically in the largest doses which can be borne. He would begin with ten grains three times a day, and would increase or diminish this quantity according to its effects. If symptoms of iodism should occur, the dose should be diminished to any necessary extent. If there were prompt improvement, and if this, after the lapse of a short time, seemed to be no longer continued, the dose should be increased again and again, if the described conditions should recur. The facts which point to the great value of the iodide in arresting a syphilitic symptom at a late period of the disease, point also to its remarkable inefficacy as against the syphilitic taint—a taint which can only be eradicated, when it can be eradicated at all, by the persistent use of mercury. In such a case as that now under consideration, the object of the writer would be, first to save the eye from destruction by the iodide of potassium, and then to cure the patient of his syphilis by mercury, which, for this purpose, should be continued for something like a twelvemonth. In any instance in which the administration of the iodide was not followed by speedy improvement, that is to say, by improvement within the first four or five days, it would be most judicious to lay it aside, and to proceed at once to mercurial treatment, not in the manner advised for the milder forms of choroiditis, but so as to produce a trace of effect upon the gums as speedily as possible. For this purpose, the surgeon would have his choice between inunction, fumigation, and administration by the mouth, and would be much guided by the general state and surroundings of the patient.

In many instances, the slight turbidity of the vitreous body, which has been already noticed, is prone to pass into turbidity of a coarser kind, composed of flocculent masses of exudation-material; and these, by their ready mobility within the eye, show that the vitreous itself has undergone fluid degeneration. Such a condition affords ground for a very unfavourable prognosis, since absorption of effused products within the vitreous is accomplished with extreme slowness, even if at all; and their formation indicates the existence of a very serious amount of morbid change. It sometimes occurs, however, that the affection of the choroid will subside under treatment and that the function of the retina may be preserved, while the flocculi remain almost unaltered, and produce obscuration of objects only when they chance to intervene between the point looked at and the yellow spot. In the worst cases, the extension of the disease is not confined to the vitreous body, but passes forwards to the iris and to the cornea, leading to the deposit of nume-

rous dots of inflammatory deposit upon the posterior surface of the latter membrane, as well as to general turbidity of its structure. When such complications occur, they leave but little hope of a favourable issue. *See Keratitis punctata*, under CORNEA, Inflammation of the.

In some instances the effusions which are occasioned by choroiditis produce detachment of the retina, and in others they are poured out between the choroid and the sclera, and detach both the internal membranes together. The ophthalmoscopic appearances are much the same in both cases, save that, when the retina is detached alone, it possesses a certain degree of mobility, and floats up and down within the eye something in the manner of the sheet by which waves are imitated upon the stage. When the retina and choroid are detached together, the greater thickness and firmness of the combined structures prevents the occurrence of these floating movements, and furnishes a symptom by which the nature of the elevation may be determined. The only available treatment is to puncture the sclerotic in the region of the detachment, so as to allow the sub-choroidal fluid to escape, and to permit the detached structures to return to their natural position. In some instances this procedure has certainly been beneficial, and reunion to some extent appears to have occurred. In order to make the puncture the eye should be brought under the influence of cocaine, and then, the place of detachment having been exactly ascertained, the conjunctiva should be drawn aside, and a cutting-needle thrust into the eyeball somewhat obliquely, and turned slightly on its axis as soon as the escape of fluid shows that sufficient penetration has been effected. When the fluid has all escaped the needle is withdrawn, and the conjunctiva is suffered to return to its proper position, so as to cover the scleral puncture. No dressing will usually be required beyond a slight pad to maintain closure of the lids during the healing process. The writer's own experience of the effects of this procedure is less favourable than the accounts which have been given of it by others; but it is at least tolerably certain to do no harm.

In cases which terminate unfavourably, and in which choroiditis leads on to complete loss of vision, followed by wasting or shrinkage of the eyeball, the shrunken organ is sometimes a source of danger to its fellow. The material effused into the degenerated choroid sometimes becomes the seat of calcareous deposits, and sometimes undergoes conversion into true bone. In either of these conditions the eye is apt to become painful and tender, and there have been several instances in which it has excited sympathetic ophthalmia. It is therefore always desirable, when an atrophied eye is tender to the touch, and especially when it can be felt to contain hard deposits, to anticipate danger by enucleation.

Suppurative choroiditis.—A brief reference has already been made to the acute form of choroiditis which leads rapidly on to suppuration, and which, in the majority of instances, is either traumatic or septicæmic. In the 'acute panophthalmitis' which sometimes follows the extraction of cataract, the choroid is only secondarily affected by extension from the parts actually implicated in the operation; but in cases of septicæmia, puerperal or other, we frequently see almost complete loss of vision, while the iris and cornea as yet participate but slightly in the morbid action. This, in such instances, probably commences in the venous plexus of the choroid. Not only the iris, but all the other structures contained within the eyeball, speedily become involved in the inflammation, which can scarcely be said to admit of treatment, and which occurs as an accidental complication of a severe and dangerous constitutional malady. The distension of the eyeball is apt, however, to be extremely painful, and the pain thus arising may be relieved, generally speaking, by incising the sclerotic with sufficient freedom to give exit to pus and other morbid products. The expediency of making the necessary incision would depend greatly upon the general state of the patient, but the best situation for it would usually be between the external and inferior recti muscles, on a line extending from the ciliary region almost to the entrance of the optic nerve.

Hæmorrhages.—The choroid is sometimes the seat of hæmorrhages, the pathology of which is obscure, but which occur chiefly in aged people, and probably, like some retinal hæmorrhages, point to the existence of general arterial degeneration. The blood may be effused either between the retina and the choroid, or into the choroidal stroma, or between the choroid and the sclera, or to some extent in all these situations; and the ophthalmoscopic appearances will be governed partly by the precise situation of the blood and partly by its quantity. Choroidal hæmorrhage is attended by sudden loss or great impairment of vision; and the ophthalmoscope discovers

a dark patch, generally with sharply-defined borders, over which the retina is visible as a slightly opalescent film, and with the continuity of its vessels unbroken. As by an inflammatory effusion, the retina may be detached from the choroid, or the chroiod and retina together may be detached from the sclera; but, even in the former case, the detached retina is but slightly tremulous, being usually supported by the blood beneath. After a short time the original appearances may be greatly masked by atrophic or other secondary changes, and by the gradual decolorisation of the clot.

The *treatment* of choroidal hæmorrhage must be conducted on general principles. The first indication will be to diminish the probability of further bleeding, the next to procure the absorption of the blood which has actually been poured out. Complete functional rest of the eyes, complete quiescence of the body, gentle purgation, and great moderation in the quantity of fluid swallowed, will afford the chief means of fulfilling the first indication; while the second will call for the careful administration of iodide and bromide of potassium, of perchloride of mercury, or of other remedies suggested by the general condition of the patient.

Choroidal hyperæmia has been described by some authors. It would be difficult to deny that a vascular structure may sometimes contain an excessive quantity of blood; but it would be impossible to draw any line between physiological and pathological vascularity, or to assign any symptom by which the alleged hyperæmia could be recognised with certainty.

Cysts and Tumours.—The choroid is liable to cysts and tumours of various kinds, the most important of which are sarcomatous or melanotic growths. The first indication of a tumour of the choroid is usually given by its lifting up the retina, and thus producing some disturbance of its contour. The result of such disturbance is that the part of the visual image which falls on the elevated portion of the retina will appear to be distorted. If the tumour be approximately central, near the yellow spot, the distortion thus produced will speedily force itself upon the attention even of the most unobservant; but, if the tumour be peripheral, the distortion, although obvious if looked for, may long remain unnoticed by the patient. Whenever it is complained of, a slight elevation of the corresponding portion of the retina will usually be discoverable by the ophthalmoscope, and it is possible that the colour of the subjacent portion of the choroid may be changed; as, for example, that a melanotic growth might reveal its probable nature, even at this early period, by the dark tint of the affected region. The diagnosis between a morbid growth and a detachment of the choroid will seldom present difficulty, since the latter is, as a rule, attended by diminished tension, while the growth, for obvious reasons, is almost of necessity attended by increased tension. If it increase in bulk, this increase of tension soon becomes more evident, and is, of course, accompanied by pain, as well as by other consequences of irritation which soon tend to conceal the details of the case. When a tumour commences at some point between the equator and the ciliary body, it may be visible through the pupil, either by focal illumination or by the ophthalmoscope, and it may attain some magnitude before vision is destroyed; but, in a general way, complete detachment of the retina is an early consequence of any choroidal growth. At the same time, the cornea is apt to become cloudy, and the transparency of the humours to be diminished by the presence of effusion; so that, except in quite an early stage, it will scarcely be possible to do more than determine, from the history of the symptoms and from the distension of the eyeball, that some form of morbid growth is inclosed within. If no treatment be employed, the further progress of the growth may either be to distend the eyeball as a whole, or to produce thinning and prominence of the sclera in some one direction. *See* Orbit, Tumours of the.

Treatment.—The presence of a morbid growth in the choroid calls imperatively for enucleation of the eye, as soon as the diagnosis can be arrived at with certainty. The melanotic and sarcomatous tumours are prone not only to recurrence, but also to recurrence in other regions; and the best prospect of avoiding recurrence is afforded by early removal. Even cysts, and other harmless tumours, are certain causes of great pain and of loss of sight; and it is, generally speaking, impossible to arrive at certainty about the nature of a growth as long as it remains within the eye. When there is unquestionable malignancy, removal may not only afford much present relief from suffering, but may also delay, possibly for many years, the ultimate fatal issue.

If the enucleation of an eye which contains a malignant tumour of the choroid be too long delayed, the disease may have crept along the optic nerve, in which case it is manifest that speedy recurrence must be

looked for. In performing enucleation for such a tumour, whether choroidal or retinal, it is always desirable to divide the nerve at the apex of the orbit instead of immediately behind the eyeball, and this may be done without difficulty by the employment of scissors with blades somewhat longer than those commonly used. Some surgeons have advised that, after the ordinary close section, the cut surface of the nerve should be examined, and that, if it shows any signs of the extension of any morbid process, the stump should be felt for with the finger, seized with strong toothed forceps, drawn forward, and cut off as far back as possible. It is better to anticipate such a proceeding by a deep section in the first instance, since the complete removal of the trunk of the optic nerve does not appear to diminish the fitness of the ultimate stump for carrying an artificial eye.

Coloboma. — Occasionally coloboma of the iris extends to the choroid. The deficiency in such cases is always downwards, and is sometimes continuous with that of the iris, sometimes separated from it by the intervention of an unbroken ring of ciliary body. The coloboma of the choroid is very variable in its width, and may either surround the circle of the optic nerve, or may stop short of its lower margin. The gap is seen with the ophthalmoscope as a white patch, of a generally oval outline, traversed by more or less wasted remains of the retina, some vessels of which are always distinguishable. Beneath the coloboma, the sclera is usually somewhat bulged out or staphylomatous; and the portion of retina which crosses it is usually insensitive, so that the deficiency is marked by a blind spot of corresponding position and magnitude. The precise appearances differ much in different cases; and no treatment is available in any of them.

R. Brudenell Carter.

CHOROID, Injuries of the. — The choroid is liable to participate in many forms of injury to the eyeball, which will be noticed in the proper place, and in which its participation is likely to give rise to a larger amount of intraocular hæmorrhage than would otherwise occur. It is also liable to be ruptured by direct violence, without injury to the other tunics; as in cases in which the eye is struck by the rebound of a twig or by a tennis-ball. The rupture, in such circumstances, is always by *contre-coup*, and usually occurs near the entrance of the optic nerve. It is attended by hæmorrhage, by which, for a time, vision may be entirely obscured; but, in most instances, improvement of sight is to be expected when the blood is absorbed. As soon as an ophthalmoscope can be employed, the seat of the injury may usually be seen, as a linear or crescentic line or lines, more or less buried under coagula; and, as the coagula disappear, the whiteness of the sclera may be seen through the gap. If the injury encroaches upon the region of the yellow spot, central vision is likely to be practically destroyed; and, in other cases, in which it is at first but little affected, there is always some risk of subsequent impairment, due to changes in the nutrition of the retina, or to the contraction of scar-tissue.

Treatment.—When injury to the choroid is suspected, the only treatment called for is the use of atropine, of sedative lotions and fomentations, and complete rest of the sound eye, until the time comes at which the diagnosis can be made certain by the aid of the ophthalmoscope. Inflammatory complications, if they should arise, must be dealt with in the usual way; and no use of either eye should be permitted until the absorption of the effused blood is complete.

R. Brudenell Carter.

CHRONIC RHEUMATIC ARTHRITIS.— An essentially chronic form of joint-disease, occurring in persons of rheumatic predisposition, affecting both small and large, one or many, articulations. It may begin insidiously with gradually increasing pain and swelling, or with more acute local symptoms. All the tissues of the joint are implicated by a chronic, and often progressive, inflammatory process, which appears to arise in the cartilages, and engages successively the synovial, bony, and ligamentous structures. Both sexes are affected, but females in larger proportion, and the disease may begin at any period, from early childhood onwards.

Cause.—Any conditions which determine the onset of symptoms commonly recognised as rheumatic, may lead to this disease. To state that all persons are not predisposed to rheumatism, is to affirm the existence in some of a habit of body peculiarly susceptible to the influences which excite it; and that such predisposition in the nature of diathetic proclivity is found in many individuals, is now believed by some of the best authorities, and the writer holds this opinion very strongly.

We have now to study the effects of certain influences upon those diathetically predisposed to rheumatic disease in general.

Foremost amongst these must be considered heredity. This counts for more than was formerly believed. Recent careful inquiries on this point furnish in most cases a clear history of rheumatic ailments in the ancestry. All circumstances provocative of catarrh must be reckoned as potent existing causes. Hence, residence in low-lying localities, on sodden soils, in ill-built or new houses, or on the ground floor, is frequently a cause. The disorder more certainly ensues upon exposure to moist conditions than to mere cold. Cold and dry climates appear little causative. It is unknown in the polar and in the equatorial regions.

Next must be mentioned all causes leading to exhaustion and enfeeblement of the nervous system, including especially an imperfect and innutrient dietary, overwork of body and mind, prolonged grief and anxiety. In women the frequency of onset after numerous pregnancies, hyperlactation, and menorrhagia is especially to be noted. Occupations such as those of laundry-women, bakers, and stokers specially affect those persons who are predisposed, the conditions obtaining in these cases being exposure to damp heat, and rapid alternations of temperature, together with vigorous bodily labour. Gardeners and out-door labourers are likewise exposed by their occupations to heavy muscular work and to wet, the former also to alternations of temperature when working under glass. The influence of moisture, apart from low temperature, is noteworthy in the cases of the very rheumatic peasantry in Ireland and the West Coast of Scotland, where, in addition to constant dampness of climate, habitation, and clothing, the dietetic conditions being also unsatisfactory, no severe cold is experienced. The influence of exposure to night air and of chill after fatigue is very marked.

Traumatism, undoubtedly, has much to do with the onset of rheumatic arthritis. Local injuries, seemingly trifling, also boils and whitlows, may set up the disease, which may thereafter spread to other articulations. Over-use of joints may also determine the onset of it. Rheumatic predisposition thus carries with it a special vulnerability. It has been taught that symmetrical invasion of joints alone indicates constitutional taint in this disease, but the writer believes that the local manifestations of the disorder are often equally significant of this.

The influence of diet has no etiological bearing on rheumatic arthritis, save only in respect of insufficiency and imperfection.

Amongst less well-recognised causes are chronic dysentery, and arterio-capillary fibrosis with contracted kidney.

Pathology.—The exact nosological position of this malady is not yet fully determined. Space forbids a review of all the opinions held at the present time. Those which commend themselves to the writer may be briefly expressed under two heads: (1) That this disease is a form of true rheumatism; and (2) That many of its characters seems to be dependent on lesion of the spinal cord, occurring thus specifically, or otherwise excited secondarily by peripheral irritation.

These views may be best considered together. The disease is one of several manifestations of the rheumatic branch of the basic arthritic diathesis. Gout is regarded as another branch of the parent stock. This position necessarily entails an indirect relation with all forms of diathetic arthritic disease, and, hence, the occurrence of chronic rheumatic arthritis is not antagonistic to the onset of other phases both of rheumatism and gout. The disease may therefore occur *specifically* in more or less grave form. Careful study of its etiology further indicates that in many cases the disorder is *symptomatic*, is 'a lesion common to several kinds of ailment' (Ord), capable of provocation by varied sources of peripheral irritation, amongst which may be enumerated injuries, over-use of joints, and, in particular, irritative conditions of the genitalia, as gonorrhœa, urethritis, ovario-uterine troubles, &c. Symptomatic arthritis, then, is regarded as a product of spinal tropho-neurosis. The nervous system is markedly implicated in the arthritic diathesis, and many of the features both of rheumatic and gouty disease point to the probability of there being a trophic centre, or centres, for the joints situated in the spinal marrow. Morbid or unstable conditions of these centres may result in a definite neurosis, which itself may be either inherited, acquired, or modified in particular instances.

The term 'rheumatic gout,' so often used as a synonym for this disease, the writer believes to be quite inapplicable save for a minority of cases where a true coalescence occurs. Gouty manifestations may supervene independently in the subjects of rheumatic arthritis, or may blend with rheumatic conditions; and in the course of many generations transitional modifications may occur and give rise to unusual forms of arthritis whose place is not always readily determinable. It is also probable

that some of the irregular forms met with may be due to coalescence with other inherited diathetic states. Although there is an indirect relationship between rheumatism and gout, the two diseases are remarkably distinct from each other and from rheumatic arthritis.

It is further to be noted that coincidences of structural change after death do not imply identity of morbid states leading up to them. Thus, it has been shown that chronic gout may produce some of the changes in joints which were formerly attributed exclusively to rheumatic influence. It has been alleged that the rheumatic diathesis is universal. The writer denies this. Some individuals will never develop rheumatism in any form, however much exposed to exciting causes. Arthritic changes, not readily distinguishable from rheumatic disease, are met with in other mammals, and are also proved to have been existent in prehistoric periods.

The forms assumed in this disease are best described under the heads of acute, chronic, and irregular. The acute and general form is more common in young persons, is met with even in childhood, and especially in women, and then assumes the characters of a severe constitutional disease in more marked form. At the menopause, too, it is apt to be acute and rapidly progressive. The smaller joints, especially of the hands, suffer more in this form. The chronic variety is of more insidious origin, is met with more often after middle life and in the male sex, affecting more particularly larger, and often single joints. Many exceptional cases are, however, met with. In by far the majority of cases, no associated visceral lesions are found, and, in exceptional cases, these may be commonly traced to antecedent attacks of rheumatic fever. No indications of important changes have been hitherto discovered in the blood or in any of the secretions in this disease, although some degree of anæmia is not infrequent in advanced cases.

The morbid anatomy of this disease relates to changes in the synovial membrane, cartilages, bones, tendons, and ligaments composing the affected joints. The appearances vary extremely, according to the stage and duration of the disorder, and differ, too, in the several joints affected. Hydrarthrosis sometimes occurs in the early stages, due to effusion into the synovial sac. This may lead to much distension of the capsule, to undue mobility, to subluxation and even complete dislocation. Recovery from this relaxed condition is naturally slow and often imperfect. *Hydrops articuli* is most common in the knee, shoulder, and elbow. Stretching of the lateral ligaments occurs in the ginglymoid joints as a consequence. The fluid removed does not present extraordinary characters, clear or fatty epithelial cells being found as in normal synovia. The synovial membrane is red and thickened, with hypertrophied vascular tufts. At a later stage the fluid is absorbed, leaving the synovial membranes unduly thick, and the capsular ligaments altered to the consistence of intervertebral cartilage, and even at times bony in structure. *See* CHARCOT'S DISEASE.

The articular cartilages present marked changes. They early lose their brilliancy, and become of a dull, yellow colour. They soften and waste, becoming thin, villous, or fibrous in texture. In the knee the semilunar cartilages may entirely disappear, or, contrariwise, become much hypertrophied and even bony. In the phalangeal joints the centre of the articular cartilage becomes villous, eroded, and wasted, exposing the bone. The first stage consists in hypertrophy, with increase in the number of the cartilage-cells and formation of capsules around them. The primary capsules on the surface become globular and distended, and ultimately burst, discharging the free cells into the joint. The next layers of capsules tend to run into a linear series perpendicular to the surface, forming parallel rows of tubes filled with cells, exactly as met with in an ordinary process of intra-cartilaginous ossification. The proliferation of these cells results in formation of embryonic medullary tissue. The grooves which lodged the cells become filled with synovia or cellular débris. The matrix of the cartilage becomes linear, fibrous, and villous at the free end of the tissue. In some of these villi may be found swollen capsules, giving a club-shape to their extremities. Owing to friction in progress of the disease, the villi disappear, and the bone is exposed and in turn undergoes specific changes. Small nodules are formed at the edges of the cartilaginous investment—true ecchondroses, giving rise to the well-recognised nodosities of Haygarth and Heberden (nodular rheumatism). Later on these ossify.

At this time, in the case of the larger joints, the synovial fringes and ligaments are undergoing changes, dendritic growths occur, accompanied by newly-formed blood-vessels. These buds or growths likewise become cartilaginous, and sometimes pe-

dunculated, tending to break off and form loose bodies in the joint. Cartilage corpuscles are sometimes normally found in synovial fringes. They may become truly bony. Ecchondroses, presenting these characters, are not significant only of chronic rheumatic arthritis, since they may be found in both strumous and gouty arthritis. They are necessitated by the anatomical features of the joint, and hence are common in arthritis of any kind, provided the process is sufficiently grave to induce them. The proliferating elements tend to accumulate at the edges of the joint, because these parts are invested by synovial membrane which includes them, and prevents their being shed into the cavity of the joint. Thus, cartilaginous overgrowths occur at any point covered by fibrous tissue or synovial membrane, and especially at the insertions of tendons and ligaments.

The bony changes are of two kinds, proliferating and atrophic, and both proceed together in different places. The former are seen in the ossification of ecchondroses, which begins at their bases. The newly-formed osteophytes undergo friction and eburnation on their surfaces. They resemble epiphysial exostoses in their structure, and are best seen in cases of *malum coxæ senile*, the head of the femur becoming expanded, and the neck of the bone curtailed. Around the acetabulum these bodies are abundantly thrown out, so that the size of the cavity is enlarged *pari passu* with its occupant. The knee-joint sometimes presents profound deformity from similar changes.

The atrophic changes are seen on the articular surface after the removal of the cartilage, and are related to the process of eburnation. The proliferating cells of the cartilage next the bone are believed to press on this texture and induce absorption of it, thus shedding themselves into the adjacent medullary spaces, and leading to conversion into, and incorporation with, new bone-corpuscles. In one or other of these ways a layer of dense bone is formed, which protects the delicate cancellous structure. Eburnation may also arise directly from inflammatory change in the cancellous tissue. On the eburnated surface may be found worn or wasted patches exposing spongy bone, and in most cases lines and grooves exist in the direction of motion, due to continued friction.

With all these profound changes it is remarkable that ankylosis is of extreme rarity. There may be complete immobility. This, however, is due not to fusion of the component structures, but to mechanical impediments, both in and around the joint. Destruction of the internal ligaments of an affected joint is common. The crucial ligaments in the knee may be disorganised, detached, or removed by absorption. The round ligament of the femur, and the tendon of the long head of the biceps within the shoulder-joint, may likewise be ruptured or removed. Bursal tumours also occur in the vicinity of affected joints.

The condition of the spinal cord, and of the nerves supplying affected joints, has not yet been studied. Researches in this direction are desirable. The heart and pericardium commonly escape associated inflammatory changes, but not always.

Symptoms and Diagnosis.—The early symptoms consist of pain, heat, stiffness, and swelling in the affected joints, with, sometimes, spasmodic startings of muscles. The pain is especially felt at night when the patient is warm in bed, or on awaking, also on resuming movements after repose. Grating and crackling sensation in the joints is both subjective and objective. The pain is of a burning or boring character, and may often be relieved by stretching and movement. In some cases no pain accompanies the progress of the disorder.

Deformities of varying extent now ensue, leading to knobby or knotty fingers, and more gross outlines in the larger joints. Temporary arrest of symptoms may occur, with recurrence under fresh provocation. A single joint may be affected, as in the case of the hip, leading often to diagnosis of sciatica or intracapsular fracture in elderly people. Patients are sensitive to climatic changes, and suffer from cold and damp, also, as the writer has found, in advanced cases, from extreme heat. As the disorder progresses, more and more crippling ensues, till the joint-movements become practically annulled by mechanical impediments. Spurious ankylosis is set up. Suppurative change is practically unknown. If many joints are severely involved, the patient becomes a complete invalid or bedridden, and frail health, with anæmia and languor (arthritic cachexia), is thenceforth established.

In the general form of the disease the joints are centripetally affected, and the upper limbs are commonly first attacked with more or less symmetry. The metacarpo-phalangeal joints of the thumb, fore and middle fingers are especially and early obnoxious, and the wrist, carpal,

metacarpal, and phalangeal joints generally are the most frequently attacked.

Changes in the axis of the fingers arise, leading to eversion of them towards the ulnar side of the arm, and in young subjects varieties of flexion and extension of the several segments of the hand occur, as the result of spasmodic muscular contractions, which may also lead to subluxations. Axial distortions are by no means pathognomonic of this affection, being found occasionally in chronic gout. They are due to the influence of the extensor muscles of the wrist and fingers, the movements of abduction being more powerful than those of adduction. With late onset of the malady these latter deformities less frequently appear, doubtless because the muscular irritability is less, the parts more rigid, and the process less acute or less general. Slow wasting of muscles is common in the neighbourhood of the affected joints as a result of disuse. Rapid wasting occurs in acute forms of arthritis, and is probably of reflex nervous origin—a true neurotrophic lesion.

Spondylitis is happily not common, but must not be forgotten. The cervical and lumbar vertebræ suffer more than the dorsal, and the atlo-axial joints most of all, perhaps because motion is there more free. The temporo-maxillary joints are sometimes affected, and occasionally unilaterally, leading to remarkable deformity. Eburnation may occur here. The lower limbs often suffer symmetrically, motion being restricted at the hips, while the thigh is bent on the pelvis, and the leg on the thigh. The femur projects on the tibia, the external condyle being prominent, and the patella, usually enlarged, resting upon it. The head of the fibula may project. At the knee there may be spurious ankylosis; at the tibio-tarsal joint more complete interlocking, the foot being either adducted or abducted, simulating respectively pes valgus or equino-varus. The great toe is commonly everted, and may overlap the others.

The diagnosis in the general form of the disease may be difficult in an early stage, where many joints have been acutely affected and rheumatic fever has been suspected. Many cases begin as ordinary acute rheumatism, and, not yielding to treatment, linger on with progressive deformity and pain. The diagnosis may thus be impossible at the outset, It must also be made from the polyarthritic form of gout, with which it is sometimes confounded when no uratic deposits are obvious. The latter must be sought especially in the ear-cartilages. Evidence in favour of gout will be found by inquiry into habits as to diet, and as to heredity, by examination of the urine and of the blood for uric acid. Associated lead-taint will declare for gout. A history of previous articular attacks in a great toe, or knee, followed by desquamation of cuticle; of inability to take malt liquors, or certain articles of food, without bringing on, sometimes promptly, joint-pains, points to gout.

Treatment.—More agreement prevails on this point than on the question of nosology. In brief, it may be affirmed that what is good for rheumatic manifestations anywhere is good for chronic rheumatic arthritis. The principles of treatment must vary somewhat with the exciting and determining causes in each case. Attention must be paid to the existence of any cross-taint. Little good will be gained till a better condition of general nutrition, and of the nervous health, is secured. All causes of depression and exhaustion must be removed. A good and varied dietary is essential, including free use of foods containing sulphur, such as onions, cruciferous vegetables, and especially mustard. Fats are of value, and cod-liver oil ranks high as a remedial agent. Animal food is conspicuously absent from the diet of the worst sufferers in Ireland and the western islands, and potatoes constitute the main vegetable support, with a scant allowance of milk. Fish is desirable, especially when fresh. A moderate allowance of malt liquor or of good wine with one meal daily, is generally advisable. Residence should be sought in a sheltered, dry, and somewhat elevated locality. It is probable that the disease would often be arrested if tropical, or semi-tropical, residence were secured for a few winters in an early stage. High value attaches to early treatment. Rest is necessary when there is much local pain, and splints and cotton wool may be required. Belladonna, opium, camphor, or soap liniments are the best applications in the acute stage. Where there is much effusion, thecal or other, iodine or cantharidine liniment may be applied, care being taken never to encircle any joint completely. Acute pain that will not at once yield to anodyne applications may be relieved by leeching or wet-cupping.

The medicinal treatment of the acute stages consists of salicylate of soda in twenty-grain doses every six hours, or of iodide of potassium and quinine given together in the respective proportions of five grains and one or two grains, made soluble

with one or two minims of dilute sulphuric acid. Quinine with citrate of potash is also of value. Small doses of compound soap pill may be given by day to secure repose, or ten grains of Dover's powder each night, if necessary.

In chronic conditions the following drugs are found most useful. Cod-liver oil, iodide of potassium pushed to ten or fifteen grains for a dose, arsenic in full doses, iron, and sulphur. Lemon juice has been of proved service in some cases. Guaiacum, sulphur, and acid tartrate of potass, in the form of the 'Chelsea Pensioner' electuary has been found of value as a local application. Flannel soaked in cod-liver oil is a good remedy for the aged poor in cases of languid circulation with dry skin. Exercise is of much importance to secure the best relations between the altered articulating surfaces, to anticipate spurious ankylosis, and so preserve the functions of the limbs. Skilful treatment by shampooing and massage, and by electricity, has a prominent place, and the resources of the best British and foreign warm sulphurous and saline spas are of high value. In this country the waters of Bath, Buxton, Harrogate, Strathpeffer, Woodhall, and Llandrindod are in the highest repute; while on the Continent those of Aix-la-Chapelle, Aix-les-Bains, Barèges, Bourboule, Franzensbad, Gastein, Kreuznach, Pyrmont, Teplitz, Wiesbaden, and Wildbad, are well adapted for resort. The arrangements at Aix-les-Bains are admirably adapted for successful treatment. Several seasons in succession should be spent at one or more of these spas in order to secure full benefit. Hot sulphur douching is of proved utility. Peat-baths and hot sand applied locally are available remedies at some of the foreign spas. The pains and weariness of the later stages of the disease are best met by opium in small doses, and by bromide of potassium.

Well-adapted support to joints by soap plaster spread on thick buckskin is very useful for the knees, and daily use of the flesh-brush is advisable. Woollen underclothing must be worn all the year through. Elderly patients should get daily exercise in the sun, whenever possible, and all exposure to draughts and damp must be carefully avoided. The malady is practically incurable in the old, and early treatment of all cases is imperative if arrest of it is sought. The importance of following up each case of acute rheumatism, till perfect health is restored, is obvious.

DYCE DUCKWORTH.

CHYLURIA. — *Synonyms*: Chylous Urine; Hæmato-chyluria.

Definition.—A milky appearance of the urine, due to the presence of suspended fatty matter having the characters of chyle, and generally occurring in persons infested by a nematoid worm, the *filaria sanguinis hominis*.

Cause.—Chyluria is essentially a disease of tropical and sub-tropical climates, but occasionally it occurs in persons who have never left temperate regions, where the disease does not prevail endemically. Whilst the immediate cause is probably the same in these two classes of cases, the remote cause most likely differs, as will be made more apparent under the head of Pathology. Though the disease does occur occasionally in those who have never resided in the tropics, most of the cases observed and recorded in this country have been imported from regions where the disease is endemic. Chyluria occurs in both sexes, perhaps slightly more frequently among females, and at all ages. The remote cause of the endemic cases is the infection of the patient with the *filaria sanguinis hominis*. Violent exercise or exertion sometimes determines the outbreak of the disease.

Geographical Distribution.—The disease is endemic in the Mauritius, Isle of Bourbon, West Indies, the Brazils, Egypt, India, China, and Australia; the range probably, as stated by Lewis, being limited by about 30° south, and 30° north latitude.

Pathology. — The analyses of many eminent chemists show that all the elements of chyle are present in the urine. Though the proportion of the main constituents of chyle — fatty and albuminoid — differ in many cases from the proportion in which they occur in chyle, this discrepancy is of doubtful significance, since the examinations of both chyle and urine have not been studied, with sufficiently exact reference to the ingestion and quality of food, to admit of accurate comparison. Vandyke Carter has shown that the correspondence may be close.

In order to understand how chyluria may be brought about, it is necessary to glance briefly at chylous exudations generally. In the first place, there have been recorded cases of chylous ascites, in which ascitic collections have had a milky appearance, suggesting, both from their appearance and chemical qualities, an admixture of chyle with serous effusion. These have been proved in some instances to be due to tumours pressing on the thoracic duct or lacteals (Hughes, Ormerod, Wilks.) In con-

sequence of such pressure the lacteals have become distended, dilated, and varicose, and rupture or leakage has followed, so that chyle has become commingled with the dropsical effusion due to pressure on the trunk or branches of the portal vein. These cases are very important, as supplying anatomical proof that the milky appearance of the exudation was caused by admixture of chyle with the serous fluid. Winkel has recorded a case of chylous ascites in a woman who came from Surinam, and in which he thought he detected filaria in the fluid. His description, however, leaves this point doubtful. Quineke has recorded a case of milky effusion into one pleural cavity, probably due to rupture of the thoracic duct by injury. Milky fluid was also found in this case in the peritoneal cavity, and was ascribed to anastomosis between the pleural and peritoneal lymphatics.

Cases have been recorded in this country of encysted hydroceles in which the fluid has been milky. Such cases appear not to be uncommon in the regions in which chyluria prevails. They have been shown to be associated with the presence of filaria in the milky fluid and in the blood, and are attributed to rupture of congested lymphatics into the tunica vaginalis. Next there occur a series of cases in which milky fluid escapes from fistulæ, or eruptions in some part of the surface of the body. In the majority of such cases lymphatic obstruction can be easily demonstrated, enlarged and hardened glands, or varicose lymphatic trunks, being apparent. In these cases fluid escapes, often in very large quantities, from the affected parts, spontaneously, or as the result of accidental or intentional injury. The fluid has, in some cases, the qualities of lymph, containing albumin, fibrin, and lymph-corpuscles. But in many cases, at some period of their progress, and in other cases at all times, the fluid has a milky appearance, and chemical examination has shown it to contain all the constituents of chyle. Such local discharges of lymphous or chylous fluid are generally situated on the trunk or at the proximal extremities of the limbs, parts at which regurgitation from obstructed and dilated lacteals would be relatively easy. Cases of this kind, known as 'lymph-scrotum,' 'varix lymphaticus,' or 'nævoid elephantiasis,' are very common in countries where chyluria prevails, occasionally co-exist with chyluria, and have been shown to be connected with filarial infection, either local or general. At the same time cases have been recorded in persons who have never left this country (Buchanan, Roberts, &c.), so that it is not directly on filarial infection that such a condition necessarily depends, but on some process which is usually initiated by filarial infection, but may be brought about by other means.

It is thus seen that chylous exudations are generally associated with obstruction or injury to lacteals or lymphatics, and that the milky appearance has, in some of the instances, undoubtedly been due to the presence of chyle, justifying the term chylous applied to them generally. These considerations would suggest the conclusion that chyluria is of a similar nature—a conclusion which is supported by the characters of the urine and its frequent association with one of the other conditions dependent on lymphatic obstruction, for it is unlikely that such frequently associated conditions would have a different causation. This view, that chyluria is dependent on admixture of chyle with the urine in a direct manner, by means of a fistulous communication between the lymphatics and lacteals in the lumbar region and the pelvis of the kidney, ureter, or bladder, is that advanced by Dr. Vandyke Carter, in 1862, previously to the discovery of the connection of the disease with filariæ in the blood and lymphatics.

It has since been established by a number of observers (1), that the endemicity of chyluria and filarial infection are the same; (2), that the habitat of the parent filariæ is the lymphatic system; (3), that in filarial-inhabited lymphatics there is a tendency to obstruction of the trunk of the lymphatic or of the glands to which it leads, with varicose dilatations and escape of the contents of the lymphatics, consequent upon such obstruction; (4), in a case recorded by the writer, the renal, lumbar, and iliac lymphatics were in a very varicose condition.

Dr. Patrick Manson has offered an explanation of the pathology of the various lesions associated with the presence of the filaria sanguinis hominis in the lymphatics and blood-vessels, having the merit of uniting a number of frequently associated conditions, which, whilst differing much in outward appearance, have the same geographical distribution. If his explanation appear fanciful and farfetched, it must be remembered that no one has done more to unravel the mystery pervading the subject, and that many of the phenomena connected with filarial infection are so strange as to seem incredible to those who have not studied the matter.

In ordinary circumstances the embryos of the parent filariæ situated in the lymphatic trunks are born with their chorional envelopes stretched, and are then of such dimensions as to be able to traverse the smallest capillaries (*see* Filaria Sanguinis Hominis). It has, however, been shown that occasionally ova escape from the female parent. The ova, with their unextended chorional envelope, are from five to seven times greater in their smallest diameter than the outstretched embryos, and their size, and perhaps absence of power of self-movement, render them too large to pass the delicate meshes of the lymphatic glands, where, acting as emboli, they plug the lymph-channel, and dam up the lymph or chyle. 'There will then be complete stasis in this particular vessel, as far back as the first anastomosing lymphatic. Along this the current will now pass, carrying with it other ova; these in their turn will be arrested at the first gland they reach. And this process of embolism, stasis of lymph, diversion of current into anastomosis, will go on until the whole of the lymphatic glands, directly or indirectly connected with the vessel into which the parent parasite ejects her ova, are rendered impervious, provided the supply of embolic ova is sufficient, kept up long enough, or renewed from time to time.' (Manson.)

If the *aborting parent* is in the lymphatic trunk of the pelvic or lumbar region, should the stasis caused by the ova involve the lymphatics of the kidneys, ureters, or bladder, chyluria may result, owing to a nævoid condition of these lymphatics discharging themselves into the urinary tract. If the discharge comes from a lymphatic reservoir, the result will be lymphous urine; if from a lacteal or from a lymphatic into which chyle has *regurgitated*, chyluria will result. Irregular pouchings and collections, which, when sufficiently distended, render the lymphatic valves incompetent, may be one of the factors in producing the irregularities in the characters of the urine in such cases. The essence of Manson's pathology is—obstruction of lymphatic trunks, stasis, dilatation of tributary lymphatics, rupture, and escape of contents. Whilst in the endemic cases, abortion of the female parasite may be the usual cause of the lymphatic obstruction that leads to the varicose condition and rupture of the lymphatics, *any other condition that leads to such obstruction* may be expected to be followed by similar results. It seems, moreover, probable to the writer that, even in filarial cases, it is not essential to invoke the premature escape of ova, but that the parent filariæ may by their presence excite inflammation of lymphatic trunks, and thus give rise to stasis. In non-filarial cases inflammation (from which it is known the lymphatics elsewhere are by no means exempt) excited by other causes, may be the explanation of the lymphatic obstruction; just as elephantiasis of the lower extremities is sometimes caused in persons who have never been abroad, by injuries that lead to inflammation and obliteration of the lymphatic trunks of the thigh. Anatomical proof is still wanting as to where the communication is established between the lymphatic system and the urinary tract. In a case recorded by the writer, the iliac, lumbar, and renal lymphatics were greatly dilated.

In a case recorded by Dr. W. Roberts, the communication was probably in the bladder, and the condition was ascribed to a nævoid state of the cutaneous and subcutaneous lymphatics, some of the varicose enlargements, on the surface of the skin, rupturing and discharging their contents externally, whilst others discharged their contents into the bladder. One other explanation has been put forward by Claude Bernard and Ch. Robin, viz. that a piarrhæmic condition of the blood is present, and that the kidneys merely eliminate the fatty matter. Robin has further suggested that this state of the blood, natural after meals, is rendered more or less permanent by some derangement of the digestive organs, especially the liver, by the filaria sanguinis hominis. But whilst some analyses of the blood have shown fatty matter in excess, others, as those by Bence Jones and Crevaux, have shown that no such excess of fat in the blood has existed in cases of chyluria. Moreover, as Dr. Roberts writes, 'it is incredible that blood-albumin and fibrin should pass from the blood into the urine through the kidneys, without being accompanied by casts of the uriniferous tubes.'

In cases in which post-mortem examinations have been made, no structural alterations have been found in the kidneys. Filariæ have been found in the blood-vessels, arteries, and veins, to their minutest ramifications. Careful examinations and injections of the lymphatics are much to be desired where the opportunity is afforded.

Symptoms.—There are usually no proper premonitory symptoms. Sometimes the disease sets in insidiously, but more usually it makes its appearance abruptly, the first indication of the malady being

that the urine is noticed to have a milky appearance. Sometimes the attack is ushered in with hæmaturia, and in many cases hæmaturia is present to a greater degree than is accounted for by mere lymphatic, or lacteally-developed, blood-corpuscles. This admixture with blood, which has led some to designate the disease 'hæmato-chyluria,' appears to be more common in Egypt, the Brazils, and the West Indies than in the cases of the disease seen in India and China. Lewis suggests that it may be due to some specific difference in the parasites causing the urinary disorder in the different countries.

In one or other of these ways, the urine acquires a milky appearance. There may be few or no general symptoms accompanying the chyluria, but local symptoms, such as pain or uneasiness across the loins, are sometimes complained of, pain may be felt along the ureters and in the bladder, and, in the male, in the perineum. This is especially the case where coagula form in the bladder, when micturition may be impeded or obstructed. In such cases, in the male, long cylindrical coagula, moulded in the urethra, are sometimes passed with relief to the obstruction. There are sometimes marked debility, depression, and wasting; but the chyluria may occur with the appearance and feeling of perfect health. There may co-exist with the chyluria, lymph-scrotum, and elephantiasis of the scrotum or lower extremities, with chylous discharges from the surface of the body. In filarial cases, irregular attacks of pyrexia are prone to occur—'filarial' or 'elephantoid fever.' These feverish attacks, sometimes mistaken for ague, differ from the latter in the irregularity of the fever and intermissions. In most cases the blood taken from a prick at any part of the surface of the body is found to contain embryo filariæ in an active moving condition. In order to detect their presence, the examination should be made at *night*, on account of their periodical appearance in, and disappearance from, the circulation. *See* Filaria Sanguinis Hominis.

Characters of the Urine.—The urine sometimes looks like milk, sometimes like a mixture of milk and blood. It has a sweet, and sometimes a milk-like, or whey-like smell, when freshly passed, especially on being warmed, but it soon becomes fœtid. When allowed to stand, a cream-like layer often rises to the surface, and the remainder of the fluid, after a short interval, sets into a blancmange-like jelly, which, after remaining in this condition for a few hours, spontaneously disintegrates, a few filmy coagula, containing blood-corpuscles, floating in the fluid, and a deposit, looking like blood, falls to the bottom of the vessel. The quantity of urine is almost invariably increased to 70, 80, or 100 ounces in the twenty-four hours. The specific gravity is generally below normal. The reaction is neutral or faintly alkaline. The ordinary constituents of urine are present, generally in natural proportions, except the water, which is increased. Albumin is always present, generally in considerable quantity, and is coagulated by heat, nitric and picric acids. Peptones, and a trace of indican have been found in the urine (Ralfe). Sugar is absent in uncomplicated cases. Casein has not been found. The clot has the property possessed by fibrin, of decomposing peroxide of hydrogen with effervescence. When the milky urine is shaken with ether in a test-tube, the fatty matter rises to the surface, leaving the urine clear or slightly opalescent. The ethereal extract, on evaporation, yields a solid or oily uncrystallisable fat, partly saponifiable, resembling that found in the blood.

In some cases the urine is *lymphous* rather than chylous; that is, it contains albumin and coagulates spontaneously; but the fat is absent, together with the opaque milky appearance which depends thereon. The coagulum in lymphous urine resembles calves-foot or currant jelly (Roberts).

Many analyses of the urine have been made in chyluria. The following by Brieger of the night urine are valuable for their completeness:—

	Maximum in 100 parts	Minimum in 100 parts
Fats	0·725	0·06
Albumins	0·798	0·581
Urea	3·4	3·7
Uric acid	0·03	0·03
Sodium chloride	1·7	1·4
Sulphates	0·22	0·23
Quantity of urine	400 cc.	300 cc.
Specific gravity	1·016	1·025

Microscopical examination of chylous urine shows finely granular, fatty matter (molecular basis of chyle), oil-globules in some, but not in all, cases, especially in the creamy layer that rises to the surface; corpuscles resembling the white corpuscles of the blood and lymph; red blood-corpuscles of various sizes and stages of development;

and, in most cases, embryo filariæ. As a rule, with scarcely any exceptions, no renal casts are present. Occasionally urinary crystals, as oxalate of lime, are found, and, when the urine has been kept for any time, putrefactive bacteria will probably be discovered. The embryo filariæ are found alive and dead. They probably do not live long in the urine when passed, owing to its decomposition. In order to detect them, any portion of clot which is blood-coloured should be placed on a slide and examined, or the coagula in the urine may be broken down by stirring, and the deposit removed after subsidence, but they also occur in the free deposit in some instances.

The degree of milkiness of the urine varies in different cases, and often in the same case at different times. In most cases it is much more chylous after meals than at other times, but this does not obtain in all. In some cases the urine is most chylous in the daytime, but in others, that passed on rising in the morning is most milky. In some cases, rest, position, and exercise appear to influence its characters; but, as Dr. Roberts writes, irregularities in regard to meals, exercise, and rest are inextricably contradictory.

Progress and Duration.—In some cases the disease persists with little variation for years. In the majority of cases, after lasting an indefinite time, it spontaneously ceases, or appears to yield to treatment; but after the patient has remained free from the malady for months or years, it becomes re-established without any explanation of its recurrence. The urine has been known to be milky on one or two occasions only, and its chylous character has persisted for upwards of fifty years. The intermissions have sometimes appeared to be due to independent illnesses or shock, but in other cases no such influence could be traced. In the majority of fatal cases, death has been brought about by intercurrent diseases. Dr. T. Lewis remarks: 'Patients, in apparently good health otherwise, have been known to die very unexpectedly from no recognised acute disorder.' The case recorded by the writer in the *Pathological Society's Transactions* affords a probable explanation of such terminations, the fatal issue in this instance apparently being due to the local consequences of the death of the parent filariæ in the abdominal and thoracic lymphatics.

Diagnosis.—As a rule no difficulty is experienced in the recognition of the disease, but the practitioner must bear in mind the possibility of the intentional or accidental addition of milk to the urine after it has been passed. In true chyluria, the urine always contains albumin and fibrin. Owing to coagulation of the urine within the bladder, micturition may be interfered with, and the case come under the care of the surgeon on this account. In one case under the care of the writer there had been cystitis at the commencement of the attack. Whilst the disease is usually to be traced to filarial infection, it must be borne in mind that chyluria may continue in cases where filariæ have ceased to be present in the blood or urine, and that it does occasionally occur in persons in whom there is no reason to suppose that they have ever existed.

Prognosis.—The prognosis will have been gathered from the account of the progress and duration of the disease. The irregularity of its course, and its liability to recurrence, render the prognosis quite uncertain in any individual instance. In cases in which filariæ are found in the blood, the possibility, however remote, of a rapidly fatal termination must be remembered.

Treatment.—No plan of treatment offers any certainty of cure. Whilst rest in the recumbent position is sometimes of decided benefit, it is too uncertain in its effect, and too irksome to the patient, who often feels well in other respects, to be always willingly submitted to. It is worth trying, however, when practicable. Dietetic treatment—the exclusion of all fatty substances—may lessen the milkiness of the urine, but will scarcely benefit the patient. No drug exercises a positively specific influence, though the mangrove bark (Rhizophora racemosa), and the seeds of Nigella sativa (a constituent of curries), enjoy local reputations. Theoretically, antiparasitic remedies appear to be indicated in cases where filariæ are found to be present; but in the first place, no remedy of this class appears to have been successfully employed, and in the second place it is not certain that the disease would be cured even if the parasites that initiated the chyluria could be destroyed, for, as already stated, the malady sometimes persists when filariæ which were present at one stage of the disease have disappeared from the blood and urine. Moreover, some good authorities are of opinion that the death of the parent worms in the lymphatics, if it could be accomplished, is by no means devoid of danger. Astringents, mineral and vegetable, are sometimes of at least temporary benefit, especially perchloride of iron in cases

where there is much anæmia, and gallic acid. The latter is chiefly trusted to in India, and may be given in doses of one or two drachms a day. Iodide of potassium has also appeared of occasional service. The writer has seen in three cases very striking benefit from benzoate of soda, in doses of from twenty grains to two drachms three times a day. Under this treatment the milkiness of the urine has been greatly diminished, or has disappeared; and, what is of importance, coagula have ceased to form in the bladder. He has not, however, been able to follow out any case for a sufficient period to ascertain how long these good effects are maintained. *See* Filaria; Elephantiasis Arabum; Lymph-scrotum. Stephen Mackenzie.

CICATRICES, Pathological Conditions of.—It is intended in this article to deal with the deformities caused by cicatrices, and with the abnormal conditions and pathological affections of scar-tissue.

Discolouration of Scars.—A cicatrix may become discoloured through the inclusion within its tissue of some foreign material. The best known instances of this staining are presented by scars formed after gunpowder injuries, and by the corneal opacity that sometimes follows the application of nitrate of silver to an ulcer of the cornea. It has been asserted by Nélaton that an indelible stain may be caused by the application of black court-plaster to a small healing wound.

In old cases of chronic and varicose ulceration of the leg the scar and surrounding skin are often marked on the surface by patches of deep brown pigmentation. The scars formed on the healing of syphilitic ulcers present for a time a coppery-red colour, and subsequently become unnaturally pale. Large strumous ulcers are replaced by uneven scars of an unsightly livid tint, and traversed by prominent bands.

Deformed Scars.—The scar of an ulcer associated with necrosis or caries of bone is usually very dense, depressed, and closely connected with the previously diseased bone, and, when present in some exposed region, as on the forehead, causes much disfigurement. Extensive cicatrices of long standing, which have been formed over the inner surface of the tibia after necrosis, often become very dense and of almost cartilaginous hardness. As good instances of the deformity and mischief likely to be caused by adherent scars may be mentioned cicatricial ectropion after bone-disease, and cicatricial closure of the jaws.

The so-called *exuberant* or *deformed cicatrix* due to excessive formation of scar-tissue is a frequent result of tardiness in the healing of a granulating surface. It is very often met with after scrofulous and lupoid ulceration and after a deep burn. Under this heading may be ranged the numerous varieties of hypertrophied scar, from the small lumpy growths mentioned by Sir James Paget, as occasionally observed after the operation for hare-lip and a vertical wound through an eyelid, to the thickened masses closely resembling keloid growths which are sometimes formed over large and multiple cicatrices.

Cicatricial Deformities.—Deformities caused by dense retractile cicatrices occur most frequently after very severe and extensive burns. The following are the different forms of cicatrix by which deformity may be produced:—(1) The *broad and expanded cicatrix* met with in most instances in front of the neck. This usually consists in a thick parchment-like membrane of a light colour, and mottled on its surface with yellow or brown spots. The surface is uneven and marked by intersecting ridges. In consequence of the retractile action of this scar on the movable skin of the face, the lower lip and the lower eyelids are dragged downwards. The lower jaw is also depressed towards the top of the sternum; and in old cases the shape of this bone is much altered, and the front teeth project forwards. Among the many troublesome results of such a condition is a constant flow of saliva, causing irritation and superficial ulceration of the scar. (2) The *narrow cicatrix* extending like a tight cord or riband from one part of the surface to another, and forming the so-called 'vicious bridle.' This is met with most frequently in the upper extremity, extending across the axilla to the arm, or from the arm to the forearm in front of the elbow. (3) A very frequent form of cicatricial deformity is that caused by the *scarring of adhesions* formed between contiguous and approximated parts. Cases have been observed of adhesion of the scrotum to the inner surface of the thigh, of the mamma to the front of the chest, of the pinna to the side of the head, and, after scalding, of the inner surface of the cheek to the gums. The most frequent instances, however, of this deformity are the adhesions of fingers and of toes after burns of the extremities. (4) The *depressed cicatrix* which is the result in most instances of a severe burn, which, without involving much of the surface, has extended deeply into the

limb. In this form of cicatrix the skin may be tightly bound down to the surface of a bone, and the muscular and other soft parts be much constricted. *Cicatricial contraction*, extending in some instances to almost *complete obliteration of a natural orifice*, as the mouth, anterior nares, and orbital aperture, is the result partly of adhesion of the burnt or ulcerated margins of the opening, and partly of concentric retraction of the surrounding scar.

In the *treatment* of cicatricial deformity the surgeon may either practise *extension* or *compression* of the scar, or these two methods combined, or have recourse to some cutting operation. If properly applied in suitable cases, extension tends to elongate and unfold the cicatrix, and compression to cause absorption of some of the special retractile material of the cicatricial tissue. Each method must be applied with great care, and demands, as a condition of success, much patience and perseverance. If the extension be used with sudden force the cicatrix may be torn, and serious inflammatory mischief, with ulceration, be set up. The agents used in extension are a specially devised collar for a large cicatrix in front of the neck, hinged splints moved by screws or cog-wheels for cicatricial bands of the upper extremity, and weights in the rare instances of contraction from scars over the hip or knee. Compression is best applied by strips of plaster, and, over these, elastic bandaging.

The following are the principal methods of operative treatment:—(1) *Simple subcutaneous dissection*, by which the adhesions of a broad cicatrix to subjacent soft parts are divided. (2) *Incision*, either by one single cut across the cicatrix, or by a number of small cuts, the distorted parts being at once restored, as far as possible, to their normal position, and one large open surface or several small wounds being formed. (3) *Division of the cicatrix*, relief of the distortion, and immediate closing of the wound by bringing its edges together in a line at right angles to that taken by the knife. (4) *Excision of the scar*, with approximation of the edges of the gaping wound by interrupted or quilled sutures. (5) *Loosening of cicatrix*, by incision of sound skin, either above or below, and by subcutaneous dissection. (6) *Plastic operations*, consisting in either simple division or complete removal of the cicatrix, and in completely or partially covering the open surface thus formed with a flap of skin taken from a contiguous or remote part of the surface of the body.

The indications and the special advantages of each of the above-mentioned methods of treatment may be thus briefly stated.

Mechanical extension associated with direct pressure by means of elastic bandaging and plaster, and with occasional manipulation of the cicatrix, will produce partial absorption of the retractile tissue, render it more pliant, elongate the bands, and, consequently, favour the restoration of distorted parts to their normal position and mobility. This non-operative treatment is applicable to a large class of cases. Most broad and membranous cicatrices which are not very thick, and not closely attached by their under surfaces to fasciæ, muscle, or bone, are more or less amenable to long-continued stretching and pressure. Where extension is applied, an essential condition of success is the presence of sound and dry integument above and below the cicatrix, for the extremities of the stretching apparatus to rest upon.

Simple incision or division of a large cicatrix produces immediate relief, which, however, does not remain permanent. The large open surface contracts as it heals, and the temporarily relaxed parts are gradually brought to their former abnormal position.

The method of multiple small incisions acts very effectually in many cases, but generally in those which are as readily amenable to non-operative treatment.

Excision is a valuable method in cases of small scars, and of long, narrow, tendon-like bands that are not very salient, but is ineffective and dangerous in any case of deformity produced by a thick and broad cicatrix.

Incision, associated with submembranous dissection and partial detachment of the cicatrix, generally produces great and marked relief, and, in some instances, complete cure. A very prolonged and wearisome course of after-treatment, however, is necessary in order to control the retractile action of the newly-formed cicatrix, and to prevent renewal of the deformity.

Autoplasty, when well-planned and successfully performed, is less likely than any other method to be followed by any return of the deformity, as the retractile structure is replaced by a flap of supple and extensile skin. This method may be applied with good prospect of success to many cases in which the cicatricial deformity is too severe and extensive to be treated effectually in any other way. *See* CHEILOPLASTY.

PAINFUL SCARS.—As a general rule the surface of a sound scar is much less sensi-

tive than that of the adjacent integument, and the thickened scars and the tight and dense cicatricial bands, formed after severe burns, are usually quite insensitive. The subjects of some large scars, however, and especially of extended patches of thin and pale scar-tissue on the back and shoulders, often complain of itching or burning sensations over the seat of the old injury, but most intense near the junction of the cicatricial tissue with the healthy skin. In most instances these attacks come on very irregularly, and are most severe during damp weather.

A more troublesome affection is what has been called *neuralgia of scar*. This is characterised by severe burning pain, which, in some cases, is limited to the scar, and in others radiates along the nerve-trunks of the affected limb or region. These neuralgic pains, which may be either paroxysmal or persistent, occur most frequently in cases of irritable stump, and in tense and depressed scars. When persistent, the pain is very often due to squeezing or stretching of the extremity of a nerve by retractile cicatricial tissue, or to compression of the nerve between bone and a tense and depressed scar. In many cases, however, of neuralgic scar, especially those in which the pains are paroxysmal, the cause of the affection is very obscure. *See* Stumps.

The itching sensations in scars, often so troublesome during changes in weather, are not as a rule very amenable to treatment. In some cases warmth, in others cold, gives relief. When painful, the scarred surface should be covered by a layer of some dry, warm, and very soft material, such as cotton-wool. A broad, painful scar, if much exposed to the friction of underclothing, should be protected by simple plaster or emplastrum opii. In cases of more severe cicatricial pains, the local application of chloroform, or of vinum opii and glycerine, or a subcutaneous injection of morphia, will afford some relief, trial being made of quinine in large doses during any attack of a paroxysmal character. In the treatment of neuralgic pains causing much and constant suffering, attempts may be made to effect a cure by cauterising or excising the scar if small; by dividing subcutaneously any adhesions that may exist between the scar and bone or other deep parts; by neurectomy; by nerve-stretching, or by excision of the extremity of the affected nerve.

Ulceration. — Cicatricial structure, though imperfectly organised and not freely supplied with blood, seldom ulcerates, except it be subjected to much violence or continuous irritation; or, together with the surrounding normal structures, it be involved in some local inflammatory action, or some disturbance of the circulation. The most frequent examples of cicatricial ulceration are the breaking down of the scar of a chronic ulcer of the leg, associated with more or less varicosity, and the rapid disappearance of a very recent and thin scar under the influence of an attack of erysipelatous inflammation. During the healing of an extensive burn there is a constant tendency in the newly-formed scar to inflame and ulcerate. The scars most liable to ulceration are those which adhere to bone, and those tightly stretched in the form of prominent bands between two segments of a limb. A slight laceration, or a scratch even, of a large and stretched scar may become the starting-point of extensive ulceration.

In cases of ulceration of scar-tissue, an endeavour having been made to remove all sources of further irritation, the affected part should be kept at rest, and the open surface be treated as an ordinary wound or ulcer.

Epidermic Growths. — Simple warts sometimes grow from cicatricial tissue, particularly of a depressed scar between two bulging flaps of a stump. These are generally the result of inattention to cleanliness. Epidermic growths are occasionally seen on the scars that result from cauterisation of the skin, where they form small conical or pyramidal eminences, resembling in appearance ordinary corns. Sometimes a long thin horn grows from the surface of a scar. Hutin related a case in which a horn two inches in length had grown from a scar produced by the actual cautery. A portion of the cicatricial tissue extended far into the centre of this horn, which was vascular and tender on section.

Keloid.—Keloid growth of scar-tissue (*keloid of Addison, false or cicatricial keloid*) usually presents itself as a firm, elevated tumour, with rounded and sometimes overhanging margins, from which spur-like processes pass into the surrounding healthy skin. The surface is smooth and glossy, in some cases of a red or pink colour, in others quite white. A few small vessels may usually be seen running over the growth, and some thin hairs may be scattered over its surface. The tumour, when large, is usually marked in its central parts by one or more distinct depressions. It is slightly tender when handled, and in some cases, particularly at

an early stage of growth, is the seat of itching or stinging sensations. Keloid consists in a circumscribed tumour, the cut structure of which has the appearance of a firm fibroma, and presents under the microscope very closely packed bands of fibrous tissue, running for the most part parallel to the surface of the growth. It may be developed in any variety of cicatrix, from the extensive and thick bands formed after a severe burn, to the almost imperceptible mark of a leech-bite. It has been observed in the scars of small-pox, herpes zoster, acne, and syphilis, and may come on, it has been stated, in the seat of a blister, or even after a contusion without any lesion of the epidermis. A case has been recorded by Verneuil in which the conjunctivæ of both eyes were affected with small keloid growths formed after the caustic action of strong sulphuric acid. The most frequent starting-points are the cicatrices of syphilitic ulcers, of burns, and of wounds caused by flogging. There seems to be a marked predisposition in coloured people, particularly Africans, to keloid, as well as to other morbid growths of scar-tissue. Instances observed by Dr. Goodhart and Mr. Clutton prove that keloid tumour may grow on different regions of the same patient, and in scars of varying form and origin, either simultaneously or in successive crops. It is probable that there may be a family tendency to keloid. It occurs most frequently in adults, but is not rare in young subjects. In one of a series of cases collected by a committee of the Clinical Society in 1879, the disease had been first observed at the age of six months, and in two other cases at the age of twelve months. According to Kaposi it occurs as frequently in males as in females.

Until recent years keloid was regarded as a permanent disease. The almost general opinion of those who had had much experience of this growth was, that after having slowly and steadily increased up to a certain point, it ceased to undergo any further change, and remained stationary during the rest of the patient's life. Cases have been recorded in which keloid had existed for ten, thirty-six, and forty years. Of late, however, an opinion has gained ground in this country that, as a general rule, keloid growths have a tendency to undergo spontaneous involution, and to disappear.

Excision of keloid is almost always followed by speedy relapse and the formation of a larger growth. Cauterisation, blistering, and the local application of iodine afford very slight prospect of success. Any neuralgic pain that may be associated with the disease is best treated by subcutaneous injection of morphia.

Fibroma.—Very closely allied to keloid growths are the fibrous and myxo-fibromatous tumours of the external ear, which have been often observed, especially in coloured people, on lobules that have been punctured for the passage of ear-rings. These, though larger and of more rapid growth, present very much the same appearance and structure as keloid, and, as has been shown by Dr. Turnbull of Philadelphia, have a tendency to recur after removal.

Malignant Growths.—Cicatrices, like other forms of imperfectly-developed tissue, occasionally become the seat of malignant or semi-malignant growths. Some few cases have been recorded of medullary and melanotic sarcoma of small scars. The most frequent form, however, of cicatricial malignant tumour is the so-called 'warty growth of scar,' first described by the late Mr. Cæsar Hawkins in 1855. The usual seat of this growth, which in most instances is a papillary epithelioma, is a very old scar formed after a burn or flogging, or the scar of a chronic ulcer. It has been observed on the back, scalp, and heel, but most frequently either in a tense cicatricial band, extending from the arm across the axilla, or on a scar over the shin. Several instances have been observed of a less malignant form of warty growth, the precise structure and nature of which seems to be still undetermined, but which, in the opinion of Follin, is an ulcerating form of keloid.

W. Johnson Smith.

CILIARY BODY, Diseases of the.—The ciliary body consists of the ciliary muscle, the ciliary processes, and the part of the choroid anterior to the ora serrata. In contact externally with the sclerotic, it forms a zone of about 6 mm. in breadth, measured in a meridional direction from the sclero-corneal margin. This part is called the ciliary region. On the inner surface of the ciliary body is the pigmented uveal layer, which becomes anteriorly the ciliary processes, and is continuous posteriorly with the pigment layer of the retina. The iris, the ciliary body, and the choroid are intimately connected by nervous and vascular supplies; they form, in fact, one continuous layer—the tunica vasculosa, or uveal tract. On account of this close anatomical relation, disease of any one of these structures has a great tendency to spread to the others.

Inflammation of the Ciliary Body (*Cyclitis*) is recognised by the following

characters:—There is a zone of congestion surrounding the cornea, due to dilatation of the anterior ciliary vessels, underlying the conjunctiva (ciliary congestion). There is slight photophobia, lacrymation, and ciliary neuralgia. There is also tenderness, often confined to one spot, on pressing the finger over the ciliary region: this marked pain on pressure being a distinguishing feature of cyclitis. The disease has a tendency to recur, to attack one part of the ciliary body more than another, and to produce secondary changes in neighbouring structures.

There are certain cases which indicate, both in their clinical and pathological features, that the inflammatory changes commence in the ciliary body; these will be described first. Cyclitis may also be secondary to iritis, but it is often impossible to say, especially in the later stages, where the primary seat of the disease was situated.

Serous Cyclitis begins with pain and tenderness over the ciliary body, and with ciliary congestion: the pupil may be dilated, but the iris is otherwise little affected; keratitis punctata soon appears; opacities form in the anterior part of the vitreous, producing some diminution of vision. After several attacks of this character, adhesions form between the iris and the lens-capsule, but only at the pupillary margin, followed, in severe cases, by complete exclusion of the pupil, a bulging forward of the iris, and secondary glaucoma. Glaucoma may, however, appear quite early in the disease, before the iris is much affected. In some instances the disease runs a mild course, the iris being wholly unaffected.

Treatment consists in giving the eyes complete rest and in keeping the pupil dilated with atropine. An extensive iridectomy may be performed if the disease persists for long, and is especially demanded when there is any increased tension, with or without exclusion of the pupil.

Cyclo-iritis (*irido-choroiditis*).—In this, as in other forms of cyclitis, the inflammatory changes vary in intensity. They are plastic in character, and are seldom limited to the iris and ciliary body.

A distinct group of cases (*anterior choroido-sclerotitis* which ends in anterior or ciliary staphyloma) take the following course:—At one or two circumscribed areas of the ciliary region there occur repeated attacks of sub-conjunctival congestion, accompanied by pain and tenderness. The area of congestion is sharply limited. The attacks last for several weeks, and are followed by intervals of complete freedom from inflammation. Eventually a slight bulging of the sclerotic at one spot is noticed, and, with each exacerbation, slowly increases. Here the sclerotic becomes thin and of a dusky colour, the choroid and ciliary body showing through it. The neighbouring part of the cornea becomes opaque, and posterior synechiæ are formed. In the later stages the whole of the anterior part of the sclerotic becomes one large staphyloma, the cornea is stretched and enlarged, the iris and ciliary body atrophied. The disease is essentially of a chronic nature, and is often completely arrested for long periods.

This form of cyclitis is very intractable under treatment. The application of the artificial leech and blistering to the temple, combined with the use of atropine, in some cases cuts short the attacks. Other cases are improved by a course of mercury. An iridectomy is sometimes of great value, and may completely arrest the disease.

Cyclo-iritis, in some of its most destructive forms, is more acute, and may commence in the iris or ciliary body, or in both together. A plastic exudation from these two structures gradually envelopes the lens, producing occlusion of the pupil, with total posterior synechia. The lens becomes cataractous, and a cyclitic membrane forms behind it. Early in the disease there is great deterioration of sight, with secondary glaucoma, and a shallow anterior chamber. Later, with shrinking of the vitreous, the eyeball becomes soft.

The exciting cause is sometimes syphilis, either hereditary or acquired. In hereditary syphilis the cyclitis occurs with interstitial keratitis; in acquired syphilis, during the secondary stage. It is in some instances a complication of rheumatic iritis, in many its causation is obscure.

Constitutional treatment, especially in the syphilitic cases, is of the utmost importance. Ciliary tenderness and neuralgia may be relieved by hot fomentations and counter-irritants; local treatment, however, is unsatisfactory. It is impossible to perform an iridectomy with any success, as the iris is very friable, and is firmly bound down to the lens-capsule.

Sympathetic Irido-cyclitis almost invariably begins with serous iritis, soon developing into the most severe form of plastic irido-cyclitis. Some cases never proceed beyond the stage of serous irido-cyclitis, and run a mild course. *See* Sympathetic Ophthalmitis.

The ciliary body is sometimes the seat of a *syphilitic gumma*. If the gumma

breaks down, a perforation of the ciliary region, with destructive inflammation of the eyeball, may ensue.

A *tubercular growth* in this situation produces great inflammatory swelling of the ciliary body, and is usually accompanied by similar deposits in other parts of the eye.

Injuries of the Ciliary Body.—Blows on the eye sometimes induce paralysis of the ciliary muscle, with dilatation of the pupil and loss of accommodation. Recovery usually occurs in a few days. Hæmorrhage into the anterior chamber or vitreous may also be due to a blow, from rupture of one of the bloodvessels of the ciliary processes. Punctured wounds of the ciliary region are especially dangerous, because traumatic cyclitis may result, and also because an injury of this part of the eye is the chief exciting cause of sympathetic ophthalmitis.

Traumatic Cyclitis is, in the great majority of cases, purulent in character, and is recognised by considerable swelling of the lids, with pain, great tenderness, and congestion of the ciliary region. The aqueous becomes muddy, and pus covers the ciliary processes and the posterior surfaces of the lens, being seen as a yellowish mass through the pupil. This purulent cyclitis is accompanied by diminished tension of the eyeball.

Certain *functional* disturbances of the ciliary muscle are to be noted.

Paralysis of the ciliary muscle alone (cycloplegia) often follows diphtheria, and usually in hypermetropic eyes. Combined with dilatation of the pupil it occurs in complete paralysis of the third nerve; finally, all the internal muscles of the eye may be paralysed (ophthalmoplegia interna). Paresis of accommodation may be the result of debilitating disease, or of overstraining of the ciliary muscle. Spasm of accommodation is sometimes found in hypermetropia. In hypermetropia the circular fibres are often greatly developed, whilst in myopia they are wanting. This, however, is far from being an invariable condition. *See* Accommodation, Disorders of, and Refraction, Errors of.

Atrophy of the ciliary body results from any prolonged pressure applied to it, and is always well-marked in glaucoma of any standing; it is also found in staphyloma of the ciliary region.

The *tumours* of the ciliary body are leuco- and melano-sarcoma. *See* Orbit, Tumours of the.

Coloboma of the ciliary body is a congenital cleft of the lower part, accompanying coloboma of the iris and choroid.

W. J. Milles.

CIRCUMCISION. — The operation of circumcision, or removal of a portion of the prepuce, may be required in the following cases:—

1. To remedy the constitutional and local irritation produced in infancy by an abnormally long prepuce.

2. To prevent the recurrence of balanitis (*see* Balanitis) in lads, produced by the retention of the secretions beneath a long and tight prepuce.

3. To relieve a phimosis produced by balano-posthitis, or by the suspected presence of a phagedænic sore beneath the prepuce.

4. To remove the irritation and difficulty in micturition sometimes present in old men as the result of a long prepuce with contracted orifice.

The usual method of performing the operation in children is as follows:—A tape should first be tied tightly round the root of the penis (a most efficient and simple plan), or Clover's circumcision-tourniquet may be applied, to prevent all hæmorrhage during the operation. The exact length of skin to be removed must then be calculated, either by marking, with an indelible pencil, the skin as it remains *in situ*, at a line corresponding to the corona glandis; or by applying a pair of long polypus-forceps to the same point, and closing them firmly on the skin, as soon as the glans penis has slipped back from between the blades. The forceps should be applied at the point selected obliquely from above downwards and forwards. The portion of skin beyond the forceps is then cut off with a single sweep of a long bistoury, or, better still, with a pair of curved scissors. On removing the forceps it will be found that, whilst the skin has retracted considerably, the mucous membrane still embraces the glans. This must be slit up with scissors well back to the corona, and the angles of the flaps be rounded off. The mucous membrane should then be turned back, and its edge adjusted to that of the skin. Before doing so it is well to secure the mouths of any vessels that can be seen with fine catgut ligature, but in infants this is seldom needful. The edges of the mucous membrane and skin having been neatly adjusted should be kept *in situ* by a long strip of dry lint six or eight inches long and half an inch wide, applied as follows:—

The glans being well pulled forward by an assistant, the middle of the strip of lint is applied to the under surface of the penis immediately behind the glans. The two ends are then passed over and around the

organ in successive turns, until the root is reached, when they will lie crossed on the lower part of the abdomen, and must be secured in that position by a couple of strips of adhesive plaster.

The advantages of this method of dressing are that the orifice of the urethra is left free, the cut edges of the mucous membrane and skin are retained in apposition, and the child is unable to pull off the dressings. The tape at the root of the penis should not be removed until this dressing has been applied. It will be observed that no mention of sutures has been made. The fact is that in infants and young lads they are quite unnecessary. If they are used they should be of the finest catgut, and should be placed as near as possible to the edges of the skin and mucous membrane. Such sutures require no removal. The old method of bringing the parts together with a number of silk or wire sutures frequently entailed the second administration of an anæsthetic during their removal. A not uncommon difficulty met with during this operation is the adhesion of the prepuce to the glans penis, especially in the neighbourhood of the corona. Generally these adhesions are easily overcome, but they are occasionally somewhat tough, and require to be broken down with a probe or director. At any rate they should be thoroughly divided, and the prepuce peeled back, so that the furrow behind the corona glandis is distinctly defined.

The after-treatment is of the simplest. The patient must remain in bed for a few days, and the bed-clothes should be kept off the parts by a cradle. On the fourth or fifth day it will be necessary to remove the dressing, and this is most easily accomplished by placing the patient in a warm bath and letting the parts soak for some time. On the removal of the lint it will be generally found that the wound has for the most part healed by first intention. That portion which has not done so will soon fill up by granulation, with little or no distress to the patient. During this process the parts should be protected by a strip of lint spread with vaseline or zinc ointment. A certain amount of œdema, especially in the neighbourhood of the frænum, remains for some weeks after the operation. Although this operation is one seldom attended by danger to life, yet there are cases on record of death from erysipelas and from hæmorrhage after its performance.

In adult cases where the prepuce is not elongated, but the orifice is contracted, the slitting operation will suffice. This may be performed by passing a director underneath the prepuce, and slitting it up with a curved, sharp-pointed bistoury; or a pair of strong, sharp scissors may be used. In either case the incision should be made on the dorsum, and care should be taken to slit the mucous membrane well back to the corona. If the prepuce is elongated a portion should be removed with scissors, the parts being put on the stretch by an assistant taking the two cut angles with a couple of fine spring forceps. These angles should then be rounded off. All vessels must be tied with fine catgut, and the edges of the skin and mucous membrane united by several sutures of the same material.

The wound should then be dressed with a strip of lint soaked in carbolic oil (1–20). The sutures, if any of them require removal, may be taken out on the third or fourth day. PAUL SWAIN.

CIRSOID ANEURISM.—*Definition.* A tortuous and dilated condition of the medium-sized and smaller arteries of a part, extending to the smallest branches, where it terminates in a central pulsating tumour. The vessels especially predisposed to the disease are the branches of the external carotid artery distributed to the scalp; but the arteries of the extremities, scrotum, and trunk are not infrequently the subject of attack. The so-called 'aneurism by anastomosis' of the orbit rarely belongs to the same category.

Etiology.—The conditions which predispose to, or excite, the disease are ill-understood. The tumour generally makes its appearance in early childhood, but may be congenital in origin, or may not appear until adult life. As a rule no cause can be demonstrated, but the morbid changes occasionally extend from a pre-existent nævus, or a more or less satisfactory history of local injury may be forthcoming.

Symptoms.—In a typical case cirsoid aneurism appears as a pulsating tumour fed by a number of dilated tortuous arteries. The tumour is usually moderately prominent, ill-defined at its periphery, somewhat lobulated on the surface, soft in consistence, reducible by direct pressure, and collapsing to some extent during compression of the main vessel. The superjacent skin may be thickened and of normal aspect, or atrophied and more or less transparent. The surrounding tributaries are contorted and irregularly dilated, gradually assuming their proper form and dimensions as they approach the main trunk. A thrill and *bruit de souffle* may

be detected over the centre of the growth and for some distance along the course of the afferent vessels.

The whole of the tissues in contact with the diseased vessels undergo atrophic changes, and the subjacent bones may be deeply grooved or even perforated. The temperature of the parts does not usually differ perceptibly from the normal register, but an elevation of between 1° and 2° Fah. has been observed in one case. The affection is sometimes associated with a local neuralgia, but, as a rule, it is painless. The course is variable. In some instances the disease advances progressively from the first, while in others it may remain stationary for long periods, but usually tends to increase rapidly about puberty, or, in women, during pregnancy. In the latter stages hæmorrhages may become frequent and dangerous.

Pathological Anatomy. — The central pulsating tumour has been found to consist of a closely aggregated mass of dilated arterioles transformed into a kind of cavernous tissue by partial absorption of the contiguous walls of the component vessels. The intimate changes in the afferent arteries vary with the period of the disease. In the early stage the walls are said to be thickened, but after a time atrophic lesions supervene, and the tunics become thinned and irregularly dilated into a multitude of pouches. Traces of fatty degeneration have been discovered by some observers in the muscular coat (Labbé, Heine). The veins seldom display any marked changes, notwithstanding the vastly augmented capacity of the arteries.

The true nature of the morbid process is not fully elucidated by the visible alterations of structure. It is still uncertain whether the disease is to be regarded as an active ataxy with hyperplasia, according to which view it may be classed as a vascular neoplasm (Virchow); or whether the first link in the chain is a diminished resistance of the arterial wall, induced either by subacute inflammation (Billroth), or fatty degeneration (Robin, Labbé) of its tissues. It is possible that neither of these views need be rejected, but that some cases may be allied to nævus, in which they are occasionally found to originate; while in other instances a subacute arteritis, with implication of the nervi and vasa vasorum, may be determined by local injury, and of this condition fatty degeneration may be a later stage. Polaillon (*Bull. Soc. de Chir.* 1884) assumes that the essential feature of the disease is an abnormally free communication between the arteries and veins, and he believes the arterial changes to be secondary to this. The theory, however, does not touch the primary cause of the lesion, nor does it explain how such a condition, which would imply a lessened resistance to the flow of blood into the veins, operates in producing dilatation and flexuosity of the afferent vessels.

The *rôle* of local injury in the primary causation appears more important than has been hitherto believed, particularly when the early period of its development in most cases, and its very frequent localisation to the scalp, are borne in mind; the cranium not only being a part especially liable to damage in the course of parturition, and by falls during the first few years of life, but one in which the counter-pressure afforded by the bone would render the effects of contusion upon the vessels of the scalp more serious and lasting than in other localities.

Treatment.—There are few non-malignant affections in surgery which have proved more rebellious to treatment than cirsoid aneurism; but it is difficult to avoid the belief that the overwhelming list of failures is, in part at least, attributable to an imperfect conception of the nature of the disease, and to the consequent adoption of wholly inadequate measures for its removal. The problem appears to have been regarded as capable of solution by the same processes of reasoning that have been so profitably applied in the treatment of ordinary aneurism; but there are special features in the cirsoid tumour which so far remove it from surgical aneurisms that the means likely to afford every prospect of success in the latter case must almost assuredly fail in the first. In place of a diverticulum from the vascular wall, out of the direct line of the circulation, and offering conditions eminently favourable to the deposit of fibrinous particles from the blood and to coagulation of the fluid *en masse*, when the hurry of the current can be sufficiently moderated, we have to deal with a multitude of dilated vessels which, though tortuous and sacculated, retain a smooth lining throughout, and offer nothing to interrupt or retard the stream which courses rapidly through them to escape by the veins. Their calibre is always adaptable to the quantity of the circulating fluid, and hence there is no tendency to stagnation of blood, however much the flow becomes diminished in amount. Even the smallest rivulet would be sufficient to maintain the patency and vitality

of the diseased vessels until the temporarily enfeebled circulation is restored to its full vigour by collateral supply.

In the treatment of cirsoid aneurism the efforts of the operator have been directed, in the greater number of cases, towards the arrest of the circulation through the focus of disease, either by ligature or acupressure of the individual afferent vessels, or one or more of the larger arteries. It is obvious, however, that in the case of a cirsoid tumour of the scalp it is impossible to secure every one of the tributary branches that converge towards the affected centre. To tie the external carotid leaves open not only all the mesial anastomoses, but many channels of communication with branches of the internal carotid, subclavian, and vertebral, any one of which would suffice to prevent any permanently beneficial result from the operation. Ligature of the common carotid removes only one of the sources of failure; ligature of both carotids brings us a step further, at a risk greatly in excess of the advantage gained; but it is only by tying every great vessel in the neck that the circulation in the tumour could be brought to a standstill. So far is the plan of treatment irrational that the sole cause for astonishment at the published results (which are not likely to be more unfavourable than the results withheld) is that, amid the host of failures and disasters, two or three successes have found a place. It is probable, however, that the cures in question were due to secondary inflammatory processes rather than to the immediate effects of the ligature.

The various methods of treatment may be classified as follows:—(α) Means intended to cut off the circulation through the tumour: such as acupressure of the aneurism and ligature or compression of the afferent vessels or large trunks. (β) Those which aim to induce coagulation of the blood in the dilated vessels: as galvano-puncture and injections of perchloride of iron. (γ) Those by which the whole of the affected tissues are destroyed: as caustics; and, lastly (δ), those undertaken for the entire ablation of the diseased part.

1. *Direct compression* of the tumour has not only been found useless, but is by no means free from danger.

2. *Ligature or acupressure* of the individual afferent arteries has been frequently practised, but with most unsatisfactory results. Out of 13 cases of cirsoid aneurism of the head, collected by Lefort, 11 are noted as failures with 2 deaths, and only 1 appears to have been completely successful (*Dict. des Sciences Méd.*).

Ligature of the larger trunks in similar cases has met with no better reward. Ligature of the external carotid has never succeeded. Of 24 cases of ligature of the common carotid, no less than 23 failures, including 10 deaths, appear against a single success: in two of the instances the operation was undertaken on account of secondary hæmorrhage following a useless ligature of the external carotid. In 9 cases of ligature of both common carotids, two cures are recorded, and the 7 failures included one death. The double operation in the well-known case of Mussey (*London Medical Gazette*, vol. viii.) had so little effect upon the circulation in the tumour, that when the latter was excised a few weeks afterwards the patient lost four pints of blood, and it was necessary to secure forty vessels. The analysis of 26 cases of cirsoid aneurism of the hand collected by Polaillon proves that here also operations upon the afferent vessels give only negative or uncertain results.

The statistics of ligature are so unfavourable as to be almost prohibitive of the operation as a means of cure, but as an adjunct to excision and some other measures it requires further consideration.

3. *Ligature of the tumour en masse*, when practicable, is a more scientific procedure, and has been carried out with success by Foubert and Bryant. Mr. Bryant records two cases, in one of which, however, the disease recurred four years afterwards, and was finally removed by excision. Lefort recommends that the afferent vessels should be secured, as a preliminary step.

4. *Destruction by caustics.*—This method of treatment is theoretically open to some objections, but in one case reported by Bonnet, in 1858, a cure followed the application of chloride of zinc paste over the afferent vessels and afterwards over the whole tumour.

5. *Coagulation of the blood in the diseased vessels.*—Electro-puncture has been successful in one case, and carefully applied in association with circular compression of the afferent vessels would involve but little risk if the needles be connected with the positive pole. Injection of perchloride of iron has been employed more frequently and with variable success. Out of 10 cases collected by Le Fort, 8 terminated in cure, but of the 2 failures 1 proved fatal from septicæmia; while Zielewitz records 6 deaths in 14 cases. It can only be performed safely in conjunction with circum-

ferential compression (continued for half an hour after the injection) or ligature of the afferent vessels. A solution of the strength of 5 per cent. to 10 per cent. would be suitable for the purpose.

6. *Removal by excision.*—This apparently formidable procedure is not only the most certain mode of cure, but, if carried out with due precautions, is comparatively free from danger. The ablation of a cirsoid aneurism of any size would, however, lead to enormous hæmorrhage, unless preceded by some measures for limiting the access of blood to the part. Hitherto the excision has rarely been performed except as a last resource after the afferent vessels or larger trunks have been tied without benefit, and under these circumstances, owing to the speedy establishment of collateral circulation, the advantages of the ligature are lessened in proportion to the time allowed to elapse between its application and the removal of the tumour. Thus, in Mussey's case, although both common carotids had been tied, the hæmorrhage was terrific when excision was performed a few weeks later. To secure the best results it would appear advisable that the ablation should be *immediately* preceded by the ligature or acupressure of every accessible tributary; the smaller unsealed arteries could then be seized as soon as exposed, and the operation would probably be completed without serious loss of blood, while the special risks appertaining to the ligature of the larger trunks, and particularly of the common carotid, would be evaded. In cirsoid aneurism of the hand, amputation of the member may be performed should coagulants and other measures fail.

It has been observed that the dilated and tortuous arteries tend to return to their normal condition after the cure or removal of the pulsating tumour. This fact indicates the latter as the starting-point of the disease, but still leaves its intimate pathology open to discussion.

In conclusion may be noticed two measures which have been tried with success, each in one instance—the use of setons after ligature of the supplying vessels (Southam), and circular section of the tissues around the tumour, also after preliminary ligature of the afferent arteries, followed by compression in the line of the incision (Verneuil). William Anderson.

CLAVICLE, Dislocations of the.—The clavicle may be dislocated at its acromial or sternal extremities. The acromial dislocations, which are the most common, will be described as dislocations of the scapula. In spite of the simple arthrodial nature of the clavicular joints, and of the exposed situation of the bone, injuries from falls upon the shoulder commonly result in fractures of the clavicle or in dislocations of the shoulder-joint, and but very rarely in displacement of either extremity of the clavicle from its articulation, as dislocation is prevented by the strong supplementary ligaments of these joints.

The *sternal end* of the clavicle may be dislocated in three directions—*forwards*, *backwards*, and *upwards*. These might be conveniently named the ante-sternal, post-sternal, and supra-sternal dislocations of the clavicle.

The *forward dislocation* (ante-sternal), is usually caused by violence applied to the anterior part of the shoulder, forcing the outer end of the clavicle backwards. In children it may be caused by lifting them by the arm, and Fergusson mentions a case which happened during birth. It may be *partial*, in which case the end of the clavicle projects somewhat beyond its normal level, and may be readily pushed back; or it may be *complete*. In the latter case the displaced bone passes forwards, inwards, and somewhat downwards upon the sternum, where it forms a very distinct projection. It could only be mistaken for a fracture close to the articulation or a separation of the epiphysis. By extending the shoulders, which may be effected by the knee pressed on the spine, aided by pressure on the dislocated bone, the deformity is readily made to disappear, but the difficulty of retaining the bone in position after reduction is very great. The treatment usually adopted is to put the arm up in precisely the same way as for fracture of the clavicle, with the addition of a pad secured by strapping over the sternal end. In the case of a lady it might be worth while to insist on the recumbent position being maintained till firm union had been secured. In any case the arm must be retained in bandages for six weeks or two months. Even then a false joint is a common result; but such a termination gives rise to little impairment of the usefulness of the limb. Hamilton relates a case in which he found it impossible from the first to reduce the dislocation, and the bone was left in the position in which it was found. Putégnat has recorded the case of a girl of seventeen who could voluntarily produce forward dislocation of both clavicles as an amusement. The double luxation had followed a severe fall upon the hands.

Dislocation backwards (post-sternal) may be produced by a fall on the back of the shoulder, forcing the outer part of the clavicle forwards, or by a direct blow upon the inner end of the bone, or by lateral compression of the shoulders. It has also been brought about gradually by extreme curvature of the spine. In order of frequency it stands next to dislocation forwards. The bone is not driven simply backwards, but becomes lodged between the upper edge of the sternum and the trachea, causing dyspnœa, difficulty in swallowing, and pain in the neck—symptoms which the patient endeavours to relieve by bending his head forward, and which are increased by throwing the head back. In a case related by Pellieux, however, these severe symptoms were not present, owing probably to the end of the clavicle not having been caught behind the edge of the sternum. In the position of the prominent end of the clavicle a depression is present, into which the finger may be dipped. The acromion is somewhat nearer the median line, and the clavicle is directed from this point inwards and backwards. In a case dissected by Erichsen, the rhomboid ligament remained unruptured, and had carried away with the clavicle the cartilage of the first rib.

The treatment of backward dislocation has been more successful than when the bone is displaced forwards. The deformity is easily reduced by placing the knee on the spine and drawing the shoulders back. To retain the bone in position, the shoulders should be fixed to a broad splint placed transversely behind the scapulæ. The splint should be thickly padded, or a small pillow may be introduced between it and the spine. The shoulders should be retained in this position for two or three weeks, after which time the splint may be removed, but the movements of the shoulder on the affected side should be restrained for two or three weeks longer.

Dislocation upwards (supra-sternal) is produced by a force acting from above on the point of the shoulder, by which the acromial extremity of the clavicle is driven downwards and inwards. The sternal end is in this way torn from its attachments, and rises between the sternal head of the sterno-mastoid and the sterno-hyoid muscles; at the same time it passes inwards so as to lie above the sternal notch, and may reach, or even pass under, the edge of the sterno-mastoid of the opposite side, as in a case observed by Malgaigne. Bryant describes the case of a young woman seen by him two years after she had been crushed in a crowd, where there was displacement of the inner extremities of both clavicles, which, by pressure upon the shoulders, could be made to touch. R. W. Smith obtained a dissection in one case, and found all the ligaments, including the rhomboid, torn, and the inter-articular fibro-cartilage separated from its sternal attachment.

The symptoms are depression of the shoulder, which approaches nearer the median line, and visible elevation of the sternal extremity of the clavicle. The sternal origin of the sterno-mastoid muscle is pushed forward by the bone, and a depression can be felt at the site of the damaged articulation. The displaced bone encroaches upon, and partially or completely obliterates, the episternal depression. The dislocation is easily reduced by raising the shoulder, and at the same time drawing it back.

For this dislocation the writer is inclined to think Velpeau's suggestion is the best. This surgeon carried the elbow forward so that the hand rested on the sound shoulder, then supported the elbow, and bound the arm to the side by means of a dextrine bandage, which was kept on for fifty days. When the elbow is carried forward, the humerus may be used to push the acromion upwards and backwards, and the writer has found this position of great service in treating dislocation at the acromial extremity of the clavicle.

Simultaneous Dislocation of both ends of the Clavicle.—There are four recorded cases in which at the same time that the sternal extremity of the clavicle was dislocated forwards, the outer end was displaced above the acromion. To treat such a case it is necessary that the shoulders should be drawn well back, and retained in that position whilst a compress is placed over the bone to steady it.

R. Clement Lucas.

CLAVICLE, Fracture of the.—This bone is commonly fractured at all periods up to advanced life; but nearly half the cases are those of children under six. Several instances of intra-uterine fracture of this bone by external violence are on record. The fracture may be transverse, or very oblique; incomplete (greenstick), multiple, or comminuted; it is very rarely compound. The break is most commonly situated at the outer part of the middle third, where the bone is small, and where the two curves meet, but any part may

give way. Owing to the absence of displacement and of crepitus, incomplete fracture is apt to be overlooked. When displacement occurs, the sternal fragment is more or less tilted up by the sterno-mastoid, and the acromial end is carried downwards and inwards by the weight of the arm and the action of the surrounding muscles. The sternal end thus overrides the acromial. This position is, very occasionally, reversed. The sternal end, when short, has been seen nearly erect. Occasionally both clavicles are broken.

Symptoms.—The shoulder drops inwards, downwards, and forwards, so as to contrast strongly with the opposite side, with which it should always be carefully compared. The patient leans over to the injured side, and often supports the elbow with the other hand. Deformity of the bone can be felt, and often seen. Swelling over the fracture is often well-marked. Crepitus is felt, if not before, by raising and drawing back the shoulder so that the fragments are brought into contact; there is acute pain at the seat of fracture, especially on movement; rarely ecchymosis. In children displacement is usually slight, and the only signs are pain, swelling, and a momentary 'click' on movement. At the sternal end fracture produces slight displacement; at the acromial end considerable; in fracture between the conoid and trapezoid ligaments displacement is very slight, or entirely absent. The vessels and brachial plexus generally escape injury; but cases of rupture of the artery, and others of the subclavian or internal jugular vein, and many of paralysis of the arm from injury to the brachial plexus, have been recorded. Paralysis may be caused by ill-applied pads and compresses. Failure of union is very rare. The functions of the arm are regained, even though deformity is considerable.

Treatment.—It is often difficult or impossible by any apparatus to keep the fragments exactly adjusted. Deformity and bony swelling are most securely prevented by keeping the patient in the horizontal posture, with the shoulders resting on a flat mattress, for a fortnight or three weeks, but few care to submit to this treatment. The old figure-of-8 bandage has been generally discarded. Many complicated appliances have been proposed as substitutes, but simple means are the most efficient. A wedge-shaped pad may be placed base upwards in the axilla, the elbow drawn a little backward on the chest, and it and the forearm be raised and supported by a sling passed over the opposite shoulder. The arm should then be securely, but not tightly, bandaged to the side. The bandages should be sewn together here and there, or brushed over with starch, to fix them. Ellis's apparatus, consisting of a crutch-pad, sling, and strap for the arm, conveniently carries out this plan; or Sayre's method, which seems at present to be generally popular, may be used:—'Two strips of plaster, spread on moleskin or strong calico, are cut, each three and a half inches wide for an adult: one long enough to encircle first the arm and then the body completely; the other to reach from the sound shoulder over the elbow of the broken limb, and across the back obliquely to the point of starting. The first piece is looped around the arm just below the axillary margin, loosely enough to avoid constriction, and the loop is strongly sewn. The arm is then drawn downwards and backwards, so that the pectoralis major is put on the stretch, and the long end of the strapping is then carried completely round the body, and is stretched to itself on the back. The second strip is then applied, commencing on the front of the shoulder of the sound side, is thence carried over the top of the shoulder, diagonally across the back, under the elbow, diagonally across the front of the chest to the point of starting, where its ends are securely sewn together. A longitudinal slit is made in the plaster to receive the point of the elbow. Before laying the plaster across the elbow, an assistant must press the elbow well forwards and inwards, and it must be held firmly in this position until the dressing is completed. It will now be seen that the arm has been converted into a lever, whose fulcrum is the loop of plaster at the lower margin of the axilla, and upon this it is believed that, in a great measure, the efficiency of the apparatus depends.' Hamilton does not favour this method, nor can the present writer. He agrees with Hamilton that, when all has been said, some simple appliance, consisting of a sling, an axillary pad, and a bandage to keep the arm to the side, is still the best that can be used. Union is generally complete in children in about three weeks; in adults in from a month to five weeks. Should stiffness of the shoulder-joint remain, the limb should be gently moved through its full range when the patient is under the influence of an anæsthetic. For this purpose nitrous oxide gas is generally quite sufficient. In comminuted fractures, should there be evidence that the vessels are pressed upon, the

patient should be confined to the horizontal position, with the arm slightly drawn away from the side. HOWARD MARSH.

CLAVUS. *See* CORNS.

CLEFT PALATE, The Mechanical Treatment of.—The successful treatment of a cleft palate by a mechanical appliance is dependent upon a clear recognition of the conditions that are essential in the treatment of all cases of cleft palate, whether the method be surgical or mechanical.

These conditions are:—

(1) The restoration of continuity of surface in the palatine arch.

(2) Separation of the arch of the palate from the floor of the nose.

(3) The possibility of cutting off communication between the mouth and the naso-pharyngeal cavities, at the will of the patient, by contact between the edge of the free border of the palate and the posterior wall of the pharynx, irrespectively of the nature of the means by which the *velum palati* has been restored.

It does not come within the scope of the present article to indicate how far these conditions may or may not be fulfilled by the operation of staphyloraphy. It is only necessary to indicate the nature of the various appliances that have been invented and used for the treatment of congenital fissure, dealing, however, only with those that possess some element of utility combined with novelty.

It is unnecessary to enter into the details by which an impression is obtained of the mouth with its fissured soft palate, soft and hard palate, or even fissured soft and hard palate and alveolar arch. Whether the cleft be limited to the uvula, or pass through to the front of the mouth and be combined with single or double hare-lip, is a matter of but little moment for our purpose. It simply resolves both deformity and treatment into a question of degree, and does not affect the principles involved in treatment.

Starting with the assumption that a perfect model of the mouth has been obtained, three methods of dealing with the case present themselves for consideration.

We will discuss the simplest way first. This consists in adapting a gold, platinum, or thin vulcanite plate to the front part of the mouth, filling up all gaps in the dental arch with artificial teeth, and covering over any portion of the fissure that may exist in the hard palate, and restoring it to symmetry of form and relative smoothness of surface. Such a plate is held in position by bands passing round the natural teeth, and, as a rule, covers the whole of the anterior part of the mouth and passes backwards nearly to the boundary of the normal hard palate. Attached to the posterior margin of the plate by means of studs, screws, stitches, or clamps, we have an artificial *velum palati*, made of elastic rubber, either moulded expressly for the particular case or cut out of a sheet of elastic varying in thickness according to the size of the cleft and the age of the patient; thus, for a child under ten years of age, 2 millimetres thick would be sufficient, whilst for an adult it may be 3 millimetres or even 4 millimetres with advantage. The elastic flap must extend back to such an extent that, by the upward pressure of the tongue, the artificial velum will be brought into absolute contact with the posterior wall of the pharynx.

Here it will be seen that we fulfil most of the conditions that have been laid down as essential to successful treatment by mechanical means. We have simplicity of construction, and an appliance that can be worn with relatively little trouble; but against this we have an elastic velum that, from its nature, must of course be perishable and apt to break down in texture, and become offensive in odour if not kept very clean and frequently renewed. It must be further observed that the whole appliance is very much of the nature of a valve covering an opening, and is not in any sense a plug or obturator in relation to the lateral boundaries or walls of the cleft. It will also be seen that the elastic velum, attached at one margin only, does not in any way represent the tense, resonant surface of the normal soft palate. The cases treated by this method have, however, given exceedingly satisfactory results in many instances, and the name of the late Mr. Edwin Sercombe, who did much to make it popular, should always be remembered in connection with this form of artificial palate.

Following on the lines of Stearn (an English surgeon who wrote about 1845), Dr. Kingsley, of New York, introduced, in 1864, a very perfectly constructed form of elastic velum which at once fulfilled nearly all the conditions that the writer has already stated to be essential. The Kingsley velum was, roughly speaking, of the nature of a stud, and, if we think of the fissure as like a button-hole torn open at one end, it will be easier to understand how the stud passed through the open end of the button-hole and

by being kept forward at the perfect end of the button-hole, became self-supporting; in other words, there was a flap to reproduce the floor of the nares, a flap to restore the palatine arch, and the two flaps were held together by a stem that was fitted to the margins of the cleft. All this being in one, and made of elastic rubber vulcanised in metal moulds, a very beautiful appliance was produced; and when fixed in the mouth by attachment to a gold plate fitting the lingual aspect of the teeth, the elastic velum moved up and down with the muscular movements of the divided soft palate, and could be brought into contact with the posterior wall of the pharynx. The earlier instruments made by Kingsley have not been described, as they were wrong in certain details and unnecessarily difficult to make, and, from their extreme tenuity, wore out very quickly. The modified Kingsley velum, however, is a most useful invention, and has been applied in a large number of cases by the late Mr. Ramsay and the writer. The only objections to it are its destructibility by the secretions of the mouth and nose, and its want of resonance as compared with other materials. It will be recognised at once that Kingsley's velum is partly of the nature of a valve and partly of the character of an obturator, plugging up the cleft.

The third method of mechanical treatment to be considered is due to the inventive faculty of Dr. Wilhelm Süersen, of Berlin. It consists of an obturator made of hard rubber, the fore part fitting around the teeth and covering the hard palate, and the rest filling up the gap of which the margins of the fissure and the wall of the pharynx are the boundaries. The front portion is of no moment; its use is obvious—namely, to support the part of the instrument that fills up the cleft. The obturator proper, however, is very interesting in form, though commonplace in material and construction. It consists of a pyramid having its base parallel with the posterior wall of the pharynx and its apex towards the anterior point of the cleft. One side of the pyramid is on a plane with the natural palate in so far as it exists, the upper side forming the floor of the nares, and grooved down its centre for the free passage of secretion. The two remaining sides of the pyramid are in contact with the lateral margins of the cleft, but do not fit so closely as to produce any pressure when the palate is in a state of repose; but as, in the process of swallowing and in the utterance of certain sounds, the muscles of the palate are drawn upwards and increased in volume laterally, so pressure is exercised upon the rigid obturator, and perfect occlusion between the mouth and the nose takes place along the margins of the cleft. At the same time, the muscular tissue of the upper and posterior part of the pharynx is thrown into well-marked action, with the effect that the space between the base of the pyramid and the wall of the pharynx is completely blocked up by the increased bulk of the muscles in this position; thus the naso-pharyngeal cavities are separated from the mouth coincidently with the closure of all communication between the nose and the oral cavity.

Such an appliance offers the following advantages over those already described:—It is easily kept clean. It does not undergo any change in texture by use in the mouth. It cannot easily be broken or damaged; and, above all, it produces a far more resonant quality of voice than if an elastic velum be used, and this resonance is still further increased if the lower surface of the palate, with the front portion, be made of gold.

The most perfect appliance will produce, however, the most disappointing results unless the patient be intelligent and painstaking. It must always be borne in mind that the restoration of an organ is not the restoration of a function, but simply a means to that end. Hence, where the work of the dental surgeon leaves off, the skill of the teacher of elocution should begin.

OAKLEY COLES.

CLEFT PALATE, The Surgical Treatment of.—The palate may be congenitally cleft in very varying degrees, from a bifid uvula, which represents the simplest form and the slightest extent of the deformity, to a complete separation of all the structures forming the hard and soft palate.

The soft palate may be cleft to uncertain degrees, but it is rarely completely divided without there being at the same time some want of union of the palate-bones.

The hard palate, consisting as it does of six symmetrical bones, usually presents one of three degrees of non-union in the middle line, viz. either the palatine portions of the palate-bones are alone separated, or with them the palate-plates of the superior maxillary bones are cleft, or, in addition, the intermaxillary bones and alveolar arch are divided.

The failure of union is usually rather to the left side of the middle line; and, in clefts involving the hard palate, the septum nasi is generally united at its lower border

with the right maxillary bone; but in some of the worst cases the bony septum of the nose hangs free, at its lower edge, being altogether unconnected with the bony palate. Clefts of the hard palate alone are scarcely ever met with; occasionally the failure in the process of union shows itself in the existence of congenital holes in the middle line of the palate, but these are very rare as a congenital defect, though they may be seen as the result of disease.

Symptoms.—The defect, if combined with hare-lip, is usually sufficiently obvious. In the slighter degrees of cleft-palate there may be no such interference with suction and deglutition as to attract attention; while in some cases the only noticeable symptom is the occasional escape of milk from the nostrils. More frequently the child cannot suck at all; or, if able to suck, it can only swallow a small quantity, the greater part of the milk escaping by the nostrils. Among newly-born infants, in any case of unexplained difficulty in taking food, it is well to examine the condition of the palate.

Treatment.—Since the only inconveniences of cleft-palate in early infancy are connected with suction and deglutition, the only treatment required at this age has for its object to secure a sufficient supply of food. Where a child cannot suck or retain its food, an attempt should be made to give nourishment very slowly, with a small spoon passed far back into the mouth, or, as recommended by Mr. Coles, an ordinary feeding bottle may be used, having a thin leaf-like sheet of india-rubber fixed above the teat, sufficiently large to occlude the cleft in the palate.

In many cases the child can be fed from a bottle with an india-rubber teat big enough to fill the gap in the palate; the teat having a large hole on the under side near its extremity, so that the milk can easily escape. Even in the worst cases children can be fed by using an old-fashioned flat feeding-bottle having a large teat, with a hole in its extremity through which food can be poured into the pharynx at suitable intervals by tilting the bottle.

Age for operative treatment.— The earlier in life the defect is remedied the more satisfactory will be the result as regards the perfection of articulation, and cases have occurred in the writer's experience where, after a successful operation at a very early age, no defect whatever has been noticed when in due time the patient had learned to speak. But the age at which the operation should be performed must vary with the nature and degree of the cleft, and the health and vigour of the patient. Doubtless the deformity can be cured in very early infancy, but regard being had to the difficulty and even danger of the proceeding, and the many possible causes of failure at this period of life, it is prudent to postpone operative treatment.

In the first three or four years of life, clefts of the bony palate generally diminish greatly in width, especially at their anterior extremity, where in the process of growth fissures in the alveolar arch may be observed to close altogether by coalescence of their opposite edges. Thus with the lapse of time the operation becomes less difficult of performance and no longer dangerous.

None but very general rules can be laid down as to the best time for operating, since each case must be judged on its own merits, and every surgeon will be guided chiefly by the results of his own experience. In deciding this question, the difficulty of the operation and the constitutional condition of the patient must be taken into consideration, and in estimating the difficulty of the proceeding, regard must chiefly be had to the width of the cleft in relation to the amount of material available for its closure.

In the case of the soft palate, this may easily be estimated by observing the width and thickness of the sides of the velum; in clefts of the hard palate the pitch of the palatine arch should chiefly be noticed, for the higher the palatine arch the more material will be available for flaps. The union of the septum nasi with one maxillary bone is also a favourable condition, as furnishing on one side at least an abundant flap; the mere length of a cleft adds little or nothing to the difficulty of closure.

In healthy children, clefts involving the velum only, without deficiency of the soft parts, may generally be cured in the third year of life. Fissures which affect the soft palate and more or less of the hard, may, as a rule, be closed before the end of the sixth year, if the cleft be not very wide and there is a sufficiency of material for flaps.

In cases of unusual local difficulty, or where the general health is feeble or there is considerable infirmity of temper, the operation may need to be still longer postponed; but, if the case be curable at all, it is rare that this cannot be accomplished before the patient is twelve years of age. When, from one cause or another, the operation has been long delayed, though a successful union may be more easily obtained, the

results as regards articulation will be less satisfactory.

Order of operation.—There is some difference of opinion as to whether the union of the hard and soft palate should be attempted in one operation. The writer believes he has sufficient experience to justify him in recommending that the whole cleft should be closed at one and the same time, unless there are circumstances of peculiar difficulty in the case. When the bringing together of the whole cleft in one operation would necessitate so free a division of the soft parts as to endanger the vitality of the flaps, it is advisable to close first that part of the cleft that can be most easily approximated, whether it be the hard or the soft palate. This, if successful, will secure for the remaining portion a large supply of blood in the subsequent operation.

Instruments.—A cleft-palate case should contain—two sharp-pointed tenotomy knives mounted on long handles, for paring the edges of the cleft; one blunt-ended knife of the same kind, for making lateral incisions to relieve tension; a small rectangular knife (Fergusson's), for tracing a flap, when one has to be brought down from the septum nasi.

Two pairs of long forceps—one mouse-toothed, the other serrated; a fine double hook. A pair of strong sharp-pointed scissors curved to a quarter circle, for dividing the connection of the soft palate with the nasal mucous membrane, at the posterior margin of the hard palate. Two raspatories curved as an aneurism needle; one raspatory very slightly curved. Two needles with eyes at the point mounted on long handles, for horsehair or silk; an instrument for catching these sutures at the eye of the needle.

A tubular needle with reel at the base for passing silver sutures, and a wire twister.

A gag of some kind is essential; it should be strong enough to keep the jaws open, and so arranged as to dilate the orifice of the mouth as much as possible, while it depresses the tongue. As is natural, the writer prefers the gag known by his name, but it may well be that other instruments of a similar kind are quite as useful. Cases are met with where the continued depression of the base of the tongue causes difficulty in breathing; for these the gag invented by Mr. Coleman or Mr. Mason is specially adapted; it leaves the tongue free and occupies but little room in the mouth. If this be used the tongue should be held down by a rectangular spatula.

The needles for passing horsehair or silk should be on long, slender handles; they should be rectangular in their curve, flattened laterally, and having a round eye close behind the point.

The best materials for sutures are well-annealed silver wire and horsehair; the wire for the hard palate, or for any part of the soft palate, anterior to the uvula, where there may be tension, the horsehair for the uvula, and the lower and more flaccid part of the velum. Both the wire and the horsehair should in their size be proportioned to the thickness and consistence of the parts to be brought together, that used for the uvula being thinner than should be employed for the velum itself.

Operation.—The patient having an empty stomach, though being in no want of food, may be conveniently placed in the recumbent position on a narrow table in front of a window, the head, thrown well back, being held on a firm pillow by the assistant who also takes charge of the gag. As a support for the head a small inflatable air-cushion is to be preferred. Two assistants are required besides the administrator of chloroform, one to steady the head and hold the gag, the other to assist in the actual operation. The complete quietude of the patient should be secured by means of a wide strap passed across the thighs and beneath the table; to this strap the hands should be loosely tied.

Operation on the Soft Palate.—The patient being under chloroform the gag should be introduced, the jaws opened, the tongue tucked under the tongue-plate, and the patient's head and gag entrusted to an assistant.

The edges of the cleft may best be pared from below upwards, the point of the uvula being held with the toothed forceps, to render the palate tense. The sponge should be sparingly used, as it tends to produce vomiting, and the flow of saliva increases. Sutures may also be conveniently passed in the same order, and be fastened, if the palate will come together, and cut off, one after another as they are fastened; one suture, the last passed, being always left in the palate, uncut, to be used to draw forward the margins of the cleft, to assist in passing the next suture. The sutures should be passed through both sides of the palate at one transit of the needle, and if the cleft will come together they should be fastened off at once—the horsehair by tying, the wire by twisting.

When there is too much tension to admit of the sutures being tied at once, they

should all be passed, and, being loosely twisted, the long ends may be cut off, and longitudinal incisions may be made on either side, parallel to the cleft and just internal to the hamular process, avoiding the immediate neighbourhood of the posterior palatine foramen. It is well to make this incision with a blunt-ended knife, after puncturing the palate with a sharp-pointed knife. Sufficient relaxation being obtained, the remaining sutures should be quickly fastened off by twisting with torsion forceps.

In cases where the cleft involves more or less of the hard palate, when the soft palate has been closed, so far as it can be without undue tension on the sutures, the operation on the hard palate can be at once proceeded with, if there is nothing in the patient's general condition to forbid it.

Operation on the Hard Palate.—If there is sufficient material for closing the palate the mucous edges of the cleft may be pared. If there is any doubt about this, the proceeding must be dispensed with, as involving a waste of flap.

To bring down the muco-periosteum from the bones, a mere puncture should be made down to the bone with a scalpel, midway between the teeth and the margin of the cleft and opposite the middle of the cleft, midway between the anterior angle of the cleft and the posterior margin of the hard palate. Through this puncture the least curved of the raspatories should be thrust between the periosteum and the bone, and be pushed onwards towards the middle line until its point appears in the cleft. At this spot one of the more curved raspatories should be inserted, the instrument first used being withdrawn. The curved raspatory should now be used to separate the muco-periosteum from the bone, and this is best accomplished by to-and-fro movements and by careful traction. The periosteum is easily detached until the posterior margin of the hard palate is reached, where the soft palate is firmly attached by fascia and by its connection with the mucous membrane of the floor of the nose.

Curved scissors should be used to divide this attachment, the palate being drawn forward with a hook to put it on the stretch while the scissors are passed behind it. The scissors may now be used with closed blades, as a raspatory, to draw forward the soft parts at the junction of the hard and soft palate and complete their separation from the bone. When the hard palate is cleft up to the incisor teeth there is often difficulty in completely separating the periosteum at the anterior angle of the fissure. Should this be the case a small rectangular knife can be used to free the soft parts.

The muco-periosteum being completely separated from one side of the palate, the assistant should thrust a sponge into the cleft and press the flap firmly against the bone. This will restrain all hæmorrhage, give an opportunity for cleansing the fauces from blood, and allow of the re-administration of chloroform.

The soft parts being separated from the bone on the opposite side of the cleft in the same manner, the sutures may be passed as in the soft palate, silver wire being used and each suture being twisted up as far as practicable without risk of breaking, and cut short, so as to leave about a sixth of an inch projecting.

Tension should be relieved by prolonging the small incisions made for the introduction of the raspatory, forwards or backwards, as the circumstances of the case may require. The incisions should go quite through the palate, and they are best made with a probe-pointed knife. All slack sutures should now be twisted up with torsion-forceps until the edges of the cleft are in exact apposition.

In bringing together this part of the palate, care must be taken to evert the edges of the cleft with a small double hook in passing and twisting up the sutures; this secures the apposition of the raw surfaces of the flaps, and it is especially necessary when the edges of the cleft have not been pared.

During the course of the operation there will be frequent interruptions, necessary either for giving chloroform or for freeing the fauces from blood. During these periods a sponge should always be kept pressed firmly into the cleft. The forceps should be very sparingly used to the palate in the operation. Bleeding is better restrained by sponge-pressure than by syringing. Forceps are the best sponge-holders; with them sponges can be seized or dropped in an instant.

In cases where the material for closing the cleft is scanty, a flap must be brought down from the septum nasi, and this can always be done when the septum, as is usually the case, is united with one of the maxillary bones. This flap should be traced out on the septum with a small rectangular knife, and brought down with a sharply curved raspatory.

After-treatment.—No food should be given until two or three hours after the

operation, or until vomiting has ceased; for the first twelve hours, cold milk, or milk and water, will suffice, and after this time the patient can be fed on lightly boiled eggs, soft bread and milk, rice-milk, cream, custard, stewed fruits, arrowroot, beef-tea, pounded meats, porridge with milk, &c. These, or such as these, may form the chief articles of diet for a fortnight. It is desirable, but not always possible, in the case of children and delicate young persons, to keep them in bed for a week. Sutures of wire or horsehair may be left in for three weeks or much longer; they should not be removed until after a fortnight from the time of the operation. The palate, in young children especially, had better not be inspected during the first week.

The writer has never met with dangerous, or even severe, hæmorrhage after the operation; but should such occur, and ordinary means fail to arrest it, pressure on or in the posterior palatine canal of the bleeding side would almost certainly put a stop to the bleeding.

It is well to recognise that the cure of a cleft palate does not cure the defect in articulation; it does, however, allow of the patient being taught, or of his teaching himself, to speak with more or less distinctness. The perfection of the result in this respect depends mostly on the care taken to correct defects in articulation by systematic instruction; much also depends on the irregularity, or otherwise, of the dental arch, and the stiffness or pliability of the new velum. M. Trélat insists on the advisability of systematic teaching preceding the closure of the palate, and with this object he postpones the performance of the operation until a later date than is advised by many surgeons. He fixes seven years as the minimum age at which the cure should be undertaken, considering that at an earlier date the operation is dangerous, compromising, or useless. THOMAS SMITH.

CLINE'S SIDE SPLINTS are adapted to the shape of the leg and foot. They are usually sold in couples, the inner of which is not provided with a footpiece, possibly with the object of allowing inversion of the foot, when used for Pott's fracture. Splints similar to these, but each having a footpiece, are known as either Cline's, Pott's, or Bell's splints. BILTON POLLARD.

CLITORIS. *See* VULVA.

CLONIC SPASM.—A condition of general spasm with distinct remissions. *See* HYDROPHOBIA.

CLOVE-HITCH, a tie which has the advantage of maintaining a firm hold on the limb to which it is applied without becoming tighter, so long as both ends of the bandage or cord are pulled equally. It is used in reducing dislocations, and is most readily made by forming two simple loops in a jack-towel or bandage, and passing the second loop under that first made.

CLUB-FOOT or TALIPES signifies any deformity of the foot caused by an unnatural contraction of muscle, tendon, fascia, or ligament. The varieties of club-foot are: (1) *Talipes equinus*, in which the heel is raised and cannot be brought to the ground, and the patient walks on the toes and the distal ends of the metatarsal bones. (2) *Talipes calcaneus*, the reverse of the last-named variety, in which the heel is depressed and the toes are raised, so that the patient walks on the former. (3) *Talipes varus*, in which the inner edge of the foot is drawn upwards, and the anterior two-thirds of the foot are twisted inwards, the outer edge resting on the ground. (4) *Talipes valgus*, the reverse of talipes varus, in which the outer edge of the foot is drawn upwards, so that the patient rests on the inside of his foot and inner ankle.

These forms are also found in combination, viz.: (1) *Talipes equino-varus.* (2) *Talipes equino-valgus.* (3) *Talipes calcaneo-varus.* (4) *Talipes calcaneo-valgus.*

Talipes may be either congenital, or may come on after birth. The cause of the congenital variety is very obscure. The writer believes it to be due to disordered nervous function acting on the muscles, which draw the foot into its deformed position; and this opinion is confirmed by the occurrence of talipes in cases of spina bifida.

Non-congenital talipes is due to various causes, chief amongst which are: Paralysis, spasmodic contraction of muscles, rupture of tendon or muscle, and the cicatrices following burns and other lesions.

Although space will not allow the pathology of club-foot to be fully considered, it may be mentioned that, in addition to the contracted condition of muscle and fascia, the bones of the tarsus, especially in congenital cases, will be found slightly altered in shape and size, and displaced from their proper positions.

VARIETIES OF CLUB-FOOT.—TALIPES EQUINUS (in which the heel is raised and cannot be brought to the ground, and the patient walks on the toes). This form of talipes is hardly ever congenital. On

examining a case of simple talipes equinus, the foot will be found to be in a straight line with the leg, neither inverted nor everted, and on attempting to flex the foot on the leg, the tendo Achillis can be felt as a rigid band holding the heel in its raised position. In the majority of these cases nothing else is at fault; but in some, on further examination being made, the arch of the foot is found unduly flexed, and the plantar fascia is to be felt tightly contracted. In some rare cases of an unusually severe nature, the tendon of the posterior tibial or those of the peronei muscles will be noticed preventing the foot being placed in its natural position. In addition to these causes of talipes equinus, in many cases there is considerable stiffness of the ankle-joint, with a contracted state of the ligaments around the joint. This will be found to vary greatly in each case, and in some to be entirely absent.

The *Treatment* of talipes equinus consists in the subcutaneous division of the abnormally contracted tendons and fascia, and, after the punctures made by the tenotome are healed, the gradual extension of the foot by means of a Scarpa's shoe. The amount of force to be used must depend on the resistance caused by the adhesions in and around the ankle-joint. In those cases in which, after division of the contracted tendon, the foot can at once be placed in the natural position, great care must be taken to keep the divided ends of the tendo Achillis in apposition until they have partially united, and to extend with caution, lest the tendon become over-stretched and the case be converted into one of talipes calcaneus. It must be observed, moreover, that when the plantar fascia as well as the tendo Achillis is contracted, it must be divided *first*, as the resistance offered by the contracted tendo Achillis offers the necessary resistance which is required in stretching it. After division of the tendo Achillis, the patient should not be allowed to rest on the foot for at least six weeks, lest the tendon become unduly stretched. After the foot has been brought to its natural position by the means indicated, a boot with a steel support will in most cases be required.

If the case be one of paralysis, and the patient has not the power to flex the foot on the leg, a back-stop must be fixed into the joint of the support, so as to allow the foot to be bent up, but to prevent its falling beyond a right angle with the leg, and the patient should wear the apparatus at night to retain the foot in its proper position, as there is danger of a relapse if this be not done. This deformity being usually due to infantile or other paralysis, it is necessary, when the foot has been brought into a good position, to supplement the weak extensor muscles by some form of elastic support, by which the toes may be raised from the ground in walking. This can be effected either by elastic cords passing from a collar below the knee, supported by a light outside steel from the foot; or, better, a double-curved steel spring can be attached to the outside steel, so as to keep the foot flexed when the weight of the body is not thrown on the toes.

Talipes Calcaneus (in which the heel is depressed and the toes are raised, so that the patient walks on the posterior end of the os calcis) may be conveniently divided into two varieties: (1) True; (2) False. The first kind is well illustrated in congenital cases, when the foot is fixed in its deformed position, and the tendons of the muscles that flex the foot on the leg will be found to be contracted, at the same time that the tendo Achillis is elongated. This variety may also be produced by burns, which leave a cicatrix on the anterior surface of the ankle-joint.

The false variety is by far the more common, and is the result of paralysis of the gastrocnemius muscle. In these cases the tendo Achillis is much lengthened, and the dorsum of the foot can be placed on the front of the leg without any resistance being offered; but there is no contraction of the tendons in front of the ankle-joint. The plantar fascia is generally much contracted. This state of deformity is sometimes produced after division of the tendo Achillis, when sufficient care has not been taken in the after-treatment, and the tendon has consequently become too much elongated.

In the congenital cases, a cure may usually be effected without the division of tendons, by rubbing the anterior surface of the ankle-joint with some oily liniment, and stretching the foot away from the leg and retaining it in position by means of a padded flexible iron splint, at the required angle.

The *Treatment* generally adopted for the relief of the paralytic cases is to have a support fixed to the boot so that an elastic band may be placed at the back of the ankle, in order in some degree to compensate for the loss of power in the gastrocnemius muscle. When the plantar fascia is contracted, it should be divided, and the contraction of the sole overcome by means

of a Scarpa's shoe, having a divided sole with a cog-wheel, and a strap that can be fixed over the front of the foot. This is necessary, as there is no contracted tendo Achillis to work against, as in cases of ordinary talipes equinus. In the case of contracted cicatrix after a burn, the treatment is the same as in the case of similar cicatrices in other parts of the body.

Talipes Varus (in which the inner edge of the foot is drawn upwards, and the anterior two-thirds of the foot are twisted inwards, and the outer edge rests on the ground) is so seldom met with, apart from talipes equinus, that, to save repetition, it will be considered under the heading of talipes equino-varus.

Talipes Valgus (in which the outer edge of the foot is drawn upwards, so that the patient rests on the inside of his foot and inner ankle) is so generally combined with flat-foot that it will be most convenient to consider them together. The congenital form of valgus is not very common; but when it does occur it is of a somewhat severe type, the sole of the foot being slightly convex, while the foot is held in its deformed position by the peroneus longus and brevis. The treatment of these cases is to stretch the foot towards the position of talipes varus, and to retain it there by means of a flexible splint, bandaged to the inside of the foot and leg. If this is found not to be sufficient to overcome the deformity, the tendons of the peroneus longus and brevis must be divided. When the child begins to walk, a steel sole-plate, with an india-rubber pad fixed to it, must be worn in the boot to support the displaced bones of the tarsus, so that in time the patient may regain the natural arch of the instep.

Cases of paralytic valgus are sometimes met with in which there is no flat-foot, and division of the peronei tendons may or may not be necessary, according to whether they are tightly contracted. In either case, a boot with an iron support attached to the outside of the sole, and with a band round the calf, must be worn, and a leather strap with two ends (T-strap) must be fixed to the inside of the boot just below the internal malleolus. The two ends are buckled round the ankle so as to include the iron support, and these pull the foot into its natural position, and retain it there. In addition to these cases of talipes valgus, either congenital or caused by paralysis, many others of a similar nature are met with in various degrees of severity, from a slight sinking of the arch of the foot, to those in which there is even convexity of the inner border of the sole, and in which the inner malleolus nearly touches the ground. In such cases the foot is firmly held in this deformed position by the contracted tendons of the peroneus longus and brevis, and, in the very worst examples, by the extensor longus digitorum and the peroneus tertius.

These cases, for the most part, begin in growing youths and girls, and are brought to the severer type by constant standing or carrying heavy weights. The treatment depends upon the stage in which the deformity presents itself, and cases may be placed under three heads.

1st. On the patient standing up, the whole of the bottom of the foot will be seen to touch the ground, but little or no valgus will be observed. On examination there will be found to be no stiffness in the ankle-joint, and the foot can be freely moved in all directions. The treatment consists in the use of a boot with a wide and flat heel, into which is placed a steel plate, with a pad attached to its inner border, to press up the fallen arch when the patient stands up upon it. It is necessary that the pad should be fixed to a steel plate, or it will be pushed inwards, and becomes useless.

2nd. In the second class, in addition to the flatness of the foot, its outer side is drawn upwards, and the inner malleolus nearly touches the ground. On manipulation, however, the foot can be inverted without resistance. In the treatment of this kind a sole-plate must be worn, as in the first kind; but, in addition, two cross-straps must be fixed to the inner side of the boot, one passing over the ankle, and the other at the back of the ankle, and buckled over, and just above, the external malleolus.

3rd. In this, the most severe form of talipes valgus, the foot will be found on examination to be in the same position as that just described, but the deformity will be somewhat more marked. The chief difference between them, however, is that the foot is firmly held in its deformed state, so much so that it is sometimes thought to be ankylosed at the ankle-joint, and severe pain is complained of around this joint, especially after standing or walking. On an attempt being made to draw the foot inwards, the tendons of the peroneus longus and brevis, and, in many cases, also the tendons of the extensor longus digitorum and peroneus tertius, will be found rigidly contracted. Although this is the most pain-

ful of all forms of club-foot, it is, perhaps, the most satisfactory to treat, for after complete division of the contracted tendons, the foot can be placed without difficulty in its natural position, and, with the use of good boots with sole-plates, the patient is freed from all pain, and able to return to his former occupation. After the tendons mentioned above have been divided, the treatment requires the use of no special instrument, as the necessary extension can be efficiently carried out by means of a padded flexible splint bandaged to the inner side of the leg and foot. If the extensor longus digitorum has been divided, the extension should not be too rapidly proceeded with. The patient may be allowed to walk six weeks after the tenotomy, but it will be necessary that he should wear, as well as a sole-plate, a steel support on the outer side of the leg, with a T-strap, as explained above. *See* Flat-Foot.

Talipes Equino-Varus is that in which the heel is raised, the inner border of the foot being drawn upwards, and the outer edge resting on the ground. The writer proposes to consider it in detail, as it is the most complex, and requires most care and attention in its treatment.

Congenital Talipes Equino-Varus in the Infant differs from that of the adult in that it is less severe, as the foot has not been walked on, and the tendons, ligaments, and fascia have not become so greatly developed and contracted in the deformed position. It will, therefore, be best to consider the treatment of the two forms separately, and to take, first of all, the infantile variety.

The treatment must commence with the cure of the varus, and it is necessary that this should be completely accomplished before anything else is attempted. For it is evident that a simple deformity is more easy to cure than a compound one, and it will be found impossible to overcome the equinus while the varus is still present, for the foot being turned inwards, and the tendo Achillis being shifted to the inner side of the ankle-joint, the attempt to stretch it is made at a mechanical disadvantage, and cannot be satisfactorily accomplished. On the other hand, attempts to stretch the tendons and ligaments which hold the foot in the position of varus are made more advantageously the more the tendo Achillis is contracted; and this is proved by the much greater difficulty that is experienced in the treatment of those cases in which the tendo Achillis has been divided before the tibials, under the mistaken idea that they can be afterwards sufficiently stretched to accomplish a cure. Therefore, it is better to perfectly cure the varus first, and thus produce a case of simple equinus, which can afterwards be readily cured. From the time of birth the foot may be advantageously shampooed, and unfolded, as far as possible, by the nurse; but at the age of six weeks, if the infant is in good health, tenotomy should be practised, and systematic treatment of the deformity begun.

If, in a case of talipes equino-varus, an attempt be made to evert the deformed foot on the leg, and the finger be placed on the inner side of the ankle-joint, the tendon of the tibialis anticus will be readily felt as a tight cord holding the foot in its deformed position. If still greater force be used, and the finger be placed on the inner side of the leg, just behind the edge of the tibia, about an inch above the tip of the malleolus, a slight movement will be felt under the finger, indicating the position of the tendon of the tibialis posticus, more or less distinct according to the extent of the contraction and the amount of subcutaneous fat. Lying very near this is the tendon of the flexor longus digitorum; but this cannot be felt.

The first stage of the operation for the cure of talipes equino-varus consists in the division of these tendons. This having been done—as described in the article on Tenotomy—after the foot has been kept at rest for four days, and the punctures are healed, a flexible splint, six inches long and one inch broad, carefully padded. must be slightly bent so as to make the padded side somewhat concave; it is to be applied to the *outside* of the foot, and bandaged on, so as to draw the foot into a rather straighter position, but not to cause pain to the child. In three or four days the splint is to be taken off, and having been made somewhat straighter, again applied. This is to be continued at about the same interval until the foot can be placed *quite* straight, or, better still, can be bent a little in the direction opposite to that of the original deformity. In ordinary cases this can be accomplished in three weeks.

In the more severe examples of this deformity, however, it will be found that progress cannot be made at such a quick rate. These are the cases in which the heels will be found to be very small and flat, and the foot to have a more rounded appearance than is common. In these cases stretching must be carried out for a longer

time, and the foot must occasionally, at intervals of a few days, be suddenly wrenched, either with or without chloroform. When at last the foot can be placed quite straight, it is advisable to keep it in that position for a prolonged time, a month or six weeks, before the treatment is proceeded with.

Having proceeded so far with the case, the sole of the foot should be carefully examined to see if there is any undue contraction of the plantar fascia, and if such be found, the fascia must be divided. In the less severe cases this will not be necessary. In the case of an infant, the tendo Achillis may be divided at the same time.

It is now necessary to decide upon the form of instrument which is to be employed for the further treatment of the case, as this must be measured for, and got ready to be applied, four or five days after the division of the tendo Achillis. If the deformity is not unusually severe, a simple one may be adopted. It is made of sheet-iron, covered with washleather, and consists of a trough for the leg, and a foot-piece at right angles with it, with a leather ankle-strap to keep the heel down, and two webbing straps. One of these is fastened round the leg, and the other goes round the toes and keeps the foot everted. There are no cog-wheels, and, in consequence, this instrument is cheap. Supposing, then, the case to be a simple one, on the fourth or fifth day after the tendo Achillis has been divided, the foot having been bandaged, the instrument is to be applied by thrusting the heel into it, and the leather strap being fixed over the front of the ankle, it is to be drawn as tight as possible and buckled, and the other straps are to be fastened. If the child should suffer much at night, the leather strap may be loosened by one hole and fastened up again in the morning. This, however, is not often necessary, as leather straps always stretch somewhat. Every two or three days the splint must be removed; when the foot will be found to be improved in position, and when the splint is reapplied the leather strap will be able to be tightened by another hole. The heel will also be found to go gradually into its place on the sole-plate of the instrument as this treatment is continued.

After three weeks the splint should be removed every night and morning, and at first the surgeon, and then the nurse, should gently work the foot up and down, care being taken that sufficient force is not used to rupture the newly formed tendon. When this has been done, the splint must be at once replaced, and a thin pad may be placed under the joints of the toes, so that on tightening the heel-strap the foot may be further flexed on the leg. In two or three months the foot will have grown into a natural shape, and move quite freely at the ankle-joint. It should now be left out of the splint for a short time each day, to allow the child to exercise its muscles, and frictions with a simple liniment may be made use of. It must be remembered, however, that in all these cases there is so much danger of relapse that the patient must be watched for the first symptoms of stiffness returning. The child must go on in this way until old enough to walk, and it must then wear irons inside the ankle and leg, and extending round the waist. It is necessary to make the supports extend to the waist, as there is always rotation inwards at the knees, which cannot be overcome by any other means.

In the more severe cases of infantile talipes equino-varus the treatment is the same as that for cases which have been left untreated until after the child can walk.

Congenital Talipes Equino-Varus after the Period of Infancy.—The treatment of talipes equino-varus, after the period of infancy, may be conveniently divided into three parts: 1st. The cure of the simple infantile varus occasioned only by the contraction of the tibialis posticus, flexor longus digitorum, and the tibialis anticus. 2nd. The cure of the remaining acquired varus, caused by the contraction of the abductor pollicis, plantar fascia, and the various ligaments connected with the misshapen bones of the tarsus. 3rd. The cure of the equinus caused by the contracted tendo Achillis. With regard to the treatment of the first part, the tendons of the tibialis posticus, flexor longus digitorum, and the tibialis anticus must be divided, and after the tenotomy punctures are healed, a wooden, padded, outside splint, extending from the knee to the end of the toes, and with an extra pad just above the external malleolus, must be applied, to which the foot is gradually drawn by means of an ordinary bandage. Great care must be taken lest a sore form on the outer side of the foot, and, if the skin on this part is observed to become red and tender, all pressure must be removed and the splint be discontinued for a day or two. In addition to the gradual stretching by these means, it is well occasionally to *forcibly* twist the foot outwards, and so to rupture any tense fibres of ligament that hold the

foot in its deformed position. This treatment must be persevered in until the foot is perfectly straight and in a line with the leg, when the second part may be proceeded with. This is, of all, the most difficult to accomplish even after complete division of the abductor pollicis and the plantar fascia, chiefly on account of the great danger of producing sloughs by such an amount of pressure as will suffice to correct the deformity. The common Scarpa's shoe, useful as it is in some forms of talipes, is quite useless here.

For the efficient application of force in overcoming the resistance formed by the contracted tissues on the concave aspect of the deformed tarsus, the fulcrum must be placed on some part of its convexity, and as near as possible to its most projecting point; the internal tubercle of the os calcis being made a fixed point, and the power being represented by the tension of a strap placed round the ball of the great toe to draw it outwards. The problem, therefore, to be solved is: How can the fulcrum be applied in this position for the required length of time without causing sloughs? The only method is by rendering it a *movable* one. In other words, the pad which forms the fulcrum, instead of being a fixed part of the instrument, should be unconnected with it and thus made capable of being shifted from point to point along the outer edge of the tarsus and leg, as circumstances require. An instrument for carrying this into execution was explained and figured in the *Lancet* of May 3, 1879. One of the chief advantages of this instrument is, that it prevents *rotation* of the foot, and it can also be used for carrying out the third stage of the treatment, viz. correcting the equinus, after the division of the tendo Achillis, by means of a cog-wheel attached behind the heel.

Talipes Equino-Varus caused by Paralysis, &c.—Although the amount of deformity in each case will be found to vary greatly, from the slightest deviation from the normal state to a condition as severe as in a congenital case, the treatment of these two varieties of club-foot is in many respects identical. Each patient must be carefully examined to determine what are the tendons or fascia that keep the foot in its deformed position. This is done by trying to force the foot into its natural position. In some cases this can be accomplished without any resistance being offered, and then it is only necessary that the patient should wear an *inside* iron and strap. In other cases, on the contrary, the same tendons and fascia which it is necessary to divide in a congenital case must be operated on. It should be remembered that the posterior tibial when contracted, causes equinus as well as varus, and in many cases the former deformity cannot be overcome unless it is properly divided.

In some examples of this deformity, after division of the tendo Achillis, the foot hangs quite loosely at the ankle-joint and with the slightest amount of pressure goes up to the position of calcaneus. When this happens, no special instrument is required for the treatment, but the foot must be kept a sufficiently long time in the position of equinus until the tendon unites, when it must be stretched with great care. This can be done by means of a flexible splint and bandage. In severe cases the details of the treatment are the same as required for congenital cases, and the same instrument must be used.

Talipes Equino-Valgus (when the foot is turned out and the heel drawn up) is rarely if ever met with as a congenital deformity. In several instances of talipes equinus caused by paralysis, after division of the tendo Achillis, the foot will be observed to have a tendency to turn *out*. This can generally be sufficiently treated by placing an iron on the *outside* of the leg and foot, and having a strap attached to the inside of the boot, passing round it. It must be remembered, however, that the peroneus longus and brevis when contracted can cause equinus as well as valgus, and in some cases it is necessary to divide them.

Talipes Calcaneo-Varus (when the heel is depressed and the foot turned in) is a very rare deformity, and requires no separate description.

Talipes Calcaneo-Valgus (in which the heel is depressed and the foot turned out). In nearly all cases of talipes calcaneus the foot is more or less turned out. The treatment is generally the same as that made use of for talipes calcaneus. The steel support attached to the boot must be on the *outside* of the leg. Henry F. Baker.

CLUB-HAND. *See* Hand, Surgery of the.

CNIDOSIS. *See* Urticaria.

COCCYDYNIA, a painful and often very obstinate affection of the region of the coccyx, described first by Dr. J. C. Nott, of New York, in 1844, and more fully by Sir James Simpson in 1859. Its marked symptom is severe neuralgic pain, radiating from the sacro-coccygeal joint, and like in

its intensity and its general effects to the pain caused by fissure of the anus. It is due in many instances to some slight injury occurring during delivery, or to some uterine or ovarian disturbance, and therefore is most frequently met with in women. In some few cases, however, it has been observed in men and also in young children. It may be caused by displacement of the coccyx either backwards or forwards, by injury to this region causing a sprain, by excessive horse-exercise, or simply by the application of cold to the region. In a well-marked case the patient suffers much from constant pain, with paroxysmal attacks of almost intolerable suffering, and is obliged when sitting to rest the weight of the body on one or the other tuber ischii, and often is unable to walk or even to stand upright. The affection in some instances is a very transient one, and in others persists in spite of varied and active treatment. For the treatment of the latter class of cases, Sir James Simpson recommended subcutaneous division of all the muscles connected with the coccyx. This operation has been practised with some success; but in most instances the affection remains intractable, and neither myotomy nor extirpation of the coccyx, a method devised by Dr. Nott, can afford any decided benefit.

W. Johnson Smith.

COCCYX, Dislocations of the, are generally of an incomplete kind. They may occur *backwards*, as the result of parturition, or *forwards*, from kicks or falls in a sitting posture. Reduction is easily effected by pressure, the finger being placed in the rectum to reduce the forward displacement. Prolonged coccydynia is apt to follow, owing to the impossibility of securing complete rest, and to the implication of the nerves in the inflammatory thickening which results.

R. Clement Lucas.

COCK'S OPERATION. *See* Boutonnière, the Operation of.

COLD is a therapeutic agent of varied and great usefulness in the surgeon's hands. It may be applied in the moist or dry state,—alone, or in combination with other remedial measures.

Cold acts, according to the manner and degree of its application, as an *anæsthetic*, *antiphlogistic*, *antiseptic*, *hæmostatic*, or *tonic*. The anæsthetic power of cold is due to the numbness and insensibility which attend the freezing of living tissues. The simplest method of securing that result is to crush a piece of ice in a cloth, by blows with a mallet, or by a tread under the heel of the boot; then, adding to the ice about half its weight of salt, to hold the mixture in a muslin bag on the part to be rendered insensible. A more elegant method is that suggested by Dr. B. Richardson —a hand-ball spray, and pure anhydrous ether. Tissues so frozen may be cut painlessly, but their hardened state is inconvenient if any fine dissection be required.

The antiphlogistic power of cold, long and justly in repute, has been greatly extended since it has become the practice to apply ice in india-rubber bags. Professor Esmarch, the leading advocate of this treatment, has thus expressed himself:—'Of all remedies which are at our command in the treatment of inflammatory processes, cold is the most important; without this remedy he would rather not be a surgeon.' The two great features in the inflammatory process are, increased afflux of blood and rise in temperature; and it is by controlling these, physically and vitally, that cold exercises its antiphlogistic power, all the more effectually when combined with position and rest.

Injuries of the head, which are so greatly benefited by cold, offer wide scope for ingenuity in practical details, applicable to other parts of the body. Nothing can be more effectual than pounded ice in an india-rubber bag, which may be suspended by a tape or bandage, to secure contact with the scalp without oppressive weight. In the absence of an india-rubber bag, the bladder of an ox or large pig answers the purpose; but as the animal membrane is a superior conductor, it lowers the temperature of the part and melts the ice more quickly than when it is enclosed in an india-rubber bag. Hence, ice in animal membranes requires closer watching and more frequent renewal, to ensure the great requisites of comfort, continuity, and safety. In the absence of a bladder the head may be cooled by wetting it lightly from time to time with water, alone or mixed with spirit, and blowing on it with the mouth, a fan, or bellows, to accelerate evaporation. To keep the patient comfortable and at rest, while cold is being applied, the bed and pillows should be kept dry with waterproof sheeting, linen cloths, or absorbent tissue. In some cases, especially in strangulated hernia and swollen joints, the even pressure of a well-adjusted ice-bag adds greatly to the efficacy of cold, which may be applied by other methods, e.g. coils of india-rubber tubing, Leiter's metallic coil, irrigation in a variety

of ways based on syphon action; water, snow, or pounded ice in bottles; or metal cases which may be made to fit any part, after moulded patterns.

In the absence of spinal appliances, it is well to bear in mind the simple teaching of Abernethy:—'Wetting the surface of the skin, whilst it is freely exposed to the air, by passing a sponge dipped in common water over it at regular intervals, and thus maintaining constant evaporation, is one of the most powerful of all the modes of reducing temperature.'

A very useful cold lotion may be prepared by dissolving in a pint of water half an ounce of nitre, two drachms of sal ammoniac, and three tablespoonfuls of vinegar, or methylated spirits of wine. By increasing the proportions of nitre and sal ammoniac to five ounces each in the pint of water, a frigorific mixture is produced, which, on emergency, acts as a good substitute for ice. To make an *ice poultice*—of special value in the treatment of thoracic and abdominal injuries—spread a layer of linseed, about an inch thick, on a piece of cloth or absorbent tissue; on it, at regular intervals of an inch or more, place lumps of ice about the size of small walnuts, sprinkle with meal, cover with another cloth, and fold in the edges ready for application. The general preference to which dry cold is entitled, is exceptionally established when it is deemed advisable to apply cold outside bandages. If these be wetted after application they may shrink, so as to produce an amount of constriction which has been known to result in gangrene of the subjacent parts.

The *antiseptic* power of cold is a corollary of its antiphlogistic influence, and is most marked when dry cold is used. Warmth and moisture are powerful factors in animal putrefaction, to which by parity of reasoning, confirmed by experience, cold and dryness are opposed. So, too, by stimulating the contractility of the vascular coats, cold acts as a hæmostatic, all the more effectually if associated with the elevated position, to retard the arterial, and accelerate the venous, current.

Of the tonic action of cold, bathing supplies abundant evidence. Patients suffering from piles, varicocele, and generally from weakness in the pelvic regions, often derive very great benefit from cold hip-baths and enemata. Cold to the face and hands is a popular reviver from faints, and deservedly so. A greater degree of cold, than by affusion with water, may be produced by sprinkling ether or eau de Cologne in the palms of the hands, or on the forehead and behind the ears, and blowing on it, to accelerate evaporation. In extreme fainting, from the effects of chloroform or other cause, a lump of ice, the size of a pullet's egg, pressed into the rectum has been known to excite a deep inspiration, and at once revive an apparently moribund person.

SAMPSON GAMGEE.

COLECTOMY. — When resection is practised upon the colon, the proceedings are practically identical with those described under ENTERECTOMY. In colectomy the chief difficulty lies in the selection of the incision through the abdominal parietes. When the obstruction is distinctly diagnosed to be in the ascending or descending colon, no incision is better than that practised for lumbar colotomy. When the obstruction is diagnosed to be situated in the transverse colon, sigmoid flexure, or cæcum, the parietal incision may be made directly over the seat of the occlusion. When the locality of the obstruction cannot be directly determined, an exploratory incision should be made in the middle line. If the resection can be performed through this median incision, it is well. If found to be impossible, the median wound should be closed, and a second incision made in one or other loin, or more directly over the seat of the obstruction. The observations made with regard to the selection of the mode of resection when dealing with enterectomy, apply equally to the operation when performed upon the colon.

The general mortality of resection operations, as estimated from some 130 reported cases, is about fifty per cent.

FREDERICK TREVES.

COLLAPSE is a state of lowered vitality, induced by reflex inhibition, affecting all the functions of the nervous system.

Causes.—1. *Injuries*, sudden and severe, e.g. burns and scalds, the crushing or mangling of a limb, capital operations, lacerations of any large viscus, severe blows on the abdomen or precordial region without any definite lesion. An injury may cause severe shock, irrespective of the pain produced, as is evidenced by operations performed under anæsthetics.

2. Pain, especially when in connection with parts supplied by the sympathetic nerve; thus shock is often considerable in renal or hepatic colic, or in hernia at the moment that strangulation takes place.

3. Hæmorrhage is a great cause of shock. Up to a certain indefinite amount

a patient is able to lose blood without suffering from shock; but when this amount is once exceeded, symptoms of collapse rapidly supervene. Hæmorrhage, even if but slight, is attended by much more serious consequences at the extremes of life than in the middle-aged, also in the anæmic than in the robust.

4. Mental emotion, e.g. sudden fright.

5. Sudden withdrawal of part of the abdominal contents, as by tapping for ascites, emptying of a hyperdistended bladder, occasionally the use of drastic purgatives.

These causes do not act equally on all patients or under all circumstances. Thus, extensive injuries are much more readily borne by children than by adults, by the healthy and vigorous than by the debilitated and diseased. Pain, on the other hand, is very badly borne by children, in whom it is perhaps the most important agent in inducing shock. The state of mind of the patient at the time of injury, exercises an important influence. If he be greatly excited, and his mind preoccupied, the pain felt will be but little, and the shock induced by the *pain* proportionately small. Nevertheless, under such circumstances, the shock induced by the severity and amount of the *injury* is but little lessened, though its oncoming is sometimes postponed. If, however, the mind be in a state of expectancy or dread of the coming danger —for example, if a patient has made up his mind that an operation is likely to prove fatal—shock is proportionately great. The *impression* produced on the patient's mind by the suddenness of the accident, by the tearing and mangling of a limb whilst he is painfully conscious of the mutilation that is taking place, by the sudden transition from an active life to lengthy confinement in bed, greatly increases the amount and intensity of the shock, due probably in part also to loss of blood; and it is on this account that a primary amputation—e.g. of the thigh, for a compound fracture of the leg – is accompanied by infinitely greater shock than a precisely similar operation performed for disease.

Pathology.—The state of shock or collapse is induced by a 'reflex inhibition affecting all the functions of the nervous system,' i.e. for the time being, the influence of the nervous system on the life of the various tissues and organs of the body is suspended to a greater or lesser extent. The various senses are all more or less affected—sight, smell, hearing, touch, and mental power being variously influenced. But it is to the interference with the nervous mechanism of the heart that most of the symptoms—and those the most serious — are due. For, whilst a patient may readily survive any interference with the sense of sight, touch, &c., a sudden slowing, or even stoppage, of the cardiac contractions will cause death, either suddenly or in a comparatively short time. The stopping, or slowing and weakening, of the cardiac contractions is probably due both to a direct influence exercised through the cardiac nerves themselves, and also to the effects of a diminished blood-pressure induced by the loss of tone in the peripheral arteries, through interference with their innervation. The post-mortem appearances after death from shock are slight, but the veins are usually turgid, and, except in cases of hæmorrhage, all the cavities of the heart are full of blood. Rigor mortis is slight, and the blood generally imperfectly coagulated. In death from the collapse induced by severe hæmorrhage, however, the vessels contain but little blood, and the various organs are of a much whiter hue than normal.

Symptoms.—In severe shock the patient is often completely unconscious for a time; and, even though moving his limbs, and with eyes open, may be quite unable to understand anything that is going on around. In cases of less severity, he cannot readily appreciate the meaning of questions, is quite unable to recall to his recollection facts of which he is really well aware, such as his own name or residence; and in yet other cases, whilst answering questions correctly, his memory appears to be lethargic, and his answers are delayed for five or ten seconds or more. The functions of his various organs are in abeyance, his sight is dim, and he feels giddy, there is a humming noise in his ears, he articulates with difficulty, his sense of touch is greatly impaired, he lies in a state of complete prostration, his muscles are powerless to move his limbs, his sphincters may be paralysed, and his eyelids droop. The skin is livid and clammy, the surface temperature, and perhaps that of the whole body, is distinctly lowered. The movements of respiration are very shallow and feeble, occasionally gasping. The pulse is generally frequent and very feeble, often irregular and dicrotous; the sounds of the heart are but faintly heard. In such a condition as this the patient may die within a very short time from the receipt of the original injury; but in other cases, not immediately fatal, where reaction does not take place

(*see* REACTION), this state of shock may be prolonged in some of its features for several days, the patient remaining depressed, and never rallying up to the time of his death.

The chief distinction between the symptoms of the collapse induced by hæmorrhage and those induced by injuries unaccompanied by excessive loss of blood is, that in the former the mental functions are but little affected in comparison with the amount of asthenia, and that the skin is white and bloodless instead of livid, as in the latter.

Treatment.—The chief object of treatment is to restore, as rapidly as possible, the functions of the heart and vessels. In order that the heart may act with as little extra labour as possible, the patient must be kept in the recumbent position, and, that the brain may receive sufficient blood, the head must be kept low, and, in bad cases, blood kept from entering the lower extremities by tight bandaging, or by the application of tourniquets to the femoral arteries for a short time. The failing body-temperature must be sustained by wrapping in cotton wool or warm blankets. Cardiac stimulants must be administered. Chief of these is brandy, in quantities not exceeding half an ounce at a time, and the total amount not exceeding three or four ounces during the continuance of the more severe symptoms, for, if these precautions be not taken, vomiting is likely to ensue. In addition to this, and in its place if the patient is unable to swallow, the brandy may be administered as an enema, or ten to fifteen minims of ether may be subcutaneously injected. Hot milk and strong coffee are often useful. Hot fomentations or mustard-blisters should be applied to the feet, and to the epigastric region. In order to further strengthen the cardiac action, digitalis (liquid extract f℥j.), strychnia (liquor. strych. ♏v.), or belladonna (tinct. bell. ♏xx.), may be given, together with the brandy. If pain be a marked symptom—e.g. in burns in children—opium may be administered with excellent results. As soon as the patient can take further nourishment, this should be supplied, at first in but small quantities, and of such a nature as to ensure rapid assimilation—strong beef-tea and essence of beef. Alcohol should be dispensed with as soon as possible, especially where great reaction or traumatic fever is to be expected. In cases of severe injury, where a capital operation is necessary, the patient should be allowed to rally from the extreme collapse, though it is not necessary, or indeed practicable in most cases, to wait for complete reaction. It is in such a condition—generally reached, if at all, within five or six hours (or less), from the time of the accident—that the additional shock of the operation makes the least impression on the system, whilst if the patient die before such a state is reached, the surgeon may congratulate himself on having stayed his hand.

In cases of operations of expediency for long-existing disease, shock may be much lessened by rest in bed and careful attention to the diet for a week or more beforehand. ANTHONY A. BOWLBY.

COLLES' FRACTURE. *See* RADIUS, Fractures of the.

COLLODION is a colourless, viscid liquid, produced by dissolving gun-cotton in three-fourths ether and one-fourth rectified spirit. When this compound is spread on the skin rapid evaporation takes place, leaving a dry, adhesive, impermeable, and contractile layer. These physical properties, and its chemical composition, render collodion a very useful antiphlogistic and antiseptic, powerfully instrumental in maintaining rest and exercising equable pressure. Successive layers of collodion, spread with a camel's-hair pencil, and alternated with layers of absorbent muslin, make well-moulded splints, very useful in fractures or wounds of the hand, and exceptionally so in the management of fractures of the nose.

Small wounds do very well under collodion; but, before applying it, all dirt should be removed and bleeding stopped. In larger wounds, strips of gauze or lint, or skeins of cotton, soaked in collodion, and placed like adhesive plaster, are superior to these in assisting sutures to maintain accurate apposition. In removing collodion dressings with the minimum of disturbance, it is important to bear in mind that they are insoluble in water, but very readily so in a mixture of equal parts of ether and alcohol. In an emergency, a little brandy or whisky will be found to soften the dressings, all the more agreeably if previously warmed. In the treatment of swelled testicle and subcutaneous extravasations of blood, collodion is very useful; so also in limited cases of erysipelas, in chilblains, and sore nipples. For these purposes some surgeons give preference to flexile collodion, prepared by adding two drachms of Canada balsam and one drachm of castor oil, or glycerine, to six ounces of collodion. The difference is not

very material. In either form, the agent admits of very varied and useful application. SAMPSON GAMGEE.

COLLOID CARCINOMA. *See* CARCINOMA.

COLOBOMA. *See* CHOROID; IRIS.

COLOTOMY.—This operation consists in establishing an artificial anus in the bowel, above the seat of some obstruction. It has been performed in all forms of occlusion of the colon, in cases of simple and malignant stricture, in cases of occlusion of the bowel from simple neoplasms, from the pressure of a tumour external to the gut, from enteroliths and plugging by foreign substances, and from bending of the colon or distortion thereof due to adhesions. It has been practised also in cases of colic intussusception, in volvulus, and in instances where a fistula exists in the bowel which communicates with the bladder, vagina, &c. Colotomy has been performed also to relieve the distress consequent upon the passage of fæcal matter over a cancerous ulcer of the bowel, in instances where no real obstruction existed.

There are two forms of colotomy, lumbar and inguinal; the former is commonly called Amussat's operation and the latter Littre's. In the former the ascending or descending colon is opened in the loin, without wound of the peritoneum. In the latter the cæcum or sigmoid flexure is opened through an incision in the iliac region, which involves a wound of the peritoneum. *See* ATRESIA ANI. Lumbar colotomy is best performed upon the left side, since the descending colon is more fixed than the ascending, has a larger non-peritoneal surface, is less frequently the seat of abnormality, is less often provided with a meso-colon, and involves an artificial anus that is nearer to the natural anus. It happens also that strictures of the colon are much more frequent in the rectum and sigmoid flexure than in any other part of the large intestine.

The operation is thus performed, presuming that the descending colon has to be opened. The proceeding, however, is the same if the right side of the body be selected. The patient is placed upon the right side, and a hard pillow is placed beneath the right loin, so as to render the left loin more prominent. From the centre of the crest of the ilium, a line is drawn with ink vertically upwards to the last rib, which it will touch near its free extremity. An incision, four inches in length, is then made across the line, at right angles to it, and so arranged that the centre of the incision corresponds to the centre of the line. The wound is therefore midway between the iliac crest and the last rib. Amussat advised a vertical incision which corresponded pretty nearly to the aforesaid ink line. The proceeding has, however, been very generally abandoned. Mr. Bryant uses an oblique incision, 'four or five inches long, beginning one and a half inches to the left of the spine, below the last rib, and passing downwards and forwards in front of the anterior spine of the crest of the ilium, with the line of the incision passing obliquely across the external border of the quadratus lumborum about its centre, and taking the same direction as the nerves which traverse this part.' In the transverse wound after the skin and subcutaneous tissues have been divided, the latissimus dorsi muscle is exposed in the incision with a small amount of the external oblique. On dividing this layer, the internal oblique muscle is exposed in the whole length of the wound. When this structure has been cut through, the posterior aponeurosis of the transversalis muscle (fascia lumborum) is exposed, and in the posterior part the anterior edge of the quadratus lumborum. As a rule the latter muscle does not require division.

After the aponeurosis of the transversalis has been divided upon a director, even in the most emaciated patients, a quantity of loose fat comes into view in which the kidney is embedded. On tearing this gently away in the position of the colon, the transversalis fascia is exposed. This structure should be cautiously torn through by means of two pairs of forceps. Its strength varies very much, and it is apt to be mistaken for the peritoneum. The bleeding, so far, is as a rule very trifling, and any hæmorrhage may be checked by torsion. If the region of the quadratus be encroached upon by the knife, a lumbar artery may be divided. The finger should now be introduced into the wound, and the position of the kidney, which lies behind the bowel, made out. The finger should then be passed into the angle between the psoas and quadratus lumborum muscles. The non-peritoneal surface of the colon looks into this angle, and if, while the finger be held in this position the patient be rolled a little over to the left side, the gut which comes into contact with the digit must be the descending colon. The bowel should now be hooked forward into the wound, and an attempt made to expose that surface which faces the

angle just mentioned. When the bowel is much distended, it will protrude into the wound as soon as the tranversalis aponeurosis is divided, and the procedure just named is not necessary. Some surgeons distend the colon by air, or by injections of fluid, before the operation is commenced; but the measure is seldom necessary. 'A large curved needle, carrying stout silk, is then to be passed through the skin to one side of the ink mark, across the bowel, and through the skin at a corresponding point on the other side of the mark, and the entire proceeding is to be repeated at the other end of the incision. The colon is thus fixed before being opened, and is held in place by the threads, which are grasped by assistants. It only remains now to open the intestine, and this is best done midway between the two threads by a small longitudinal incision, which may be cautiously enlarged so as to be about one and a half inch in length. The finger passed into the bowel can now draw out each loop of thread by which it is transfixed, and these being divided will give four threads already passed through skin and intestine, and only requiring to be tied. The anterior and posterior extremities of the wound should afterwards be drawn together with two stitches, and the operation is completed' (Heath).

As regards after-treatment, the skin about the wound should be kept carefully oiled, and the parts protected by a large pad of 'tenax.' The stitches may be removed at the end of six or seven days, or may be allowed to cut their own way out. When the parts are consolidated, it is well to gently introduce a tube into the bowel below the fistula, and wash out the fæcal matter contained therein, since the retention of such matter often gives rise to much inconvenience. When the case is not urgent, it is well to perform the operation by two stages, the first of which may be done antiseptically. In the first stage the gut is exposed and secured to the wound by sutures which only penetrate the muscular coat. The bowel is not opened. At the end of a few days, when the gut has acquired firm adhesions to the margins of the wound, the antiseptic dressings may be left off, and the artificial anus established. In this way the extensive suppuration that sometimes follows the escape of fæces into the subserous or inter-muscular connective tissues, may be avoided; the evils of an accidental opening of the peritoneal cavity are reduced to a minimum, and the healing of the wound is greatly hastened. To avoid the trouble consequent upon the accumulation of fæces in the bowel below the artificial anus, Madelung proposes to empty this segment of the gut of its contents, and then entirely close the end of the intestine below the abnormal opening.

In *Inguinal Colotomy* the abdomen is opened by an incision about three inches in length, which is made parallel to and just above Poupart's ligament; the inner end of the incision being just external to the deep epigastric artery. The bowel, having been exposed, is secured to the margins of the wound by the same means as in lumbar colotomy. The great disadvantages of this operation are the less convenient position of the artificial anus, and the fact that it involves an opening into the abdominal cavity. Erckelen's statistics, which deal with 262 examples of colotomy, show that the mortality after all forms of colotomy, taken together, is about 54·2 per cent.; the mortality after Amussat's operation is 38·4 per cent.; and after Littre's, 46·4 per cent.

FREDERICK TREVES.

COLOUR-BLINDNESS. — Colour-blindness may be either congenital or acquired. The congenitally colour-blind, though possessing perfect sight for form, are unable to appreciate some differences in colour which are obvious to others. The three colours principally concerned in well-marked congenital colour-defects are red, green, and violet. Light of these three colours when combined by mirrors, by two overlapping spectra, or on a rotating disc will appear to a normal eye white or grey. These three colours are, moreover, peculiar, in that they are the only ones which cannot be produced by the mixture of other spectral colours. They are therefore called fundamental colours. While normal vision appreciates these three fundamental colours in the spectrum, and, in addition, certain others, yellow and blue, between them (omitting the orange), most congenitally colour-blind persons appreciate only *two* fundamental colours. Their vision is consequently said to be dichromic.

But there are very rare cases in which one colour only is appreciated in the spectrum, whose various parts consequently appear different only in their degrees of brightness. Achromatopsia is the term applied to such a defect. Those above referred to as possessing a dichromic system are said to suffer from *partial* achromatopsia.

Total colour-blindness (achromatopsia) is very rare, occurring perhaps once among ten thousand men. We are unable to say

exactly how things appear to the totally colour-blind, whether, for example, in shades of grey, from white to black, like a photograph to us, or in various shades of one of the fundamental colours, such as, for example, violet. A total colour-blind would pick out coloured wools indiscriminately, except for the different amounts of light which different colours reflect. The defect may be completely developed, or a feeble perception of all three fundamental colours may still exist. It is very questionable whether total achromatopsia ever occurs, unless in association with other ocular defect. It is usually observed that, in association with some defect for form, the disc is white, or there is nystagmus or photophobia. Partial colour-blindness (partial achromatopsia) occurs more commonly. It does not appear to be necessarily associated with anything pathological, since the sight for form amounts to about the average.

One of the fundamental colours is wanting entirely or in part to the partially colour-blind. Their colour system is therefore dichromic. Occasionally violet is the defective colour. In such cases the sufferer would appreciate only two out of the three fundamental colours that are normally visible in the spectrum. Whereas we see *on the left* red, followed by orange, yellow, green, blue, and violet, he would see only one *to the right*, representing violet, blue, and green, and one only *to the left*, representing the red and orange, his two colours being separated by a grey band which occupies the position of the yellow. Consequently he will mistake—unless, indeed, he can guess at them by the relative degrees of brightness with which they are associated in his mind—green, blue, and violet for each other, but he will sharply distinguish them from red and orange. Violet would be a darker shade to him than to us, so that dark violet would be undistinguishable by him from black, and the extreme right hand of the spectrum would be shortened. Such cases are extremely rare, perhaps 1 in 10,000 men, and on this account, and from the nature of the colour concerned, are of less practical importance than those next to be described. It is said that the drug santonine will produce temporary violet-blindness.

The great majority of partial colour-blinds are defective to red and green, and consequently their defect has received the name of red-green blindness. The spectrum is divided to them by a narrow grey band where the green and blue shade into each other. All to the *left*—viz., the red, yellow, and green—appears of the same colour, though of vastly different shade in its different parts; and all to the *right*—viz. blue and violet—of another strongly contrasted colour. The yellow is far brighter to them, as to us, than the neighbouring red and green. Consequently they are not liable to confuse yellow with either red or green. But the two latter, being far nearer in shade, are liable to be mistaken for each other.

Red-green-blindness is undoubtedly divisible into two varieties, of which the one is called *red-blindness*, and the other *green-blindness*. It is difficult to say how these colours really appear to the red- or green-blind; but, judging from rare cases of colour-blindness in one eye only and from other evidence, it is not unlikely that to the *green-blind* all to the left of the blue and violet (which appear as blue) is represented *at its brightest part* by yellow, just as to us, shading off on either side into a much duller reddish hue, which is slightly darker to the *right*—that is to say, in the green than to the left, i.e. in the red. Their two fundamental colours, speaking generally, will thus be blue and some variety of red, and the two will be separated by a narrow belt of neutral or grey colour. Though they will never match yellow, whether in the spectrum or in pigments, with green or red, they will be liable to confuse the two latter colours. But to match a vivid scarlet they will pick out a green lightened by some slight admixture of yellow, and they will see bluish-green and grey alike.

Similarly, to the *red-blind* all to the *left* of the spectrum is represented by yellow, shading off into a greenish colour, which is much darker in the red than in the green region of the spectrum. Indeed, the extreme left-hand end of the spectrum cannot be distinguished from black by the red-blind. It is as if the brightness of the left-hand part of the spectrum were shifted rather towards the right, and with it the dividing band between the blue and their other colour, whereas in green-blindness it is moved, though to a much less extent, the reverse way. Consequently the red-blind will match a scarlet with a dark green and with a dark brown.

It is obvious, from what has been said, that the detection of physiological colour-blindness is not so very simple a matter as it would at first sight appear. Even a total colour-blind—i.e. one to whom differently coloured objects appear simply as various shades of one colour, as does a photograph to us—will not match yellow with an average blue or even with a red, since the three appear of quite different shades, from

the brightest, the yellow, to the darkest, the blue. In the same way a red-blind would not match an average red with an average green, the first appearing to him much darker than the other. But if coloured surfaces or coloured lights of exactly corresponding shades to him were presented, he would be totally unable to distinguish them. All tests of colour-vision are on this principle. The most scientific is doubtless by the use of the double spectroscope. But others, which are more easily and conveniently applied, suffice for all practical purposes.

The coloured wools which pass under Holmgren's name show a large number of shades of differently coloured woollen skeins.

The person to be tested is given a skein of a pure pale green colour; *pale* because many will fail at this who would be successful with a stronger colour, and *green* because it is a defective colour, not only to the red- and green-blind, but also to the violet-blind. He is asked to pick out all the skeins which seem to him like the sample given or, perhaps better, all which contain some of that colour, little or much. It is important that the colour should not be named, otherwise an ignorance of the names of colours may possibly be mistaken for colour-blindness. If his colour-vision be defective, he will pick out other colours as well as various shades of green; for example, greys, browns, pinks, or blues and violets. This alone is sufficient to demonstrate the fact of colour-blindness. If we want to know something as to its degree and kind, we may go further. If he has selected greys, browns, or pinks to match with the green, he is probably red- or green-blind. If then, a pale rose-coloured skein—i.e. a mixture of blue and red—be given him, he will, if red-blind, pick out dark blue and violet to match with it, the red being to him little more than a darkening shade. If, on the other hand, he be green-blind, the rose will be to him more of a neutral tint, and he will match it with grey and with bluish-green. If he is offered a scarlet he will match it, if red-blind, with a green or brown which appears to a normal eye much darker; whereas, if he be green-blind he will match it with a light brown or with a green lightened with some slight admixture of yellow. If his failures do not extend beyond the first test, excluding violet-blindness, he is called an incomplete partial colour-blind.

The coloured squares of 'Ole Bull' are on the same principle, but here red, green, blue, yellow, and grey squares, 10mm. in diameter, are arranged in rows from the faintest—i.e. the first—down to the most intense, the tenth row. The colours of each row, from the strongest upwards, are successively diluted by admixture with grey, so that those of each row, while being all of exactly the same shade, are of less intense colour than the row below them. Consequently the colour-blind will readily mistake the colours of the various rows; and the amount of his defect will be judged by the faintest row he is able to indicate correctly. The colours of the first row are recognisable by the normal eye at 1 metre distance in good light. The patient is shown the grey square, and asked to name the other colours of the first row. If he fail at this, squares in other rows below are successively indicated. If, for example, he can do only the one marked No. 6, his colour-vision will amount to one-sixth only. The test is therefore quantitative, and in this respect it excels that by coloured wools. It is also, as will be seen presently, better adapted for most pathological colour-defects.

What is called the shadow test is interesting. If an object be illuminated by two lights, one coloured and the other an ordinary light or colourless, the shadow cast on the coloured ground by any object, such as a pencil, takes by contrast the complementary colour. Thus, if the light be red, the pencil will throw one shadow from the ordinary light, which will appear red, and one from the red light, which will appear green. But to the red- and green-blind the complementary colour is not recognisable.

The pseudo-isochromatic tables of Stilling are on the same principle. Letters of one colour are printed on a background liable to be confused with it. But, in consequence of the great difficulties in making lithographic colours present a similar surface as to smoothness and brightness, as well as exactly the same shade, the test is of little practical use.

Donders has arranged certain quantitative tests. They consist of small circular coloured spots of different sizes attached to a surface of black velvet. The normal distance having been previously carefully determined by experiment, the distance at which the candidate can recognise them is noted. A spot of red or green should be recognised in good daylight at 5 metres (about 16 feet). Similarly, discs of coloured glass are presented in front of a light successively, by aid of a revolving disc. Since ordinary coloured paper or glass rarely approaches a pure colour, the material for this test requires great care in its selection. These tests of

Donders are, on the whole, best adapted for determining the fitness of railway-drivers or look-out men at sea for their work.

Colour-blindness exists to a greater or less extent in about 4 per cent. of men. In women it is at least ten times as infrequent, and even correspondingly less in degree. It is slightly less common in the upper—that is to say, the more educated—classes of life, than among ordinary people. Education will, however, do nothing for its removal, and, so far as we know, nothing for its prevention in the individual. We can only speculate why it is less common in women. It is very liable to be transmitted by inheritance, perhaps as much through the mother, though she so rarely manifests it herself, as through the father. After total achromatopsia violet-blindness is the most rare, perhaps amounting to ½ per cent. in men. Consequently defects to red and green are far more important, not only on account of their greater frequency (about 3·5 per cent.), but because lights of these colours are universally used as signals. Indeed, any other colours would be quite unsuitable. Yellow would be liable to be mistaken for an ordinary light, and blue, being much duller than any ordinary yellow, would be visible at a much shorter distance, and so could not be opposed to it. The importance of colour-blindness in relation to coloured signals reaches its maximum in the case of the red-blind, to whom a red light appears far darker than the green. Indeed, it is so much darker to him than to the normal eye that he cannot recognise it at all, even as a light, till within a much shorter distance than normal. If the two were contrasted at a short distance only, he would consequently see both, and distinguish them by their relative brightness. But if either were exhibited at a distance, and under conditions of brightness previously unknown to him, as at sea, he would be utterly unable to recognise its colour. The peripheral parts of the retina are normally less sensitive to certain colours than to others. If red and green spots be presented under ordinary daylight at the periphery of the visual field, their colour cannot be distinguished, whereas blue and even yellow can be perfectly recognised.

Acquired colour-defects are also important, both in their relation to coloured signals and as symptoms of certain diseases, such being atrophy of the optic nerve, both primary, as from tobacco and alcohol poisoning, and secondary to more general conditions, such as locomotor ataxia and disseminated sclerosis. Green and red are the first colours to go, the former being usually called white and the latter brown; or the two colours are undistinguishable. In tobacco and alcohol amblyopia the loss is at first limited to the immediate neighbourhood of the point of fixation (central colour scotoma), so that the patient, though he can recognise small spots of these colours when held somewhat laterally in any direction from his point of central vision, fails to recognise them when moved to the centre. This failure may be partial, in which case the colours are seen less vividly, red as brown, for example (relative scotoma), or total, in which case he sees the spot of no *colour* at all (absolute scotoma). *See* Amblyopia.

But in other diseases, such as the atrophy of locomotor ataxia and disseminated sclerosis above mentioned, and the atrophy that sometimes follows blows on the head or typhoid fever, appreciation of red and green becomes entirely lost, or all perception of colour may be permanently gone. A complete loss of all colour-vision may occur temporarily in hysteria.

It is in the highest degree questionable whether an acquired defect for red and green ever exists without some loss of central acuity for form, but it is certain that colour may fade in undue proportion to form, especially in tobacco amblyopia. Consequently a patient suffering from this affection may go about and carry on all his other duties perfectly well, and still be totally incapable of distinguishing a red from a green signal right before him. It is probable that acquired colour-blindness is even more important in respect to signals than the congenital form, since the sufferer has had, in the former case, little time or, indeed, opportunity to recognise his defect, occurring almost invariably, as it does, between forty and sixty years of age; and he being able, in early cases of tobacco and alcohol poisoning, still to recognise colours in the circumstances under which they are usually presented in every-day life.

From what has been said it will be evident that certain acquired defects of colour will escape detection by Holmgren's coloured wools. It needs the use of the coloured discs of Donders or of 'Ole Bull,' or, perhaps better than either, of red and green squares, 10mm. and less in diameter, mounted on a black card, which may be conveniently supported on a handle. The examination may be made, either by the patient fixing the corresponding eye of the observer at a distance of a foot, or by the use of the perimeter.

W. A. Brailey.

COMA. *See* Head-Injuries.

COMEDO.—*Definition.*—A collection of sebum distending beyond its normal limits a sebaceous gland, the external aperture of which remains patent.

Symptoms.—Comedones form at or about puberty, when the hair-follicles of certain regions are in active development. The sebaceous glands enlarge and secrete more sebum than can be expelled from the mouth of the follicle.

People with coarse skin and feeble circulation and a scanty growth of hair are most prone to them. The forehead, nose, cheeks, chin, inside the ears, the chest, back, and neck, are the parts commonly affected, and they rarely occur elsewhere. Sometimes they are congenital. They appear as yellow or black specks on the skin, slightly raised, which, when squeezed, eject a long worm-shaped mass, consisting of sebaceous matter, and in its substance there is occasionally found a minute grub. *See* Acarus Folliculorum. The elongated shape of the mass is the result of its having been squeezed through the narrow neck of the follicle. Some think the black on the surface is due to dirt solely, others trace it to pigment. When, as is often the case, the comedones become inflamed, acne vulgaris is produced.

Treatment.—Where there is a tendency to the development of comedones it is well to wash several times daily with hot soap and water, using at the same time much friction with a rough towel. All the spots should be squeezed and the matter forcibly removed, and, to prevent the sacs refilling, it is necessary to insert a needle and scarify the lining membrane, which will have the effect of completely obliterating them. Lotions or liniments containing soap and spirit are most useful, to dissolve the sebaceous matter and to stimulate the capillary circulation. The following is a good formula: ℞ Sapo mollis, ʒj.; Eau de Cologne, fʒjss.; Sp. vini rect. fʒij.; Aq. sambuci ad fʒvj.; fiat lotio. To be used twice a week at bed-time. Mildly stimulating ointments containing small quantities of either sulphur or tar are also of value. Internal remedies should be employed if there is any irregularity of the digestive organs or other functional disturbance.

Malcolm Morris.

COMPRESS. *See* Pressure.

COMPRESSION. *See* Pressure.

COMPRESSION OF THE BRAIN. *See* Brain, Compression of the.

CONCUSSION OF THE BRAIN. *See* Brain, Concussion of the.

CONCUSSION OF THE SPINAL CORD. *See* Back and Spine, Injuries of the.

CONDYLOMA. *See* Mucous Patch; Syphilis; Warts.

CONGENITAL DEFORMITIES. *See* Atresia Ani; Club-Foot; Congenital Dislocations; Ectopia Vesicæ; Hare-Lip, &c.

CONGENITAL DISLOCATIONS.—Congenital dislocations are most frequently found at the *Hip-joint.* Cases, however, have been described of similar luxation of the *Humerus*, of the *Patella*, of the *Lower Jaw*, of the *Elbow* (probably only of the radius), of the *Knee*, and of the *Wrist.*

In the last four positions the dislocation is rare. It is usually partial, complete dislocation occurring only with other extreme deformities, the subjects of them being little better than monstrosities. These rare forms may be dismissed in a few words.

A case of congenital dislocation of the *Lower Jaw* on the right side has been described by R. W. Smith of Dublin. The right side of the jaw and right zygoma were smaller than on the left side, the condyle was undeveloped and destitute of cartilage, the coronoid process was small and thin, and the sigmoid notch was barely existent. There were neither glenoid cavity, nor interarticular cartilage, nor capsular ligament. The right superior maxilla and malar bones, and the right side of the sphenoid, were also much smaller than on the left side. In these cases the jaw is abnormally movable, and not fixed as in ordinary dislocation.

Good specimens of congenital dislocation of the *Head of the Radius* backwards exist in the museums of the Royal College of Surgeons of Dublin and of Guy's Hospital. The former was fully described by the late R. Adams. The outer condyle exists, but in front of it there is no rounded head for the radius, nor any trace of the usual convex articular surface ever having existed. The coronoid process and great sigmoid cavity of the ulna are unusually large transversely, and stretch almost the whole way across the lower articular extremity of the humerus, which is entirely formed into one single trochlea wider than natural. The head of the radius, which seems never to have been adequately developed, is situated behind the plane of the outer condyle of the humerus. The tubercle of the radius, directed somewhat backwards, is twice its natural length, and instead of

reaching merely to the level of the lesser sigmoid cavity of the ulna, stretches so high up the ulna as to reach nearly to the level of the summit of the olecranon process, while the carpal extremities of the radius and ulna are in their natural state, on an even line with each other. The arm in these cases is in a state of pronation and semiflexion, and there is little or no power of supination. There is a case also recorded by R. W. Smith of dislocation of the radius backwards, with deficiency of the condyle of the humerus, in which there was also on the same side an outward dislocation of the patella, with deficiency of the external condyle of the femur.

Congenital dislocations of the *Knee* are very rare, but a few cases have been described. They generally take the form of partial dislocation of the tibia forwards in one or both limbs.

Very few cases of congenital luxation of the *Wrist*, not in monstrosities, are recorded. There is a case fully described by R. W. Smith, of a female lunatic, æt. thirty-six, who had from birth a luxation of the right carpus forwards and of the left carpus backwards, with the upper end of the left radius small and atrophied. The bones of the forearm in both limbs were only half the ordinary length, and the bones of the carpus were atrophied. A case described by Cruveilhier as traumatic, Smith alleges to have been an example of congenital luxation. There is also a specimen of congenital dislocation of the wrist in the Dupuytren Museum.

Congenital dislocation of the *Patella* is not very uncommon. In nearly all the cases recorded the luxation was in the outward direction, the number of cases in which the displacement was single and symmetrical being about equal. In many of the instances deficiency of the external condyle of the femur fully accounted for the malposition of the patella. In all there was considerable muscular wasting and relaxation of the structures of the joint. In many of the cases the hereditary nature of the condition was remarked.

Congenital dislocation of the *Head of the Humerus*, though less rare than any of the above forms of luxation, does not occur, or at all events is not recognised, so frequently as the similar condition at the hip-joint. There are two varieties, the sub-coracoid and the sub-acromial. Guérin gives two examples of the former, and one of the latter. Both varieties have been fully described by R. W. Smith, who gives four cases of the former, and one of the latter. The leading characteristics of all are wasting of the muscles of the shoulder and arm, an abnormal prominence of the acromion process, and a marked limitation of the movements of the arm. Of the sub-coracoid dislocations, three occurred in males:— 1. Æt. 20, the luxation being on the left side. This man had also left talipes equinus. 2. Also a male, æt. 20, the dislocation on the left side. 3. A lunatic woman, æt. 29, with congenital luxation on both sides, the deformity being more marked on the left side. 4. A boy, æt. 9, with luxation on the right side. The only case of congenital sub-acromial or sub-spinous dislocation recorded by Smith was found in a woman æt. 42. She had been a lunatic fifteen years, and was subject to severe epileptic fits, in one of which she died. The brain presented the appearances common in idiots. Each humerus was dislocated upon the dorsum of the scapula, the coracoid process formed a remarkable projection on each side, and the acromion process was unusually prominent, but the glenoid cavity could not be felt beneath it. In fact, an examination showed that there was no trace of a glenoid cavity in the usual position, but there was a well-formed socket, surrounded by a glenoid ligament, upon the outer surface of the neck of the scapula, broader above than below, and reaching upwards close to the under surface of the acromion. The tendon of the biceps, perfect throughout, adhered to the upper and inner part of the circumference. The head of the humerus was oval in form, and atrophied, and occupied the cavity immediately beneath and behind the summit of the acromion.

The third case of sub-coracoid dislocation mentioned above died of meningitis; and examination showed that there was, similarly, no vestige of a glenoid cavity in the normal position; but directly beneath the under surface of the coracoid process, and formed partly upon the costal surface of the scapula and partly upon its axillary margin, there was a well-formed socket about an inch and a-half in diameter. The head of the humerus was close to the under surface of the coracoid process, and only separated from it by the capsule, there being no interval, as there is in the natural condition of the bone, between the upper margin of the abnormal socket and the process just named. Around this socket the glenoid ligament, perfect and well-formed, was continued from the undeveloped glenoid cavity, from the apex of which sprung the tendon of the biceps, in every respect natural. The capsular

ligament was perfect throughout. Here, also, the head of the humerus was oval from deficiency of the posterior part of the bone, and there existed, between the greater tubercle and the margin of the head of the bone, where the investing cartilage terminated, a broad, shallow groove corresponding to the elevation which distinguished the normal from the abnormal portion of the glenoid cavity. The shaft of the humerus was small, and seemingly atrophied. Upon the right side, where the deformity was less marked, the deficiency of the glenoid cavity was confined to its inner border, which, to the extent of an inch from above downwards, was entirely wanting, so that the head of the humerus had passed inwards, though not to such an extent as in the opposite joint. The internal boundary of the socket was formed by a ridge of bone, which passed downwards from the under surface of the coracoid process. The oval form of the head of the humerus, and the deficiency of its posterior part, were more striking than on the left side.

It is probable that congenital luxations of the shoulder are less rare than is supposed. They are almost certain to be overlooked during the early years of the patient, and until the bones and muscles have become developed; and then, except in the atrophic cases, so much freedom of motion may have been acquired that this peculiarity is attributed to awkwardness, and the anatomical condition is rarely critically and accurately examined. In those cases where atrophy of the muscles is complete, there ought to be no difficulty in diagnosing this condition from a local paralysis.

Congenital dislocations of the *Head of the Femur* are not rare, although, as Dupuytren pointed out, they frequently escape notice in the infant. Carnochan expresses the opinion that the congenital form of luxation of the head of the femur is of as frequent occurrence as the corresponding dislocation caused by external violence during extra-uterine life.

Dislocation occurs in three directions. The most usual form is luxation upwards and outwards upon the dorsum of the ilium; the second form, directly upwards, is rare; as is also the third form, upwards and forwards, which is usually associated with other very considerable deformities. The great majority of the cases are of the first variety, but the first and second varieties may be taken together, as they are very similar. They occur most frequently on both sides and in girls. Dupuytren, who saw 26 cases, found 22 in females and only 4 in males. In all but four of the cases the dislocation was double. Of Brodhurst's 36 cases, 28 were females and 8 were boys; 29 were double luxations, and 7 were single. Of Cruveilhier's 7 cases, 5 were double and 2 single. In 7 cases seen by the writer, 6 were double and 1 single, and all were in girls. Four of these symmetrical cases were shown together, on November 17, 1883, at a meeting of the Royal Medical and Chirurgical Society.

The signs of this dislocation are not distinctly marked at birth, and, unless they are sought for, are easily overlooked. When the child has acquired the power of walking they become unmistakable. They are best seen in the erect position, for when the patient is lying horizontally on the back many of the peculiar symptoms disappear. The main characteristics of symmetrical congenital dislocation of the hip-joint are —an abnormal prominence of the great trochanters, which are situated higher and generally more backward than usual. There is a wide, flattened appearance of the nates; a marked compensatory lordosis, and accompanying prominence of the belly; a more or less wasted condition of the muscles of the hip and thigh; and a peculiar, swaying, waddling gait, the width of the hips being increased, the knees more nearly approximated, and the usual movements of the hip-joints being somewhat limited and awkward; the legs, also, are small, and the feet weak, with a tendency to *flat-foot*. When the dislocation is on one side only, the gait is, of course, different, and less characteristic, the shortening of one limb causing more marked lameness.

The increased mobility of the head of the dislocated thigh-bone is very remarkable, but is well accounted for by the relaxed condition of the ligaments of the joint. The anatomical conformation of the bones of the part varies somewhat according to the age at which the examination is made. Before the age of attempting to walk, the head of the femur will not be found to have travelled far, but only to occupy the posterior and superior border of the shallow acetabulum where its fibrous margin is deficient. But a few years later the somewhat flattened head of the femur will be found upon the dorsum of the ilium in a direction backwards and upwards, the acetabulum being shallow, and sometimes of a more or less triangular shape, and filled with adipose tissue. The ligamentum teres is elongated and attenuated, and the capsular ligament presents an hour-glass appearance, being large at its attachment to the margin of the acetabulum

and to the head of the femur, but very narrow at its middle, where it surrounds only the ligamentum teres and is greatly stretched. In a few cases that have been described, the round ligament has been said to have been absent, and it is probable that in these cases it has gradually become so attenuated as to have given way.

In the cases where the dislocation is more directly upwards, the gait is slightly less characteristic, and the lordosis and prominence of the abdomen are less marked, but the anatomical condition is very similar.

There is no agreement amongst the writers on this form of dislocation as to its pathology. Amongst the different causes and explanations which have been given of the occurrence of congenital dislocations, the following may be enumerated :—1. External violence affecting the fœtus in utero ; 2. The position of the fœtus in utero, and violence during parturition (Cruveilhier) ; 3. Morbus coxæ in utero ; 4. A distension of the capsular ligament, and a consequent disproportion between the head of the bone and its socket (Stromeyer) ; 5. A primitive alteration in the germ, or an aberration of the formative power (Dupuytren) ; 6. A primitive alteration in the nervous centres ; 7. An arrest of development in the acetabulum ; 8. An arrest of development of the head of the femur ; 9. An active or primary retraction of the muscles (Guérin) ; and 10. Paresis of the muscles.

The first cause mentioned may be dismissed as unsupported by evidence. In support of the second it has been asserted that in the majority of these cases either the breech has presented at the time of birth, or they have been first children, or born after difficult or tedious labours. It is difficult to ascertain if there is really any foundation for these assertions. The birth-presentation is not recorded in the majority of the cases which have been collected. In the writer's seven cases, only one was a breech presentation ; one other was a first child ; but with the rest the labours were easy and not prolonged. Adams, too, reported that in the majority of his cases, 50 in number, the labours were free from difficulty. If luxations did occur from this cause, it would be more accurate to describe them as traumatic dislocations occurring at birth than as strictly congenital luxations. It may be further added, that it has been sought to explain the more frequent occurrence of this dislocation in females, by pointing to the greater width of the female pelvis, as being more likely to be the subject of compression and consequent displacement of the femora during birth by the breech. As a physiological fact, however, the pelvis of the female at birth is smaller than that of the male, and the supposition is incorrect. Nos. 3 and 4 have been given as causes in a few cases, on good authority. The great majority of the cases, however, are due to one or more of the remaining causes, Nos. 5 to 10, which may all be classed under the one term of *arrest of development* or *faults of formation*. This arrest of development, whilst it is more marked in the acetabulum than in the other parts entering into the formation of the joint, is, in all probability, primarily due to some deficiency or derangement of the nervous centres. And this is probably the case in all the forms of congenital dislocation, and is especially evident in the more unusual forms which have been shown above to be generally associated with idiocy or lunacy. In some of these cases the malformation has undoubtedly been hereditary.

The absence of the ligamentum teres in a few of the hip cases has led to the suggestion that such absence may possibly be a reversion to the structures of the hip-joint in fishes and reptiles, where it is absent, as it is also in the kangaroo, the elephant, the rhinoceros, the hippopotamus, and in the phocidæ, sloths, and orangs.

During the growth and development of the subjects of these dislocations, considerable changes take place in the bony framework of the pelvis and the surrounding parts. The innominate bones are found to be smaller and more vertical in position. According to Carnochan 'the anterior inferior spinous processes of the ilia are found to be more prominent, and the depressions existing below them are seen to be deeply grooved by the continued traction of the tendons which played in them during life.' The greater the amount of displacement of the head of the femur, the more the shape of the pelvis is altered ; but in all the cases the antero-posterior diameter is diminished, whilst the transverse diameter is proportionately increased. The sacrum is usually somewhat stunted in growth. When the dislocation is on one side only, the pelvis becomes gradually somewhat twisted, and the ilium of the affected side occupies a slightly higher level than on the sound side, the symphysis pubis being drawn a little towards the same side. Wherever congenital dislocation exists, the bones are thinner than usual and somewhat atrophied. Any imperfect acetabulum that may have existed becomes filled up with adipose tissue, and the margin, if any, becomes flattened.

In many cases a shallow depression is formed in the new position of the head of the femur, and this depression usually becomes sooner or later surrounded by a deposit of new bone. At the same time the head of the femur may become smaller and more rounded.

Treatment.—Much difference of opinion has existed as to the possibility of surgically correcting the displacement in these cases. Dupuytren denied it. But since his day several cases of successful reduction have been reported, and it is probable that there are some cases in which an attempt at rectification should be made. There are two conditions of success:—The luxation must be recognised in early life, and before the relative condition of the parts has been altered by the natural adjustment which gradually takes place; and, secondly, the departure from the normal conformation of the articular surfaces must be moderate and much less than exists in many of the cases. If nothing is done, the tendency is to increased deformity, the amount of displacement being augmented by the weight of the body in the erect position. Where such increased displacement has taken place, and where the changes in the bones above described have been accomplished, no readjustment is possible. But in an earlier stage, and where the displacement is not excessive, some attempt at reduction should be made. To effect this, when ordinary manipulation is insufficient, Guérin has suggested the subcutaneous division of tendons which seem to maintain the deformity, and also some subcutaneous scarifications in the vicinity of the acetabulum, in order to promote the deposit of organising material. Cases of success at twelve and fifteen years of age have been recorded; but it is only in early years that we may count upon success, and then only in the less marked cases. Apparatus is required to maintain the bones in proper position. The horizontal position of the patient must be maintained, and after the first few weeks passive motion must be daily used. A few months later an apparatus is necessary, to enable the patient to move and exercise the limbs whilst still remaining in the horizontal position, the joint being, of course, unable to bear the weight of the body until the parts have had time to be consolidated in their new position. This motion and exercise must be persevered in for many months before permitting exercise in the erect position, the head of the femur being throughout retained in position by a firmly and properly adjusted bandage. The general treatment of the patient must not be neglected. A webbing support and strap will be required as a permanent means of support, and this will be found of some service in the great majority of cases in which no other treatment is advisable.

GEORGE COWELL.

CONGENITAL FRACTURES. *See* INTRA-UTERINE FRACTURES.

CONGENITAL HERNIA. *See* HERNIA, Inguinal.

CONGENITAL SYPHILIS. — The terms 'congenital,' 'transmitted,' and 'hereditary' may, so far as syphilis is concerned, be considered synonymous. They all stand in contradistinction with 'acquired,' and imply that the disease was obtained from a parent before birth, and not from post-natal infection. In all cases of acquired syphilis, with the exception perhaps of a woman pregnant with a tainted fœtus, a primary sore, or chancre, is of necessity the first stage of the disease. In inheritance no such sore occurs, but the virus passes directly from the fluids of the parent into those of the child. The term 'congenital' must not be held to imply that the inheritance is obvious at the time of birth, for it may easily be the fact that no signs of it become apparent until long after. Not the less is it true that the taint—or rather the living virus—was existent in the child at birth.

There may be some variety as to the precise details of inheritance. It may be that it is from the father alone, or from the mother alone, the poison being in each instance present in the parent at the time of conception. To these modes we may give the name 'conception inheritance,' qualified as 'paternal' or 'maternal,' or 'sperm and germ inheritance' respectively. This is the only kind of direct inheritance which, so far as the father is concerned, is possible. The mother may, however, be the means of communicating the disease to her offspring in another manner. It may have been the fact that at the date of impregnation she was perfectly free, and that she acquired the disease at some period of her pregnancy. In this case the fœtus will receive the poison, not at the very starting-point of life, but after a period, of variable length, of healthy intra-uterine life. Facts in abundance prove that at whatever period of pregnancy a woman acquires syphilis, if only time be allowed for her development of the disease, there is great probability that it will pass to the fœtus also. Nor does this happen in the case of syphilis only. If a pregnant woman suffers from small-

pox, her fœtus will also be affected, and very probably it would prove to be the same with the other exanthemata if their stages were sufficiently prolonged.

It may be convenient here to ask the question whether the transmission of syphilis in this way from the mother's blood to that of her child, through the placental circulation, produces results differing from those which follow sperm—or germ—inheritance. The question may be answered, temporarily at any rate, with a denial, and the *onus probandi* may be suitably thrown on those who assert it. The writer attended a lady in the seventh month of her pregnancy for primary syphilis. He saw her indurated chancre and also her rash. Her husband was also under his care for the disease. The child was born looking healthy, but it began, as usual, to suffer from snuffles at a month old, and it went through a severe infantile illness with all the usual symptoms. It recovered under mercurial treatment, but subsequently showed characteristic teeth and physiognomy, and had a severe attack of keratitis with periostitis of the tibia and effusion into knee-joints. This child was under observation for ten years, and there was nothing whatever to distinguish its symptoms from those which we see so frequently as the result of sperm—or germ—inheritance. Other cases of a similar kind might be adduced, and they justify us in holding for the present that the results of pregnancy-infection and conception-infection may be, and probably are usually, closely similar.

We must next ask whether sperm inheritance differs in its results from germ inheritance, and whether when the child receives a taint from both parents it suffers more severely or in any way differently from when it receives it from only one. We enter here upon a most difficult enquiry, and our knowledge of the laws of inheritance are not sufficiently advanced to permit of categorical answers being given. Nor, indeed, have our facts, as to the inheritance of syphilis, been as yet collected and compared with sufficient care. It may prove that future investigations will succeed in establishing more detailed and definite laws, as explanatory of the variety of clinical phenomena which we witness. On the other hand, it may perhaps come about that we shall see that we have already gone farther in this direction than either our present or our future knowledge will warrant. We are met at the very threshold of our enquiry by the fact, that we do not yet know the limits of possible variability in the phenomena of syphilis, independently of any appreciable change in the conditions of its origin. Thus we are constantly in danger of assuming that differences which we observe in the course and severity of the disease are due to peculiarities in the mode of acquisition, when in reality they were quite possible under modes which were identical. The more we study the subject, the more shall we feel obliged to acknowledge the importance and width of bearing of this fallacy. We must also be exceedingly careful as to giving our confidence to single and isolated narratives, whether they be the results of our own observation or the records of other surgeons. There are in respect to syphilis such endless sources of mistake that, however clear the seeming inference may be, it is never safe to trust it unless it has the support of many independent observations. Acting on this rule as to the reception of evidence, the writer will in what is to follow, trust far more to the general indications of daily experience than to the apparent lessons of individual but isolated cases.

Whilst all admit that a child may inherit syphilis from its mother, there are possibly still some who doubt whether it can inherit from its father independently of the mother. The evidence on this point seems to the writer overwhelming. It is a matter of constant experience that the father of a syphilitic infant is known to have had the disease before marriage, whilst not a symptom has ever been observed in his wife. It is improbable in the highest degree that a large number of married women should acquire syphilis in its primary form, pass through its secondary stages, and yet never know it. Yet this is the supposition which we must adopt, not once or twice, but as an every-day hypothesis, if we reject the belief that a syphilitic father may beget a syphilitic child quite independently of any previous infection of its mother. There are, however, other supporting facts. In these cases it very frequently happens that the taint in the father is wholly latent, and that he has for long appeared to be absolutely well, and that he has no trace whatever of sore on his penis by which a primary infection might be effected. Then, again, not only has the disease wholly escaped the observation of the mother, but she appears, on the most minute examination, to be wholly free from symptoms, and in many instances she remains so in after-life. Such facts are wholly inconsistent with the supposition that she has passed through syphilis in its ordinary stages as an acquired disease.

In nine cases out of ten, acquired syphilis is an affair which its victim cannot either ignore or forget.

It being then taken as established that a child may at the time of conception inherit syphilis from its father alone, from its mother alone, or from both simultaneously, and that it may take it from the mother's blood during pregnancy, we have to ask whether the disease presents any differences under these several conditions. The answer to this has already in part been given, for it has been asserted that what has been termed 'pregnancy inheritance' is just as severe as conception inheritance. Diday has cited a number of facts in proof of this, and all that the writer has observed is in unison with his conclusions. To avoid tediousness, it may perhaps be asserted briefly that there is no reason for believing that the inheritance from the mother (germ-transmission) produces more serious results than sperm-transmission, or that the child who inherits from both parents suffers more severely than he would if one were free. In connection with this assertion it is to be freely admitted that there are certain facts for which as yet we can find no explanation, and which may possibly lead to some modification of this rule. The cases exceptional to rule are here referred to, in which children are born with syphilitic lesions actually present or with traces of intra-uterine disease, and to the fact, apparently established, that the two sexes do not suffer exactly in the same ratio, the examples of infantile iritis, of keratitis in adolescent periods, and of syphilitic deafness being much more common in girls than in boys.

Having just asserted that the several modes of inheritance amount as regards the heir to exactly the same thing, we have next to ask whether the stage which the disease has reached in a parent makes any difference as to that manifested in the offspring. This is best answered by saying broadly that there is no evidence in proof that it does so. Some facts which are unexplained undoubtedly exist, but there is enough of positive evidence in proof that children which present precisely similar phenomena may be born at the most various periods of the parental disease to make us put them for the present aside. Diday and others have collected evidence on this subject. We shall probably be quite safe in making a *tabula rasa* as regards all theories hitherto advanced in explanation of the different degrees of severity which inherited syphilis displays. These differences are probably not greater than those which we observe in the case of the acquired disease. Chancre-syphilis, as is well known, falls with very different severity of incidence on different individuals. The reasons why it does so are inexplicable, just as are those which apply to the parallel phenomena in smallpox and scarlet fever. It will be wise, therefore, to clear away the old hypotheses and begin the investigation of facts anew.

With the hypotheses which we thus put aside it may be well to associate a piece of matter-of-fact observation which is probably a mistake. It is generally said and accepted that the inheritance of syphilis, when continued through a family of children, shows a tendency to fall off, and decreases in severity in each successive child until it comes finally to an end. The writer himself must take some share of responsibility for the perpetuation of this opinion, which he now believes to be an error. It is also strongly stated by Diday. That the eldest child or elder children—those born nearest to the parental acquisition—are the most likely to inherit it, is unquestionable, and so also is the fact that the younger ones often escape. In admitting this, however, we by no means deny that the disease is apt to occur in a modified form in the younger ones. We shall probably be nearer the truth if we assert that the inheritance of a syphilitic taint is often irregular, that frequently, of several children born under apparently similar conditions, one may receive it and another escape; but that, if it be received, it is always one and the same specific malady. Although it may and does develop with very differing degrees of severity, yet the child who inherits it at all inherits its full risks, and is just as liable as another to its severest manifestations. Much evidence might be adduced to show that, when a succession of children suffer, the youngest may suffer as severely as the eldest. It might also easily be proved that under such circumstances the disease may skip one child and appear again in one still younger.

All authorities are agreed that, as a rule, parents who have reached the tertiary stage, although themselves still liable to suffer, do not transmit. Now and then transmission under such circumstances does occur, especially in the case of the mother, but the rule is as here stated. It may be expressed in another manner—namely, to the effect that those who have allowed a long period to elapse—say two or more years—are not, as a rule, capable of transmitting. The body of evidence on this point in the case

of fathers is very large indeed. We see every day fathers of families, none of whose children have ever shown a symptom, but who are yet themselves—after, it may be, long periods of latency—destined to suffer from tertiary phenomena. Such facts are far less frequently seen in the case of women; but then we must remember that the proportion of mothers who have in former life suffered from syphilis is far smaller than that of fathers. Making, however, all allowance for this, we may still believe with confidence that a child has much less chance of escape if the mother be diseased than if the disease be confined to the father. In the latter case, sperm-transmission is the only mode of conveyance possible; whilst in the case of the mother, should the poison not be conveyed with the germ at the time of conception, there are yet nine months of risk to be run, during which it may pass from the blood.

The expressions just used will suggest the hypothesis which is perhaps the best for our use in the attempt to unravel the intricate phenomena of syphilis. It is that the transmission of the disease, as well in inheritance as in acquisition, is always effected by the conveyance from person to person, not of a tendency to disease, but of a particular virus. This virus is probably as specific and individual as are the seeds of barley or clover. If it passes into the sperm or germ, then the fœtus is liable to the full development of the disease; and if it chance that none of its elements do pass, then the offspring, although born to a tainted parent, escapes free. This virus is, during the early periods of syphilis, existent in great vigour in the parental fluids, and during these transmission is almost certain. It diminishes in power, or probably in quantity, as time passes on—and hence the greater chance of escape of younger children—until finally it wholly disappears or dies out. Its disappearance is, however, by no means coincident with entire restoration to health of the patient, who, although fortunately impotent to transmit, is, as just stated, still liable to suffer.

Before proceeding to sketch the results to the child of inherited taint, it is necessary to advert to the curious and unexpected fact that a woman who bears a syphilitic fœtus inheriting from its father—although herself remaining free from symptoms—acquires silently a state of constitution which protects her from syphilis in the future. No other interpretation can, the writer thinks, be given to the facts, upon which is based what is known as Colles' law. The child born of such a mother, if suckled by a wet nurse who has recently had syphilis, will not cause any fresh disease, but if by a woman hitherto free from taint, the risk is great that a nipple-chancre will result. Now the mother of the child, although, so far as appearances have gone, free from syphilis, is, as regards fresh contagion from her child, wholly free from risk. She has thus in some way gained the position of one who has suffered from acquired disease. We know nothing as to the relation which such a protected mother would assume towards other children which she might bear. It is obviously possible that if, in a second marriage, she should bear a child to a healthy father, such child might inherit from her, but it is by no means certain. It is also possible that, in continuing to bear children to a first husband, her taint, acquired through the fœtus, may act in reference to later conceptions, and may thus prolong the risk to their family after the father has ceased to transmit.

The evolution of hereditary syphilis.—The usual course, when syphilis is inherited, is for the fœtus to remain quite healthy during its intra-uterine life. At the time of birth it almost invariably has a clear skin, and appears to be in perfect health. At the end of three weeks or a month, symptoms of coryza, as shown by what is named 'snuffles,' usually begin, and are quickly followed by some eruption on the skin, attended by wasting and fretfulness. During the second, third, and fourth months, unless cured by treatment, all the symptoms will be at their height. Excepting in the addition of 'snuffles,' these secondary symptoms are much the same as those observed in the acquired disease. The precise type of the skin-eruption may vary in the same way—may be papular, scaly, pustular, or bullous. Polymorphism is noticed, and most of the other less frequent phenomena of constitutional syphilis in its early stage, such as loss of hair, iritis, condylomata, and rheumatoid pains are apt to occur. All these secondary symptoms are symmetrical in arrangement and transitory in duration, just as they are in the acquired disease. If the child survive, whether treated or not, by the end of a year all the symptoms will probably have disappeared. The influence of mercury as a specific is just as definite as in the acquired disease. All the symptoms, as if under the influence of a spell, vanish when it is used. Certain peculiarities are stamped upon all the symptoms, however, which are probably due to the very tender age of the patient and in-

complete development of the tissues. Thus the general health suffers much more than in the acquired form, and death—an event almost unknown in the latter—is a not infrequent consequence. Periostitis of a definite character occurs in connection with the rheumatoid pains, and, in the case of the epiphyses of long bones, may result in abscess, whilst in the case of the skull-bones it often causes simultaneous thinning and deposit of new bone.

In consequence of the fatness of young infants, the eruptions are prone to assume the form of intertrigo; and, owing to the irritation of the buttocks, &c., by urine and fæces, all syphilitic eruptions are very prone to affect those parts severely. The diagnostic recognition of secondary syphilis in infants is usually easy, but in a certain proportion of cases it may call for the utmost care and skill in observation. The character of the eruption, its colour—like the lean of ham—its location and symmetry of arrangement, its coincidence with snuffles, wasting, and withered aspect generally, make up a picture which it is often impossible to mistake. The very widest allowance for variations in severity must, however, be permitted, and common eczema and other infantile eruptions often closely simulate those of syphilis. It is not uncommon for the *rôle* to be exceedingly imperfect; thus there may be snuffles and mucous patches only, the general rash being quite omitted, or there may be no snuffles and the rash may be ill-marked. Instead of the 'old-mannish aspect' which is constantly mentioned, the child may continue throughout in apparently excellent health. Lastly, it is certain that an infant may pass through the secondary stage of inherited syphilis without ever presenting any symptoms which attract the attention of its nurse. Such cases are common, and they have their exact parallels in the case of the acquired disease. Those who have shown no symptoms in infancy may yet suffer in later life. It is clearly to be understood, however, that when this happens to adolescents they suffer from a class of symptoms wholly different from those of infancy. It is not that the secondary stage has been delayed, but simply that it has been passed through without ostensible disturbance. If secondary symptoms of the kind described are to occur at all, they will show themselves in infancy, and in a vast majority of cases within the first three months of life. This is a very important fact. Many syphilitic infants perish during the outbreak of the secondary stage, and were it not for the specific influence of mercury, probably many more would do so.

If, however, the child survive, in the course of from six months to a year the symptoms common to this stage—the rash, snuffles, mucous patches, &c.—will wholly disappear, and there will follow a period of some years during which no active symptoms occur. After this period of latency there will in many cases come a group of very peculiar affections. Amongst these we must mention chiefly inflammations of certain parts of the sense-organs, the eye and ear. The affection of the ear is attended by noises, &c., but usually neither by otorrhœa nor by pain. It affects both ears, and may induce almost total deafness in the course of two months. Many cases in the early stage recover, but if once the deafness is complete it appears to be incurable. This affection rarely occurs before puberty, and may be delayed till the twentieth year. About the same period of life, but with wider limits still, since it may occur yet earlier or much later, there is a remarkable liability to a very peculiar inflammation of the cornea. Interstitial keratitis in a typical form is always a consequence of syphilis, and it is sufficient for the diagnosis. It must, however, be carefully diagnosed. It usually begins by cloudiness of the substance of the cornea, with ciliary congestion and irritability. The clouds increase and coalesce until the whole cornea looks like ground glass. The affection begins in one eye, but, in the course of a few weeks, attacks the other also. It is always, in the end, symmetrical, although in rare cases the interval between the two eyes may extend to several years. When at its height, interstitial keratitis may for a few weeks almost entirely abolish sight; but one of the most remarkable features in its clinical history is its invariable tendency to recovery. In the end the cornea usually clears completely. *See* Cornea, Inflammation of the.

At the same time as the keratitis, the patient often suffers from chronic synovitis of one or more of the large joints. The knees are most frequently affected, and there may be free effusion lasting for some weeks, but not often attended by much pain. Almost invariably the effusion disappears, and the joint is perfectly restored. These joint-affections may occur either before or after the keratitis, and sometimes in those who never suffer from the latter.

Periosteal affections of the long bones are at this stage not uncommon, and sometimes very severe. They may occur in any part

of the skeleton, and often produce numerous and large nodes. If near to joints, these nodes may produce much crippling of movement. If situate on the shaft, they may produce an appearance of curving, which, in former times, used to be mistaken for rickets. Overgrowth of the bone in length, as well as thickness, is an almost constant result of this form of periostitis, since it often persists for years. This overgrowth, if one tibia only be affected, may produce an increase of length in relation to the other of an inch or inch and a half, and constitutes, with the bending, one form of the malady known as osteitis deformans. Sometimes almost all the long bones in the body are simultaneously affected by these ossifying nodes. The skull, however, at this stage of the malady, but rarely suffers. Occasionally suppuration attends the periostitis, and a surface of diseased bone, roughened and much thickened, is exposed. The condition produced may usually be diagnosed from other forms of suppurative periostitis with necrosis, by the circumstance that the exposed bone is not enclosed by any shell of new bone, that it is extremely slow to separate, often remaining visible, but firmly fixed, for a year or more. The periosteum and cellular tissue overlying it are usually destroyed.

At the stage of the disease of which we are speaking, nothing is less common than for any special affection of the skin to occur. The only eruption which can happen is a form of rapidly destructive lupus. No scaly or papular eruptions, and nothing in the least resembling common lupus, or the serpiginous ulceration so common in the acquired disease, are—with the very rarest exceptions—observed. Nor are any forms of disease of mucous surfaces of the tongue or the palate at all frequently seen. It may be asserted also that affections of the viscera are very exceptional, and diseases of the nervous system scarcely less so. A few cases of ophthalmoplegia, and a few of epilepsy, apparently in connexion with inherited taint, are on record, and a few also in which the grey matter of the hemispheres appeared to suffer, and a state approaching idiotcy was the result; but all observers agree that they are very infrequent.

The subject of such taint having passed through the attack of keratitis, attended, it may be, by periostitis or loss of hearing, usually afterwards regains fair health, and continues through the rest of his life free from symptoms. No diseases likely to shorten life have been associated with the diathesis; above all we may assert that there is no special proneness to diseases of the scrofulous or tuberculous class. Year by year usually the physiognomical and other characters of the diathesis become less and less obvious, and in advanced life it may be very difficult to recognise it.

No trustworthy evidence in support of the suspicion that the subjects of inherited taint can in turn transmit it to their children at present exists. Most of the facts recorded have been published by the writer. It is perfectly certain that those who have themselves suffered very severely may become the parents of children who appear to be in every respect healthy. There is neither evidence nor probability in support of the conjecture that syphilis is, in the third or fourth generation, the cause of any chronic diseases of the skin or of scrofula.

Such being the general picture of the course and final results of inherited syphilis, it remains to notice certain facts which are more or less exceptional to what has been said. Although it is true that for the most part the taint does not appear to affect the infant until some time after it has commenced independent existence, yet there are numerous instances in which it causes intra-uterine death. Thus, abortions and miscarriages at various periods of pregnancy are common in syphilitic mothers. It is quite possible, however, that the influence of syphilis in this direction has been exaggerated. It is also possible that the cause of what happens to the fœtus is, in such cases, due rather to disease of the mother, and perhaps of the placenta, than to the breeding of the syphilitic virus in the fluids of the fœtus itself. If this be not so, it is exceedingly difficult to explain why the majority of syphilitic infants should be born plump and well-nourished, and remain for a month or so without symptoms, whilst others, on the contrary, perish at, it may be, an early period of intra-uterine life. Enough of pathological evidence has, however, been recorded to compel us to admit that the fœtus may itself suffer from syphilis, and may exhibit lesions of the viscera, bones, or skin which conclusively denote it. Such lesions are, however, rare. It is a most noteworthy fact that, if syphilis affects the fœtus it almost invariably causes its death, for nothing is less common than for an infant to be born alive with extant signs of taint. Three weeks or a month almost invariably intervene before the eruption, snuffles, &c., appear. A very perplexing exception to this occurs in the case of what is known as infantile pem-

phigus. In this disease the eruption may appear, in an apparently healthy child, within a day or two of birth, and the case may end in death within a week. These cases need further investigation, and it is hopeless, in our present state of knowledge, to attempt to explain them.

Diagnosis.—It will be convenient to treat of diagnosis under different heads according to the age attained by the infected child.

1. *In the fœtus and at the time of birth.*—It is probably far too hastily assumed that if a dead fœtus presents a peeling skin, and is shrivelled, it has probably died from syphilis. Such conditions are common whenever death has occurred long before expulsion. So also, as has been already hinted, is the belief that miscarriages imply syphilis held probably far more widely than facts warrant. Miscarriages are common from many other causes, and, conversely, it is quite certain that many mothers, suffering severely from syphilis, carry their infants easily to full term, and produce them in a viable condition. The recognition of syphilis in a dead and possibly decomposing fœtus is a matter of great difficulty and uncertainty. As to the existence of signs of syphilis in living infants born at full time, we must receive the published testimony of the older surgeons with caution. Not having the importance of this special point in mind, they often assumed, on seeing a syphilitic infant, that it had been born with the symptoms. Obstetricians would probably give evidence of a different kind. Thus, whilst Diday, who had enjoyed very extensive opportunities of special observation, had never seen signs of syphilis present at birth, we find Sir Astley Cooper stating that he had seen several children born with copper-coloured eruptions on the palms, soles, and buttocks. Probably all that he meant is that the infants were young when seen. The writer has never himself seen an infant born with a syphilitic eruption, or one in whom the evidence was clear that such an eruption was present at birth. In spite, however, of some scepticism, the facts must be accepted that such infants are occasionally seen. Rondelet, Doublet, Gilbert, Guérard, and Landmann are all quoted by Diday as having published single cases in which infants were born with characteristic eruptions. Visceral disease, as of the liver, spleen, thymus gland, &c., has also been encountered under conditions implying that the poison had been actively at work in the fœtal organism during intra-uterine life.

2. *During Early Infancy.*—In many cases the recognition of inherited syphilis at the age of six weeks or two months is exceedingly easy. The stuffed and expanded nose, the snuffles, the pallor, the patches of peeling erythema about the face, neck, and nates, constitute a picture which can scarcely be mistaken; but which is yet often heightened by such symptoms as sores at the angles of the mouth and anus, a peculiar odour, and periosteal tenderness of various bones. In many cases, however, one or several of these symptoms may be omitted or ill-marked, and in some they are all of them so. In certain instances, therefore, it is to be admitted that the diagnosis may become very difficult or even impossible. In such cases help must be sought from the parents' history, and from facts, if there are any, as to previous births. In doubtful cases each one of the symptoms must be scrutinised with suspicion. Infants often have a certain kind of snuffles who are not syphilitic, and common eczema of the nates may assume exactly the same tint as that which is specific. Sores, in connexion with diarrhœa, may occur at the anus, which may be mistaken for condylomata. It is seldom safe to trust to any one symptom unless it is very well characterised. A typical condyloma is conclusive, and so also of certain types of skin-eruption, and certain forms of bone-disease.

For a knowledge of the conditions of periostitis which denote syphilis in the infant, we are indebted to very recent observations. When M. Diday, in 1856, wrote his work on this disease, he stated that the records of medicine comprised scarcely any instances of bone-disease in connexion with inherited taint. At the date of the writer's own work, 1863, he had recognised the frequency of nodes in later periods of life, and the occasional occurrence of periostitis in infants. It was reserved, however, for Dr. Taylor, of New York, Dr. Wagner, of Berlin, and Professor Parrot, of Paris, to show that bone-lesions were really very frequent at early periods. They had been overlooked because they were usually—like the other phenomena of this stage—transitory, and because they but rarely led to suppuration. The careful investigation in this country by Drs. Barlow and Lees of the opinions expressed by Professor Parrot, have confirmed the correctness of these in the main, whilst they have corrected certain errors of inference. *See* CRANIOTABES. The chief difficulty consists in the similarity which some of the infantile bone-lesions of syphilis present to those of rickets. As a

rule, however, the syphilitic lesions occur at an earlier age, are attended by more definite signs of inflammation, and are not accompanied by the other phenomena of rickets, such as profuse sweating of the head, and buttons on the costal cartilages. Congenital syphilis and rickets very often co-exist; but there is no reason for believing that the one is in any sense the cause of the other. For purposes of diagnosis it may be sufficient to state that, in infants suffering from syphilis, it is very common to find certain areas in the skull tender and slightly swollen, and the regions of the epiphyses of long bones often suffer in a like manner. These lesions are often multiple, and may make all movements of the limbs so painful that paralysis may be suspected. Careful examination will always detect tender swellings of periosteum near to the junctions of the epiphyses, and sometimes on the shafts. These swellings are often of considerable size, much larger and, at the same time, more inflamed than those of rickets. Suppuration is not common, but it does occasionally occur. If this form of multiple periostitis is seen within six months of birth, it is almost certainly due to syphilis.

The state of nutrition is no safe guide in cases of doubtful diagnosis. In those which are self-evident it is often very characteristic. The infant is puny, emaciated, and shrivelled, and has features which resemble those of an old man. It is not uncommon, however, for syphilitic infants to remain throughout plump and healthy-looking. In doubtful cases reference may be made to the state of the palms and soles, which often show peeling patches, and to that of the nails, which sometimes become malformed and look as if they had been pinched laterally.

3. *At periods of life subsequent to infancy.* — After the infantile phenomena have passed away—roughly speaking after the end of the first year—the recognition of the subjects of inherited syphilis will depend—1st, upon certain structural peculiarities which have been left as the results of the secondary lesions; and 2nd, upon the occurrence of new local inflammations which are characteristic of the disease. To take the latter first, it may be broadly stated that if a child or young person, without either ear-ache or otorrhœa, becomes quickly and completely deaf, it is almost certainly syphilitic. In like manner the same diagnosis becomes almost certain if it shows well-characterised and symmetrical interstitial keratitis, or erosive lupus, or ulceration of the palate. Respecting each of these lesions, the exceptions to the statement that they are due to inherited taint are very few indeed. Such is also the clinical fact respecting multiple chronic nodes of long bones, and disseminate choroiditis.

Under the head of marks left by secondary lesions, we have to describe the hereditary syphilitic physiognomy, the peculiar features of which were first characterised by the writer, although he was not fortunate enough to assign all correctly to their true causes. This physiognomy consists, in the first place, of a peculiarly square forehead, with prominent frontal eminences and shallow furrows beneath them; a flattened and wide bridge of nose; a pale, soft, muddy skin, with little scars or pits in it; and radiating scars about the mouth, especially at the angles. To these we must add —as of yet higher value than any or even all of them—that the upper central incisor teeth, of the permanent set, usually show a single vertical notch, and are dwarfed in all their dimensions, but especially as to width. Other malformations of the teeth, and especially of the other teeth, are usually present also, but are indicative rather of the specific treatment which the child has required in early infancy than directly of syphilis. Hence it follows that in other cases than syphilis, if for any reason mercury has been much given, similar malformations may be present. Under this head reference is made to defects in enamel, to horizontal markings, to warty growths on the free edge, and to what are known as honeycombed teeth. The upper central incisors are the only teeth upon the malformations of which reliance can be placed. When their notches are well-marked the condition is, the writer believes, quite pathognomonic. Great caution must, however, be exercised in appreciating their peculiarities.

In many patients the physiognomy of hereditary syphilis is rendered more easy of recognition by the fact that the patient has already passed through an attack of keratitis. Such attacks often leave, for long periods, a certain slight degree of haze of the corneal structure and a peculiar steel-grey tint of the iris, which very much assist the diagnosis. If the recognition is difficult the ophthalmoscope should be used, and the periphery of the fundus carefully explored. If conditions resembling either disseminate choroiditis or pigmented retinitis are discovered, the diagnosis of syphilis is made highly probable.

Treatment.—The principles of treatment of inherited syphilis may be very briefly expressed. Mercury should be given, cautiously but efficiently, in all stages of the disease. If the patient be feeble and cachectic there is the more need for the remedy, though of course the greater must be the care taken that it does not disagree. The infant must be judiciously and liberally fed during the course. As a rule iodide of potassium is both more depressing and far less efficient than mercury, and should be avoided. It must be admitted, however, that we have, in the risk of damage to the teeth, a reason against the use of mercury. This risk is so considerable that, in cases in which the symptoms are but slight, and the child's health not suffering, it may be right either to avoid specifics, or to use only the iodide. This remark applies only to infancy, whilst the permanent teeth are as yet uncalcified. In all the later periods there is no objection to mercury. Especially ought mercury to be speedily pushed if deafness is threatened. It is quite true that it does not arrest the progress of the lesions due to inherited taint in the same definite and speedy manner in which it subdues those of the acquired disease. Notwithstanding this admission, the writer is sure that its use is generally very advantageous, and that we usually err in not giving it sufficient confidence. Inunction is the safest plan, especially in infants, but it may be given internally, in the form either of grey powder or the solution of bichloride. The dose must vary with the age and strength of the child. It is well to begin with very small doses, and to increase until definite effects are produced, either of disorder to health or disappearance of symptoms. The oleate of mercury, 10 or 15 per cent., is very convenient for inunction, and less likely to excite suspicion than the ointment. If given by the mouth, small doses frequently repeated are much to be preferred to large ones.

It goes without the need of saying that the utmost attention is to be given to the general health of the syphilitic infant. As a rule the mother should be the nurse, and her diet should be liberal and carefully regulated. If the mother cannot nurse, then artificial food, cow's milk, or still better, that of asses, must be given. On no account, under no circumstances, and with no precautions, must a healthy wet nurse be allowed to take a syphilitic infant. The risk of nipple infection is far too great. In this respect the child's own mother is in no danger.

The attempt to treat the child through the mother's milk by administering to her either mercury or the iodide, is a roundabout and inefficient plan. It is sometimes resorted to in cases of extreme debility on the part of the infant, but even in these it is probably more likely to disagree and less likely to cure than a mild inunction would be.

The treatment of the fœtus in utero is often carried out by means of the administration of mercury to the mother, and probably with success. If a woman who is known to have had syphilis within two years become pregnant, she ought, for the sake of her child, to take mercury during most of her pregnancy. For this purpose the grey powder in doses of a grain, three times a day, is probably both efficient and harmless. If the mother be robust, larger, or, still better, more frequent doses may be desirable. The writer has recently seen an infant suffer very severely indeed from syphilis, whose mother had, under the advice of a distinguished obstetrician, taken minute doses of the bichloride through almost her whole pregnancy. Thus we are warned that to be efficient the course must be a real one. Whenever in married life a syphilitic infant has been produced, it is desirable that both parents should be put under treatment, with a view to the safety of future conceptions. There is a drawback to the administration of mercury to a woman actually pregnant, that it may damage the development of the infant's teeth (first set). This makes it the more desirable that the mother should be well treated with the specific before conception.

JONATHAN HUTCHINSON.

CONICAL CORNEA. *See* CORNEA, Variations of Curvature of the.

CONICAL STUMP. *See* STUMPS, Affections of.

CONJUNCTIVA, Diseases of the.—HYPERÆMIA OF THE CONJUNCTIVA.—*Causes.*—The presence of foreign bodies in the conjunctival sac. Impure or irritating atmospheres, e.g. air charged with coal or tobacco smoke. Alcoholic excesses, stenosis lacrymalis, and other forms of lacrymal obstruction. The use of unsuitable spectacles, or the use of the eyes for near work without spectacles when the condition of the accommodation requires them, e.g. in hypermetropia, and in presbyopia.

Pathology.—The blood-vessels of the palpebral rather than those of the bulbar conjunctiva become engorged, slight che-

mosis sometimes appears, small vesicles may form, and there may be some swelling of the papillæ, and development of lymph-follicles.

Symptoms.—These consist of lacrymation and photophobia, with hot, burning sensations, and a feeling as of a foreign body or sand in the eye, and the eyelids are heavy. All these symptoms are aggravated in artificial light.

Diagnosis.—The only disease for which this condition is likely to be mistaken is simple catarrhal conjunctivitis, of which the symptoms are very similar; but in the latter there is more or less discharge from the mucous membrane, while in hyperæmia of the conjunctiva there is none.

Treatment.—In addition to removal of the cause, the use of iced compresses to the closed eyelids for twenty minutes several times a day, and the instillation of a drop of tincture of opium and distilled water in equal parts once daily, will be found very beneficial. It is also desirable to clear out the lacrymal passages with a stream of fresh water from an Anel's syringe, even where no decided lacrymal obstruction is present.

Conjunctivitis (in general).—In addition to hyperæmia of the mucous membrane, abnormal secretion is here present. There are several forms of conjunctivitis, the secretion from each being, more or less, contagious. Infection may take place either by the direct application of the secretion, or through the air, in which float particles of the infecting substance. The former is the more common mode, but the latter is liable to occur in ill-ventilated rooms, where some people affected with conjunctival disease are present with others possessing healthy eyes.

Catarrhal Conjunctivitis (Simple Acute Conjunctivitis). — *Causes.* — Draughts of cold air, contagion, foul atmospheres, foreign bodies, as a sequel of or attendant on scarlatina, measles, or smallpox.

Pathology.—The hyperæmia of the conjunctiva is here well-marked, often concealing the Meibomian glands, and extending sometimes over to the bulbar conjunctiva as far as the cornea. Enlarged papillæ and lymph-follicles are often present, but not necessarily so. There is a sticky, serous discharge, which sometimes produces ulceration of the intermarginal portion of the eyelid. If the catarrh becomes chronic the papillæ become more developed, while the blepharitis is apt to extend over to the cutis, causing eversion of the lower punctum lacrymale with resulting stillicidium, and this, in its turn, aggravates the conjunctival affection.

The *Symptoms* are very much those of a severe case of hyperæmia (sensation of sand in the eye, hot, burning sensations, weight of eyelids), with the addition of the annoyance caused by the secretion, which gums the patient's eyelids together on his awaking in the morning and, by coming across the cornea, causes momentary clouding of the sight. Photophobia may be present, but is not usually severe unless there be some corneal complication. The latter, sometimes, is seen in the form of minute marginal infiltrations which rarely attain to very serious dimensions, but rather disappear as the conjunctiva becomes normal.

Diagnosis.—The presence of the gummy secretion distinguishes this affection from mere hyperæmia of the conjunctiva. A common mistake amongst those not familiar with eye-disease is to regard a case of iritis as one of simple acute conjunctivitis, the 'redness' of the white of the eye in the former affection being taken for conjunctival hyperæmia, &c., and, moreover, a slight secondary conjunctivitis does, undoubtedly, attend many cases of iritis. The circumcorneal subconjunctival vessels are those which become engorged in iritis, and the conjunctival vessels may be distinguished from them by the possibility of moving them, along with the membrane in which they are, by manipulations which can be made with the lower lid of the patient, but these manipulations do not affect the subconjunctival vessels. The condition of the iris itself, however, is that upon which the diagnosis chiefly depends. *See* Iris.

The *Prognosis* is good unless there be reason to suspect that the mild form is but the commencement of a more severe inflammation.

Treatment.—At the first onset nothing more than iced compresses, used intermittently (twenty minutes every two hours), should be employed, and in mild cases this alone soon brings about a cure. On the second or third day the application, with a camel's-hair pencil, of a solution of five to ten grains of nitrate of silver to one ounce of water by the surgeon to the everted palpebral conjunctiva, is to be recommended; provided it be immediately and thoroughly neutralised by the application of a saturated solution of common salt to the conjunctiva —to prevent too severe a reaction—the whole being washed off finally with plain water. A few daily applications of this kind are usually enough to cure these cases.

Iced compresses, or cold sponging, immediately after the dressing, relieve the smarting.

The greatest care is required in the use of nitrate of silver in conjunctival affections for any prolonged period, lest it cause staining of the membrane; thorough neutralisation and washing, as above recommended, being the best precautions. The writer is opposed to the use even of weak solutions of nitrate of silver as eye-drops to be used at home by the patient, for staining is very apt to be caused in this way.

Should the surgeon be unable to see the patient daily, the following well-known eye-drops are capable of effecting a rapid cure in most cases: ℞ Acid. boracic. gr. viii., Zinci sulph. gr. iv., or Tinct. opii fʒij., Aq. destill. ad fʒij.; one drop in the eye once a day. Solutions of sulphate of alum (gr. iv. to fʒj. of water) and of tannic acid (gr. v.–viii. to fʒj. of water) are often prescribed, but are not so effectual as the foregoing.

Follicular Conjunctivitis. — *Causes.* These are much the same as in simple catarrhal conjunctivitis. The long continued use of either atropine or eserine is liable to bring about the disease.

Pathology.—The condition of the conjunctiva is that found in catarrhal conjunctivitis, with the addition of small, oval, pinkish bodies the size of half a carraway-seed, which disappear completely as the disease passes off, leaving the mucous membrane as healthy as they found it. These little bodies are situated chiefly in the fornix of the conjunctiva, especially of the lower lid, and may be seen, on eversion of the latter, arranged in rows parallel to the margin of the lid. Whether they be easily discovered or not depends on their size and number, and on the amount of co-existing hyperæmia or chemosis of the conjunctiva. The structure of these bodies shows them to be lymph-follicles. They have no relationship to the granulations of granular ophthalmia, although some authors have regarded them as an initial stage of the latter.

The symptoms are much the same as those of catarrhal conjunctivitis. Frequently there is little or no injection of the conjunctiva, and the chief symptom is asthenopia—an inability to continue near work for any length of time—and much distress in artificial light. The presence of even a few follicles in the conjunctiva may cause annoying symptoms of this kind. Between the fifth and fifteenth years of age is the time of life most liable to it.

Prognosis.—Follicular conjunctivitis is a most tedious form, lasting often for months, and this is the most serious point in connection with it. Slight marginal infiltrations and ulcers of the cornea sometimes occur in its course.

Treatment.—The most useful remedy is an ointment of sulphate of copper of from gr. ss. to gr. ij. in ʒj. of vaseline. The weaker ointment should be used at first, and later on the stronger ones, if it is found that the eye can bear them. A piece of ointment of the size of half a pea is inserted into the conjunctival sac with a camel's-hair pencil once a day. Eye-drops of equal parts of tincture of opium and distilled water are of use in some cases, and the eye-douche should be recommended. Abundance of fresh air, with change from a damp climate or neighbourhood, if the patient live in such, to a dry one, are of importance. If the use of atropine has induced the disease, it should be discontinued, and, if a mydriatic be still required, a solution of extract of belladonna (gr. viii. ad fʒj.) may be employed in its stead.

Spring Catarrh is the eye-complication which accompanies 'hay fever.' It is not, strictly speaking, a catarrhal affection, for it is usually unattended by secretion, and the prefix 'spring' is misleading, as it is seen also in summer and autumn. The hay harvest is the most common period for it, owing, probably, to certain minute particles which then float in the air.

Pathology.—The bulbar conjunctiva is chiefly affected. It becomes injected, slightly œdematous, and close around the cornea somewhat elevated, with greyish swellings. The microscope shows (Uhthoff) that this swelling is due to hypertrophy of the epithelial layer of the conjunctiva in this situation, combined with subepithelial infiltration with a substance which is, or is similar to, coagulated albumen. The connective tissue layer of the conjunctiva remains tolerably normal.

Symptoms.—The chief symptoms are photophobia and lacrymation.

Some persons are liable to be attacked at each hay harvest.

Treatment.—Dark glasses for protection from the light. Weak astringent collyria (sulphate of zinc, acetate of lead). Or, iodoform ointment (1 in 15), a little put into the eye once a day. Massage applied twice daily, in conjunction with strong precipitate ointment, is a treatment recommended by some. Occasional cold sponging, or the eye-douche, are grateful to the patient.

Granular Conjunctivitis, Granular Ophthalmia, or Trachoma.—This disease occurs in two forms, the acute and the chronic.

Causes.—The disease is regarded as very contagious. The acute form is said to be often epidemic in places where the hygienic conditions are bad, but it has not come under the notice of the writer in this form. He has seen only some sporadic cases. The chronic form is much more common. It is very frequent in countries where the dwellings are overcrowded and dirty, and where the climate is damp, as is the case in Ireland amongst the lower orders. Amongst the better classes of all countries the disease is very uncommon. High, dry, mountainous countries are almost free from the disease. Some believe that it is dependent upon constitutional disease, such as scrofula, tuberculosis, syphilis, &c., but this is incorrect. No doubt many of these patients are anæmic and out of health; but this is due to the moping habits they contract and the little open-air exercise they take, in consequence often of their semi-blindness.

Pathology.—In this disease, in addition to the usual appearances of simple conjunctivitis, there are developed greyish or pinkish-grey bodies in the conjunctiva, each about the size of the head of a pin or larger. They attack, especially, the fornix conjunctivæ of the upper lid, but are also found disseminated over other parts of the palpebral membrane. They do not attack the bulbar conjunctiva. These bodies are the 'granules' or 'granulations,' and in the acute form of the disease they somewhat resemble the follicles of follicular conjunctivitis, but are paler, not so apt to occur in rows, and are more isolated. Microscopically the granulations have no capsule, as have the follicles, but seem to grow from, or in, the stroma of the conjunctiva. In the acute form the granulations consist of lymph-cells alone; but in the chronic form this is the case only towards their surface, while at their bases they are formed chiefly of connective tissue. Sattler has discovered the presence of a peculiar micrococcus in the interior of the granulations and in the secretion, and to this probably is due the marked infectiousness of the disease. The danger associated with these granulations, and one of the chief dangers of the disease, is the tendency they have to produce cicatricial degeneration of the mucous membrane. In some cases the whole conjunctiva is destroyed; and xerophthalmia, which may involve even the bulbar conjunctiva, may come on, but this is not very common. A more frequent result is that the submucous tissues, including the tarsus of the eyelid and the bulbs of the eyelashes, become secondarily affected, with resulting entropion, distichiasis, and trichiasis.

An affection of the cornea, termed *pannus*, is very frequently seen as a result of granular ophthalmia. Its occurrence does not seem to depend on the severity of the conjunctival disease, for it may be found in slight cases of the latter, or at least where the granulations and consequent conjunctivitis are not very markedly developed. This pannus consists in opacity and superficial vascularisation of the cornea, and always commences in its upper half. *See* Cornea, Inflammation of the.

Symptoms. — In acute granular ophthalmia there is often a great deal of swelling of the upper lid, great injection of the whole of the bulbar and palpebral conjunctiva, and swelling of the papillæ with development of the characteristic granulations. There may be but little discharge, but there is generally much lacrymation, with photophobia and pain in the brow and eye. Superficial marginal ulcers of the cornea may form. The inflammation and papillary swelling is, sometimes, almost absent in the very commencement. Soon, however, they appear and gradually increase to such an extent as to hide the granulations from view, and then, taking on a blennorrhœic form, the process gradually subsides, until, in the course of two or three weeks, it quite disappears, having brought about absorption of the granulations, and ultimately the mucous membrane is left in a healthy state. If, however, in the blennorrhœic stage, the inflammation be severe, the eye may run all the dangers of an attack of acute purulent conjunctivitis. Or, if, on the other hand, the inflammation be very slight, it may not be sufficient to effect absorption of the granulations, and the process may run into the chronic form.

In chronic granular ophthalmia the first onset of the disease is often without inflammation, and is then unattended by any distressing symptoms, except that the eye may be more easily irritated by exposure to cold winds, foreign bodies, &c., or more easily wearied by reading and other near work. If such a case come under our notice, the conjunctiva will be found free from injection and swelling, but greyish-white semitransparent granulations of the size of a rape seed, or less, will be seen disseminated over the palpebral conjunctiva and protruding from it. Gradually these granulations, acting as foreign bodies, give rise to a more or less active vascular reaction,

attended with swelling of the papillæ—in short, to blennorrhœa of a chronic form. The patients then begin to be more inconvenienced, owing to the discharge, which obscures their vision, and to sensations of weight in the eyelid and of foreign bodies in the eye, and this is generally the earliest stage at which we see the disease. The enlarged papillæ sometimes grow to a great size, completely hiding the granulations. In this stage the granulations may become absorbed, and the disease undergo cure, but more commonly it makes further progress. Fresh granulations appear, while the old ones increase in size, until they often become confluent, leaving only here and there an island of vascular mucous membrane, and the stage of cicatrisation is present.

At any period prior to cicatrisation of the conjunctiva an attack of purulent blennorrhœa is liable to come on. If not too severe, this may result in cure by absorption of the granulations, and should not be checked. If, however, the attack be very severe, the eye runs dangers similar to those of an ordinary attack of purulent conjunctivitis. These dangers are less, the more complete and the more intense the pannus.

Prognosis.—On the whole, if the disease come under treatment at an early period, it may be hoped that vision will be retained in the majority of cases, although a radical cure may be difficult or impossible. These cases require to be under constant or intermitting treatment for long periods, often for years.

Treatment.—The aim of this is to bring about absorption of the granulations with the greatest possible despatch, in order to prevent the destruction of the mucous membrane to which they tend. No caustic application should be made with the object of directly destroying the granulations, for this can only be done at the expense of the mucous membrane around them. If at the first visit any difficulty be found in everting the upper lid, it is advisable, in bad cases of granular ophthalmia, acute or chronic, to at once perform a canthoplastic operation (*see* EYELIDS, Diseases of), as this tightness of the eyelid is an obstacle to the cure.

In acute granular ophthalmia it is desirable to abstain from active measures in the commencement of the affection, owing to the tendency to natural cure which is often present, and, in particular, astringents and caustics should be avoided. At the utmost an antiseptic lotion of boracic or salicylic acid, and cold, or iced, applications for relief of the pain and heat, are admissible. Dark protection-glasses are agreeable, and, wearing them, the patient should be encouraged to take open-air exercise. But, if it be evident that the inflammatory reaction is too sluggish, poultices or warm fomentations should be employed to promote it. Once the blennorrhœic stage has been reached, great care is required to control it, and, if it threaten to exceed safe bounds, it must be restrained by means of suitable applications, such as acetate of lead, nitrate of silver, or sulphate of copper in solutions of medium strength; or it may be necessary to use them in strong solutions, or even to employ the solid mitigated nitrate of silver, according to the severity of the blennorrhœa.

In chronic granular ophthalmia, as already stated, the occurrence of a blennorrhœic attack often produces marked improvement. Following the hint nature thus gives us, we should endeavour by our treatment to produce a certain papillary reaction (blennorrhœa). For chronic cases, with little swelling of the papillæ and with little or no cicatrisation, the best application is the solid sulphate of copper lightly applied to the conjunctiva, especially at its fornix, but, when there is considerable papillary swelling, the writer prefers a 10 grain to Aq. f℥j. solution of nitrate of silver, properly neutralised, after application, with a solution of salt. An interval of twenty-four hours, at least, should be allowed to elapse between each application, whether of sulphate of copper or nitrate of silver, and cold sponging for fifteen minutes should be employed immediately after the application. A change of treatment will be required occasionally, even if the remedy first used answer well in the beginning, and one of the following can be adopted:—Liq. plumbi acetatis dil., never to be used except with everted lids, and washed off with plain water by the surgeon, and not even in this way if there be ulcers of the cornea, as a deposit of acetate of lead on the ulcer is liable to occur. Tannin ointment: tannin, gr. iij., vaseline, ℥iij.; a piece the size of half a pea to be put into the eye once a day. Sulphate of copper ointment: same strength as the last, and to be used in the same way. Solution of alum: gr. x. to f℥j. of distilled water; one drop in the eye once a day. Where an active pannus is present, a drop of solution of atropine should be instilled into the eye once a day, as a precaution against iritis.

Some surgeons employ scarifications of the conjunctiva when it is much swollen and the papillæ too exuberant, but the writer has not adopted them, fearing the resulting cicatrices. Again, it has been

proposed to excise or abscise the granulations. This may, perhaps, be allowable if they are isolated and protrude much over the conjunctival surface. Electrolysis has been employed for the destruction of the granulations, but the method has not as yet been generally adopted. It is worthy of further trial. The negative pole, in the form of a needle, is plunged into the granulation, while the positive pole is placed either on the temple or other adjacent region.

Inoculation of the conjunctiva with pus from a case of blennorrhœa neonatorum has been much practised in Belgium, especially in cases of severe pannus. By this means a violent acute blennorrhœa is set up, which is then guided to a cure; and, when it has subsided, the granular ophthalmia and pannus should have disappeared. This method is attended with considerable danger to the cornea, even where the pannus is well developed, and has not, therefore, found general acceptance.

Infusion of jequirity (*Abrus precatorius*, Paternoster-bean), long used in the Brazils, has been introduced to the notice of European surgeons by De Wecker. A 3 per cent. infusion is applied morning and evening, or even three times daily, for two or three days. The affected eyelids are everted, and the infusion is applied plentifully to the conjunctiva with a sponge, or it may be rubbed into the mucous membrane. The result is a purulent ophthalmia of a somewhat croupous tendency (the cornea being hidden by a false membrane), accompanied by great swelling of the eyelids, much pain and considerable constitutional disturbance, rapid pulse, and a temperature of 100° or more. In the course of eight or ten days the inflammation subsides, and the cornea is then, in many cases, found free from pannus, or almost so, while complete cure of the granular ophthalmia itself is rarer. Iced compresses to the lids should be used during the inflammation. A fresh infusion (not more than seven days old) must be used, in order to have the most certain effect from the application. The majority of surgeons find the remedy perfectly harmless, if not always very efficacious; but a good many cases are on record where violent diphtheritic conjunctivitis, followed by blennorrhœa of the conjunctiva, and by more or less extensive ulceration and destruction of the cornea, and even complete loss of the eye, was produced. De Wecker regards the presence of a purulent discharge from the conjunctiva as a contra-indication for the remedy, which, he finds, is then liable to increase the intensity of the blennorrhœa in a dangerous degree. Cases where there is little or no papillary swelling, but nearly dry granulations with pannus, are the most suitable for its use. The presence of well-marked pannus of the cornea without ulceration is, in the opinion of a large number of surgeons, the only thing which can render the employment of jequirity justifiable, and, in addition to this, the conjunctiva should be free from blennorrhœa.

In addition to local remedies, it is of the utmost importance that the hygienic surroundings of patients suffering from granular ophthalmia be seen to, and that they be obliged to spend a considerable time daily in the open air.

Purulent Ophthalmia. — *Causes.* — The two most common forms in which we find this affection are, as gonorrhœal ophthalmia, and as ophthalmia neonatorum. In the former the etiological element is the introduction of some of the urethral or vaginal discharge into the conjunctival sac, while in the latter the infection is believed to take place, as a rule, during the act of birth, by an abnormal secretion (not necessarily gonorrhœal) of the vagina finding its way into the infant's eyes. For, although the eyelids are closed during birth, they are not so tightly closed as to preclude the possibility of fluid making its way between them. Ophthalmia neonatorum may also be the result of inoculation taking place after birth by pus conveyed by the fingers of the mother or nurse, or by towels, &c., used for washing the child's face. It is never due to mere exposure to strong light or to cold, as is popularly supposed. Acute conjunctival blennorrhœa also comes about without any assignable cause; but, in all these cases, it is probable that the introduction of some septic matter into the eyes has taken place, although without the knowledge of the patient.

Pathology.—Neisser, who first observed the presence of a peculiar micrococcus in the gonorrhœal discharge, also found the same micrococcus in the pus from the conjunctiva in cases of gonorrhœal ophthalmia, and it was thought that this might account for the remarkable virulence of this ophthalmia; the same micrococcus, however, has been found in the conjunctival discharge in ophthalmia neonatorum.

Symptoms and Progress.— In mild cases the bulbar conjunctiva may be but little, or not at all, affected; the palpebral conjunctiva alone becoming velvety and discharging a small amount of pus, while there may be no swelling or œdema of the eyelids. Such mild cases are not uncommon

in ophthalmia neonatorum. In severe cases of blennorrhœa of the conjunctiva there is, soon after the onset, serous infiltration of the palpebral mucous membrane, which consequently becomes tense and shiny; serous chemosis of the bulbar conjunctiva, serous discharge, swelling of the eyelids, making it difficult to evert them, pain in the eyelids, often of a shooting kind, burning sensations in the eye, and photophobia. This first stage lasts from twenty-four to forty-eight hours, and then begins the second stage, in which, owing to swelling of the papillæ, the palpebral conjunctiva becomes less shiny and more velvety, while the discharge alters from serous to the characteristic purulent form, the chemosis, however, remaining unaltered, or becoming more firm and fleshy. The swelling of the lids continues, the upper lid often becoming pendulous and hanging down over the under lid. Gradually the chemosis and the swelling of conjunctiva and eyelids subside, and the discharge lessens, the mucous membrane being left in a normal state, unless in a small percentage of cases in which chronic blennorrhœa remains. A severe attack of conjunctival blennorrhœa lasts from four to six weeks.

Complications with secondary corneal affections are the great source of danger in this affection. They occur in four forms: —1. Small losses of epithelial tissue on any part of the cornea. If these occur at the height of the inflammation, they are apt to go on to form deep perforating ulcers. 2. The whole cornea becomes opaque (diffusely infiltrated), and towards its centre some greyish spots form, which are interstitial abscesses or purulent infiltrations. 3. The infiltration may form at the margin of the cornea, and extend a considerable distance around its circumference, giving rise to a marginal ring ulcer, and, later on, to sloughing of the whole cornea. 4. A clean-cut ulcer may form at the margin of the cornea without any purulent infiltration of the corneal tissue, and may also extend a long way round the cornea. Such ulcers are particularly apt to occur where there is much chemosis which overlaps the margin of the cornea, and, being hidden in this way, these ulcers are easily overlooked. The chemosis should be pushed aside with the point of a probe, and these peculiar ulcers sought for. They are very liable to perforate. See *Suppurative Keratitis*, under Cornea, Inflammation of the.

All the foregoing forms of secondary corneal affection are common to ophthalmia neonatorum and gonorrhœal ophthalmia, but the two last are more frequent in gonorrhœal ophthalmia than in that of the newborn. They may appear at any period of the affection, but the earlier they occur the more likely they are to result seriously.

Treatment.—In the commencement of the affection the only local applications admissible are antiseptic lotions and iced compresses. The conjunctival sac should be frequently washed, not syringed out, with the former. In syringing out the conjunctival sac a morsel of the corneal epithelium may be removed, and through this the cornea become infected, and consequently this method is objectionable. The iced compresses should be kept to the eye for an hour at a time, with a pause of an hour, and so on, or even continuously. In this and in the next stage the chemosis should be freely and daily incised with scissors. If the swelling of the eyelids be great, the external canthus should be divided with a scalpel from without, leaving the conjunctiva uninjured; by which means the tension of the eyelids on the globe is reduced, and, by bleeding from the small vessels, depletion of the conjunctiva is effected. If, in adults, the degree of chemosis, palpebral swelling, and rapidity of the onset, indicate that the inflammation is severe, the writer is in the habit of placing the patient quickly under the influence of mercury, by means of inunctions or small doses of calomel, as, by this means the chemosis is often rapidly brought down, and one source of danger to the cornea removed. He does not use mercury in ophthalmia neonatorum.

In the second stage, i.e. when the conjunctiva has become velvety and the discharge purulent, caustic applications are the most trustworthy, and in this respect iodoform, and other lauded means, cannot compete with them. The application employed may be a solution of nitrate of silver of 15 to 20 grains in f℥j. of water, which should be applied by the surgeon with a camel's-hair pencil to the conjunctiva of the everted lids, and neutralised with a solution of common salt. Or, the solid mitigated nitrate of silver (one part nitrate of silver, two parts nitrate of potash, in the solid form as stick) may be used; the first application being a light one, in order to test its efficacy, when careful neutralisation with salt water, immediately followed by washing off with fresh water, are most important. After each caustic application the use of iced compresses for an hour is beneficial.

The immediate effect of a caustic application to the conjunctiva is the production of a more or less superficial slough, under which a serous infiltration takes place. This latter increases and finally throws off the slough, and then the epithelium begins to be re-formed. From the time the slough separates until the epithelium has been regenerated a diminution in the secretion may be noted; but the discharge again increases as soon as the regenerative period is ended, and this latter is the moment for a new application of the caustic. From one caustic application of ordinary severity until the end of the regenerative period about twenty-four hours usually elapse.

No corneal complication contraindicates the active treatment of the conjunctiva just described; but, when a corneal ulcer is present, care must be taken that, during eversion of the lids, no pressure is made on the eyeball, lest the floor of the ulcer give way.

Iodoform, finely pulverised, has recently been much praised as a local application in the second stage of acute blennorrhœic conjunctivitis. It is to be dusted freely on the everted conjunctiva once or twice a day. The writer would trust to it in mild cases only.

When only one eye is affected it is important to protect its fellow from infection by means of a hermetic bandage. This may be made by applying to the eye a piece of lint covered with boracic acid ointment, and over this a pad of salicylicated cotton wool. Across this, from forehead to cheek and from nose to temporal region, are laid strips of lint, soaked in collodion, in layers over each other; or a piece of tissue guttapercha may take the place of the lint and collodion, its margins being fastened to the skin by collodion. The shields invented by Maurel and Buller respectively are very serviceable for this purpose.

The *prophylaxis* of blennorrhœa neonatorum is very important, and should form part of the routine of lying-in practice. Careful disinfection of the vagina before and during birth, and the most minute care in cleansing the face and eyes of the child with a non-irritating disinfectant (e.g. solution of corrosive sublimate, 1 in 1000), immediately after birth, are to be recommended. The antiseptic lotion should be freely poured into the eyes, the lids being held open for the purpose. The method of Dr. Credé has found very general acceptance, and is a good one. It is as follows:—While, after division of the umbilical cord, the child is in the bath, the eyes are carefully washed with water from a separate vessel, the lids being scrupulously freed, by means of medicated wool—absorbent or borated—of blood, slime, or smeary substance; then, before the child is dressed, a few drops of a 2 per cent. solution of nitrate of silver are instilled into the eye.

Treatment of Corneal Complications.—Many surgeons use solution of the sulphate of eserine (gr. iv. ad Aq. f℥j.) dropped into the eye as soon as any corneal complication arises and as long as it continues, because this drug is believed, in addition to its myotic power, to have the effect of reducing the intra-ocular tension (a circumstance to be desired in these instances) and to act, also, as an antiseptic. Its power to reduce the normal intra-ocular tension is not great, and its antiseptic action, if it exists, must be very insignificant, while, on the other hand, in the writer's opinion at least, it has a decided tendency to promote iritis in these cases, where the iris is so liable to become inflamed secondarily to the corneal process. For these reasons the writer does not recommend its use in these cases. His own practice is to employ atropine here, with the object of diminishing the tendency to iritis, by keeping the muscles of the iris and ciliary body at rest. Only if a marginal ulcer should perforate, with prolapse, or danger of prolapse, of the iris into the opening, would eserine seem to be indicated, and then simply for the purpose of mechanically drawing the iris out of, or away from, the perforation by the contraction of its sphincter.

On the first appearance of an infiltration or ulcer of the cornea, besides the use of atropine, nothing can be done further than the steady continuance of the conjunctival treatment, no remission or relaxation of which is indicated. Greater care, however, is required in everting the lids, lest pressure on the globe might cause rupture of the ulcer; and, when a case of acute blennorrhœa of the conjunctiva first presents itself, the surgeon, not knowing the condition of the cornea, must use the utmost caution in making his examination, and yet must never fail to get a view of the cornea for the purposes both of prognosis and of treatment. At each visit the cornea must be examined, and it may be found that, as the conjunctival process subsides, the corneal affection also progresses towards cure, infiltrations becoming absorbed, and ulcers filling up. But, even though the conjunctiva be improving, and still more so if it be not, the corneal process may progress, the infiltration becoming an ulcer, and the ulcer going on towards perforation by becoming gradually deeper. (For the management of

the corneal complications see *Suppurative Keratitis, Ulcers, &c.*, under CORNEA, Inflammation of the.)

Central capsular, or pyramidal, cataract may be the result of a small perforating corneal ulcer in blennorrhœa neonatorum. On perforation taking place, the lens, or rather its anterior capsule, comes to be applied to the posterior aspect of the cornea, owing to there being now no anterior chamber, as the aqueous humour has escaped through the opening. The pupillary area is soon filled with fibrinous exudation, the opening in the cornea finally becoming closed, and the iris and lens are pushed back into their places by the aqueous humour, which has again collected. Adherent to the anterior capsule, on the spot which lay against the cornea and which corresponds with the pupillary area, is a morsel of fibrin, which in the course of time becomes absorbed by the aqueous humour. Meanwhile changes have been produced by this exudation on the corresponding intracapsular cells, which result in a small permanent central opacity at that place, where there is also a slight elevation of pyramidal shape over the level of the capsular surface. This is the condition called central capsular cataract, and rarely results from corneal perforation in adults. *See* CATARACT.

It will frequently occur that, on the surgeon's visit to a case of blennorrhœa of the conjunctiva, he will find the margins of the eyelids gummed together by sero-purulent secretion, while the eyelids are bulged out by the pent-up fluid behind them. The attempt to open the eye should then be very carefully made, lest some of the retained pus spurt into the surgeon's eye. The surgeon should also be most careful to thoroughly wash and disinfect his hands and nails immediately after his examination is concluded.

CROUPOUS CONJUNCTIVITIS.—*Causes.*—Contagion. Epidemic.

Symptoms and Diagnosis.—This disease is chiefly found in children, and is not common. The palpebral conjunctiva is a good deal swollen, and is covered with a delicate smooth grey false membrane that may be peeled off, leaving a mucous surface underneath, which then bleeds little, or not at all. The disease is not a severe one, and does not often cause secondary corneal affections. It must not be mistaken for diphtheritic conjunctivitis, from which it is easily distinguished by the readiness with which, in it, the false membrane can be removed, and by the vascular condition of the underlying mucous membrane.

Treatment.—Iced compresses to the eyelids during the croupous stage, with antiseptic cleansing of the conjunctival sac (Sol. hydrarg. perchlor., 1 in 2000, or Sol. acid. borac. 4 per cent). No caustic should be used in this stage, as it is apt to produce corneal changes. Sulphate of quinine sprinkled on the conjunctiva is praised by some surgeons as a useful application in this stage. When the false membrane ceases to be formed a slight blennorrhœa comes on, which may be treated on the principles above laid down.

DIPHTHERITIC CONJUNCTIVITIS.—*Causes.* This disease is very rare in the United Kingdom, but is not infrequent in some parts of Germany. It is difficult to assign a cause for it. It is frequently epidemic, and is extremely infectious.

Symptoms and Diagnosis.—There is no more serious ocular disease than this, for it may destroy the eye in twenty-four hours, while in severe cases treatment is almost powerless.

The subjective symptoms of its initial stage are similar to those of blennorrhœic conjunctivitis, although the pain especially is more severe. The objective symptoms differ from those of blennorrhœa, in that the lids are excessively stiff from plastic infiltration of the subepithelial and deeper layers of the conjunctiva, while the surface of the mucous membrane is smooth, and of a greyish or pale buff colour. The bulbar as well as the palpebral conjunctiva is infiltrated in severe cases. If an attempt be made to peel off some of the superficial exudation, the surface beneath will be found of the same colour, not red and vascular as in croupous conjunctivitis. This stage of infiltration lasts from six to ten days, and constitutes the period of greatest peril to the eye; for, while it lasts, sloughing of the cornea is extremely apt to occur. Towards the close of the first stage the fibrinous infiltration is eliminated from the conjunctiva, which gradually assumes a red and succulent appearance, and secretes a purulent discharge. This constitutes the second or blennorrhœic stage. A third stage is formed by cicatricial alterations in the mucous membrane, which often lead to symblepharon or xerophthalmos; so that, even if the patient escape corneal complications in the first and second stages, other dangers, almost as serious, await him in the final stage. *See* XEROSIS or XEROPHTHALMOS.

Corneal complications (infiltrations, ulcers) are most likely to occur in the first stage, and are then also most likely to prove destructive to the eye. The earlier they

appear the more dangerous are they. The corneal complications are more easily managed, if they do not appear until the blennorrhœic stage has commenced, or even if the latter stage come on before an ulcer contracted in the first stage has advanced far.

Treatment.—In the first stage, warm fomentations frequently, with antiseptic cleansing, are the only local measures for the conjunctiva admissible. No caustic or astringent application should be used. Internally the patient should be treated with iron and quinine, and generous diet. In the second, or blennorrhœic, stage, careful caustic applications are to be used. Corneal ulcers must be dealt with, whenever they arise, as though the case were one of blennorrhœic conjunctivitis. When the purulent discharge ceases, solutions of soda, milk, or glycerine may be prescribed as lotions for the conjunctiva, to arrest, if possible, the xerophthalmos.

Phlyctenular Conjunctivitis. — *Causes.*—The strumous constitution—as indicated by the swollen nose and upper lip, and sometimes by the enlarged lymphatic glands in the neck, and by eczema of the eyelids, face, and external ear, and catarrh of the Schneiderian mucous membrane—is that most liable to this affection, the subjects of which are usually children up to the twelfth or thirteenth year of age. Often, however, it will be found in apparently strong children with good general health; but, even in them, there is probably some allied irregularity of nutrition, of which the great tendency to recurrence of the eye-affection is evidence.

Pathology. — This is an eczematous affection, and is characterised by the eruption of vesicles or pustules on the bulbar conjunctiva—so-called phlyctenulæ.

Symptoms.—Two types of the eruption are to be recognised: 1. The solitary, or simple, phlyctenula. Of this there may be one or several, varying in size from 1 mm. to 4 mm. in diameter. Around the phlyctenula is a localised vascular injection, but the general conjunctiva is normal. At first there may be shooting pains in the eye and lacrymation, but these soon pass away. If a phlyctenula be not seated close to the cornea—which might in that case become infiltrated—the affection is not serious. The length of time required for its cure depends on the size of the phlyctenula, varying from seven to fourteen days, as a rule. 2. The multiple, or miliary, phlyctenulæ. These are minute, like grains of fine sand, and are always situated on the limbus of the conjunctiva (i.e. that portion of the bulbar conjunctiva which immediately surrounds the margin of the cornea), which is swollen. The general injection and swelling of the conjunctiva, in this form, is considerable. The lacrymation and photophobia are often very great, and there is a good deal of conjunctival discharge. This form is very apt to appear after measles and scarlatina.

Both forms are liable to extend to the cornea, and then only does the disease become serious. *See* Cornea, Inflammation of the.

Treatment.—The solitary phlyctenula is best treated with the yellow oxide of mercury ointment (Pagenstecher's Ointment: ℞. Hydrarg. perox. præcip. gr. xxx., vaselin ʒj.), of which a bit the size of a hempseed should be put into the eye once a day. Or a small quantity of pure calomel dusted into the eye once a day will also cure. This last remedy should not be used if—as is indeed unlikely—iodide of potassium is being at the same time taken internally, for then iodide of mercury is liable to be formed in the conjunctiva.

The miliary phlyctenular conjunctivitis at its outset should be treated with cold or iced applications; or, at most, some freshly-prepared solution of Liq. chlori (1 part Liq. chlori, 9 parts water), may be dropped into the eye. Later on Liq. plumb. dil. or Sol. arg. nitr. (gr. v. ad Aquæ fʒj. and neutralised), applied to the everted conjunctiva, are suitable; or, if the phlyctenular appearances predominate over the catarrhal, the yellow oxide of mercury ointment, or insufflations of calomel, may be preferred. When the cornea is slightly affected near the margin, in cases of miliary phlyctenulæ, calomel, or the yellow oxide of mercury ointment, and warm fomentations should be used.

The after-treatment of phlyctenular conjunctivitis is important, in order to prevent recurrence of the affection. It consists in the insufflation of a minute quantity of calomel into the eye once a day, until, on awaking in the morning, the eye is found to be quite free from vascular injection. This after-treatment may require to be continued for three or four weeks.

Conjunctival Complication of Small-pox.—A good deal of uncertainty has prevailed with regard to this affection, as the initial stages were not observed by physicians owing to swelling of the eyelids, while the ophthalmologist saw only the results of the process in the period of convalescence from the general disease, or later. The following embodies the view of Professor Horner, who made a special study of this

matter throughout a severe epidemic of smallpox.

Smallpox pustules on the cornea are extremely rare. Horner saw but one case. The most frequent and most serious mode of attack consists in a greyish-yellow infiltration of the conjunctiva close to the lower margin of the cornea, not extending to the fornix conjunctivæ, nor far along the inner or outer margin of the cornea. It occurs in the eruptive stage, and is to be regarded as a variolous pustule. This infiltration or pustule gives rise to a corneal affection, either in the form of a marginal ulcer, or as a deep purulent infiltration, ulcerating, perforating, leading to staphyloma, purulent irido-choroiditis and panophthalmitis, results which are often first observed long after the primary conjunctival affection has disappeared. The germ of the conjunctival affection probably makes its way between the eyelids. This theory would account for the constancy of the position of the primary affection—that part of the conjunctiva, with closed eyelids and eyeball consequently rotated upwards, being the most exposed to particles entering.

Treatment.—On this ground the prophylactic use of boracic acid ointment on lint applied over the eyelids is to be recommended. If a conjunctival pustule has already formed without any, or with only commencing, corneal affection, Horner advises the destruction of the pustule with fresh Liq. chlori, or with mitigated lapis (Arg. nitr. 1 part, Potassæ nitr. 2 parts, in the solid form as stick), carefully neutralised with solution of common salt after application. Corneal complications are treated as in blennorrhœa or diphtheritis of the conjunctiva.

The frequency with which the eyes become affected varies in different epidemics of smallpox.

Amyloid Degeneration of the Conjunctiva.—*Cause.*—This rare disease is not associated with amyloid disease in any other part of the system. It seems sometimes to be developed from granular ophthalmia, but occurs also as a primary disease.

Symptoms and Diagnosis.—The affected eyelid is much swollen, but there is a complete absence of all inflammatory symptoms. The patient can but partially elevate his lid, which is so stiff and hard that it is everted only with difficulty by the surgeon. The conjunctiva has the appearance of white wax. The positive diagnosis may be made by submitting a small portion (removed) of the diseased conjunctiva to the iodine test.

The disease attacks chiefly the palpebral conjunctiva, but is also seen in the bulbar portion. It ultimately extends to the cartilage and is a strictly local disease, unassociated with amyloid degeneration in other parts of the system.

Treatment.—When feasible, removal of the diseased parts by the knife and scraping is the only measure possible.

Tubercular Disease of the Conjunctiva.—This is an extremely rare disease. It commences in the bulbar or palpebral conjunctiva as small, pale, yellowish nodules, which soon ulcerate. The ulcers are apt to extend very widely, in one case the whole of the bulbar conjunctiva and part of the palpebral conjunctiva having become involved. The margins of the ulcers are irregular but well-defined, and their floors covered with a pale yellowish creamy deposit. The surrounding conjunctiva is swollen, and, if the palpebral conjunctiva be much involved, the lid becomes enlarged in every dimension.

Symptoms.—There is often no pain, or only a slight burning sensation; but, again, when the ulceration is extensive, very severe pain may come on.

Diagnosis.—Secondary syphilitic disease is that most apt to simulate the appearances of tubercular disease in the conjunctiva. The absence of a syphilitic taint, the presence of tubercular disease elsewhere in the system, or the existence of well-marked family tuberculosis would all point to the disease being of tubercular nature; but the most certain method of diagnosis will lie in the microscopic examination of morsels removed from the nodules or ulcers, and, above all, in inoculation experiments made with such morsels.

Treatment.—Tonics, especially cod-liver oil, are indicated. But inasmuch as the disease is apt to spread to other tissues of the eye (cornea, sclerotic, iris, choroid), the destiny of these eyeballs is, probably in most cases, enucleation. H. R. Swanzy.

CONJUNCTIVA, Injuries of the.—Foreign bodies frequently make their way into the conjunctival sac and cause much pain, especially if they get under the upper lid, by reason, chiefly, of their coming in contact with the corneal surface during motions of the lid and of the eye.

If the foreign body be under the lower lid it is found by drawing the lid down, and, provided it be not actually embedded in the tissue, it is readily removed with a camel's-hair pencil, or with the corner of a soft handkerchief. But if the foreign body

be under the upper lid, it is necessary to evert the latter before it can be reached, Should the foreign body be embedded in the conjunctiva it will require to be removed with a needle suitable for the purpose; and the little proceeding will be made easier, both for patient and surgeon, by the instillation of a few drops of solution of cocaine (two per cent.) into the eye.

The conjunctiva is frequently implicated in severe injuries of the eyelids or eyeball; but the consideration of these cases does not come within the scope of this article. The most common form of injury, which may involve the conjunctiva only, is a burn, by fire, acid, or lime.

In the case of a strong acid getting into the eye, if the patient be seen soon after the occurrence, the whole conjunctival sac should be well washed out with an alkaline solution; while, in the case of lime, a solution of a weak mineral acid is indicated for the purpose. Cocaine may be employed to relieve the pain. Subsequently, protection of the eye, with the use of olive or castor oil dropped into it, will best promote the healing process.

In the case of a severe burn of the conjunctiva the resulting cicatrix is liable to produce a more or less extensive union of the eyelid to the eyeball (symblepharon), which often interferes with the motions of the latter, or even with vision if the cornea be obscured. No measures taken during the healing process can prevent symblepharon if the degree of the burn be such as to bring it about.

In many cases it becomes desirable to relieve the symblepharon by operation. The mere dissection of the lid from the eyeball, with the interposition between the two of morsels of oiled lint, &c., proves futile in these cases. It is always necessary to cover one or other of the resulting wounded surfaces with a layer of mucous membrane, in order to prevent recurrence of the condition. This can be effected in some cases by transplantation of conjunctival flaps with pedicle from a healthy portion of the eyeball, according to the proceeding of Teale (*Ophthal. Hosp. Rep.* vol. iii.), or of Knapp (*Archiv für Ophthalmologie*, vol. xiv. pt. 1). A more universally applicable method is the transplantation of conjunctival flaps without pedicle from another patient on the occasion of enucleation of an eyeball, or from a rabbit's eye, or of a portion of mucous membrane from the lips, or from the vagina (Stellwag). The chief precautions necessary for success in this proceeding are:—That the flap to be transplanted be not applied in its position until all bleeding in the latter place has ceased; that the flap be nothing more than mucous membrane, all submucous tissue being carefully removed; that it be sufficiently large to cover the surface without stretching (and it is to be remembered that the flap shrinks to two-thirds of its size after being detached from its own bed); that the flap be kept moist and warm during the period, as short as possible, which elapses between its detachment and its adjustment; and, finally, that it be kept firmly in its new position by a sufficient number of points of interrupted suture. H. R. Swanzy.

CONTRE-COUP. *See* Head-Injuries, Diagnosis of.

CONTUSIONS. *See* Bruises.

COPAIBA-RASH.—Copaiba not only causes disturbances in the digestive canal, but may, as it is eliminated in the breath and perspiration, give rise to certain slight affections of the respiratory and cutaneous surfaces. The skin affection consists, in most instances, in a bright red roseolar eruption, which is to be found chiefly on the back of the neck and arms, and on the chest. This eruption, which usually causes much itching, appears very soon after the first dose of copaiba has been taken, but often persists for several days after the administration of the balsam has been discontinued. It is never the cause of any marked febrile disturbance. The so-called copaiba-rash of which this is the most frequent form seems to be due to the irritating action of this remedy on a skin that is predisposed to become affected with some form or other of eruption. In some cases the rash is a well-marked and painful urticaria, in others it is decidedly papular, and in others, again, it consists of small dusky patches.

CORACOID PROCESS, Fracture of the.—This process may be broken through at any part between its tip and its base. The injury which, however, is extremely rare, is caused only by great direct violence, as when a wheel passes over the shoulder. It is often combined with other lesions, e.g. dislocation or fracture of the upper end of the humerus, or of the clavicle. When the fracture is beyond the coraco-clavicular ligaments the fragment is drawn down by the muscles connected with it; but when the process is broken at its base the ligaments prevent any marked displacement, and the

only symptoms are mobility, crepitus, and pain; but these are often obscured by swelling, or by other lesions that are present.

The *treatment* consists in supporting the elbow, brought forward across the chest, in a sling, so as to keep the muscles at rest. HOWARD MARSH.

CORNEA, Examination of the.—Anatomically, the cornea is usually regarded as consisting of five layers, namely, the epithelium; the anterior elastic layer (Reichert's or Bowman's); the fibro-cellular substance, or *substantia propria*; the posterior elastic membrane (Demours' or Descemet's); and the endothelium. Embryologically, however, there are only three layers, namely, (1) the epithelium and anterior elastic membrane; (2) the proper substance; and (3) the posterior elastic membrane with its endothelium. Each of these embryonic layers has a peculiar mode of development, and there are significant differences in their origin. The anterior layer is derived from the external layer of the blastoderm or epiblast, and is continuous with the epidermis of the external integument, while the middle and posterior layers are derivatives of the mesoblast, and are therefore related to all the fibro-vascular structures of the body, including bones, muscles, blood-vessels, and cutis. This relationship extends not only to the mode of development and the nutrition, but also to pathological changes of these several systems. Lesions of the epithelial layer of the cornea resemble those of the epidermis and superficial layer of the dermis, and are associated with them; lesions of the proper substance are associated with those of the fibro-vascular structures of the body; while lesions of the posterior layer are often associated with toxæmic states in which the serous or synovial membranes are implicated. As concrete examples we may take the association of phlyctenular keratitis with eczema in strumous persons, interstitial keratitis with manifestations of hereditary syphilis, keratitis punctata with gonorrhœal rheumatism.

The cornea is nourished partly by blood and partly by lymph. The blood-vessels are derived from branches of the anterior ciliary arteries, and are, in health, found only at the peripheral portion of the anterior surface, where they form delicate loops near the corneal margin, and anastomose with the vessels of the conjunctiva. The posterior layer and the proper substance of the cornea are nourished by the aqueous humour, which gains access to them through the lymphatic spaces of Fontana, and through the stomata in the endothelium. Consequently, the integrity of these layers depends, more or less directly, upon a healthy state of the ciliary body and iris, by which the aqueous humour is secreted. *See* CILIARY BODY; IRIS.

The cornea is innervated by branches of the ciliary and conjunctival nerves. The greater number of the nerve-branches enter the deeper layers of the cornea, and lose their myelin sheaths. They then form plexuses in the stroma, from which fine branches pass forwards to penetrate the anterior elastic membrane. Here they are arranged in a fine sub-epithelial plexus, from which fibrillæ are given off to end between the epithelial cells as free terminals or in corpuscles.

Pathology.—In the economy of the eye and vision the cornea has at least three separate functions to perform. First, by its texture and general construction it fills in and supports the anterior segment of the globe. Second, by its transparency it permits the admission of light within the eye. Third, by its curvature it so refracts this light that, after passing through the dioptric media, it is brought to a focus upon the retina. Alterations of any one or more of these functions constitute disease. Alterations in nutrition of the cornea may affect either its texture, or its translucency, or its curvature. The cornea may also be the site of neoplasmata of an epithelioid or of a sarcomatous nature; but these are rare.

Physical Examination.—In examining the cornea it is necessary, not only to search the surface, but also the substance and the posterior layer. Attention should also be given to the adjacent structures, more particularly the circumcorneal blood-vessels, the anterior chamber, and the iris. This can best be done by adopting a definite plan of inspecting by direct light, by oblique illumination, by the ophthalmoscopic mirror, and by palpation.

1. Examination of the cornea by direct light is most conveniently done by placing the patient opposite a window, so as to obtain a reflection of the window on the cornea. If the eye be made to follow the observer's finger, moving in various directions of the visual field, it is easy to observe whether the polish and lustre of the surface is disturbed or not. If the surface be intact the image will be unbroken in every position; but if it be uneven, whether from cicatrisation, ulceration, or the pre-

sence of a foreign body, the reflection is broken.

2. In oblique or focal illumination, the patient is placed by the side of a lamp, while the light is concentrated on the cornea by a convex lens of about three-inch focal length. By this means, not only the surface, but the substance and deeper layers of the cornea may be thoroughly examined for opacities, foreign bodies, or breaches of continuity.

3. Transmission of light into the eye by means of the ophthalmoscopic mirror not only discloses the presence of opacities, but is often the only means of discovering irregularities of conical cornea, semi-transparent facets, or fine nebulæ.

4. Palpation is less applicable to the cornea than to some other organs, but it may assist diagnosis, either by eliciting alterations of tension or of sensibility. In health the cornea is exquisitely sensitive to touch, but in some neuropathic states it may be hyperæsthetic or anæsthetic in isolated portions, or throughout its whole extent. JOHN TWEEDY.

CORNEA, Inflammation of the.—KERATITIS OR CORNEITIS.—The phenomena that follow the impaction of a foreign body on the cornea are well known. At first, there is sudden smarting, spasmodic closure of the lids, profuse lacrymation, and redness of the conjunctiva. If the particle be not removed, the manifestations soon undergo some change. The smarting pain is displaced by a dull aching throb above the eyebrow and down the side of the nose, and the sight is dimmed. Coincidently, for some distance around the foreign body the cornea becomes hazy, and a well-defined zone of congested blood-vessels appears around the margin. Still later—especially if the injury be very severe, and the foreign body possess infective properties—the haziness may increase in extent and in intensity; the surface of the cornea ulcerates, pus infiltrates the laminæ and invades the anterior chamber. Eventually perforation may occur, followed by prolapse of the iris and probable destruction of the globe. Inflammation of the cornea may, however, be induced by injury and yet the subsequent course be different, the series of tissue changes culminating in one or other of the forms of keratitis described below; or inflammation may begin without any appreciable injury. The subjective symptoms vary greatly in the different forms of keratitis. There is always more or less pain, together with impairment of sight. Speaking generally, it may be said that inflammation of the anterior layer is more painful than inflammation of the middle and posterior layers; whereas the impairment of sight is usually greater in inflammation of the middle and posterior layers than of the anterior layer.

Pathology.—In all forms of keratitis, whether the inflammation affect the superficial or the deeper layers, there is an appreciable alteration of texture, consisting of an increase in the number of cellular elements and an accumulation of fluid. The canaliculi of the cornea are distended with fluid and with cells. The precise origin of these cells has not been definitively determined. According to Cohnheim and his disciples, all are derived, by a process of diapedesis, from the adjacent blood-vessels, and are in no degree due to the proliferation of the fixed corpuscles, as formerly believed, and as Böttcher still maintains. Experimental evidence goes to show that, in the earlier stages of keratitis, the cells which first congregate are entirely migratory, inasmuch as they are met with before the fixed corpuscles have had time to multiply. Indeed, the advocates of the migratory theory allege that the fixed corpuscles do not proliferate at all, so long as inflammation continues. Whatever change they may undergo is of a retrogressive character. Stricker, Norris, Fuchs, and others believe that the cellular elements of inflammation are derived from both sources. The truth may be that the nature and degree of the inflammation determine what share the blood-vessels and what the tissue-elements shall take in furnishing new cells. If the inflammation be slight, the fixed corpuscles may supply some of the cells; but, if it be severe, these ciliary and conjunctival blood-vessels are probably the sole contributors.

The disposition which the cell-infiltration assumes differs in the different layers of the cornea. When the epithelial layer is affected, the leucocytes are commonly collected into isolated masses, which are called 'phlyctenules' or 'pustules.' When the middle layer is affected the infiltration is more diffused. When the posterior layers are affected the inflammatory product consists mainly of a serous effusion into the anterior chamber, and of deposit of lymph and leucocytes upon the endothelium, corresponding exactly with the changes that occur in, say, serous pleuritis. When the inflammation affects the proper substance, the new cells and the fluid are at first con-

fined to pre-existing channels; but later, the fibrillæ are destroyed, partly by softening and pressure, and partly by the corroding action of the leucocytes. As soon as the fibrillæ are broken the cells wander through the disintegrated cornea, or collect into a circumscribed cavity to form an 'abscess.' If the softening and disintegration lead to an opening on the external surface, the lesion is called an 'ulcer'; if to an opening through the posterior layer, with escape of pus into the anterior chamber, it is called 'hypopyon.'

Repair.—The amount and character of repair which takes place in the cornea depend upon the degree of inflammation. If only the epithelium have been implicated, it is reproduced without leaving any scar, but if any portion of the anterior elastic membrane or the fibrous substance have been destroyed, a cicatrix will always remain to record the fact. When, however, the inflammation of the cornea has been slight, the exuded fluid and cells are absorbed, while the fixed corpuscles assume great nutritive and formative activity, and finally restore the tissues to their former state of integrity; if more severe, many of the fixed corpuscles will have perished, and the leucocytes must participate in the reparative process, and then restoration is not so perfect. If an appreciable portion of tissue have been destroyed, the loss is made up almost entirely by migration cells, new blood-vessels being developed to supply the nutrient material. This process is known as 'granulation' and 'cicatrisation.' By it perfect restoration to the normal state never takes place, the site being ever afterwards indicated by an opacity, which consists of scar-tissue. As the reparative process approaches completion, the new vessels gradually shrink, and ultimately disappear. See *Opacities of the Cornea*, under CORNEA, Ulceration of the.

Causes.—The causes of keratitis are twofold, namely, predisposing and exciting.

The *predisposing* causes may be (*a*) general, or (*b*) local.

The chief general predisposing causes are—age, diathesis, occupation. *Phlyctenular keratitis* (q.v.) occurs most frequently between the ages of three and fifteen years; *interstitial keratitis* (q.v.) between eight years and twenty; whereas *keratitis punctata* (q.v.) is most frequent between the ages of seventeen and thirty. Diathesis plays an important part in keratitis. Scrofula and syphilis each notoriously determines a peculiar form of keratitis, and there is reason to believe that the arthritic diathesis, gonorrhœa, and toxæmic states may be the predisposing conditions of inflammation of the lining membrane of the anterior chamber—keratitis punctata.

Among the local predisposing causes are acute or chronic congestions or inflammations of the conjunctiva; impaired innervation of the eyeball, either from disease of the fifth nerve, or from disorders of the sympathetic, or from dental irritation, or from a tumour encroaching upon the medulla oblongata. Morbid states of associated and correlated tissues may also predispose to keratitis. In inflammation of the ciliary body, for example, the quality of the aqueous humour is altered, and the nutrition of the cornea is, in consequence, prejudicially affected, and the resistance of the tissue thereby diminished. The vascular engorgement of the front portions of the eyeball, which is associated with uncorrected or miscorrected errors of refraction, may render the cornea susceptible to inflammation from slight exciting causes.

The *exciting* causes are, however, the factors that initiate the characteristic pathological phenomena. These agents are always of the nature of 'irritants,' whether material, chemical, thermal, or organic. Foreign bodies, acids, alkalies, sparks, or infective fluids and particles, such as may occur in purulent conjunctivitis or in the accumulated contents of an obstructed lacrymal sac, or other septic fluids, are the most common exciting causes of keratitis.

Treatment.—The objects to be aimed at are: (1) to relieve pain; (2) to arrest the progress of the inflammation; (3) to promote early and rapid resolution; (4) to prevent complications; and (5), if possible, to obviate recurrence.

Happily, those measures which are calculated to attain any one of these ends may be trusted to reach the others. In all cases the indications suggested by a survey of the various predisposing and exciting causes should be carefully followed. In the beginning of the treatment, not only must actual extraneous substances be removed, but precautions must be taken to protect, as far as practicable, the eyes from irritating influences of every kind. Rest of the eyes is always desirable and often obligatory.

It cannot be too strongly insisted upon that, in the early stages at all events, the treatment must be of a soothing and sedative character. Stimulating applications are contra-indicated until resolution is well advanced, and are then only justifiable if the reparative process seems to flag.

One of the most convenient and efficient remedies for the relief of pain, and for favourably affecting the inflammatory process, is moist warmth, either in the form of vapour or fomentations, simple or medicated. Of the medicated applications, decoction of poppies, or a solution of extract of belladonna (gr. iv.–viij. ad ℥j.), is the most accessible and the best. These should be used every two, three, or four hours, according to the severity of the pain. In the intervals the lids should be kept tied up with a light compress saturated in the fomentation, except when there is much conjunctival or lacrymal secretion. Permanent compresses are unsuited to cases in which there is much secretion.

In addition to these external applications, a solution of atropine (gr. ij.–iv. ad f℥j.), should be dropped inside the lids two or three times a day, or oftener, according to circumstances. The benefits of atropine are manifold. It is anodyne, mydriatic, and antiphlogistic. It has an additional use in putting the muscular tissue of the iris, ciliary body, and choroid at rest. Solutions of eserine or pilocarpine (gr. j.–iv. ad f℥j.) are preferred by many practitioners for superficial corneal ulcerations. According to the writer's experience it is not suitable in the earliest stages; and at any time it is, perhaps, most serviceable when the inflammation is marginal. Eserine, or other myotic, is especially indicated whenever the tension of the eyeball is increased, provided there be no iritis.

If the pain be severe, and more particularly if it be supraorbital, the application of one or two leeches to the inner angle of the orbit or over the malar bone, followed by hot fomentations, will seldom fail to give relief. Local depletion answers best in the early or vascular stages of the inflammation, or at the beginning of exacerbations of an existing inflammation.

As the cornea is always liable to be infected by morbid secretions of the conjunctival or the lacrymal sac, cleanliness and drainage should be ensured. Secretions should not be allowed to collect, and those that are present should, as far as practicable, be rendered innocuous. Antiseptic preparations of some kind may be needed; but care must be exercised in their selection. For instance, solutions of carbolic acid are too irritating, and solutions of permanganate of potash are equally inapplicable on account of their solvent action on the corneal cement. The safest and best preparations are solutions of boracic acid (gr. iij.–viij. ad f℥j.), sulpho-carbolate of soda (gr. v.–x. ad f℥j.), perchloride of mercury (gr. $\frac{1}{16}$–$\frac{1}{10}$ ad f℥j.), sulphate of quinine (gr. iv. ad ℥j.), and iodoform ointment (gr. iij.–x. ad ℥j.).

While it is indisputable that, both for the relief of pain and for completeness of the ultimate recovery, the treatment of keratitis must be pre-eminently local, internal remedies are not to be despised. The drugs most likely to ease pain are croton-chloral hydrate, in three-grain doses every half-hour, with or without small doses of gelsemin; juice of conium, in one-drachm doses every two to four hours; opium, either as compound soap pill or compound ipecacuanha powder. Mild aperients and alteratives are useful adjuvants. A mercurial purge at the beginning of keratitis, especially when this is due to injury, often gives distinct relief, and favours the action of the local remedies. In the diathetic inflammations, appropriate constitutional treatment is of course required. It is, however, well not to be too precipitate in adopting 'a tonic plan of treatment.' This caution applies especially to the employment of ferruginous preparations. Iron almost invariably does harm in the irritation-stage of keratitis, although it may otherwise seem to be indicated by anæmia and general debility.

After the acute symptoms have subsided, and reaction is advanced, the process of repair may often be expedited by the occasional application of mild stimulants, such as the yellow oxide of mercury ointment (gr. iij.–xv. ad ℥j.), powdered calomel, and weak perchloride of mercury lotion. Still later, when cicatrisation has begun, these applications may be advantageously combined with light frictions of the lids over the cornea. Friction (massage) systematically employed certainly promotes the absorption of the inflammatory products, and thereby minimises the subsequent opacity.

Counter-irritation by means of a blister behind the ear, or still better over the temple or forehead, is often beneficial in chronic keratitis; but in acute keratitis its value is, to say the least, equivocal. The same remark applies to setons.

If haziness or opacity remain about the centre of the cornea while the margin becomes clear, an artificial pupil may be made opposite the clear cornea. *See* Iris, Diseases of the; Iridectomy.

Finally, it should be remembered that when once a cornea has been inflamed it is liable to recurrences on slight provocation. Hence, the importance of abstaining from close application of the eyes until

repair has had time to become thoroughly established, and for some time after.

Forms of Keratitis.—Inflammation of the cornea has been variously classified. Sometimes the classification is based on the character of the inflammation or the stage of the inflammatory process, or its results, as exudative, infiltrative, suppurative, or ulcerative; sometimes on the appearance of the cornea, whether it be vascular or not; sometimes on the constitutional condition with which the inflammation is associated, as struma, syphilis, rheumatism, &c. In this article it is proposed to classify them according to the relations and affinities disclosed by the study of the embryology and physiology of the cornea. Keratitis may therefore be considered according as it affects—(1) The anterior layer; (2) the proper substance; and (3) the posterior layer.

As, however, the phase of the inflammation has important clinical bearings, it is convenient to consider keratitis in its three principal modes of—I. Infiltration; II. Suppuration; III. Ulceration.

I. Infiltration-keratitis may, in accordance with the above-named principle, be classified as it affects—

1. The anterior layer: (*a*) traumatic; (*b*) trachomatous; (*c*) phlyctenular; (*d*) neuropathic, including herpes of the cornea.

2. The proper substance: (*a*) circumscribed, interstitial, or parenchymatous; and (*b*) diffuse interstitial keratitis.

3. The posterior layer: Keratitis punctata, vel Aquo-capsulitis, vel Iritis serosa.

II. Suppuration or abscess due to (*a*) phlyctenular, purulent, or diphtheritic conjunctivitis; (*b*) variolous or neuropathic keratitis.

III. Ulceration which may be (1) inflammatory or (2) non-inflammatory (neuropathic), each of which may affect the superficial or the deeper layers.

(1) Inflammatory ulcers:

(*a*) Superficial, simple, and irritable, or vascular; (*b*) deep, suppurative, and infective.

(2) Non-inflammatory (neuropathic):

(*a*) Circumscribed, superficial, deep, and crescentic; (*b*) diffuse, or necrotic.

I. Infiltration-keratitis.

1. Inflammation of the Anterior Layer, viz. the epithelium and elastic membrane.

(*a*) *Traumatic Keratitis.* See *Keratitis* above, and Cornea, Injuries of the.

(*b*) *Trachomatous Keratitis or Pannus.* In trachoma, or true granular lids, in addition to the presence of the characteristic growths in the tarsal portions of the conjunctiva, there is a peculiar affection of the cornea and adjacent conjunctiva called 'pannus.' This consists of infiltration, thickening, and vascularisation of the anterior layers, especially at the upper half or two-thirds. These changes are due partly to the mechanical irritation of the roughened lids, and partly to the infiltration. There is no necessary proportion between the amount of trachoma and the degree of pannus. On the one hand, there may be great roughness of the lids, with but slight pannus; and, on the other hand, the pannus may be extreme, but the affection of the lids slight. Indeed, in some cases, the pannus is an early phenomenon, and is fully established, while the trachomata are still confined to the subepithelial layer of the mucous membrane. In such cases, therefore, the corneal affection would seem to be the result of inoculation rather than of friction.

The amount of thickness and opacity varies: when slight, it is called *pannus tenuis*; if thicker, *pannus crassus*, and if very thick and fleshlike, *pannus sarcomatosus*. Except in very chronic cases only the upper half or two-thirds is hazy and vascular, while the lower portion may be unaltered, so that the sight may continue acute, though weak. In severe cases, the swelling, opacity, and vascularity are so great as to give to the cornea the appearance of fleshy granulations, and may implicate its whole extent. A rich network of blood-vessels extends on to the cornea from the conjunctiva and episcleral capsule over the surface. Under these circumstances the subjective symptoms are more marked. Lacrymation, photophobia, and supraorbital pain are present in proportion to the degree of corneal implication. In those instances where ulceration or suppuration of the cornea occurs, these symptoms are very severe.

The infiltration takes place between the epithelium and the anterior elastic layer, and may lead to thinning of this layer and its ultimate destruction. Pannus may be complicated by ulceration of the cornea and perforation, or the inflammation may extend to the deeper structures, and set up iritis, and even panophthalmitis. But short of this retrogressive changes of the cornea may take place, leading to bulging of the cornea and staphlyloma, or the whole of the cornea may become opaque from cicatrisation, followed by flattening and atrophy. In rare cases the pannus undergoes progressive hypertrophy, so as to form

permanent growths, which may be mistaken for actual tumours. Glaucoma is a not unfrequent late complication of eyes damaged by trachomatous keratitis.

Diagnosis is usually easy. The keratitis is at first limited to the upper part of the cornea, and an eversion of the upper lid discovers the presence of trachomata. There is, in addition, slight ptosis, with some thickening and incurvation of the upper lid.

Treatment must be chiefly directed to the trachomatous conjunctivitis, though the cornea itself may require special attention. It may, however, be pointed out that corneal implication is not a contra-indication for the active treatment of the trachomatous state of the conjunctiva. On the contrary, it usually denotes that more vigorous measures are needed. For the details of the various modes of treating pannus, see *Trachomatous Keratitis.*

(*c*) *Phlyctenular Keratitis*—This is the most frequent of all the forms of inflammation of the cornea. It is characterised by the presence of one or more minute vesicles, or vesiculo-pustules, situated on the surface of the cornea, or at the corneal margin. When the phlycten is in the cornea, there is always more or less injection of the conjunctival or epithelial vessels; but when at the margin the congestion is limited and patchy, and generally disposed triangularly with the apex towards the phlyctenule and the base towards the conjunctival *cul-de-sac.* The epithelium is rapidly shed, giving rise to a superficial ulcer, which, as a rule, soon heals. Associated with the phlyctenulæ on the cornea there is generally eczema with abortive vesicles on the lids, about the anterior nares, lips, and ears. The subjective symptoms are lacrymation, photophobia, and spasmodic closure of the lids—blepharospasm.

There are three other clinical forms, namely, (1) the miliary, (2) the pustular, and (3) the diffused.

In the miliary form the phlyctenulæ are not discrete, but are scattered around the entire circumference of the cornea. There is more circumcorneal injection; indeed, the general redness of the front of the eyeball resembles that of catarrhal conjunctivitis.

In the pustular form the phlyctenulæ are larger, and usually form around the corneal margin. Necrosis often takes place, resulting in a deep ulcer, which creeps over the cornea, eating its way into its substance, down to the posterior elastic membrane.

In the diffused form phlyctenulæ occur from time to time on the surface of the cornea, leading to general haziness and a vascular condition resembling trachomatous pannus. The anterior elastic membrane is always more or less involved, so that repair is always attended with more or less cicatrisation, though often the scar is not enough to permanently interfere with vision. When repair is retarded the ulcer resulting from the ruptured phlyctenule may become vascular, and partake of the characters of the ordinary irritable ulcer. See *Superficial Vascular Ulcer*, under Cornea, Ulceration of the. Owing to depraved states of health, the inflammation may be of a low type, and go on to suppuration of the parenchyma and the formation of abscess, followed by ulceration and perforation.

Phlyctenular keratitis is prone to return, and recurrences may be induced by slight causes, as errors of diet, temporary illness, close work, foreign bodies, &c.

Pathology.—The essential anatomical condition of a vesicle in the skin is stratified epidermis. This fact explains the site and distribution of corneal phlyctenulæ. These only occur on, or near, the cornea, and it is noteworthy that only on the cornea and adjacent portions of the conjunctiva the epithelium is stratified. In the rest of the conjunctiva the epithelium is columnar, in which neither vesicles nor pustules form. There are pathological and clinical reasons for believing that a phlyctenula always occurs at a nerve-terminal; this accounts for the photophobia which seems to depend upon the exposure of nerve-terminals.

Causes.—The disease is usually one of childhood, being most common between the ages of two and fifteen years, and it is generally associated with a scrofulous or lymphatic habit of the body, in which cutaneous disorders of an eczematous type are common. It may be provoked by any depraved condition of health, and is set up by an attack of measles, scarlet fever, or whooping cough. In subjects otherwise predisposed, the disease may be early induced by irritants of every kind—wind, dust, foreign bodies, conjunctivitis, &c., and in some cases it seems to be due to reflex irritation, both dental and gastro-intestinal.

Treatment varies somewhat according to the stage. Locally, in the acute stages, warm applications, moist or dry, simple or medicated, with mild antiseptic and detergent lotions, especially when there is eczema of the lids, with copious lacrymation. In the later stages, when vascularity

is established, mild irritants are beneficial. When there is reason to suspect septic influences are at work, either the perchloride of mercury lotion, quinine lotion, or chlorine water should be used; for photophobia, cold douches, chloroform vapour, alkaline lotions containing hydrocyanic acid. Blepharospasm usually subsides as the state of the cornea improves, but sometimes it also is perpetuated by fissures at the outer canthus. These may be relieved by forcible separation of the lids, so as to tear the fissure, or by a division of the canthus. In the pustular form, when ulceration begins, eserine is useful to diminish tension, and thereby lessen the risks of perforation. But, if in spite of this, perforation becomes imminent, then the base of the ulcer should be incised, and the aqueous allowed to escape. The eczematous condition of the lids, &c., require appropriate treatment. *See* Eczema. There is almost always at the beginning much constitutional disturbance; alteratives and mild aperients are then useful, as small doses of mercury and chalk powder, with belladonna or compound rhubarb powder, magnesia, &c. In acute cases, where the photophobia is very distressing, nauseating doses of antimonial wine give quick relief to the more urgent symptoms. When the irritative symptoms have subsided, tonics may be employed, as quinine, iron, cod-liver oil, arsenic, phosphorus, hypo-phosphites, &c.

(*d*) *Neuropathic Keratitis.*—It is well known that in injury and other irritative affections of the cutaneous nerves, inflammation and ulceration of the skin supplied by these nerves are not uncommon. Erythema, urticaria, herpes, pemphigus, and eczema are the commonest forms which these nutrition-changes in the skin assume. They are characterised by suddenness of onset, and by a tendency, either spontaneous or easily induced, to suppurate and ulcerate. In some cases the ulceration is so rapid and so extensive that it amounts to necrosis of a material portion of the skin. An illustration of this is seen in the sacral eschars which occur in some acute diseases of the brain and spinal cord. Similar lesions may take place in the cornea in irritative disorders of the fifth nerve and its ganglion. Magendie first showed that division of the fifth nerve may be followed by inflammation of the cornea, with exudation into the interior of the globe. The experiment has been repeated and varied by many subsequent observers with similar results. Clinical experience harmonises with the facts of experimental physiology. The investigations of Bärensprung and others have shown that herpes zoster is associated with irritative change in an intercostal nerve and its ganglion; and in 1866 Mr. Jonathan Hutchinson recorded several cases of frontal herpes in which there was inflammation of the conjunctiva, cornea, or iris of the corresponding eye. In some of the cases the inflammation was so great that the eyes were lost (*Ophth. Hosp. Rep.*, vol. v. 191).

Whatever may be the alteration in the nerve and its ganglion which gives rise to the changes in the cornea, it is almost certain that it is of an irritative rather than of a paralytic character. It is difficult to map out the chief clinical forms of neuropathic keratitis, because they are all prone to run on to suppuration and ulceration. Indeed, with the exception of herpes of the cornea, it may be said that neuropathic keratitis is almost invariably ulcerative. In the writer's opinion there is reason to believe that inflammation of the cornea dependent on neuropathic causes is much more frequent than is commonly supposed. It is usual to recognise as neuropathic only those forms of keratitis that are associated with other and obvious affections of the fifth nerve, such as herpes of the brow and nose, together with anæsthesia of these parts and the cornea. On the other hand, it is probable that many cases occur in practice in which the affection of the eyeball is the *only obvious* evidence of altered innervation. At all events, it is certain that cases are by no means infrequent in which the inflammation of the cornea behaves exactly like unquestionable neuropathic keratitis, and which is amenable only to the kind of treatment that best suits the genuine form.

The state of sensitivity of the cornea does, however, seem to influence the kind of change which takes place and the rate of progress. If the cornea be anæsthetic, suppuration and ulceration often take place with extreme rapidity, though without any subjective symptoms beyond the loss of vision. Within a few days of the first appearance of noticeable symptoms the cornea may be completely destroyed. In less severe cases the cornea becomes dull and sodden-looking on its surface, the substance is more or less infiltrated, and there is, perhaps, a small collection of pus in the anterior chamber. If the necrotic process continue, all these signs increase, and the cornea may at length give way. When the cornea is not insensitive the rate of progress is slower, but the pain, photophobia, and other

subjective symptoms are greater. In this form the signs of inflammation are also more conspicuous, as redness, watering, and swelling of the lids and conjunctiva. In some cases it would almost seem as if the ordinary pain of ulceration of the cornea had superadded to it the exaggerated, but perverted, sensibility of the diseased nerve.

In some instances the corneal change is more circumscribed, and may simulate simple phlyctenular keratitis. A minute, very superficial, abscess forms, which quickly opens externally to form an ulcer: but, instead of healing, the ulcer becomes more and more infiltrated, and increases both in extent and depth. See *Neuropathic Ulcers*, under Cornea, Ulceration of the.

The change in the cornea may be modified by the condition of the lids and conjunctiva. A certain amount of conjunctivitis always accompanies neuropathic keratitis; if the secretion is purulent, or if it be allowed to become septic, it may aggravate the corneal trouble. The position of the lids also influences the course of the inflammation; if there be ptosis, from paralysis of the elevator of the upper lid, the nutrition-changes in the cornea will probably be very slight; but if, on the other hand, there be paralysis of the orbicularis, then the destructive changes in the cornea will progress with great rapidity, if care be not taken to close the lids and keep them closed.

Treatment.—Protection of the eye is an indispensable precedent to the success of every other measure. In the majority of cases repair will speedily take place if the lids be closed, and the fluid contents of the conjunctival and lacrymal sacs be kept free from decomposition and other septic deterioration. In mild cases it may be enough to close the lids by means of a well-fitting compress, smeared with lard, vaseline, or, preferably, with boracic acid ointment (gr. xx. ad ℥j.). If, however, the ulceration refuse to heal with simple closure of the lids, then a more effectual exclusion may be secured by paring the edges of the upper and lower lids, and stitching them together, except at the outer and inner canthi, and a small space in the centre of the palpebral fissure. In this way all foreign particles are excluded, at the same time that the secretions of the conjunctiva have a ready exit at the inner canthus. Even when the edges of the lids are stitched, a light boracic acid compress should be worn, and the conjunctival sac should be washed out once or twice a day with boracic acid or quinine lotion. The lids should be kept closed for some weeks after the cornea is healed and all pain or discomfort has subsided.

If there be iritis, atropine should also be applied two or three times a day; and if the pain be great, a hot belladonna compress may be substituted for the boracic acid one.

Herpes of the Cornea.—Arguing from analogy, this is a neuropathic affection, and is indeed sometimes associated with herpes frontalis. Whether accompanied or not by the appearance of vesicles in the area supplied by the ophthalmic division of the fifth nerve, it usually begins with neuralgic pain about the brow and side of the nose, and may be accompanied by pyrexial symptoms—headache and vomiting. Minute vesicles appear on the cornea, disposed in groups or linearly, and raising the epithelium. At first the contents are clear and transparent, but in the course of twenty-four hours they abound in leucocytes. When the vesicles appear, the pain generally subsides. In a few days the vesiculo-pustules burst, giving rise to minute superficial ulcers, which may soon heal without leaving any scar behind. The subjective symptoms are photophobia and lacrymation. In some cases the ulceration spreads both in extent and depth, and may end in destruction of the cornea. The disease usually only affects one eye at a time; but it is liable to recurrence, and then the opposite eye may be affected. *See* Eyelids, Diseases of the; Herpes Frontalis.

Treatment.—Protection of the eye by closure of the lids, either with a belladonna compress or a simple compress of boracic acid ointment. Atropine may be put in once or twice a day, to relieve the pain. Internally, quinine, phosphorus, or arsenic, separately or suitably combined.

2. Inflammation of the Proper Substance of the Cornea.—This occurs in two forms—(*a*) circumscribed, (*b*) diffuse. In both there is migration of leucocytes into the stroma of the cornea; and in both there is but little tendency in the inflammation to go on to suppuration or ulceration.

(*a*) *Circumscribed interstitial keratitis.* Compared with the diffused form of interstitial keratitis to be described below, this is rare. It does, however, occur sufficiently often to merit notice. It shows itself as dense circumscribed infiltration of the substance of the cornea, usually associated with considerable inflammation of the sclerotic, the iris, and the ciliary body. There is great ciliary injection, together

with other signs of irido-cyclitis. The infiltrations may occupy any portion of the area of the cornea, though they are generally more pronounced towards the margin, in which case they resemble invasions of the sclerotica into the cornea. Hence the name *Sclerosing keratitis* which has been given to the disease. The corneal epithelium remains smooth, and the infiltrations rarely suppurate or ulcerate. The tension of the eyeball is subnormal, and, in all the cases which have come under the writer's notice, the lids have been considerably discoloured; but in all the discolouration has disappeared as the inflammation of the anterior segment of the eyeball subsided. Subjectively, the disease manifests itself by impairment of sight, photophobia, lacrymation, and general weakness of the eyes. After some weeks or months the infiltrations gradually disappear, though more or less opacity permanently remains.

Causes.—The etiology of the disease has not yet been elucidated. The disease generally occurs in adults, and is sometimes associated with chronic rheumatism. There is no evidence to show that it is connected with syphilis. It is perhaps more common in women than in men.

Treatment.—The disease is chronic, and the treatment must be conducted on the lines laid down in the directions for dealing with keratitis in general. It should, however, be remembered that the disease is not limited to the cornea, but involves the whole of the anterior segment of the globe, including sclera, iris, and ciliary body. The treatment of inflammation of these parts must therefore be combined with that more particularly suited to keratitis. *See* Ciliary body; Iris. Besides the use of fomentations, leeches, atropine, counter-irritation, protection of the eyes, &c., it may be necessary to resort to the operation of iridectomy (q. v.). As regards general treatment, quinine, salicylate of soda, and hypodermic injections of pilocarpine have been extolled. The writer has found Donovan's solution very beneficial in doses increasing (at discretion) from five to fifteen minims three times a day.

(*b*) *Diffuse interstitial keratitis* passes through three well-defined stages—(1) infiltration, (2) vascularisation, (3) resolution. In the *first stage* the cornea becomes more or less hazy, usually beginning at the centre, but gradually invading the whole extent. In addition to the general haze, minute milky-looking dots, resembling 'microscopic masses of fog,' are scattered throughout the substance. In the course of two or three weeks the haziness increases, and the cornea becomes quite opaque. The epithelium at first is unaffected, but it soon becomes steamy, giving, with the opacity of the cornea, the appearance of ground-glass. The subjective symptoms, beyond the progressive impairment of sight, are, as a rule, but slight. Little is complained of beyond a weakness and watering of the eyes. After three to six weeks the *second stage* is ushered in. The perikeratic injection, hitherto slight, becomes more pronounced, and new vessels are seen extending into the substance of the cornea, from the sclerotic and conjunctiva. These vessels may at length become so numerous that the cornea resembles a patch of ecchymosed blood. Usually the vascularisation is not so great, and the cornea is of a pink hue, not unlike the flesh of salmon. Unless the natural history of the disease be known, the advent of this vascular stage is likely to create alarm. The surgeon is distressed to witness the disease apparently progressing in spite of his best endeavours to stay its course. The truth is, however, far otherwise. The formation of new vessels is to be welcomed, not only as affording present safety of the cornea, but as an indispensable condition of ultimate repair. The infiltration is sometimes so great that it breaks through the superficial layers of the cornea and projects from the surface like exuberant granulations. Even when this happens, the hope of recovering useful vision is not to be abandoned. The cornea may eventually clear sufficiently to allow of moderate sight, though a central leucoma may persist. The vascular stage lasts from three to six months, and is followed by the *third stage* of resolution. The discolouration of the cornea begins to fade; the vessels become smaller and less numerous; semitransparent spaces appear between individual vessels, and gradually the vessels shrink towards the margin, till at length they entirely disappear. In the course of three to twelve months the cornea may recover its normal translucency, or retain only a nebulous haze about the centre. Usually, however, the cornea remains more or less hazy throughout its whole extent, with deeper haze about the centre, which prevents perfect acuteness of the sight. Leucomatous opacity does not occur, except in the comparatively rare event of ulceration.

In most cases the iris and choroid are implicated. Iritis and choroiditis seriously complicate the corneal affection. Unless the possibility of their occurrence be kept

persistently in mind, the inflamed iris may contract adhesions to the anterior capsule of the lens, with total posterior synechia and obliteration of the pupil. This in turn may lead to inflammation of the ciliary body (cyclitis), of the choroid, or of the vitreous. During the vascular stage the cornea may become so soft that it yields to the intraocular pressure, and a staphyloma results.

The disease usually affects both eyes, though it generally begins in one eye a few weeks, or may be months, before the other. Indeed the second eye sometimes does not show any symptoms till the disease has reached the third stage in the eye primarily affected.

Causes.—Interstitial keratitis is dependent on constitutional causes, though the exciting cause may be an injury. It generally makes its appearance during childhood or adolescence, between the ages of five years and twenty years. Almost invariably it may be shown to be associated with hereditary syphilis, and in most cases positive or circumstantial evidence of this taint may be obtained either from the history of one or both parents, or from the presence of syphilitic lesions in the patient, as nodes, ulceration of the throat, &c. In many cases there is a peculiar and characteristic physiognomy, exhibiting prominent frontal eminences, depressed bridge of the nose, fissures about the angles of the mouth, nose, and forehead, together with a remarkable configuration of the permanent central incisor teeth, which are peg-shaped and notched at their edges. In less typical cases the shape of the teeth resembles that of a screw-driver.

Treatment.—The cyclical character and constitutional nature of the disease must be borne in mind. As far as present knowledge and the resources of therapeutics go, the disease must run its course and pass through its three stages. All that the practitioner may hope to do, is to guide the disease through its various stages, and to obviate complications. The first indication is therefore to alleviate actual pain and to control the local inflammation; the second to expedite and shorten the various stages, remembering always, other things being equal, the shorter the course of inflammation the more complete the recovery. Whatever may be the stage, protection from all irritating agents and influences is indispensable, but particularly in the vascular stage. The treatment must be of a soothing and mildly antiphlogistic character. In the first stage, moist warmth by means of steam, or fomentation either of hot water or of belladonna, gives relief, especially when combined with the instillation of atropine. Care should be taken to protect the eyes by means of spectacles or shades, and astringents and other stimulating applications should be avoided. Atropine should be used, whether the iris be obviously inflamed or not, and the precaution should be taken not to stop its employment because the iris ceases to be visible through the opaque cornea. If there be much supraorbital pain, the application of one or two leeches will give relief. If the iritis be severe and obstinate, especially if the ciliary body be likewise implicated, some practitioners resort at once to iridectomy. The prudence of the practice is, however, debateable. The operation should be reserved for those cases in which the iridocyclitis is accompanied by persistent, increased hardness of the globe, which does not yield to atropine and hot fomentations. The general treatment must have reference to the constitutional condition on which the keratitis depends, namely hereditary syphilis. *See* Congenital Syphilis.

3. Inflammation of the Posterior Layer of the Cornea.—The posterior layer of the cornea, consisting of the posterior elastic membrane (Descemet's) and endothelium, is subject to a special form of inflammation. There are anatomical, embryological and morphological reasons for believing this layer to be directly continuous with the choroid. This connexion is likewise indicated in morbid states. Inflammation of the posterior layer of the cornea is always associated with inflammation of the anterior layers of the iris, and probably also of the choroid. Hence the various names which have been applied to this disease, namely, keratitis punctata, serous iritis, aquo-capsulitis, and inflammation of the lining membrane of the anterior chamber. The disease was first described by Wardrop, under the last-mentioned name, about the beginning of the present century. He pointed out that the lining membrane of the anterior chamber has the characters of a serous membrane, and that inflammation of it resembles inflammation of the other serous membranes of the body. The symptoms which he described as characterising the disease were haziness of the posterior layer of the cornea, and deposition of lymph. This deposition usually takes the form of brownish dots, arranged as a pyramid with the apex upwards. The anterior chamber is deep, the aqueous slightly turbid, the anterior surface of the

iris loses some of its lustre, though the fibrillation remains, and the pupil is semi-dilated. The injection round the cornea is slight and of a delicate pink hue, and often the eyeball is harder than natural. The iris is pushed somewhat backward by the dropsy of the anterior chamber, and, instead of being convex forwards, it is concave. There is total posterior synechia, though the amount of lymph is comparatively small. The pupil does not respond readily to atropine, partly because of the adhesion, and partly in consequence of the increased accumulation of fluid contents within the eye.

Beyond dimness of sight, the subjective symptoms of keratitis punctata are not as a rule very marked. Wardrop called special attention to the subjective sensation of distension and fulness in the eyeball, accompanied by a dull aching pain in the forehead, sometimes also at the back of the head, all of which symptoms are, he said, 'instantly and permanently relieved by evacuating the aqueous humour.'

Causes.—The associated constitutional state is variable, but is generally of that order in which the serous membranes are affected. Rheumatism (simple or gonorrhœal), syphilis, disordered menstrual functions, renal disease, and other toxæmic and septicæmic conditions, predispose to it. In some instances no predisposing cause can be discovered. The writer has so often met with keratitis punctata as the precursor of ordinary interstitial keratitis that he is disposed to believe that, in some degree, it precedes all such cases. In actual practice, however, cases of interstitial keratitis are rarely seen by the ophthalmic surgeon before the parenchyma of the cornea is involved. Keratitis punctata is also one of the earliest objective signs of Sympathetic Opthalmitis (q.v.).

Treatment.—The local treatment varies somewhat, according to the state of eyeball-tension. If the eyeball be distinctly hard, and if the hardness do not at once respond to atropine, the cornea may be punctured. This is often followed by speedy relief to pain and rapid subsidence of the inflammation. The hardness of the eyeball might seem to contraindicate the use of atropine, and point rather to the employment of eserine; but it should not be forgotten that the conditions of keratitis punctata are different from those of acute glaucoma, where eserine is indicated. In the former there is a dropsy of the anterior chamber; in the latter the anterior chamber is shallow, and may be obliterated. In keratitis punctata a mydriatic is needed to break down the adhesion of the iris to the capsule of the lens, and to restore the communication between the anterior and posterior chambers. If this be accomplished, the hardness quickly disappears. If there be much pain, leeches may be applied either at the inner or outer angle of the orbit, followed by hot fomentations. Of all internal remedies, the writer is disposed to regard turpentine as the most useful. This drug was originally recommended by Carmichael, of Dublin, for syphilitic iritis, on account of its acknowledged influence in some inflammations of the general serous membranes and especially in peritonitis. He gave it in one-drachm doses; but Chian turpentine in five-grain doses, every three, four, or six hours, is less disagreeable, though it is not quite so active. Cases in which turpentine is administered early seem not only to recover more quickly, but with less permanent damage, than those in which other modes of treatment have been tried. This is particularly true of the gonorrhœal form. Next to Chian turpentine is the employment of mercury in small but repeated doses, especially combined with quinine: from one to two grains of the latter, with one-sixth to one-third of calomel, three times a day. Subcutaneous injections of pilocarpine have been recommended, and are said to have been followed with considerable benefit. After the acute symptoms have subsided, then tonics: iron, quinine, arsenic, phosphorus, with cod-liver oil. *See also* Iris, Diseases of the.

II. Suppurative Keratitis.—Abscess of the cornea may complicate ordinary phlyctenular ophthalmia, but more commonly it is due to traumatic or infective causes operating in debilitated states of the health. It is a common complication of purulent and of diphtheritic conjunctivitis, and is especially prone to occur after smallpox or from slight injuries in persons suffering from chronic conjunctivitis, or who have catarrh and obstruction of the lacrymal sac and duct. Suppuration of the cornea may also be due to an impaired innervation, associated with disorders of the fifth nerve. *See above—Neuropathic Keratitis.*

An abscess being a more or less circumscribed collection of pus within the corneal substance, the fibrillæ are necessarily destroyed, and repair can only take place by cicatrisation. An abscess may form in any part of the depth of the cornea, and may begin at one or several spots. When it begins at several foci, each grows in size till they all run together to form a common collection of pus. Around this collection there is always more or less infiltration of

the layers of the cornea. The shape is usually circular, but may be crescentic. If a crescentic abscess form at the lower part of the cornea, it is called by the special name *Onyx*.

Abscess in the superficial layers of the cornea may undergo gradual absorption without opening externally; but when more deeply situated, softening and destruction of the superficial layers take place, and the contents of the abscess escape on the surface with the formation of a deep ulcer. *See* CORNEA, Ulceration of the. Rarely, the abscess opens into the anterior chamber through the posterior layer, forming *hypopyon*; indeed, abscess of the cornea is usually attended with more or less pus in the anterior chamber. The pus in hypopyon may be derived from one or more of four sources:—(*a*) Actual perforation of the ulcer through the posterior layer; or (*b*) infiltration through the corneal canals into the lymphatic spaces at the angle of the anterior chamber; or (*c*) proliferation of the corneal endothelium; or (*d*) by transmigration of leucocytes from the iris and the ciliary body.

Hypopyon, though resembling onyx, may readily be distinguished from it. In hypopyon, the pus in the anterior chamber being free to move, gravitates to the most dependent part of the anterior chamber when the head is inclined; whilst in onyx, the pus, being confined within the lamellæ, cannot change its place.

Perforation of the cornea with entanglement of the iris, or cataract, or even escape of the lens, may supervene as a complication of abscess of the cornea. A peculiar opacity at the anterior pole of the lens is a not uncommon result of suppuration of the cornea in ophthalmia neonatorum. *See* CATARACT.

Treatment.—Abscess of the cornea is not only a painful affection, but it always places the cornea in the greatest jeopardy. It is also an indication of debility, or of impaired innervation, or of local septic influence. Moist warmth, combined with atropine or belladonna, gives relief and promotes the absorption of pus. The effect of atropine should, however, be carefully watched. If the eyeball becomes hard under its employment it should be discontinued, and the cornea should be punctured through the abscess, especially when perforation is imminent. Where there is reason to believe that the pressure of the lid (as in purulent ophthalmia) may be promoting suppuration of the cornea, the lid should be freely cut through vertically and towards the other canthus. This not only removes the pressure, but facilitates the application of remedies. See also *Purulent Ophthalmia*, under CONJUNCTIVA, Diseases of the.

As abscess of the cornea is usually septic, and as, at all events, when disruption of the external layers of the cornea has taken place, infection is liable to take place, antiseptic agents should be used as local applications. Of these, solution of sulphate of quinine is one of the best, for, unlike many other antiseptic agents, it is also antiphlogistic. It helps to arrest the inflammatory process and check the migration of leucocytes. Precautions should be taken against the infection of the cornea with the decomposing contents of the lacrymal sac; any accumulation in the sac should be removed and free drainage ensured.

The treatment of hypopyon may vary with the character of the pus. If this be serous and scanty it will probably soon disappear under the influence of hot belladonna fomentations; but if it be copious and tenacious, section of the cornea must be done across the base of the ulcer, after the plan proposed by Saemisch, in order to evacuate the contents of the anterior chamber. The incision should be made with a sharp and clean Graefe's knife, and a section made by transfixion freely through the whole thickness of the cornea at the seat of abscess, so that the pus may have a free exit. If the hypopyon re-form, it will be necessary to reopen the incision, either by means of a fine probe or by a fresh incision. The drawback to the procedure is entanglement of the iris in the wound. Something may be done to avert this by using atropine or eserine freely, according to the situation of the section and the state of the iris. If the section be near the centre of the cornea, then atropine is indicated, to draw the iris away; if more towards the periphery, then eserine, to contract the pupil and prevent prolapse of the iris into the wound.

Abscess of the cornea is debilitating in its effect, and usually dependent on depraved states of the general health; generous diet and tonics, especially quinine, will therefore be required, in addition to local treatment.

JOHN TWEEDY.

CORNEA, Ulceration of the.—The usual antecedent of ulceration is inflammation. In suppuration of the substance of an organ, the tissue-elements are disintegrated by the action of the inflammatory fluids and leucocytes, and a cavity forms which is filled with pus-cells (abscess). The same process occurring on the surface of an organ leads to the formation of a chasm, or ulcer.

It is in this way that most of the ulcers of the cornea are produced, the degree of ulceration being proportionate to the amount and kind of the inflammation. There are, however, other ulcers in which inflammation is either altogether absent, or, if present, is so slight that it cannot account for the degree of ulceration. The probable cause of the latter kind is that the nutrition of the tissue-elements is deteriorated by disturbed innervation. This explanation is fortified by the fact, that such ulcers do resemble those which are associated with appreciable disease of the ophthalmic division of the fifth nerve, and behave in a precisely similar manner.

Ulcers of the cornea may therefore be classified as :—1. Inflammatory; 2. Non-inflammatory (neuropathic). They may be described in the same terms as those of the skin, and like them may be spoken of as spreading, stationary, or healing. In each of these phases the constituent parts of a corneal ulcer present the aspects of corresponding phases of cutaneous ulcers. In spreading ulcers the form is irregular, the edges are elevated, jagged, or sharp-cut, the base is covered with débris, and the adjacent parts are infiltrated with serum and leucocytes. The lamellæ are broken and bend towards the surface. When repair begins, the surrounding infiltration disappears, the base clears, the edges smooth down, new vessels extend from the periphery to the floor of the ulcer, the epithelium gradually encroaches upon it, and at length the breach is filled by cicatricial tissue, never by proper corneal substance.

In ulcer of the cornea there are present most of the objective signs of keratitis, such as redness of the conjunctiva, circumcorneal or ciliary injection, and lacrymation, blepharospasm, &c. The subjective symptoms are pain in the eyeball and around the orbit, and photophobia. These symptoms vary with the degree of inflammation and with the position of the ulcer.

1. Inflammatory Ulcers may be classified as they affect (*a*) the surface of the cornea, or (*b*) the deeper layers.

(*a*) *Superficial Inflammatory Ulcer* presents itself clinically in two forms—namely, the simple and the vascular or irritable.

(1) *Simple ulcer* usually follows the bursting of the pustule in phlyctenular ophthalmia, but may result from any inflammation of the superficial layer of the cornea. A small greyish patch is seen on the cornea, with congestion of the nearest conjunctival and sclerotic vessels. The amount of congestion varies, however, with the degree of inflammation, and with the site of the ulcer. In most cases, if the eye be protected the ulcer soon heals, and its place is marked by a thin scar (nebula). But if the ulcer be irritated, either by topical remedies, or by decomposing secretions of the conjunctival or lacrymal sac or other septic agents, or if it should occur in debilitated persons, or in a cornea damaged by previous inflammation, it may spread into the deeper layers and become the so-called *Deep Inflammatory Ulcer* (q.v.)

Treatment, in the acute stages, is the same as that recommended in phlyctenular keratitis; in the later stages mild stimulation to the ulcer.

(2) *Irritable Vascular Ulcer.*—Sometimes, either from the conditions of health or from inappropriate treatment, the phlyctenular ulcer, instead of undergoing repair, remains vascular, and the granulation tissue fails to undergo cicatrisation. One or two large vessels may be seen extending from the margin of the cornea to the base of the ulcer, which is itself covered by a network of fine vessels. When touched with a probe these ulcers are exquisitely tender; the morbid sensibility in all probability depending upon the presence of exposed and inflamed nerve-terminals. Such ulcers are usually situated just within the margin, but may occur on any part of the surface. They are intensely painful, and are always attended with distressing photophobia and profuse lacrymation. In some cases the pain is so great that it prevents sleep, destroys the appetite, and seriously affects the general health.

Treatment.—Where there is reason to believe that the vascularity of the ulcer is the result of over-stimulation, all that may be needed to ensure recovery is discontinuance of local applications. Should this not suffice, then the application of a solution of nitrate of silver (gr. x.–xx. ad ℥j.), or even the careful application of the mitigated stick of nitrate of silver, destroys the diseased surface and quickly relieves the pain and initiates healthy repair. This treatment is safe, provided the cases are properly discriminated, and is certainly more effectual than the painful and tedious plan of inserting setons into the temple or of applying other forms of counter-irritation.

(*b*) *Deep Inflammatory Ulcers.*—These may be the result of extension of superficial ulcers, or of the opening of an abscess or of an infecting traumatism. Of these deep ulcers it may be stated generally that, unless complicated by iritis, hypopyon, &c. they are not, as a rule, so painful as superficial ulcers, and, conversely, that when a

superficial ulcer spreads to the deeper layers the pain often abates. The explanation of these facts is to be found in the distribution and termination of the corneal nerves.

(1) *Suppurative Ulcer.*—In this ulcer the objective signs of keratitis are necessarily always present, and usually most of the subjective symptoms also. It is, however, noteworthy that a deep ulcer, following abscess of the cornea, may be attended with very little pain or irritation. If the corneal affection be complicated with iritis or iridocyclitis, there may be very great pain over the eyebrow and at the root of the nose. The ulcer itself has a sloughy base, and the adjacent portions of the cornea are infiltrated. The anterior chamber is at first usually deep, and may contain more or less pus. The ulceration comprises the deeper layers, and as these give way, a hernia of the posterior elastic lamina (keratocele) occurs, followed after a short interval by rupture with prolapse and entanglement of the iris, so that when it is healed there is a dense opacity of the cornea called 'leucoma,' with an anterior synechia—*leucoma adherens.*

This kind of ulcer is often traumatic, but may apparently occur spontaneously in eyes that have been damaged by previous inflammation, whether phlyctenular or trachomatous. It is, however, frequently met with in connexion with purulent and diphtheritic conjunctivitis, and is then due to the inoculation of the cornea with specific virus. Old age and impaired states of health, from any cause whatever, predispose the cornea to suppurate and ulcerate on comparatively slight excitation.

Treatment.—The indications are: protection and cleanliness, drainage of all secretions, disinfection of the conjunctival and lacrymal sacs by means of antiseptic solutions, moist warmth, either simple or medicated, to allay the inflammation and to relieve pain. If the intraocular tension increases, eserine should be used; and if perforation become imminent, paracentesis of the cornea; or section, after the plan recommended by Saemisch, should be done. When much hypopyon appears, section of the cornea through the ulcer should be performed. If prolapse of the iris take place with the formation of a fistula, the prolapsed portion of the iris must be freely excised, and a compress applied, the aperture being left to heal by cicatrisation. In removing a prolapsed iris, the protruding mass should be grasped close to the level of the cornea, and pulled gently out of the perforation, so as to overstretch it. If the iris then be cut it will retract into the anterior chamber, and so obviate further anterior adhesion. During the process of cicatrisation it may be well to keep the iris under the influence of eserine, to prevent further entanglement, as well as to lessen tension. If, in spite of these precautions, a fresh entanglement occur, especially if it be near the corneal margin, an iridectomy should be done at the site of the entanglement. This not only takes away the risk of glaucoma, but lessens that of sympathetic ophthalmitis.

(2) *Infecting Ulcer* is an extremely obstinate and malignant form of ulceration, and generally ends in perforation, with more or less permanent damage to the eye. Whatever may be the primary cause, when once the ulceration has begun it spreads by infection. The edges creep into the cornea, and extend in all directions. The base is greyish, the edges swollen and irregular, the anterior chamber is deep, the aqueous turbid and contains pus, and there is more or less deposit on Descemet's membrane opposite the ulcer. The ulcer may spread so rapidly that in a few days the whole of the cornea is implicated and converted into a slough. Perforation speedily ensues. When this accident happens there is a sudden cessation of pain, due to the relief of pressure consequent on the escape of the contents of the anterior chamber. From that moment repair may begin. But unless the perforation be large, it is liable to become blocked with tenacious pus and shreds of membrane. In this event there is a recurrence of the pain after a few hours or days. Even when repair does begin, it is slow and intermittent, and the reparative material is apt to break down from time to time. At the beginning this ulcer is seldom painful, though the pain increases as the ulceration extends, and often immediately before the perforation, whether spontaneous or by artificial means, the pain is excessive.

Causes.—It may begin spontaneously, but more commonly it is the result of an injury in which the cornea has become inoculated by the septic matter, or by the decomposing secretions of the conjunctiva or lacrymal sac. It is especially common in farm-labourers, who are liable to injuries of the cornea from thorns or from particles of chaff, &c. It seldom occurs before forty years of age, and is usually met with only in debilitated subjects.

Treatment.—It is in this form of ulceration that incisions of the cornea, as recommended by Saemisch, are of such signal

service. *See* above. After incision, warm fomentations and the antiseptic application of perchloride of mercury, quinine, &c., should be freely applied to prevent further infection of the exposed corneal layers. Some practitioners recommend that the base of the ulcer should be scraped, and then either strong solutions of nitrate of silver be applied, or even the actual cautery.

2. Non-inflammatory Ulcers (Neuropathic).—These ulcers all seem to begin primarily on the surface of the cornea, though they may subsequently implicate the deeper layers, and, like the inflammatory deep ulcers, tend to perforation. In the absence of a degree of inflammation sufficient to induce ulceration, the only sufficient cause seems to be arrested or perverted innervation. Hence these non-inflammatory ulcers may be designated neuropathic.

Ulceration of the cornea, associated with altered innervation, may exhibit as many forms as a corresponding lesion in the skin. In most cases there is a preliminary stage of cell-infiltration rapidly running on to suppuration and ulceration; but it may happen in the cornea as in the skin, that the inflammatory stage is so brief or so slight that the ulceration seems to be a primary phenomenon. Neuropathic ulceration seems to begin at the terminations of the nerves, the kind and extent of the ulceration being dependent partly upon the number of terminals involved, and partly upon the character and seat of the central change. This form of ulceration may therefore be either circumscribed or diffuse.

(*a*) *Circumscribed Non-inflammatory Ulcers* present almost numberless varieties. There are, however, certain well-recognised forms:—(1) Superficial non-vascular ulcer; (2) deep non-vascular ulcer; and (3) the crescentic ulcer.

(1) *Superficial Non-vascular Ulcer.*—This is also called 'ulcer by absorption,' or 'facetted ulcer,' or 'superficial transparent ulcer.' It usually appears in the centre, and apparently suddenly. There is slight depression, with smooth, rounded, non-vascular border. When examined by ordinary daylight the ulcer appears transparent and glassy-looking, and may be easily overlooked. There are few symptoms of inflammation, such as pain, photophobia, or lacrymation. Perhaps the only complaint is that the sight is obscured. The ulcer may remain stationary for weeks, or even months, and it is always slow to recover. It occurs most frequently in children who have delicate skins, who are liable to eczematous and impetiginous disorders, and who are subject to phlyctenular keratitis. Indeed it often co-exists with this disease. When it heals it leaves behind it a semi-transparent cicatrix, producing a facetted appearance.

Treatment.—At first, warm fomentations and protection; later, mild stimulation with eserine night and morning; and, when the vascularity occurs, stronger stimulation with weak yellow-ointment, calomel powder, perchloride of mercury, &c. Care should, however, be taken to avoid over-stimulation.

(2) *Deep Non-vascular Ulcer*, called also *Asthenic Deep Ulcer.*—It usually appears suddenly, and generally about the centre of the cornea, thus resembling the superficial non-vascular ulcer. The edges are deep and irregular, and the outline inclines to an oval. The ulcer rapidly increases in depth till it reaches the posterior elastic layer. Hernia of this layer follows, so that the ulcer may not seem so deep as it really is. The ulcer may remain stationary for many months. When repair does take place, the edges become vascular and rounded off; the cavity is gradually filled up by granulation and cicatrisation. As with the superficial ulcer, the cicatrix is semi-transparent, and leaves a facetted appearance. It is distinguished from the superficial non-vascular ulcer by its great tendency to perforate the cornea, by its occurring in adults rather than in children, and in eyes that are damaged by old disease, as phlyctenular keratitis, granular lids, &c. It is usually symmetrical. In the rapidity of this formation, and in many of its other characters, it resembles acute bed-sore, which is apt to occur in some cerebral and spinal affections.

Treatment.—Treatment must be directed towards preventing perforation and facilitating repair; warm fomentations, compresses to the lids, the cautious application of eserine, to lessen tension and to set up a certain degree of stimulation. If the tension be increased, and the cornea threatened with rupture, then paracentesis through the base of the ulcer, or sclerotomy, may be practised. When the ulcer has become vascular, then mildly stimulating applications like those recommended above may be cautiously employed. As there is great risk of this ulcer becoming infected by the secretions of the conjunctiva, or from the decomposing accumulations in the lacrymal sac, care should be taken to disinfect these secretions, and to secure efficient drainage of the lacrymal apparatus. If, in spite of treatment, the ulcer continues to spread, or

refuses to heal, then it is well to employ some antiseptic application, such as quinine lotion, or boracic acid, or salicylic acid, and to tie up the eye with a compress of boracic acid ointment (gr. xx. ad ℥j.).

(3) *Crescentic Ulcer*, though rare, is generally recognised as a distinct clinical entity. In its developed state it appears as a deep crescentic or horseshoe-shaped ulcer just within the corneal margin. In the early stage it begins as one or more opaque dots near the corneal margin, accompanied with some congestion of the adjoining conjunctival and episcleral vessels. Necrosis quickly takes place at these dots, and ulcers form. These ulcers lengthen, so that they become first oval and then curvilinear, always running concentrically with the margin of the cornea. At length two or more of these curvilinear ulcers merge and constitute the crescentic ulcer. At first the ulcers are semi-translucent, but they soon become infiltrated with pus-cells. If unchecked the ulceration destroys the deeper layers of the cornea, and ends in perforation and prolapse of the iris. If, however, repair takes place the infiltration disappears, the edges round off, vessels pass inwards, and healing by cicatrisation slowly takes place.

Crescentic ulcers are generally extremely painful, and attended with great photophobia and lacrymation; they usually occur in persons who are suffering from nervous exhaustion, or who manifest other neuropathic states.

Treatment.—Crescentic ulcers resist all modes of treatment so long as the lids are free to open; but, in the writer's experience, they speedily begin to heal if the lids be securely closed, either by means of a well-fitting compress of boracic acid ointment, or, if necessary, by means of paring the edges and stitching them together. The conjunctival sac should be gently cleansed once or twice a day with boracic acid or quinine lotion, and belladonna fomentation may with advantage be employed to the closed lids for ten minutes at a time every two hours. Internally, tonics, especially quinine, phosphorus, small doses of arsenic and cod-liver oil, are beneficial, and in the later stages, iron.

(*b*) *Diffuse ulceration* is the most frequent form of neuropathic disease of the cornea, and occurs most frequently in association with herpes frontalis. There may be but few subjective signs beyond impaired sight; pain, referable to the eye, may be entirely absent, though there may be excessive pain in the eyebrow, forehead, nose, and temple. The whole of the cornea, but particularly the portion opposite the palpebral aperture looks steamy. The epithelium is sodden, roughened, and disintegrated. Still later the cornea becomes infiltrated, and presents in addition numerous foci of collected leucocytes. At length pus appears in the anterior chamber, the whole of the cornea obviously suppurates, and perforation occurs. In most cases there is more or less iritis of a serous character, a deep anterior chamber with perhaps increased intraocular tension.

Opacities of the Cornea.—Apart from the transitory opacities due to inflammation and the opacity associated with changes of curvature described below, as staphyloma, there are other opacities which are more or less persistent. These are (*a*) cicatricial, (*b*) glaucomatous, (*c*) sclerosal, (*d*) degenerative, as calcareous change in the corneal epithelium, arcus senilis, metallic deposits and stainings.

(*a*) *Cicatricial Opacities* are called 'nebulæ' or 'leucomata,' according to their density. They are the scars left after phlyctenulæ, abscess, ulcer, wound, or inflammation of any kind. As already stated, a leucoma complicated with an entanglement of the iris (anterior synechia) is called 'leucoma adherens.' Slight nebulæ are often more embarrassing to sight than a dense but limited leucoma, inasmuch as the former are often widely diffused. If a leucoma have a well-defined margin, and if it do not cover the whole of the papillary area, there may be good vision past its edge. Old cicatrices are sometimes mistaken for actual keratitis. The polish on the surface of a leucoma, and the absence of circumcorneal injection and the other subjective and objective symptoms of keratitis, should ordinarily render diagnosis easy.

(*b*) *Glaucomatous opacity* appears as a diffused haziness of the whole cornea, with steaminess of the anterior surface, or, in later stages, as a transverse, semi-opaque stripe opposite the exposed part of the cornea. In cases of chronic glaucoma, minute vesicles or bullæ, with ulcerations, may be seen scattered over the surface of the cornea, or involving its depth. The cornea looks like ground glass, and its epithelium is rough.

(*c*) *Sclerosis* is usually the result of circumscribed interstitial keratitis. It occurs, therefore, at or near the corneal margin. *See* Cornea, Inflammation of the.

(*d*) *Calcareous Degeneration* of the corneal epithelium is a very rare condition. A case under the writer's care some years

ago exhibited a lenticular-shaped streak crossing each cornea about the middle horizontal line, but inclining slightly obliquely down and out. Underneath the calcareous epithelium the cornea is generally clear.

(*e*) *Arcus Senilis* or *Gerontoxon* is said, on the authority of Canton, to be a degeneration of the periphery of the cornea. This opinion is probably erroneous. Many persons have arcus who show no other evidence of degenerative change; and besides there is no reason for believing that a cornea with arcus heals less readily after operation. The condition is probably rather sclerosis. It generally affects both eyes, and as its name indicates, is more frequent in elderly persons. It usually begins, as a whitish arc, just within the edge of the cornea at the upper and lower parts. A narrow band of transparent cornea is always left between the arc and the sclerotic. In course of time the ends of the upper and lower arcs join and form a white ring. It is always confined to the periphery of the cornea.

(*f*) *Metallic deposits* and *stains* are usually due to iron-rust or to lead deposit, and are removed by scraping and excision.

Treatment.—For cicatricial opacities, if repair be not complete, mild stimulating applications with frictions will often aid in the absorption of the inflammatory matters around and in the cicatrix, and thus help to thin them; but when repair is completed there can be little hope of removing the opacity. If practitioner and patient would recognise that the opacity is really a 'scar' a good deal of disappointment and misunderstanding might be avoided. If the opacity occupy the pupillary portion of the cornea, while the margin is clear, an artificial pupil opposite the clear portion may improve the sight. If, however, the sight be not impaired, or if there be no hope of improving it by operation, something may be done by tattooing the scar to render the blemish less conspicuous.

In glaucomatous opacities, as in ordinary cicatricial opacities, sclerotomy or iridectomy is often followed by considerable clearing of the cornea. In glaucoma, however, where the opacity is very pronounced, the disease is usually beyond any very effectual help from operation, inasmuch as degenerative changes have begun in the posterior segments of the eye, which contraindicate either iridectomy or sclerotomy. But even here eserine is often of service, both in relieving the pain and in removing the opacity. Calcareous epithelium may be scraped off, and so also may most of the metallic deposits and stains. In the case of lead deposit, however, the opacity implicates the stroma of the cornea, and must therefore be cut out with a fine knife. JOHN TWEEDY.

CORNEA, Variations of Curvature of the.—The cornea, as regards its curvature, is practically a section of a sphere. Any sensible deviation from this disposition gives rise to some impairment of vision. If the curvature alone be at fault, the result will be merely an error of refraction, with more or less astigmatism. *See* REFRACTION, Errors of. In many cases, however, both the curvature and the texture of the cornea are involved. In these cases alteration of texture has not only always preceded change of curvature, but is its predisposing cause. The textural defect may be due to want of development, or to intra-uterine disease, or to any subsequent morbid state of the cornea. From one or other of these causes, the resistance of the cornea is diminished, so that it cannot bear up against the intra-ocular pressure, and a bulging, or *ectasia*, results.

ECTASIA CORNEÆ may present itself in one of two forms, viz.:—

(1) Where the translucency is preserved, as in conical and globular cornea.

(2) Where there is more or less opacity —staphyloma.

(1) The TRANSLUCENT ECTASIÆ are (*a*) globular cornea, and (*b*) conical cornea.

(*a*) *Globular Cornea*, kerato-globus, buphthalmos, or hydrophthalmia, is usually congenital, and probably dependent upon corneo-iridian disease occurring during intra-uterine life. It may, however, occur from the same cause operating in early infancy. The cornea is expanded, and may be twice its natural size; the anterior chamber is deep, so that the iris, which is tremulous, seems to have receded; the pupil is distorted and probably adherent to the capsule of the lens; the sight is always impaired; the cornea itself may possess its normal translucency or be opaque in places. The disease usually affects both eyes, though one eye may be more affected than the other. In some cases the enlargement of the anterior segment of the eye may be so great that the lids do not cover it. Ulceration of the cornea is then apt to take place, which may ultimately demand excision of the globe. Otherwise there is little to be done in the way of treatment. Operations are hazardous in such eyes and rarely do good.

(*b*) *Conical Cornea*—Keratoconus.—As the term indicates, the curvature of the cornea in this affection is so changed that, instead of being spherical, it is conical. The

conicity usually occurs about the centre of the cornea, and consequently its summit is opposite the pupil. In typical cases the appearance of the eye is characteristic. When looked at from the front, the cornea has a brilliant appearance, as if a drop of dew were lying on its surface; and when looked at in profile, the glistening apex of the cone becomes very conspicuous. The change of shape may often be easily demonstrated by placing the patient opposite a window and observing the alteration of form which the image of the window undergoes as the cornea moves from side to side or up and down. The surest way of discovering conical cornea is to throw light into the eye by means of a plane ophthalmoscopic mirror. A peculiar semi-rotatory dancing shadow is seen in the area of the red reflection as the mirror is rotated on its various axes. By this means, too, an apparent opacity is often observable, and when the optic papilla is examined by indirect ophthalmoscopy (*see* OPHTHALMOSCOPY), the image of the disc is easily distorted by slight changes in the position of the object lens. Both these phenomena are due to the irregular astigmatism produced by the alteration in the curvature of the cornea. In advanced cases there may be real opacity of the apex of the cone.

The chief subjective symptoms are weakness of the eyes and progressive impairment of sight. Distant objects are seen with increasing difficulty, reading becomes painful, and all near work has to be brought closer and closer to the eye. Hence the patient is thought to be growing short-sighted. These visual defects are but little, if at all, relieved by lenses. Indeed, it is often this circumstance that first suggests an examination of the cornea for conicity. When conical cornea has existed some time, more or less keratitis usually supervenes at the summit, followed by ulceration and cicatrisation. The progress may be slow or rapid. Though the apex of the cornea may be reduced to extreme tenuity, it rarely, if ever, gives way spontaneously.

Causes and Pathology.—The causes are not known. Most authorities believe the change to be of a glaucomatous nature. M. de Wecker has quite recently stated that it is unquestionably due to a glaucomatous state, though he admits the increase of intra-ocular pressure is never sufficiently pronounced to cause excavation of the optic papilla. (*Traité Complet d'Ophthalmologie:* Paris, 1883, t. ii. p. 193). Against this hypothesis must be put the fact that in most cases, and certainly in the worst cases, the eyeball is softer than natural. Indeed, in extreme cases, the apex of the cone actually leaks. Moreover, in conical cornea the anterior chamber is deep, and not shallow, as in glaucoma. Even if the bulging be indirectly dependent upon increased intra-ocular pressure, some other factor must be introduced to account for the *shape* of the bulging. Fluid pressure behind a spherical pressure does not produce a conical protrusion. The writer would suggest that the primary condition is a want of development of the centre of the cornea. In support of this hypothesis it may be mentioned that conical cornea is sometimes congenital, and often hereditary (the writer has known three sisters affected); it usually begins in childhood; it is often associated with a peculiar condition of the skin and teeth, due to ill-development. In typical cases the skin is pale, dry, harsh, and slightly sclerosed, either generally or in patches, with large sebaceous glands which are often blocked with blackened sebum; in some cases there is distinct though slight ichthyosis; the teeth are often honeycombed and deficient in enamel, resembling the teeth so frequently associated with zonular cataract. These facts all point to an embryological origin of conical cornea, and a reference to the mode of development of the cornea shows how a failure of the process of development may leave, in the centre of the cornea, a structural imperfection favourable to the formation of conical cornea.

Treatment may be palliative or curative. Palliative may, again, be local or general. Local: the lenses, spherical or cylindrical, combined, or not, with the stenopaic slit, which are found to give the best sight. Hyperbolic lenses have occasionally been found useful. Solutions of eserine are recommended, partly with a view to lessening the intraocular tension, and partly to diminish circles of diffusion by contracting the pupil. Formerly, the operation of iridodesis was practised, with a view of making the pupil stenopaic; but the operation has wisely been abandoned, on account of its liability to set up sympathetic ophthalmitis. In addition, avoidance of excessive near work is necessary. Small and long-continued doses of arsenic are worth trying, with the hope of favourably influencing the nutrition of the cornea.

The curative treatment varies with the theory of conical cornea. Those who regard keratoconus as glaucomatous adopt measures calculated to arrest the glaucoma, as

iridectomy and sclerotomy, and the prolonged use of eserine. This is the line of treatment laid down by De Wecker. Graefe, on the other hand, attacked the apex of the cone, so as to induce cicatricial contraction. The theory propounded in this article indicates operative interference on the apex of the cone itself.

Von Graefe removed a thin layer from the apex without penetrating the anterior chamber. Two or three days later he touched the exposed surface with a stick of mitigated nitrate of silver, and repeated the application every three or four days, in order to set up ulceration. In the third week he punctured the anterior chamber through the base of the ulcer, and kept the opening free for from six to eight days, and then allowed it to heal by cicatrisation. The contraction of this cicatricial tissue led to the reduction of the conicity. This method has been variously modified by others. Bader, for instance, recommends the removal of a small and elliptical flap of the cornea, and bringing the lips of the wound together by means of one or two fine sutures. The practice which is now most commonly followed at Moorfields is that proposed by Sir William Bowman. With a suitable trephine a disc of cornea is cut, care being taken not to penetrate the anterior chamber. The disc is then seized with a fine forceps and severed by means of a cataract-knife. Atropine (or eserine) is then instilled, and the lids tied up with a moist or dry compress. In favourable cases, as cicatrisation of the corneal wound takes place, the conicity gradually disappears, a faint leucoma remaining. If necessary, the operation may be repeated, and eventually an artificial pupil may be made opposite a clean part of the cornea. In some cases the results of these three methods are really brilliant; but, unfortunately, they are all attended with considerable risk of suppuration of the cornea, and consequent destruction of sight. To lessen this risk, the writer has had recourse, in several instances, to multiple puncturings of the apex of the cone with a fine cataract-needle. The summit of the cone is transfixed from three to six times at each sitting, which may be repeated at intervals of two weeks or more. The first effect of the punctures is to allow some of the aqueous humour to escape, and then the eye is firmly but gently supported with a compress and bandage. The pupil is kept under the influence of eserine. Eventually a network of cicatricial tissue forms, which flattens the cone without giving rise to much corneal opacity.

(2) Opaque Ectasia or Staphyloma.—This is bulging of a cicatrix involving any part or the whole of the cornea. It is, consequently, a result of inflammation or injury. In most cases, the inflammation or injury has been attended with perforation. It is especially common after purulent ophthalmia, and suppuration or ulceration of the cornea from any cause. In true staphyloma the iris is entangled in the projecting cicatricial tissue; hence the peculiar bluish appearance, from which the name staphyloma is derived (σταφυλή = a grape). The presence or absence of iris in the staphyloma determines, to a large extent, the gravity of the condition. When the iris is free, staphyloma rarely need give much anxiety; whereas if the iris be involved, there is always a possible danger of sympathetic inflammation of the opposite eye. The bulging may involve only a small portion of the cornea, or it may involve the whole extent. The prospect of recovering any useful degree of sight will depend largely upon the circumstance whether the staphyloma be partial or total.

Partial staphyloma is most frequently found in the lower part of the cornea, that is, the part corresponding with the palpebral aperture. Not only is this portion of the cornea more exposed to traumatic and septic agencies, but, being less supported by the lids, is more liable to give way when weakened by ulceration, or, later, by cicatrisation. On the other hand, staphyloma following purulent ophthalmia in adults is, perhaps, more common in the upper part of the cornea, the presence of the swollen upper lid favouring ulceration of this part.

In total staphyloma there is generally a large entanglement of the iris near the centre. The bulged portion may be so large that the lids cannot cover it. It has a bluish-white appearance, with several large conjunctival vessels running over it from the periphery towards the centre. There is generally a narrow zone of semi-transparent corneal tissue between the staphyloma and the sclerotic. In some cases, however, the sclerotic is also involved, or the staphyloma may be at the corneo-scleral junction—ciliary staphyloma. The amount of sight depends largely upon the extent of the staphyloma and the nature and amount of the implication of the iris. If the staphyloma be total, the sight will not be more than perception of light; but, if partial, there may be even good sight through the transparent portion of the cornea.

The chief complications of both partial and total staphyloma are glaucoma and sympathetic ophthalmitis. *See* GLAUCOMA; SYMPATHETIC OPHTHALMITIS.

Treatment.—The prophylactic treatment of staphyloma is identical with that of suppuration and ulceration of the cornea (q. v.). For small staphylomata, without enlargement of the iris, repeated punctures or incisions often suffice, but larger ones may need excision or abcision. When there is entanglement it should, if practicable, be liberated. This may be done either by iridectomy, or by excision of the portion of the cicatrix containing the iridian entanglement. A recent staphyloma is often greatly reduced by iridectomy, and useful sight may be secured. As a rule, however, staphylomatous eyes do not, under the most favourable circumstances, possess good vision, and are at best weak-sighted. If the bulging affect the whole of the cornea, and especially if it be increasing, so as to protrude between the lids and to prevent proper closure of the eye; and still more if there be ulceration with pain, then more radical procedures are called for, either removing the front of the eyeball—abcision—or excising the whole globe. It cannot be denied that ablation of the staphylomatous portion, inasmuch as it leaves a stump for an artificial eye, is a seductive procedure. But as after abcision the patient is still exposed to the risk of sympathetic irritation and inflammation, it is not so much in favour as it formerly was. Of late, the practice of excising the eyeball altogether has steadily grown. By excision, the risks of sympathetic trouble may certainly be obviated, provided the operation be not delayed too long.

NEW-GROWTHS OF THE CORNEA.—Neoplasmata, beginning primarily in the cornea, are extremely rare. Tumours do, however, begin in the conjunctiva and invade the cornea, or the cornea may be invaded by tumours growing from within the eye. The new-growths which do occur in the cornea are epitheliomata and sarcomata. Pterygium is really an affection of the conjunctiva. *See* PTERYGIUM.

As soon as the nature of either is recognised, enucleation of the globe should be performed.

JOHN TWEEDY.

CORNEA, Injuries of the.—The principal forms of injury of the cornea are abrasions, impaction of foreign bodies, wounds, and burns.

1. ABRASION of the corneal epithelium, though apparently a trifling accident, is always painful, and may be followed by suppuration and destruction of the cornea. The subjective symptoms are pain, photophobia, lacrymation, and a feeling as if grit were in the eye. Objectively, there is a disturbance of the polish of the corneal surface at the seat of the abrasion; though in the early stages the anterior elastic membrane continues to give a glistening appearance to the base. There is also more or less injection of the globe. The sequel depends upon the precise cause of the injury, the age, and health of the patient, and the kind of treatment adopted.

Treatment.—If the injury be inflicted with a clean instrument, and the patient be healthy, the instillation of a drop of castor oil, and tying up the eye with a soft compress for a few hours, may suffice.

But if the injury be inflicted with a foul instrument, as a dirty finger-nail, or if the patient be debilitated by want of proper food or by drains upon the strength, further precautions must be taken against suppuration. The eye should be tied up with a compress, which should only be removed to allow of the application of hot fomentations of water, poppies, or belladonna, and the instillation of atropine. An aperient should be given, if necessary, but care must be taken not to depress the nutritive activity. If the pain be very great, particularly over the eyebrow and at the root of the nose, one or two leeches should be applied to the inner or the outer angle of the orbit, followed by hot belladonna fomentations. If suppuration of the cornea and hypopyon occur, section of the cornea through the abscess should be made, with the double purposes of getting rid of the pus from the anterior chamber and of lessening the intra-ocular tension. As these untoward results rarely occur except in persons out of health, tonics and generous diet should be superadded to all local measures. Opium, croton-chloral, gelsemin, or conium may be necessary to give freedom from pain and to secure sleep.

2. FOREIGN BODIES of all kinds may be lodged in the surface of the cornea or become impacted in the deeper layers. In the latter case the track of the extraneous substance may be sagittal or oblique. The impaction of the foreign body may be further complicated by some peculiar quality of this substance; if it be a particle of hot metal there will also be some burning of the cornea; if it be septic, special reaction may follow.

In examining an eye with an alleged foreign body, it is necessary not only to look at the cornea in the manner directed

above, but also to search the conjunctivæ of the upper and lower lids. Even though a foreign body be visible on the cornea, this precaution should not be neglected; otherwise extraneous matter may be left under the lids, to the annoyance of the patient and the discredit of the surgeon.

Treatment.—When the foreign body lies on the surface of the cornea its removal is easy. The application of a drop of a two per cent. solution of cocaine, five minutes before attempting the removal, will simplify matters by rendering the cornea and conjunctiva insensitive.

If the foreign body be deeply embedded there may be risk of pushing it through the posterior layers in the attempts to remove it. To obviate this a broad needle should be passed through the cornea behind the foreign body, but without penetrating the anterior chamber. The body may then be removed. But if the foreign body have penetrated the posterior layers and project into the anterior chamber, then the broad needle should be passed into the anterior chamber to support the inner end of the particle, while attempts are made to remove it from the front. Lastly, if the foreign body be forced through the cornea into the anterior chamber, the cornea should be incised, as for iridectomy, and the foreign body removed by forceps, with or without excision of the iris. If the foreign substance be iron or steel it may conveniently be withdrawn from the chamber by means of the electromagnet. Before attempting to remove fragments that are deeply embedded in the cornea, or which have penetrated the cornea, it is well to apply eserine, in order to contract the pupil and thereby lessen the risk of wounding the lens.

After the body has been removed, a drop of castor oil should be applied and the eye tied up a few hours or two or three days, according to the severity of the injury. Should keratitis supervene it must be treated on the principles laid down above.

3. Wounds of the Cornea may be classified as incised, contused, lacerated, punctured, poisoned, and complicated.

Incised wounds are usually simple in character, and seldom need give anxiety. Contused, lacerated, punctured, and poisoned wounds, on the other hand, are apt to be followed by suppuration. The most serious wounds, however, are those which are complicated by prolapse and entanglement of the iris, by wound of the capsule of the lens, by dislocation of the lens, or by involving the corneo-scleral region, and implicating the ciliary body.

Treatment.—In simple wounds atropine should be applied, and the eye tied up with a light compress. In wounds of a severer kind belladonna compresses, and every other means of preventing or allaying inflammation, should be used. The sound eye should also be protected by means of a shade or tinted spectacles.

Complicated wounds must be treated according to the nature of the complication. If there be a simple entanglement of the iris, an attempt may be made to return the iris; but this failing, the prolapsed portion should be firmly grasped with iris-forceps, and gently pulled forwards so as to detach it from the margin of the wound; and then, while thus over-stretched, it should be excised close to the cornea. The resiliency of the iris will draw the stump of the iris into the anterior chamber, and thus prevent further entanglement. Avoidance of entanglement is one of the surest precautions against sympathetic ophthalmitis. If there be a large perforating wound of the cornea with a hernia of the lens, iridectomy should be performed and the lens removed. *See* Cataract. In all cases of wound the local treatment must be soothing and mildly antiphlogistic, and inflammatory reaction should be combated in the manner indicated under *Keratitis*: see Cornea, Inflammation of the.

4. Burns of the Cornea may be caused by hot metals, sparks, lime, ammonia, mineral acids, &c. Burns with lime and strong ammonia are the most destructive, and are apt to cause suppuration or necrosis, and are, under the most favourable circumstances, followed by leucomata. Such burns generally involve the conjunctiva and lids also, and may give rise to adhesions of these parts to the cornea. *See* Conjunctiva, Injuries of the; Eyelids, Injuries of the.

Treatment consists of the removal of all foreign particles, and, if the case be seen early enough, by the neutralisation of the chemical substances—of alkalies by weak acids, of acids by weak alkalies. Later the treatment should be directed against inflammatory reaction, and to putting the cornea in the most favourable state for recovery with the least amount of damage. *See* also Conjunctiva, Injuries of the; Crystalline Lens; Eyelids, Diseases of the; Iris, Injuries of the.

J. Tweedy.

CORNS.—*Definition.*—Local hypertrophies of epidermis, due, for the most part, to the intermittent friction of ill-fitting boots.

Boots, especially of women from their absurdly small size and high heels, throw

abnormal pressure on certain spots: but misshapen, loose, ready-made boots may also produce corns by friction. Corns are especially met with on the dorsal surface of the phalanges doubled down and driven under one another, on the outer surface of the little toe, and over the heads of the first and fifth metatarsal bones.

Structure.—This varies somewhat according as corns are hard or soft. (*a*) The structure of *hard corns* is that of a wedge or column-like mass of epithelium, which is driven down on the subjacent papillæ; these soon become depressed and atrophied, the subcutaneous fat disappears and a small bursa often forms, to keep off the pressure on the parts below. (*β*). *Soft corns.*—The chief difference between these and hard corns is that, occurring as they do between the toes, they are spongy, vascular, and covered with soft macerated epithelium. The writer has met with them especially in summer, and in the wearers of patent-leather boots.

The importance of corns depends on the trouble which they occasion, and their *complications.* In early life lateral curvature may take its starting-point in a painful corn, the girl throwing her flexile spine over on to the opposite foot. Abscess under a corn, due to suppuration in the little subjacent bursa; partial dislocation of one or more toes at the metatarso-phalangeal joints due in part to reflex contraction set up by the corns, and in part to the same pressure which has caused the corns, are not unfrequently met with in patients who are well-to-do. Amongst the poorer classes neglected corns have been complicated with cellulitis and erysipelas, or have even, in elderly people, become the starting-point of a fatal gangrene.

Treatment.—The cure of corns would be easy by removing their cause; but few patients obtain a radical cure, as their perseverance ceases as soon as they obtain a sufficient but temporary relief. As a rule patients act upon a too widely spread opinion, viz., that medical men do not know how to treat corns, or, if they do, think them beneath their dignity, and go to some self-dubbed 'chiropodist,' or only present themselves for the treatment of inflammation or some other complication of corns. A medical man should always insist on his patient wearing properly made and well-fitting boots or shoes: these should be neither too large nor too small, with a straight inner border, rounded, not pointed, toes, and low heels; the boots, moreover, should allow of sufficient spring and expansion of the foot in every direction at every step. Patent leather should be forbidden, and the material used be as soft and supple as possible.

In the removal of corns the surgeon should pare a little of the top off carefully, without any attempt to 'cut out' the corn, and then apply, on one or two occasions, a little nitric or glacial acetic acid. A few days after each application the thickened cuticle can be peeled off and a fresh application made, two or three of which are usually sufficient. Of course neither these remedies nor the silver-nitrate in stick (to which the writer considers the former superior), are to be used when the corn is at all inflamed, and in elderly people with feeble circulation, any interference with corns must be undertaken with caution, for fear of causing inflammation which may pass into gangrene. If the patient object to caustics he may apply at night water dressing or a solution of sodæ bicarb., or one of caustic potash well diluted, on lint or cotton wool. A few applications of this will macerate away the chief part of the corn, and the rest will shrivel away, if the patient, having dried the corn well, paint on a solution of silver nitrate, gr. x.–f℥j.

Relief may be given, when any further treatment is declined, by the use of circular perforated plasters of amadou, 'elephant' plaster, or buckskin; but it is always to be remembered that these remedies, while pleasing to the patient, do not cure the corn.

Suppuration under a corn may be known by the presence of a yellow speck at the base of the corn, ushered in by intense throbbing pain. A puncture should be made with a tenotomy knife, and the parts relaxed by the constant application of warm water dressing. Where a row of corns occurs on the phalanges of the toes, crooked and crumpled by the pressure of ill-fitting boots, the toes must first be straightened by splints, aided, if needful, by tenotomy. *See* Hammer-Toes.

Obstinate ulceration occasionally follows on suppuration and inflammation of corns. *See* Perforating Ulcer.

Moist corns, between the toes, may easily be cured by keeping the parts very dry, dusting with zinc oxide and starch, or pulv. æruginis, and painting occasionally, if need be, with solution of silver nitrate, gr. x.–f℥j. If moist corns are accompanied by 'sweating feet,' the patient should bathe his feet frequently, and after thorough rubbing and drying, apply lin. belladonnæ, or equal parts of this and eau de Cologne. Socks

or stockings, shoes or boots, should be frequently changed. *See* Bromidrosis.

W. H. A. Jacobson.

CORNUA CUTANEA. *See* Horns.

COSTAL CARTILAGES, Fractures of the.—These are very rare, and generally due to the same causes as those giving rise to fractured ribs. The cartilages from the fifth to the ninth are those most likely to be injured. They are frequently complicated by fracture of the sternum, and it is said that injury to the eighth cartilage occasionally may rupture the transverse colon. The pericardium and heart are, however, the thoracic viscera most likely to suffer. The treatment should be the same as for fractured ribs; but if there be deformity a pad and spring pressure may be used to correct this, the elastic structure of the cartilage yielding under the constant pressure. The cartilages generally unite by bone-callus, formed around the broken ends which remain passive in the sheath; but occasionally they unite by new cartilaginous material.

H. G. Howse.

COUNTER-OPENING.—If, after incision of a suppurating cavity, the opening fails to afford free exit to its contents, and the pus either collects at a lower level or has a tendency to burrow along the adjacent soft parts, it will be found necessary to make another incision—the so-called *counter-opening*—in a more dependent or suitable situation, in order to remove this accumulated and probably decomposed purulent discharge. *See* Abscess.

COXALGIA. *See* Hip-Disease.

CRADLES are light arched frames made of wire or cane, which are used to protect injured or inflamed parts from the pressure of the bedclothes. They are made of various sizes, some of sufficient span to bridge across the body, and others merely across a limb. Some cradles, such as Salter's or Arnold's, are of a stronger build, and adapted to suspend a broken limb or diseased joint in a swinging position. In the former the swinging apparatus is suspended from a pulley running on a longitudinal bar; this contrivance prevents the limb being disturbed if the patient slip lower down in the bed. Bilton Pollard.

CRANIAL NERVES, Injuries of the.—I. The Olfactory Nerve.—Blows or falls on the head not infrequently cause separation of the nerves from the lobes, when olfactory anæsthesia—i.e. anosmia—ensues. Loss of the sense of flavour is first noticed, but afterwards that of smell is appreciably lost, as made out by presenting an aromatic oil, such as that of cinnamon or clove, to the nostril. Acetic acid or ammonia irritate the fifth nerve, not the olfactory, and are therefore apt to mislead.

II. The Optic Nerve.—Injuries to the optic nerve, chiasma, and tract exhibit symptoms which depend on the part injured.

Injury to one optic tract causes loss of sight in the corresponding half of the field of vision of either eye—*lateral hemiopia.* This is accounted for by the crossing of the inner set of fibres at the chiasma, so that each tract supplies the same side of both eyes. Injury of the optic chiasma at its margins causes loss of the power of vision on the outer side of both retinæ, appearing in projection as loss of vision in the inner part of each field, i.e. *nasal hemiopia.* Injury to the centre of the chiasma causes loss of function in the inner part of the retinæ, appearing in projection as loss of the outer half of each field of vision, i.e. *temporal hemiopia.*

Destruction of the nerve between the chiasma and the optic foramen causes simply blindness. Injury to the nerve at the optic foramen or within the orbit usually involves other orbital nerves.

III. The Third Nerve is distributed to all the muscles of the eyeball, except the superior oblique and external rectus; to the levator palpebræ; to the sphincter pupillæ, and to the ciliary muscle. *Irritation* of the nerve causes spasm of some one or all of the muscles supplied, but most frequently it is the lateral rectus which is affected, causing internal strabismus; the sphincter pupillæ, causing myosis; and the ciliary muscle, causing the eye to be accommodated for near objects only.

Complete paralysis causes:—

1. Ptosis.
2. Immobility of the eyeball in the position of external strabismus.
3. Dilatation of the pupil.
4. Loss of the power of accommodation.
5. Slight prominence of the eyeball from the compressing action of the superior oblique.

Diagnosis of the seat of lesion:—

1. Injury to the nerve in the crus causes coincident hemiplegia of the opposite side.
2. Both nerves are affected when the interpeduncular space is the seat of lesion.
3. Paralysis of the internal rectus alone causes divergent strabismus and crossed diplopia.
4. When the superior rectus is paralysed, there is crossed diplopia in looking upwards.

5. Exactly the reverse obtains when the inferior rectus is paralysed.

IV. The Fourth Nerve when paralysed causes loss of function in the superior oblique muscle. Owing to the consequent loss of power of rotating the eyeball downwards and outwards there is diplopia, when the patient attempts to look obliquely downwards, from the healthy towards the paralysed side. Giddiness when descending a stair is usually the first symptom, owing to the diplopia induced by looking at the steps whilst descending.

V. The Fifth, Trigeminal, or Trifacial Nerve may be affected in its entirety, in its motor root alone, or in one or more of its primary divisions.

Of the three primary branches the first, wholly sensory, supplies the forehead, upper eyelid, the conjunctiva, the inside of the inlet to the nose and the lacrymal gland. The second, wholly sensory, supplies the cheek from the lower eyelid to the upper lip, including both; the side of the nose, and the upper gums and teeth. The third, partly motor, partly sensory, supplies with motor power the muscles of mastication; and by its sensory branches the lower lip and cheek, the gums and teeth of the lower jaw, the anterior two-thirds of the tongue, the front of the ear, and the parotid gland.

Paralysis from an injury dividing the *sensory* root causes anæsthesia of the regions between the frontal suture and the lower jaw, and between the middle line of the face and the ear. The skin of the face is cold to the touch and exhibits a purplish tint. The conjunctiva may be touched without causing winking, the eyeball looks glazed, and in the course of eight days, if unprotected, the cornea may slough, allowing the escape of the contents. The nostril is dry, and irritation produces neither watering at the eye nor sneezing. The effect of unilateral paralysis causes the patient to think the glass from which he drinks is broken. The tongue on the affected side loses the power of appreciating the presence of sweet, sour, bitter, or saline substances. The gums become spongy and ulcerative. There is diminished secretion in the lacrymal and the salivary glands. Paralysis from severance of the *motor* root is evident by the impaired action of the lower jaw, and by the loss of strength in the masticatory muscles. Irregularity of movement becomes evident, and by placing the hand on the cheek of the affected side, the defective power of the muscles becomes apparent. The impairment in lateral movements is more diagnostic than the simple up and down movement. The diagnosis between central and peripheral affections is made out by observing the following points.

1. When central, the lesion of the fifth is associated usually with hemiplegia of the same side, i.e. the side opposite to the injury.

2. In peripheral affections the anæsthesia is more complete, and in it the trophic and vaso-motor changes are pronounced.

VI. The Sixth Nerve—the abducens—supplies the external rectus of the eyeball. This nerve, on account of its connection with the basal cranial bones, is more frequently involved in fractures of the anterior part of the skull than is any other of the orbital nerves. Its division causes internal strabismus. There is a default in the projection of the field of vision, diplopia of the homonymous type, the images appearing more distant as the object is moved across the field of vision towards the affected side.

VII. The Facial Nerve, or portio dura of the seventh, when torn through, causes paralysis of the muscles of expression—Bell's paralysis. The nerve may be injured after, during, or before its passage through its canal in the petrous portion of the temporal bone—the aqueductus Fallopii.

Injury after its exit from the bony canal causes paralysis of all the muscles of expression—i.e. all the facial muscles, with the exception of the levator palpebræ—of the posterior belly of the digastric, and the stylo-hyoid muscles. The symptoms are:—1, smoothness of the forehead; 2, inability to close the upper eyelid; 3, smoothness of the cheek; 4, loss of the naso-labial furrow; 5, inability to expand the nostril; 6, on laughing the mouth is pulled towards the sound side; 7, whistling, or blowing a candle out, is impossible; 8, food collects between the cheek and the gum. When the injury is three lines *above the exit* of the nerve from the canal, the chorda tympani is paralysed. The patient then experiences a pasty taste in the mouth, and is unable to recognise the difference between bitters and sweets, acids and salines.

When the injury is near the entrance of the nerve into the canal, then the petrosal nerves are involved. See *Spinal Accessory*. When the nerve is injured before its entrance into the canal, the auditory is usually involved. When the cause is central, the sixth is usually paralysed, and there is hemiplegia of the opposite side. When central, the electric response of the muscles and nerves remains active, but when peripheral it is usually lost.

VIII. The Auditory Nerve is frequently destroyed by fractures of the base of the skull, by blows, by loud, sudden noises or explosions, as of dynamite. The inability to hear a vibrating tuning-fork placed on the cranium or between the teeth, is diagnostic of complete destruction. Irritation of the part of the nerve supplying the semicircular canals is supposed to produce the giddiness, vertigo, and vomiting characteristic of Menière's disease. *See* Ear, Internal, Diseases of the.

IX. The Glosso-Pharyngeal Nerve.—Injury to this nerve is unknown apart from its neighbours. When it is destroyed taste proper is lost, and various muscles of the palate are affected. See *Spinal Accessory.*

X. The Pneumogastric Nerve, and the part of the spinal accessory applied to it, must be considered together. These endow the circulatory, respiratory, alimentary, and urinary tracts with motor, sensory, trophic, vaso-motor, vaso-inhibitory, secreto-motor, inhibitory, and accelerating fibres.

If the *trunk* of one vagus is destroyed near its root, respiration becomes slower, and, if both be divided, the pauses between inspiration and expiration become more marked, the patient dying of pneumonic congestion. When the pharyngeal branch is destroyed deglutition is impaired, food collects in the pharynx, and fluids taken are ejected through the nose. This probably indicates paralysis of the palatal, as well as of the upper constrictor muscles.

Division of the superior laryngeal nerve allows food to enter the senseless larynx, causing thereby asphyxia. Division of the inferior laryngeal causes paralysis of all the muscles of the larynx, except the crico-thyroid supplied by the superior laryngeal. When this is unilateral, one vocal cord is useless, and being at first semi-abducted and then adducted, causes the voice to be at first hoarse and finally high-pitched. The change is, in all probability, brought about by the increasing tension of the crico-thyroid. Dyspnœa supervenes only during exertion, owing to the inaction of one vocal cord.

When the trunk of the pneumogastric in the neck is paralysed, the recurrent laryngeal suffers; the respirations become slower, the cardiac beat is quickened, and death ensues, usually within half an hour. If, in an operation, the pneumogastric is pulled upon, the heart's action is slowed.

XI. The Spinal Accessory Nerve.—The accessory filaments to the vagus and its branches supply motion to its pharyngeal, laryngeal, and, probably, its respiratory and cardiac, branches. The portion which takes a separate course supplies the sterno-mastoid and upper part of the trapezius muscles. Irritation of the nerve-trunk causes spasm of these muscles; complete division paralyses them. The head can be maintained in the erect normal position; but shrugging the shoulder, or turning the head so as to hear better, are impossible movements on the paralysed side.

The muscles of the soft palate are affected in paralysis of the fifth, facial, glosso-pharyngeal, pneumogastric, spinal accessory, and hypoglossal nerves. Anatomical teaching ascribes the nervous supply of these muscles to the facial through the fifth for the most part; but clinical observations do not bear out this teaching, as deviation of the uvula—a doubtful symptom at any time—is found when other than these nerves are injured. At present, it is safest to make no definite statements until anatomical and clinical observations are more in accord.

XII. The Hypoglossal Nerve is chiefly devoted to supplying the muscles of the tongue.

In bilateral paralysis deglutition, mastication, and articulation are hindered or impossible. In unilateral affections these are but little affected, but on protrusion of the tongue it is easy to be seen that it is pushed to the affected side, and *vice versâ* when withdrawn. Paralysis of the palate and one vocal cord has been observed in a case of unilateral paralysis.

James Cantlie.

CRANIOTABES — CRANIAL BOSSES.—By craniotabes is meant a special form of atrophy, or thinning, of the cranial bones in infancy. The parts affected become flexible like parchment, and small conical pits are formed which commence on the inner table and extend outwards, leaving in well-marked cases only a lamina of the external periosteum. The parchment-like flexibility is easily appreciated when gentle pressure is applied; but the pits are difficult to demonstrate during life, because, except in extreme cases, the outer table retains its continuity of surface. The part of the cranium commonly affected is the posterior inferior angle of the parietal (on one or both sides), and in this position the bone is more easily bent by the finger than in any other, and such bending as can be obtained with moderate pressure is not attended with either risk or pain to the child. There are no symptoms specially

suggestive of craniotabes. Infants who have the lesion highly marked, are sometimes very tender about the head, and cry when raised from the horizontal position; but this is by no means constant. The back of the head is often bald. Elsässer, who gave the first description of the lesion, and whose monograph (1842) is admirable, was inclined to look upon craniotabes as the cause of laryngismus stridulus; but there seems no sufficient reason to suppose that the two things, when they coexist, are more than coincidences. It is certain that many cases of craniotabes exist without laryngismus, and many cases of laryngismus occur in children who are not craniotabetic.

The age at which craniotabes is first found is of some importance. There are some exceptional cases in which it appears to be a fœtal condition, and these have special features to be subsequently mentioned; but there is no doubt that craniotabes, as commonly met with, is an infantile and not a congenital lesion. The bones of the vault of the cranium of a full-term fœtus will be found, on examination, tough, firm, and unyielding. Change in shape of the skull of a new-born infant under pressure, is brought about in great part by the overlapping at the sutures, not by the bending of bones. There may be a little yielding along the margin of the sutures; but flexibility of the bone beyond, and actual pits, rarely occur before three months, although they have been detected as early as six weeks. The onset of craniotabes has been repeatedly recognised in infants who were under frequent observation early in life, and who when first examined showed no sign of it. With respect to duration, this lesion may be only capable of detection for a few weeks; in the majority of cases it ceases to be recognisable within the first ten or twelve months of life, but it may continue, in rare cases, up to eighteen months.

The post-mortem appearances present the shallow conical pits already mentioned. These pits are excavations primarily of the inner plate, whilst the apex of the cone is hollowed out of the outer plate, which, in extreme cases, is reduced to a mere membranous lamina of periosteum. The walls of the pit present a markedly granular surface. The size is rarely greater than enough to hold the end of a cedar pencil; the number varies from two or three to a dozen. The pits are generally symmetrical, but deeper and more numerous on one side than the other. The 'place of election' is the posterior inferior part of the parietal. With less frequency the thin upper portion of the occiput, the temporals, the upper surface of the orbital plates of the frontal, and very rarely the upper parts of the frontals and parietals are affected.

Three associated cranial conditions deserve special notice:—(1) The excessive, or rather the premature, formation of convolution-impressions in the hinder parts of the skull. The craniotabes pits are, without exception, situated in these early-formed convolution-impressions. (2) Where the craniotabes is considerable, there is generally also some asymmetry of the skull, and it will be found that, on the side on which the pits are deepest and most numerous, the posterior parietal region is flattened, as a whole, compared with the other side. (3) Cranial bosses. Spots of craniotabes will be found *post mortem* in most of the cases of the so-called natiform skull of M. Parrot, in its vascular and active stage. In this form of cranium, massive bosses occur around the anterior fontanelle, and more or less broad sinuous areas of osteophytic deposit surround, but rarely invade the centres of ossification of the frontals and parietals, and sometimes the occiput and temporals. The association of massive hyperostoses in definite parts of the skull with atrophic areas in other definite parts, is a very remarkable one. Now although a multitude of cases of craniotabes may be found in which at no period are definite bosses to be made out during life, yet a minute examination, *post mortem*, of the outer surface of the cranium in the neighbourhood of the tabetic spots, will, the writer believes, almost invariably reveal a deposit of fine, granular, osseous material. This is sometimes only comparable with what would be obtained by sprinkling over the bone the finest sand. In other cases it is more marked, and can be identified as a 'splash,' so to speak, of the same kind of granular osteophytic deposit which, by insensible gradations, is traceable into the massive bossy growth before mentioned.

Etiology.—No entirely satisfactory explanation of the causation of craniotabes has been offered. The view that the pits represent islands of incomplete ossification in the membranous bones of the cranium is certainly untenable, at least so far as the ordinary cases are concerned. Delayed ossification is by no means a rare condition along the posterior border of the parietal, and along its upper margin, especially near the position nor-

mally occupied by the parietal foramina, and such delay may explain some of the flexible parietals which are felt during life; but the actual pits which are seen *post mortem* are well within the sutures, and cannot be so explained. It is true that in skulls of infants who are the subjects of meningocele, small gaps of incomplete ossification may be found in various parts of the cranial bones; but the inner surface of these gaps is quite smooth, instead of presenting the rough granular condition of craniotabes pits, whether the latter have progressed to actual perforation or stopped short of it.

There seems every reason to regard the true craniotabes pits as being due to an actual removal of osseous material from the inner surface by a process of absorption. The doctrine which finds most favour is that the weight of the brain is the efficient cause of this absorption, by pressing against the thinner portions of the hinder part of the cranium, which hinder part also is subjected to counter-pressure from the frequent horizontal posture of the infant lying against the pillow, or on the arm of the nurse. However brought about, it seems probable that in the formation of the convolution-impressions, which are not present at birth, a certain amount of absorption of osseous material takes place. It is possible that an amount of absorption, enough to allow of a slight degree of flexibility of the posterior parietal regions, may be physiological. The writer has, in more than one instance, observed the occurrence of a slight degree of flexibility lasting for a few weeks in a perfectly healthy infant of between three and four months old. But Friedleben's view that actual craniotabes, with the formation of pits, is physiological, appears to the writer quite untenable.

To the two factors of weight and resistance before mentioned, it would appear essential that a third should be added, viz., a special morbid condition of bone by which it becomes more readily acted upon, from within and without, than in the normal state. The writer has already stated his belief that, in however attenuated a lamina, some evidence of fine granular deposit of osteophytic material can generally be found on the outer surface in the neighbourhood of the pits. In the active vascular stage, even the osteophytes which form the massive bosses are so soft that they can readily be cut with a knife. These portions, it is to be remembered, are not subjected to pressure and resistance like the posterior parietal regions. The premature formation of convolution-impressions on the inner surface, and the very marked general flattening of the whole of one posterior parietal region, so often found with craniotabes, form together a strong presumption in favour of the plasticity of this part of the skull. It is true that such asymmetry may be congenital, but its onset may be actually observed in some of the above cases, along with evidences in other parts of the skeleton of yielding to pressure.

It must be admitted that the above view does not explain the rare cases of craniotabes of the upper parts of the frontals, and of the parietals. The full history of these cases is much to be desired, especially with regard to the date of onset. Is it possible that some of them may be truly congenital, and so comparable with a remarkable group described by M. Parrot? This group consisted of premature still-born fœtuses, and the pits were found distributed with remarkable constancy around the neighbourhood of the anterior fontanelle. M. Parrot's ingenious contention was that in intra-uterine life, the head being generally dependent, this region of the inner surface of the skull would be very liable to pressure, and that if any localised morbid condition of bone occurred rendering it soft in this region, intracranial pressure might be expected to come into play.

The question now arises, with what general morbid condition is infantile craniotabes related?

1st. It is not necessarily associated with simple general atrophy or marasmus. Dr. David Lees examined a number of marasmic infants in whom no craniotabes could be found; and, on the other hand, the lesion has been found repeatedly in many stout, apparently well-nourished, children.

2nd. It is certainly found in a high degree in many syphilitic children, and is regarded by M. Parrot as always syphilitic; but it is equally certain that in many cases no evidence of congenital syphilis is forthcoming.

3rd. The prevalent view, first propounded by Elsässer, supported by Virchow, and accepted by most German writers, is that craniotabes is the earliest manifestation of rickets. With respect to this view, it is undoubted that craniotabes may be found in breastfed infants, who at the time present no other sign of rickets, so far as can be detected during the life of the infant, although it may be urged that at a subsequent period, beading of ribs, &c., may become manifest. The writer has, however, recorded one case of craniotabes in a pro-

bably syphilitic breastfed child in whom post-mortem examination revealed no proliferation of cartilage at the sternal ends of the ribs, although the child was seven months old, a sufficient age for beading to have become manifest.

The question, however, ultimately turns upon the interpretation which is to be given to the nature of the cranial osteophytes which, in larger or smaller amount, the writer believes always accompany definite spots of craniotabes. If these osteophytes are, as M. Parrot taught, to be regarded as syphilitic, then the craniotabes spots ought to be regarded as a sort of syphilitic epiphenomenon. If, however, the osteophytes are rickety, then the craniotabes spots ought to be considered as a sort of rickety epiphenomenon.

The writer has observed some notable examples of cranial bosses in syphilitic infants in whom other signs of rickets were either *nil* or extremely slight, and, for this and other reasons, was at one time led to believe that M. Parrot's view was correct, viz. that the cranial bosses were in themselves syphilitic. Subsequent investigation has convinced him, however, that, although such bosses occur in a large number of syphilitic children, they may unquestionably arise in non-syphilitic children, and that the older view, according to which they were held to be rickets of the skull, was the correct one.

The difficulty that occasionally other signs of rickets are slight, or even absent, is a real one; but it may be partly met by the parallel observation of the occasional excessive incidence of this disease on particular bones or portions of the skeleton, and by the wonderful variety of clinical forms which occur in consequence of the commencement or arrest of the disease at varying stages of bone-development. The readiness with which the osseous system of a child responds to the slightest perversion of general nutrition is one of the most striking facts of pathology. It seems possible that, even in a breastfed infant, some temporary impoverishment of the mother's milk, some slight chronic catarrh in the infant, or some fault in its surroundings, may start a change in the growing cranial bones, and lead to the deposition of morbid osseous material, in consequence of which craniotabes may follow, and, the cause having come to an end, no further affection of the skeleton supervene.

Thus, as rickets, in its well-marked indubitable forms, may become arrested at various stages, and healthy development occur, so the view may be held that the craniotabetic phase of rickets may remain the only manifestation of the disease, and thus the difficulty of the frequent non-appearance of other classical signs would be met.

Treatment.—Craniotabes, so far as the writer knows, is attended with no special risks *per se*, and needs no special treatment; but its detection ought to set the doctor on the *qui vive* for faults of diet and hygiene, even if no other evidence of rickets be present at the time; and if evidence of congenital syphilis be forthcoming, the child should be promptly treated with mercury. Thomas Barlow.

CREPITUS. *See* Fractures.

CRIPPS' LONG SPLINT, for fractures of the thigh, differs from all others in that the extending and counter-extending forces are both obtained by the elasticity of a rubber accumulator. The splint is provided with a sliding footpiece, from which a cord passes round a pulley, and then upwards along the outer side of the splint to a double pulley, around the lower wheel of which it is reflected, and then fixed to the upper end of the accumulator, which is itself attached at the other end to one of a series of hooks on the outer side of the splint. The perineal band terminates in a cord at each end; both cords pass over a pulley let in to the upper end of the splint, and join on the outer side of the splint to form a loop, which is placed on the upper wheel of the double pulley above mentioned. It will be seen that when the accumulator is put on the stretch traction is thus made on the perineal band at the same time as on the footpiece. Bilton Pollard.

CROFT'S PLASTER OF PARIS SPLINTS. *See* Immovable Bandages.

CRYPTORCHISM. *See* Testis, Malpositions of the.

CRYSTALLINE LENS. — The crystalline lens presents abnormal and morbid conditions of several kinds. Its *transparency* may be impaired or lost through faults of development or growth, through injury, through senile degeneration, or through malnutrition due to disease of the structures which surround it. Its *elasticity* may be destroyed by the usual senile sclerosis of the fibres, or by morbid changes of structure at any time of life. Its *form* and *size* may be abnormal, by reason of errors of development and growth, or of the mechanical

pressure of surrounding structures. Its *position* and *relations* may be at fault through malformation or rupture of its suspensory ligament, through defect of the aqueous or vitreous humour, through adhesion to the iris or other adjacent parts, or through the presence of foreign bodies or new-formations in its neighbourhood. Having no nerves, no blood-vessels, and no connective tissue in its substance, the lens is not subject to those morbid processes which depend on the presence of these structures. Its most frequent and most important disorder is the condition known as cataract. *See* CATARACT.

MISPLACEMENT AND DISLOCATION OF THE LENS.—Instead of hanging evenly suspended behind the pupil and concentric with the axis of the eye, the lens may assume various abnormal positions. It may be displaced laterally with or without tilting of the one edge in advance of the other; it may pass through the pupil into the anterior chamber; it may fall back into the vitreous humour; it may even, in case of forcible rupture of the sclera, be driven out of the eye and remain lying beneath the conjunctiva.

Causes and Pathology.—The causes of these displacements are of three kinds—errors in development; injuries; and degenerative processes affecting the integrity of the suspensory ligament.

Congenital misplacement is sometimes associated with coloboma of the choroid or optic disc, sometimes with persistent hyaloid artery; more frequently it is met with in eyes which appear otherwise healthy. A partial lateral displacement indicates a faulty development of the suspensory ligament, by reason of which the traction upon the lens is unequal at different parts of its circumference. The displacement is usually upwards, or upwards and outwards, indicating a defect in the lower part of the ligament analogous to an imperfect closure of the fœtal slit. It is usually present in both eyes, and is symmetrical, or nearly so, in the two. It has been frequently met with in several members of one family, and in successive generations.

Traumatic dislocation may be produced by perforating or by non-perforating injuries, more frequently, perhaps, by the latter; the suspensory ligament ruptures under violent distortion of the globe, and the lens is displaced in the direction of least resistance. The attachments of the lens to its ligament and to the hyaloid membrane are less strong in senile than in youthful eyes, and they are weakened by conditions which damage the nutrition of the vitreous humour; in such cases, therefore, less force suffices to dislocate the lens than in a sound and youthful eye.

Spontaneous dislocation occurs only in presence of morbid changes in the lens itself, or in the vitreous. These structures depend for their nutrition upon the uveal tract, and when this latter passes into an atrophic state—e.g. in retinitis pigmentosa choroiditis disseminata, extreme myopia, &c.—they are apt to degenerate, the one liquefying, the other developing the posterior-polar form of cataract. It is in these same conditions of uveal atrophy that spontaneous dislocation of the lens is chiefly met with. It is promoted also by those pathological changes which overstretch the suspensory ligament, namely, by the shrivelling of the lens which usually occurs in the hypermature stage of cataract, and by the distension of the ciliary region which results from the long continuance of glaucomatous tension. A lens misplaced at birth may, and not unfrequently does, in course of time break loose still further from its suspensory ligament, and undergo a spontaneous dislocation into the vitreous or the anterior chamber; the deep-seated changes just referred to are, of course, not to be looked for in such a case.

Symptoms and Diagnosis.—*Lateral displacement*, such as occurs congenitally, involves more or less defect of vision; usually there is myopia, and sometimes astigmatism also. If the displacement be so great as to bring the one edge of the lens well within the area of the pupil, the eye has, as it were, a double refraction, being, as regards the free part of the pupil, hypermetropic, as in aphakia (absence of lens); while, as regards the part occupied by the lens, it is myopic, or, at any rate, very much less hypermetropic. Moreover, the retinal image is doubled, for the eccentric lens acts as a prism, and deflects to one side the rays which traverse it, while those which pass by it are not so deflected. Hence the patient has a peculiar confusion of vision, and may see double with a single eye. A concave lens, combined, if necessary, with a cylinder, may give good vision through the displaced crystalline, while a cataract-glass may do the same for the free area of the pupil. In either case, the patient may succeed in disregarding the second image, especially as by the action of the glass it is rendered all the more diffuse. Objectively, the displacement reveals itself by tremulous movements of the iris when the eye is quickly moved in different directions.

These indicate a loss of the fixed support which the iris normally receives from the lens, and correspond with similar tremulous movements of the lens itself. The anterior chamber is seen on careful inspection to be unequally deep at different parts, being too shallow at the side towards which the lens is displaced, too deep at the opposite side. With the ophthalmoscope the edge of the lens presents the striking appearance of a dark line, well-defined on its convex side, shading off more gradually on its concave side, crossing the pupil near to its margin. If the displacement be slight, the dark line will be visible only on looking obliquely behind the margin of the pupil. It is due to the fact that rays of light falling on the extreme edge of the lens strike it at such an angle as to be totally reflected from its surface, instead of passing through it. The free area of the pupil gives a brighter reflex from the fundus than the part occupied by the lens, and if it be large enough to permit of an examination of the fundus through it, two images of the disc may be seen at once, for the same reason that two images of an external object are formed upon the retina. It is asserted that congenitally displaced lenses are usually of subnormal size, but there is no decisive evidence on the point. A lens of this kind, recently removed by the writer from the anterior chamber of a boy aged 6, measured 7 mm. transversely, 4·75 mm. antero-posteriorly, and weighed 129 mgrms.

Dislocation into the anterior chamber is always noticed by the patient as producing marked and sudden impairment of vision—a high degree of myopia—and in some cases is very shortly followed by the onset of glaucomatous symptoms of a very severe character. Objectively, it gives rise to the peculiar appearance of a shining yellow circle, or golden ring, in the anterior chamber; this, like the dark line already described, is due to a total reflection of light at the edge of the lens. The lens may lie completely on the anterior surface of the iris, or it may remain more or less embraced by it. The pupil, and so much of the iris as is seen through the lens, are unusually magnified. If small and smooth, the lens may lie for a considerable time in the anterior chamber without causing pain or serious irritation, and it may from time to time, with changes in the position of the head, return to its original place behind the iris, and again fall forward through the pupil. In the case of the boy above referred to, it was possible at any time to bring the lens into the anterior chamber by giving the head a jerk. In eyes long blinded by iridocyclitis and other deep-seated changes, a degenerated and calcareous lens will sometimes fall forwards into the anterior chamber, and light up a fresh injection of the eye. Whether cataractous or clear, a lens remaining in the anterior chamber leads, sooner or later, to secondary opacity of the cornea and to ciliary injection.

Dislocation into the vitreous can be diagnosed only by means of the ophthalmoscope, or in some cases by focal illumination. The lens is seen lying in the lower part of the vitreous chamber, and oscillating from side to side with the movements of the eye. If the function of the retina be not lost, the best vision will be obtainable by means of a strong convex lens, as after cataract-extraction. Cases are on record of persons thus affected who could, by placing the face in the prone position, bring the crystalline into the pupillary region, and, for the time being, obtain excellent vision by that means. On the other hand, a lens lying unattached in the vitreous may, in consequence of such a prone position of the face, fall through into the anterior chamber, and at once set up serious symptoms. Lenses dislocated into the vitreous have been known to remain transparent for years, but their usual tendency is to become semi-opaque. In rare instances they gradually disappear, apparently by absorption.

Each of the three forms of displacement above described may arise as a direct result of injury. In such cases other symptoms, such as wound of the tunics, hæmorrhage into the chamber, or rupture of the iris or choroid, are usually present, and the eye frequently becomes glaucomatous. Secondary glaucoma, of very sudden and severe type, occurs also in some cases of spontaneous dislocation of the lens; the mode of its production deserves special consideration. A lens in the anterior chamber may form a complete barrier to the escape of the intraocular fluid from the eye. Under normal conditions, the stream which passes from the posterior to the anterior chamber on its way to the outlets in the neighbourhood of Schlemm's canal, raises the iris to an imperceptible extent from the surface of the lens, and meets with no resistance at the pupil; but when the lens lies in front of the iris, this same stream tends to press the iris against it, and, if once its passage through the pupil should be stopped, the accumulation which ensues in the posterior chamber drives the iris forwards still more forcibly, and, as the pressure rises, the

blockade becomes more and more complete. The periphery of the iris, where not supported by the lens, is then driven forwards until the angle of the anterior chamber is closed by contact of the iris with the cornea. An intensely acute glaucoma may arise in this way simply through the spontaneous falling of the lens into the anterior chamber; and, what is still more remarkable, the glaucomatous tension may effect its own relief, by driving the iris forwards round the margin of the lens until the latter falls back again through the pupil, whereupon the filtration channels are reopened, and the glaucoma is at an end, until the accident occurs again. The glaucomatous complication occurs more readily when the lens is large than when it is small—in other words, it occurs more readily in the old than in the young. A lens dislocated laterally behind the iris may cause glaucoma by pressing against the ciliary processes at the side towards which it is displaced, and thus closing the angle of the anterior chamber throughout a considerable part of the circle. Cases in which a mechanical production of glaucoma by a dislocated lens in the way described was proved by dissection have been recorded by the writer (*Ophth. Rev.* vol. i. p. 209; vol. ii. p. 257).

Treatment.—A congenital partial displacement, so long as the lens remains transparent, admits of no satisfactory treatment beyond a correction of the refraction according to the indications already given. Should the lens become opaque, an attempt may be made to remove it, or the safer plan of making an iridectomy in the direction opposite to that of the displacement may be adopted. This gives an eccentric but clear pupil which, with the help of a cataract-glass, may permit of good vision. Should a congenitally displaced lens fall into the anterior chamber, it should, as a rule, be removed without delay. Possibly it may return spontaneously, once or twice, to its former position behind the iris; possibly it may be kept there a while by the persistent use of eserine; but temporising will in the end prove useless: it is best to remove the lens before inflammatory or glaucomatous complications are set up. It may be needled if the patient be young, or it may be extracted entire through a corneal incision of sufficient size. In order to prevent the lens from falling back through the pupil at the time of the operation, the iris should be well under the influence of eserine; but this should not be applied until shortly before the operation, for contraction of the pupil under these circumstances has been known to induce glaucoma in the way above referred to. If a sufficient support to the lens cannot be obtained in this way, it should be fixed with a needle passed through the cornea while the incision is made. It will escape through a suitable incision without traction. An escape of vitreous is inevitable. In cases of traumatic dislocation into the anterior chamber, immediate extraction of the lens may afford the only chance of saving the eye, especially if glaucoma be present, but it is hazardous. A lens lying in the vitreous can rarely be extracted with safety to the eye. In all cases of dislocation of the lens in which vision is already lost, and in which treatment is necessary, enucleation of the eye is the safest course.

PRIESTLEY SMITH.

CUPPING may be Wet or Dry. WET CUPPING is a method of blood-letting in which blood is taken from a number of small incisions by atmospheric pressure.

Situations suitable.—Any region which is smooth and fleshy; hence in fat persons a large number of parts are available. In emaciated subjects, the nape of the neck, loins, buttocks, &c.

Parts to be avoided.—Irregular surfaces of all kinds (e.g. over the intercostal spaces in the very thin), regions over sensitive organs—as the mamma, and the immediate neighbourhood of inflamed skin or cellular tissue.

Apparatus required.—Cupping-glasses of several sizes, scarificator, spirit lamp, hot water, sponge, and bleeding bowl. The *glasses* are bulbous in form, contracted at the mouths, which may be oval or circular; the latter are the easier to apply. The *scarificator* is a small machine fitted with a number of fine blades (from 3 to 12 in number), which can be withdrawn and suddenly projected, by a spring and trigger arrangement, from a flat plate which is applied to the surface of the skin. The knives can be set at any depth, and should be so adjusted as to cut through the '*cutis vera*' *only*, which varies in thickness in different situations.

Operation.—With a warm sponge moisten the selected spot, take the cupping-glass, which should have been lying in hot water, and *partially* exhaust the contained air by placing the flame of the spirit lamp in its interior; the lamp having been quickly withdrawn, place the mouth of the glass evenly on the part to be cupped, whereupon the soft tissues within the rim

should swell and project towards the glass cavity. Several glasses may be applied side by side in this manner until a considerable area is covered, but care must be taken that they are not placed in *actual contact* with one another. After an interval of one minute, remove the glass by tilting it to one side, press the scarificator, already properly adjusted, on the swollen part, discharge the blades, remove it instantly and reapply the glass as quickly as possible in the same way as before. Blood should then flow from the cuts until the vacuum in the glass is destroyed. The flow having ceased, remove the glass with its contents, sponge the part with warm water, and, if necessary, apply another glass. As a rule not more than about two or three ounces will be obtainable from one application of the scarificator, which must never be applied in exactly the same place a second time at one cupping. After the operation, bleeding stops spontaneously, and a piece of strapping may be put over the wounds.

Caution.—If no blood follows the application of the glass after the use of the scarificator, one of the following causes will probably exist:—(1) Improper adjustment of the blades; if these cut *too superficially*, the vessels are not laid sufficiently freely open; if they cut *too deeply*, the subcutaneous fat is invaded and projects into the wounds, effectually plugging them. (2) Insufficient or complete exhaustion of the air in the glass. In the former case the vacuum is too slight to produce any material flow; in the latter the pressure on the parts under the rim is so great that the vessels are occluded.

In addition to the glasses already mentioned, others may be obtained which are fitted with an arrangement by which they are exhausted by means of a syringe, so that the spirit lamp is not needed; but they are not so effectual as the simpler form.

Dry Cupping.—A method, seldom useful in surgery, by which the congestion of deep structures is said to be relieved by causing a temporary determination of blood to the surface of the body by the application of cupping glasses in the manner described in the first stage of wet-cupping.

William H. Bennett.

CURVATURE OF THE SPINE. *See* Antero-Posterior Spinal Curvature; Lateral Spinal Curvature; Caries of the Spine.

CUT-THROAT. *See* Throat.

CYLINDROMA. *See* Sarcoma.

CYNANCHE. *See* Pharynx; Tonsils.

CYPHOSIS. *See* Antero-posterior Spinal Curvature.

CYSTICERCUS CELLULOSÆ—more properly known as the cysticercus telæ cellulosæ—is the cystic form of the tænia solium or common tapeworm; and, if we except a doubtful case of C. tenuicollis, is the only form of cysticercus known in the human body.

Cause.—One of the matured segments of a tapeworm, with its already developed embryos, has but to be swallowed to undergo further development. Located in the stomach of a pig it speedily bores its way into the tissues of its host, becomes encysted, constituting the condition which is known as measly pork, which condition is precisely analogous with the C. cellulosæ of man. According to Leuckart, the segments of the tapeworm need not pass into a second individual, but may infect the person who is already affected with tapeworm. The cysticercus may be found in one part only of the body, or may pervade the whole, as in a remarkable case recorded by Delore, in which over two thousand cysticerci were found after death. They were distributed all over the various tissues, from the brain to the skin, but had not contributed apparently in any way to produce death. The cysticercus is found most commonly in the connective tissues, with scarcely less frequency in the muscles, and more rarely in the various organs and in the skin. In a few cases it has appeared in the aqueous or vitreous chambers of the eye.

Diagnosis and Symptoms.—As a rule there are but few symptoms which will lead to correct diagnosis during life. Unless the cysts are in some superficial position, their very existence cannot be conjectured; indeed it is possible, as in Delore's case (*supra cit.*), that the whole body may be riddled with cysts without their presence being suspected. If they approach the surface, it is more than probable that their true nature will only be revealed by the aid of the surgeon's knife. In the brain they have been known to give rise to epileptiform, maniacal, and other obscure nervous symptoms, the true import of which could only be determined by a post-mortem. When the parasite makes its appearance in any part of the eye, it can as a rule be readily detected, at least by the aid of the ophthalmoscope. On this point our chief knowledge is derived from Von Graefe, who

enjoyed considerable opportunities for studying the subject. He describes two kinds—the free and the encysted form—the former being probably due to the rupture of the cyst-wall, and having been seen, so far, only in the aqueous humour or lens capsule, whilst the encysted form grows in or behind the retina.

The *symptoms* to which such a cyst will give rise depend greatly upon its situation. In the deeper parts of the eye its presence is chiefly characterised by a gradually advancing blindness, leading in some cases to total disorganisation of the eye and permanent loss of vision.

If a suspicious cyst, whether situated in the eye or elsewhere, has been opened, its contents should be examined microscopically for hooklets. If enough of the fluid can be obtained, it should be tested for chlorides, which it contains in great excess. It rarely contains albumen. The specific gravity varies from 1,005 to 1,008 usually.

If the cyst comes away as a whole, the coiled-up worm should be looked for. The condition of the worm will vary with the age of the cyst.

Treatment.—Before discussing the question of treatment, it is of the greatest importance to bear in mind the natural term of existence of the cysticercus, after which it undergoes a gradual diminution in size, mainly owing to the absorption of its fluid and calcareous degeneration of its envelopes, which processes terminate its existence within eight months of its first appearance (Cobbold). Such being the natural process of cure, the prognosis is almost invariably good where a correct diagnosis has been made. If a cyst has been discovered in any obvious position, it can either be dissected out or freely opened and drained, or packed with lint and allowed to heal from the bottom. The situation must determine which mode of treatment is to be preferred. *See* Hydatids.

In the case of the eye, if the cyst is situated in the anterior chamber or lens, it admits of removal if necessary; but if placed in the vitreous, or attached to the choroid, no operative treatment is admissible, unless so much inflammation should chance to be set up as to make it advisable to remove the eyeball. Every operation that has been attempted for removal of the cysticercus from the vitreous humour has resulted in complete failure. W. Bruce Clarke.

CYSTIC TUMOURS.—As non-malignant growths, these tumours may consist of a cluster of cysts, or cysts may be interspersed in a solid matrix, or a cyst may have solid matter growing up within it, and thus more or less completely filling up its cavity. As to situation, they are found most commonly in the breast, the ovary, the thyroid gland, and the lower jaw.

Cause.—No cause peculiar to these tumours can be assigned for their occurrence.

Pathology.—Some of the cystic tumours of the ovary are seen to have arisen from a cluster of enlarged Graafian vesicles, which are again enclosed in a common capsule—that of the ovary. These cysts, as they enlarge, coalesce by the absorption of their common septa, and thus gradually merge into one or more large cysts. The evidence of these changes is seen in the numerous fenestræ, all having curved borders, which mark the inter-cystic communications. In other cystic tumours well-defined cysts may be seen scattered through or intertwined amongst solid growths, and are termed 'exogenous cystic tumours.'

In a third variety, termed 'endogenous tumours' or *proliferating cystoma*, the solid growths are attached to and spring up from some part of the walls of the various cysts, and may fill up and obliterate the cysts. The sero-cystic disease of the breast is a tumour of this character. The solid growth is composed of fibro-cellular elements, and not infrequently may be a spindle-celled 'sarcoma.'

Another variety of a mixed fluid and solid tumour occurs in the softening or cystiform degeneration of fibrous and other tumours, the result being that definite but not encapsuled collections of fluid are produced which may contain serum—pure, or mixed with blood—or a mucoid material. These changes are more prone to occur in malignant than in non-malignant tumours.

Diagnosis.—A cystic tumour grows to a large size without giving rise either to inflammation or ulceration. It is seen to be lobulated; the apparent lobules are the component cysts, which plainly fluctuate; the skin is often thinned in places. As a rule these tumours do not cause much suffering. When occurring in the breast, the nipple, if displaced, is not retracted, and the axillary glands, when affected, are generally simply enlarged, and not indurated.

Treatment.—Cystic tumours should be removed early and completely. If this proceeding is impossible, and the cysts are few and large, they may be tapped, and in rare instances treated successfully by iodine injections or by setons.

Alfred Willett.

CYSTINE or CYSTIC OXIDE. *See* CALCULUS, Urinary.

CYSTITIS. *See* BLADDER, Diseases of the.

CYSTOCELE, a tumour formed by the prolapse of the bladder into the vagina. *See* VAGINA, Affections of the.

CYSTOPLASTY. *See* ECTOPIA VESICÆ and EPISPADIAS.

CYSTORRHŒA. *See* BLADDER, Diseases of the.

CYSTS.—By the term 'cyst' is meant a collection of a fluid, non-inflammatory in its nature, which is contained in a single closed bag termed the 'sac.' A cyst, unless there is an occasional accidental discharge of its fluid contents, is a permanent and usually an increasing swelling, the contents of which, whilst varying in character as well as in consistency, are capable of complete evacuation when the cyst is laid open. There are two clear distinctions between cysts and cystic tumours, the first, that a cyst contains within it nothing of the nature of a new growth, and the second, that all the fluid in the tumour is contained in one sac. Hence the terms 'a cyst' and 'cystic' convey quite distinct ideas of the nature of any tumour.

The varieties of cysts are very numerous, not because the actual nature of the sac itself varies much, but because of the very varying nature of the origin and, still more so, of the contents of cysts. A source of confusion moreover exists, viz. that of fluid swellings having precisely the same nature pathologically, some may be regarded as cysts, i.e. tumours, whilst others never have these appellations given them. Cysts receive their distinctive names generally from the nature of the fluid contained within the sac, whilst they are classified according to the manner of their production. Thus cysts are styled serous, synovial, mucous, sanguineous, milk, salivary, oil, seminal, colloid, sebaceous, dermoid; whilst, when classified, they are described as exudation, retention, new-formation, congenital, and parasitic cysts. A brief explanation of the typical forms of these classified cysts is perhaps necessary, whilst any special description of the designated cysts can scarcely be required.

Exudation Cysts are formed by the distension of a pre-existent space, varieties of which are seen in the synovial cysts of chronic bursal effusion or of ganglia, and in the serous collections in tooth-sacs; whilst hydrocele of the tunica vaginalis—a swelling of this nature—is not called a cyst.

Retention Cysts are those in which the orifice of a duct from some cause closes up or is obstructed, so that the secretion being pent up accumulates and distends the duct forming a tumour, of which the ordinary sebaceous cyst in the skin, the mucous cyst of the lips and of the vagina, milk cysts of the breast, salivary cysts, such as ranula, and seminal cysts of encysted hydrocele, are illustrations.

The New-formation Cysts comprise instances of nearly all the named cysts, some of the more noteworthy being the large serous cysts found in the neck, under the name of hygroma—collections of fluid diffusing themselves widely, yet never becoming tense—thyroid gland cysts, mammary cysts—some of which evince no disposition to proliferate, as, on the contrary, do most of the ovarian cysts—and parovarian cysts of the broad ligament.

Under *Congenital Cysts* are placed, meningocele (somewhat erroneously), congenital cysts of the neck, dermoid cysts, so frequently found at some point around the orbits, and especially at the outer angles, and the ovarian dermoid cysts.

Amongst *Cysts of parasitic origin* the chief is the well-known hydatid cyst of the liver and elsewhere.

Pathology.—In a cyst, regard has to be paid to the investing membrane or sac, and the nature of the contents. The contents of most of the cysts being natural secretions, only such changes would occur as condensation or inflammation might effect. Of the sac, it has to be noted how greatly it varies in substance. In hygroma of the neck it is so thin and delicate as to be scarcely separable, whilst in some ovarian cysts it may be one-fourth of an inch in thickness. In serous cysts which have not been inflamed the lining membrane is smooth and glistening, whilst in others it has a rough and leathery appearance.

On its outer aspect, if placed in a serous cavity, a cyst will of course be covered by this membrane, but under other conditions it may be loosely invested with areolar tissue, or so intimately blended with the structure in which it has been developed that the sac cannot be detached. The intervening portion of cyst-wall consists mainly of fibrous tissue, with perhaps some tissue-elements indicative of the part in which the cyst has developed. Often, too, the configuration of the cyst may indicate the mode of its production, being either long and tapering or irregularly pouched.

Symptoms and Diagnosis.—The physical symptoms of a cyst might shortly be

described as those of a chronic abscess, except that, as a rule, a cyst is more tense; hence, elasticity, fluctuation, or undulation become the symptoms most to be depended upon, as the cyst varies from a tense hard swelling to a soft flaccid one. Inasmuch, then, as the existence of fluid in a sac is seldom difficult to diagnose, and since the doubt, where it exists, as well as the nature of the fluid can be at once cleared up by an exploratory puncture with an aspirating needle, it is needless to lay stress on the diagnosis of cysts.

Treatment.—The mode of dealing with cysts is governed partly by their nature and partly by reference to the structure in which they are placed, or the organ with which they are associated.

The most effectual way of dealing with a cyst of moderate size which has no entangling connections, is to excise it, taking care, as a rule, to remove the cyst-wall. In others, such as milk cysts and most of the simple serous cysts, if a single tapping fails to cure, the better course is to lay open the sac and effect its cure by granulation; whilst the large cysts of the neck, after tapping and evacuation, may be injected with iodine. In a few cases, where pressure can be adequately employed, cysts may be cured by this means—of course, after evacuation of the contents. ALFRED WILLETT.

D

DACTYLITIS. —Inflammation of a finger, e.g. dactylitis syphilitica. *See* HAND, Surgery of the.

DALTONISM. *See* COLOUR-BLINDNESS.

DAVY'S LEVER.—This instrument, used by Mr. Richard Davy for compressing *per rectum* the aorta and the iliac arteries, consists of a straight and smooth cylinder of ebony from 18 to 22 inches in length, and with a maximum diameter of five-eighths of an inch. The rectal portion, which has a slightly bulbous extremity, is graduated to an inch scale, so that the length of cylinder passed into the rectum can always be readily determined. This is introduced into the rectum as far as the common iliac artery or the aorta, its projecting part being kept nearly parallel to the opposite thigh, and, when it is supposed that the vessel has been reached, the external arm of the lever is raised, the perineal tissues acting as a fulcrum. Compression of the artery by the rectal end of the lever is indicated by arrest of the pulsations of the femoral artery. This method of restraining hæmorrhage, though practised most frequently in cases of amputation at the hip-joint, has been advocated by Mr. Davy as applicable to any surgical procedure where it is desirable to check for a time the blood-current through the aorta or the iliac arteries. It has recently been applied with success in two cases of large traumatic aneurism of the gluteal artery treated by incision and double ligature. The most salient advantages of rectal compression by the lever are held to be, perfect control of the artery with a minimum amount of disturbance of the circulatory system. This instrument is certainly very useful in effecting temporary arrest of the circulation of the lower extremity, and has been applied with success in a long series of cases. It needs, however, to be applied by skilled hands and with much care, as, by the action of so long a lever, the intestine might be ruptured or serious injury done to the soft structures of the pelvis.

DEAFNESS, Diagnosis of.—Deafness is a blunting or abolition of the perception by the ear of the external world. This defect may arise in the sensorium itself, which is essentially the perceiver of sound, or in the sensory organ, which supplies to the brain the material which it transforms into a sensory perception. How this change of the physical into the physiological process is effected remains a mystery. How the collection and conduction of sonorous vibrations to the auditory sensorium are effected is, so far as surgical purposes are concerned, fairly well known, and it is with the integrity of the structures acting in these capacities that the surgeon will be required to deal.

The defect may be of such a slight character that it is not perceptible even to the patient himself, as in the cases where the range of audition is limited, or when it affects one ear only, and it has not been brought under his notice. Or it may be apparent under certain conditions only, as

in cases affecting the accommodation of the ear, when it causes an inability to join in mixed conversation. In other cases the facultative loss is so great that it is apparent to all, and prevents the sufferer following the usual avocations of life, or enjoying the conversation of his fellow-beings. The cases which seek surgical aid are those in which an inconvenience is felt in the usual intercourse of life, and to these our examination will be confined.

How do we determine the degree of the defect complained of? Numerous methods have been proposed and are in use, but for practical purposes the watch, the tuning-fork, and the voice are sufficient.

The want of any index of the strength of the voice, when used as a test, prevents it being employed as a means of comparison with the observations of others, or even with the observation of the same surgeon at different times; and, although valuable in being the form of vibrations which the patient generally desires to hear best, and also in being a method which commands conclusive answers, it is much less exact than the tests by the watch and tuning-fork. As it, however, happens that there is no exact relation to be found between the ability for the hearing of speech and simple tones, and that it may increase for the one while it remains *in statu quo*, or even decreases, for the other, the voice ought to be employed by the surgeon in all cases, and more especially in those where the patient will be under observation upon different occasions by the same attendant.

In testing by speech a whisper is usually employed, and the patient, closing the opposite ear, and turning the ear to be experimented upon towards the speaker, is thus unable to assist himself by observing the motion of the lips, in repeating the words or answering the questions of the surgeon. The distance at which the patient recognises the words spoken is taken as the degree of hearing for that day. If single words be employed, care must be taken to use words containing vowels of similar tone and of equal familiarity on different occasions. The asking of several questions which have no connection with each other seems to be more practical, and as conclusive.

The acuteness of hearing is determined with the watch by causing the patient, with his eyes and opposite ear closed, to say at what moment he hears the tick of a watch brought gradually towards the ear under examination. The distance of the watch from the ear at that moment is noted, and is employed as the numerator of a fraction, the denominator of which is the number of inches at which the tick of the watch in use is heard by a normal ear. By this mode of noting the observation, a comparison can be made of the acuteness at different times and by different observers. When the patient cannot hear the watch unless it be in contact with, or pressed upon, the auricle, the numerator becomes $\frac{C^o}{}$ or $\frac{P}{}$ respectively. A stop-watch is useful for verifying the statements of the observed, but, by noting repeatedly the distance at which the patient avers that he becomes cognisant of the watch-tick, the examination can be made with the usual watch. It must be remembered that in testing with a watch two particular notes only are employed, and therefore that the examination thereby is but a rough-and-ready way of giving a comparison of one ear with another.

Hitherto our examination has been confined to the acuteness of hearing of sonorous vibrations through the usual sound-conducting apparatus, while that through the cranial bones has not been in view. For determining the latter, a large tuning-fork of 512 vibrations in the second, with clamps grasping the prongs in order to destroy the harmonics of the fundamental tone, is the most convenient. But should that not be at hand, the watch will give a rough general estimate thereof, by placing the watch on different points of the head and making a comparison of the position of the cranium at which a weak watch-tick is lost, with the point on the observer's head at which the same occurs.

When a fork is employed, the examination is conducted as follows:—After causing it to vibrate, the handle is placed on some part of the patient's head, usually the mastoid process, and the number of seconds noted during which the sound can be recognised by the observer's normal ear, after the patient has ceased to hear it. This recognition may be effected in two ways, viz., by placing the fork on the mastoid, or close to the concha of the observer. The former is the usual mode, and of it we shall speak. The number of seconds from the cessation on the patient's mastoid to its cessation on the observer's, gives the loss compared with the normal ear. For example, if the observer finds that he hears through his mastoid the fork-vibrations for ten seconds after the patient has ceased to recognise them through his mastoid, the loss is noted as 'acoustic p. mastoid—10″,' and if the ages of the patient and practitioner are nearly the same, the loss is assigned to the parts

beyond the conducting apparatus, but not excluding affections thereof. Should the fork not be heard by the observer on its transference to his mastoid, the acuteness is reckoned normal, unless there are obstructions in the meatus or cavity sufficient to reflect the vibrations passing outwards, and so reinforce those acting on the inner ear. But, for practical purposes, the acoustic may be recognised as normal.

In using the tuning-fork for the determination of the acuteness of hearing aerially-conducted vibrations the loss is determined in the same way as on the mastoid, care being taken to place the fork in the same position in relation to both the observed and observer's ears. It would further the diagnosis of such affections if a standard fork could be settled upon, which we could use as the denominator, as we do in the case of the watch.

It will be simple from the above methods to fairly apportion to its proper seat the cause of deafness. No affections, however severe, of the external or middle ear which are conducting apparatus alone, will prevent the recognition of sonorous vibrations sufficiently loud to be perceived by a healthy acoustic nerve through the mastoid, from reaching the internal ear of the patient through that bone. No such vibrations, however well conducted, either through the meatus or through the mastoid, can arouse an acoustic whose function is in abeyance. If a watch be heard at what has been determined to be its normal distance, the acuteness of hearing, for that note, may be taken as normal. If a fork be heard as long on the mastoid of the patient as on the mastoid of a normal ear, the internal ear may, for that note, be taken as fairly healthy. If the fork be heard to the natural extent or exceed it on the mastoid, but neither it nor the watch reach the standard determined for aerially-conducted vibrations, an affection of the external or middle ear is diagnosed. If the watch be not heard at its proper standard of distance, nor the fork to its proper extent through the mastoid, the apportioning of the amount of the defect to the external and middle ear, and to the internal ear, may be roughly made by the examination of the structures, and by noting the loss of vibrations conducted by the meatus after their perosseal recognition has ceased. Thus, if a fork, the vibrations of which are heard at the concha thirty seconds after they have ceased to be recognised on the mastoid, is heard by the patient five seconds less on the mastoid, and only ten seconds at the concha, the loss is marked as five seconds and twenty seconds respectively.

W. Laidlaw Purves.

DECUBITUS. *See* Bedsores.

DEFORMITIES, Congenital. *See* Club-Foot; Hare-Lip, &c.

DELHI BOIL or SORE.—This disease first attracted attention by its great prevalence among the British troops stationed in the city of Delhi after the mutiny of 1857. Before the mutiny the troops were garrisoned in a cantonment situated outside the city walls, and they appear there to have enjoyed an immunity from these sores. In the year 1864 as many as from forty to seventy per cent. of the men suffered from them; and the Government of India appointed a commission, of which Dr. John Murray, Inspector-General of Hospitals, was president, to investigate the nature and cause, and advise as to the prevention and cure, of this troublesome complaint. The commission submitted a long and interesting report. They found that the disease was not dependent on poverty or malaria, and that it was inoculable; associated it with the filthy state of the city, more especially with the use of impure water drawn from foul wells; and recommended sanitary improvements and the supply of river or canal water to the troops for all purposes.

Much interesting information on this and allied subjects will be found in the late Dr. Tilbury Fox's work on *Diseases of the Skin*, and in a volume published by Drs. Tilbury Fox and Farquhar in 1876, under the sanction of the Secretary of State for India, *On Certain Endemic Skin and other Diseases*.

It has been established, by the observations and researches contained in these reports and publications, that the disease known as Delhi boil or Delhi sore is by no means confined to the town of Delhi and the neighbouring villages, but prevails in other parts of Northern India.

A similar disease has been observed and described by Colville, Wortabet, and others as existing in Syria and Turkish Arabia, more particularly in the towns of Aleppo, Bagdad, and Bussorah, and other localities situated in the land of Mesopotamia—the valley of the rivers Tigris and Euphrates. It is known in these parts as the Aleppo Evil, Date Mark, and the Bouton d'Alep. The same disease has been met with at Aden. An affection apparently identical with the Indian and Arabian sores has been observed

in Egypt, Morocco, and Algeria. Finally, Dr. Vandyke Carter discovered a disease which he considers to be the same as the Algerian and Syrian maladies in the island of Candia, where it has the name of Canеotica (from Canea, the capital town of the island), Bouton de Crete, Lib-lib, &c. He has carefully studied, described, and figured the sores of Algeria, Crete, and Aleppo, and advances the opinion that there is an 'essential bond of connection between the maladies of Biskra, Crete, Bagdad, Aden, Scind, and Delhi.'

Causes.—The disease is endemic, and has a very definite geography. Its causes must therefore consist in conditions and circumstances common to the localities in which it is met with. What these are has not been clearly ascertained. It prevails in towns and crowded centres of population rather than in hamlets and sparsely inhabited villages. In these its homes it attacks all classes, both sexes, and all ages indiscriminately, but seems to have a preference for new-comers and young children. It does not seem to depend on climate, for then it would be more generally distributed in town and country; but climatic conditions may, and probably do, combine with local conditions to produce it. These latter appear to be, or to be closely associated with, filth. The disease has almost disappeared from Delhi in consequence of sanitary improvements and improved water-supply (see *Report on Sanitary Measures in India in* 1873–74, and Drs. Lewis and Cunningham's report), and it lingered longer among the native troops and the native inhabitants of Delhi, who continued to draw their water from wells, than among European troops for whom river-water was provided. The well-water of Delhi has been found to be very impure, exceedingly hard, and to contain large quantities of nitrates and nitrites. The water of Biskra is also said to have been extremely impure; but here also a similar effect has followed similar changes in sanitation. In Aleppo and Bagdad the disease is ascribed to the use of impure river-water, and those resorting to clean wells are said to remain free from it. In Algeria the disease presents a marked seasonal character, attacks being most common in November and December; but in other places this feature is not so well marked. Occasionally, according to Carter, Aleppo Evil presents an epidemic character; and there is strong evidence that it was imported into Candia in the year 1827 by Turkish troops from Aleppo and Damascus who were sent to quell an insurrection in the island. It took root in Canea, and spread thence to other places. The sore is undoubtedly inoculable; this has been proved by experiment in India and Algeria, and the Jews of Bagdad practise inoculation of children. The disease is not contagious in the ordinary sense, but it seems to be communicable in a manner not yet determined. Nor does it appear to be hereditary. One attack is not protective from subsequent attacks, but repeated attacks are not the rule, and old residents appear to enjoy comparative immunity. Dogs and horses are said to contract the disease. What the intimate or immediate cause of the disease is has not been discovered. It has been ascribed to depraved nutrition of the body due to climatic influences, and considered to be 'a local manifestation of a cachectic condition due to residence in unhealthy localities' (Tilbury Fox); but these sores attack persons to all appearance in good health, and in other than endemic localities, where people also manifest climatic cachexia, they are not known. The fact that the most exposed parts of the body—arms and hands, face and legs—are those most liable to attack, points to a local causation. The disease has been attributed to the entrance of parasites through the pores of the skin and to poisonous material conveyed by mosquitoes and flies; but of these views no positive proof has been advanced.

Pathology.—In the language of modern pathology the disease belongs to the category of infective granulomata. Drs. Lewis and Cunningham found, as a result of very careful study, that its microscopic characters were identical with those of lupus as described by Virchow and others, and Carter's descriptions and plates support this view, which is also that of Geber, who investigated the Aleppo button. The skin is found to be infiltrated with lymphoid cells, which are found more abundantly near the vessels, glands, and lymphatics, and, gradually increasing in number, supplant the elements of the tissue. The features of the disease depend on the number and fate of these cells. Among them, miliary particles of an epithelial character and origin are found, some of them being altered hair-bulbs and impacted gland-ducts. The disease consists, in fact, of a conversion of the true skin into granulation-tissue, the epithelium being first increased and then shed, and the disintegration of the cells giving rise to breach of surface, which is eventually repaired by a process of granulation and cicatrisation. The cells appear to possess infective properties, but no structure of a parasitic kind has

as yet been discovered in the morbid tissue. The new structure has a definite lifetime, and if the surrounding parts possess sufficient vital resistance limitation takes place and repair ensues. If the vital resistance is weak, from general ill-health, limitation does not occur so soon or so completely; new areas of skin are invaded, and the disease spreads in the manner indicated by the term 'serpiginous.'

Symptoms and diagnosis.—The disease in a well-marked case presents several phases or stages, which may be called the stages of (1) infiltration, (2) ulceration and incrustation, and (3) repair. It commences as a small, hard, itchy papule or pimple resembling a mosquito-bite. A few dilated vessels may be seen converging to the centre of this spot, which presently enlarges and becomes smooth, raised, dusky, and shining. Ridges of smooth swollen skin radiate from this elevation, or new spots appear in its vicinity. The affected area pits on pressure, and a stinging sensation is experienced on touching it. The hair-bulbs are specially involved, and present the appearance of minute, yellowish points in the glazed, dusky, red material. Presently the epithelium is shed; a viscid ichor exudes from the surface, which becomes covered by a crust. As the disease extends the crust enlarges, and at the centre breach of surface takes place, and pus and disintegrated tissue assist in forming the crust, which may exhibit cracks emitting a sanious or puriform fluid. On removal of the crust an ulcer is revealed, with hard edges and a red, flabby, irregular surface, covered with fungoid granulations that bleed freely. Eventually cicatrisation commences at the centre and proceeds towards the circumference. The outer infiltrated ring of the sore undergoes resolution, and a smooth, depressed, reddish-brown cicatrix, with sharp edges, remains. No contraction results from the loss of tissue, which does not involve the subcutaneous areolar structure. This is a description of a typical case; but in mild instances of the disease no breach of surface or ulceration occurs, the granulation material undergoing in part disintegration and in part organisation into cicatricial tissue. In other cases the process is complicated by suppuration, a small, deep, punched-out abscess forming in the centre and giving rise to a hollow ulcer, or these ulcers may be multiple. In other cases the course of the disease may be materially modified by the application of caustics and irritating agents.

The progress of the disease is slow and protracted, and occupies from six to twelve months from first to last. The parts of the body most commonly attacked are the forearms—the back and ulnar aspect by preference—the wrist and front of the forearm, the elbows, the hands, the neck and face, the knees, legs, and feet. The trunk is very rarely affected. Persons arriving at a place where the disease is endemic do not contract it for several months, and the sore may appear many months after leaving the locality, so that there would seem to be a long period of incubation. The neighbouring glands are not affected except when the sore is irritated, and there is no indication of any constitutional change accompanying the local disease.

The diagnosis is not difficult. Residence in a locality where the disease is known to prevail, and careful study of the features of the sore as above described, suffice to distinguish it from any other cutaneous disease except lupus, with which many competent authorities consider it identical. Spreading serpiginous ulcerations sometimes appear on the genitals and groins as a result of chancroid which present features somewhat resembling the Oriental sore; but these are generally more extensive and protracted, and show little or no disposition to undergo spontaneous cure. The locality of these ulcers, and the absence of a history of residence in a place where the sore is endemic, aid in establishing a distinction. The only other affections for which this sore might be mistaken are the syphilitic and pseudo-syphilitic granulomata, such as the frambœsia of the West Indies and the Parangi disease of Ceylon; but the eruption in these cases is more extensive, the severity of the disease greater, and constitutional cachexia more apt to accompany it. It only remains to add that, in its endemic haunts, ordinary wounds, scratches, or abrasions may take on the features of the specific sore.

Treatment.—The best *preventive* treatment is obviously removal from the locality where the sore is endemic. Next to that, attention to general sanitation, and more especially the use of pure water, appear, from the evidence above referred to, to exercise a decided influence over the prevalence and development of the disease. As regards local or curative treatment, destruction of the indurated papule or tubercle in its early stages, by means of caustics, is allowed, by all who have had an opportunity of testing it, to be a thoroughly effective means of stopping its progress and minimising suffering and loss of tissue. Various agents have been employed for this pur-

pose—principally nitric and carbolic acids, potassa fusa and strong liquor potassæ, and nitrate of silver. A preliminary incision has been recommended, to admit of readier access of the caustic to the doomed tissue. Even after ulceration has been established, the destructive treatment is considered by some authorities the best, as saving time and tissue. Care must be taken, however, in the later stages that the cure is not worse than the disease. Scraping away the neoplasm with Volkmann's sharp spoon, or the cautious use of chloride of zinc paste, would be preferable to the stronger caustics in this stage. Irritating and stimulating applications of all kinds, such as the tinctures of iodine and iron, preparations of zinc, copper, and mercury, have been used without effect. They probably do more harm than good by weakening the vital resistance of the surrounding tissues. Soothing poultices, lotions, and ointments have also been employed, with more sense and success. It is very important, by means of tonics and diet, to improve the general health and intensify the vital resistance of the organism generally, and of the tissues adjoining the sore specially. K. McLeod.

DELIRIUM TREMENS may come under the notice of the surgeon as an independent complaint; but the cases dealt with in this article are those in which the symptoms supervene upon, and are the consequence of, a surgical injury, occurring in a person suffering from the effects of alcoholic excess. It is a well-known fact that intemperate individuals are unfavourable subjects for any injury or operation, and one direction in which this is revealed is in their liability to delirium tremens. In the writer's experience at the Liverpool Northern Hospital the symptoms did not come on in persons who were injured while drunk, but rather in those who were habitually intemperate, but by no means always to such an extent that they became intoxicated. Indeed, in some instances the patients would strenuously resent the charge that they were intemperate, because they were never drunk, and never lost a day's work. The kind of injury which is followed by delirium tremens varies, and it may be in itself of no danger, or even very trivial, such as a simple fracture or sprain, or a superficial wound. How far the suddenly enforced abstinence from alcoholic drinks may account for the development of delirium tremens is a matter of dispute; but there does not appear to be any real danger from this cause if the patient is properly supported in other ways. In some instances bad living, anxiety, injurious habits—such as excessive smoking—or previous illness, act as predisposing causes.

Symptoms and Diagnosis.—The more characteristic symptoms of delirium tremens may set in, in surgical cases, either rapidly and without any warning, or more gradually, being preceded by premonitory symptoms, such as disturbed sleep or sleeplessness; restlessness and tremulousness; mental agitation and confusion, with lowness of spirits and foreboding of ill; anorexia and disorder of the alimentary canal, with foul tremulous tongue and offensive breath; a quick but soft and compressible pulse; and more or less free perspiration. The actual symptoms usually appear within three or four days from the date of the injury, and often supervene during the night. The more striking of these symptoms, connected with the nervous system, may be summed up as absolute sleeplessness; mental disorder, with a peculiar form of delirium; and marked muscular trembling, combined with restlessness. The mental condition is one of mingled confusion, excitement and agitation, irritability, sense of dread, and suspicion. The delirium is usually of a busy character, and attended with various delusions, illusions, and hallucinations, of a strange and often horrible nature, which are generally transient and changeable, but occasionally fixed. Thus, the patient fancies he sees hideous objects, hears strange sounds, or feels insects crawling over him. He has an anxious, wandering expression, and is suspicious and distrustful of all who come near him. It may be possible to attract his attention for a moment, so that he will answer a question or do some act which is requested, but he speedily wanders off again. His own ideas prompt him to perform various actions, but there is an evident want of control, with unsteadiness of purpose. In some cases the delirium is of a violent character, and the patient tries to injure himself or others, or to tear the dressings off wounds or the splints off fractures. In other instances it either is from the first, or very speedily becomes, of a low and muttering type. There is marked trembling, which is especially evident in the hands and tongue.

There is usually little or no fever, but the patient is bathed in perspiration, while the pulse continues rapid and wanting in tone. In bad cases it may become dicrotic, as revealed by the sphygmograph. Occasionally marked pyrexia is observed, and

the temperature may reach a considerable height. If the patient is violent, he becomes much exhausted after the fits of exertion. Should the symptoms not abate, and sleep be obtained, the tendency is towards rapid prostration and adynamia, and the patient dies from exhaustion or in a comatose state. Complications, especially pneumonia, may also supervene and hasten the fatal issue.

Delirium tremens, in surgical cases, has to be diagnosed from traumatic delirium which is independent of alcoholic excess; and from acute inflammation of the brain or its membranes. Attention to the history and symptoms will generally render the diagnosis sufficiently clear.

Treatment.—The treatment of cases of delirium tremens in surgical practice must be conducted on similar principles to those which are adopted in other cases. General management is highly important. The patient must be kept as quiet as possible, undisturbed by friends or others; at the same time being constantly watched by a competent nurse, one who combines the necessary firmness of purpose with gentleness of manner. He should, as much as possible, be humoured and influenced judiciously, without being opposed or physically coerced. Special care must be taken to prevent him from injuring himself, and for this purpose two or more attendants may be necessary. It is only in violent cases, where the proper amount of help cannot be obtained, that restraint by means of the strait-waistcoat is admissible; but still it may be imperatively demanded under such circumstances, otherwise the patient may convert a simple injury into a very serious one.

Attention to diet is another most important indication. A free supply of nutritious, easily assimilated, liquid articles of food is demanded, to be administered at frequent intervals, by night as well as by day. They may be previously digested by the peptonising agents now in use. Not uncommonly it is a difficult matter to get patients to take food, but much may be done by judicious coaxing. If, however, the difficulty is great, nutrient enemata, with some digestant, must be employed at regular intervals. As regards stimulants, whether they should be given or not, and in what quantities, must be determined by the circumstances of each case, and this matter always requires careful consideration. In many instances undoubtedly no stimulant should be given; but in others of a low type, or attended with much exhaustion, some kind of stimulant must be allowed, and it has been recommended to give that one to which the patient is accustomed. There are, moreover, other circumstances affecting surgical cases which may determine the question of the use of stimulants, apart from the delirium.

With regard to the use of medicines, these are often required in order to procure sleep and calm the cerebral excitement, but they must be given with due caution. In surgical cases the subcutaneous injection of morphia (gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$), is the best remedy to employ as a rule, repeated at more or less frequent intervals according to circumstances. Opium in a solid form, or the tincture; chloral hydrate (gr. xx.—xl.), and bromides, are also useful agents. Chloral hydrate and a bromide together form a valuable combination. How far it is desirable to push drugs of this class must depend upon the circumstances of each case, and their administration needs constant watching. It may be an imperative necessity to compel sleep at any risk, and in one case which came under his notice the writer believes that the attainment of this object, by the use of large doses of morphia, was the means of saving the patient's life. Chloroform may be serviceable as a temporary aid, in relieving violent excitement, enabling some surgical procedure to be carried on, or an enema to be administered. Among other medicinal agents recommended under certain circumstances, may be mentioned tincture of digitalis in full doses, tartar emetic (when there is much excitement), and capsicum.

The bowels should be opened from time to time by the aid of a saline purgative. Should adynamic symptoms set in, ammonia with bark and ether, and similar remedies, may be administered.

FREDERICK T. ROBERTS.

DE MORGAN'S SPLINT, for fracture of the thigh, is a long splint, which is applied to the sound side of the body, and which reaches from the axilla to well beyond the foot; from its lower end a crossbar passes at right angles towards the other foot. An extension apparatus is fixed to the injured limb, and the cord connected with it passes first longitudinally to the extremity of the crossbar, where there is a pulley, round which it passes to a second pulley at the end of the long splint, and thence up the outer side of the latter to an elastic accumulator, by means of which the proper amount of extension can be given to the limb.

BILTON POLLARD.

DENTIGEROUS CYSTS.—The development of *cysts* in connection with uncut teeth is a subject of great practical importance to the surgeon, since mistakes in the diagnosis and treatment of these cases are far from rare.

Dentigerous cysts may occur in either jaw, a tumour being gradually formed, the growth of which is slow, and for the most part painless.

A careful examination of the neighbouring teeth will be the best guide to a correct diagnosis, for if a tooth be absent, or if, as sometimes happens, a temporary tooth occupy the position of a permanent one, the tumour in all probability is a dentigerous cyst, and no mutilating operation should be undertaken without first opening up the tumour to discover its nature.

Dentigerous cysts arise in connexion with teeth which, from some cause, have remained within the jaw, and have undergone a certain amount of irritation. They are most commonly connected with the permanent teeth; though the writer has met with a cyst in a boy of four, in whom a temporary canine tooth was wanting, and on cutting into the cyst, extracted seven small irregular nodules of dentine and enamel. Frequently the tooth in fault is inverted, but often there is nothing to explain the formation of the cyst, which is apparently due to an increase in the quantity of the small amount of fluid ordinarily found in the tooth-sac, after the completion of the development of the enamel.

The cyst-wall is usually too dense to give rise to the crackling so characteristic of the presence of fluid within, and is lined by a thick vascular membrane. Usually the tooth projects through this membrane; but a case has been met with in which a large cyst of the lower jaw was carefully searched in vain for a tooth, which, however, made its appearance some weeks after, when the membrane had been to a great extent destroyed by suppuration. Dentigerous cysts have been mistaken for solid growths on many occasions, one of the most remarkable specimens of the kind being one side of the lower jaw, removed from a girl of thirteen, in error, by the late Mr. Fearn, and now in the museum of the Royal College of Surgeons of England. Here the two plates of the lower jaw are expanded from the angle on the left to beyond the symphysis on the right side, forming a bony cyst, the cavity of which is lined with a thick vascular membrane, through which a well-formed permanent canine tooth projects.

The *treatment* of these cases of dentigerous cyst is sufficiently simple, when once a diagnosis has been made by an exploratory puncture. The removal of a portion of the cyst-wall, so as to allow of a search for, and the removal of, the hidden tooth is all that is necessary, the cyst-wall rapidly falling in so soon as a free vent for the contained fluid is secured.

Occasionally the contents of these cysts have suppurated before being opened, and in all cases care should be taken to use antiseptic lotions, and to ensure cleanliness by syringing. Cysts in connexion with fully-developed teeth undoubtedly occur, although possibly some of the so-called cysts are nothing more than abscess-sacs, which follow the fangs to which they are attached when extracted. *See* ANTRUM, Diseases of the. CHRISTOPHER HEATH.

DENTITION.—Writers on the diseases of children have been accustomed to lay at the door of teething a great variety of ailments, ranging from minor disturbances of the digestive tract to convulsions and marasmus. Why a normal developmental process should be so often a pathological one has puzzled many more recent authorities, and there is a growing disbelief in the ill-effects of 'teething.' So far as surgical treatment goes, it is limited to the lancing of the gums, which, if done at all, should be done freely, the tense gum being divided by a linear incision in the case of incisors and by a crucial incision in the case of molars. This will relieve some degree of worry and discomfort, if it does no more. Of more interest to the surgeon are the deformities of the teeth induced by constitutional conditions during the period of formation of the permanent teeth, which commences nearly coincidently with the time of birth. Congenital syphilis has been shown to induce a stunting of the first-formed portions of the teeth, so that the tips are contracted in all dimensions, whilst the bases of the crowns, formed later, are of normal size. Thus the incisors come to be peg-shaped, with a semi-lunar notch from side to side; the canines short and contracted at their points; and the first permanent molars have stunted cusps, the second and third molars being better formed, as their calcification does not commence till a later period.

Teeth with craggy honeycombed enamel are believed by Mr. Hutchinson to owe their deformity to the administration of mercury in infancy; it is certain that they are often found in children who have suffered from

convulsions, but it is not fully established that they may not arise in any ill-nourished child independently of mercury, or of any form of stomatitis. CHARLES TOMES.

DESAULT'S LONG SPLINT for the thigh differs from that of LISTON in having a footpiece for the outer side of the foot in place of the notched extremity of the latter splint; it is also slightly hollowed, so as to fit the limb more comfortably, and it increases in width gradually from the footpiece to the upper end. The foot is attached to the footpiece, and counter-extension is maintained by means of a perineal band fixed to a notch at the upper end of the splint. The spica and body bandages are applied as usual. BILTON POLLARD.

DIABETES. — Certain surgical disorders occur in the course of diabetes with sufficient frequency and regularity to entitle them to be considered, not merely as accidental complications, but as in causal connection with it, or in some way or other dependent on it. They may be either purely functional or inflammatory, the general nutrition being so much impaired that the tissues break down into pus, or even slough and become gangrenous under altogether exceptional causes. The pruritus that is so exceedingly common, especially in the later stages, is an example of the first of these. All through the course of diabetes the skin is dry and harsh (like the dryness of the mouth and fauces, probably from purely physical reasons), very often scurfy and irritable; in the neighbourhood of the genital organs, especially of the female, this is so marked and so frequent that in all cases of severe pruritus it is necessary to examine the urine for sugar.

Boils and carbuncles are instances of the latter class. These affections stand in some peculiar relation to diabetes, for cases have been recorded in which, while suffering from an outbreak, otherwise healthy persons have passed considerable quantities of sugar in their urine. Boils occur most often in the earlier stages, and may come out in successive crops for a long period; carbuncles rarely till the disease is far advanced, and then the prognosis becomes exceedingly grave. Chronic urticaria, psoriasis, impetigo (Kaposi), and paronychia have also been observed, but not with the same regularity.

Affections of the eye are not rare. Diabetic cataract, arising from the defective nutrition of the lens, has long been known. Unless the case is severe it does not, as a rule, make its appearance until late in the course of the disease, so that operation for it, though sometimes successful, is seldom attempted. One eye is usually attacked first, and then later the second becomes involved, but it is rare for it to be complete in both long before the patient's death. Amblyopia, either temporary and recurring, varying in its degree with the progress of the general symptoms, or permanent and rapidly becoming worse, is probably dependent on a similar impairment in nutrition of the retina, and the paresis of the muscles of accommodation that is met with occasionally is probably to be explained in the same general way. In one or two instances hæmorrhagic retinitis independently of albuminuria has been observed.

Gangrene of exposed parts and of the extremities, resembling the ordinary senile form but more rapid in its action and always moist, accompanied by sloughing inflammation, is not uncommon as the immediate cause of the fatal issue in diabetes. The circulation is so feeble, the character of the blood so profoundly altered, and the vital energy of the tissues so depressed, that the slightest injury, especially of the foot, may suffice to induce it. For fear of this, from the extreme susceptibility to shock and the great tendency to secondary hæmorrhage, operations, unless absolutely essential, are rarely undertaken in diabetic patients. All wounds, even slight injuries, are repaired with great difficulty and are very prone to slough.

Glycosuria, sometimes only transient, sometimes permanent and indistinguishable from diabetes, is an occasional sequela of injuries. The former is not uncommon after prolonged narcosis, and may probably be attributed to the derangement of the circulation or the action of vasomotor nerves; the latter is more rare and difficult of explanation. Injuries of the head, general concussion of the whole body, or of the spine alone, afford the best known examples, but it has also been observed after blows on the abdomen, or over the kidneys, fractures of vertebræ, violent and prolonged muscular exertion, and even after burns; sometimes setting in within a few hours, sometimes only first noticed after months. Brown-Séquard is of opinion that under these conditions it must be of reflex origin.

C. MANSELL MOULLIN.

DIAPHRAGMATIC HERNIA.— This form of rupture possesses little practical interest. Out of 250 cases collected by Leichtenstern, the condition was dia-

gnosed in 5 only. Even when diagnosed, the hernia is not amenable to treatment. Two general forms are described. In one the viscus that is protruded through the diaphragm from the abdomen into the thorax is contained in a sac formed either by the peritoneum or pleura, or by both. This is the true hernia. In the other there is simply a hole or rent in the diaphragm, and no sac. This is the false hernia. The false is more common than the true, in the proportion of 10 to 1. Some of the herniæ are congenital, and depend upon arrest of fœtal development, whereby the partition between the thorax and abdomen is imperfectly formed. Others are acquired, and depend mainly upon injuries that lacerate the diaphragm, such as stabs, gun-shot wounds, fractures of ribs. The acquired forms are much more common than the congenital. The hernia is more often on the left side than the right, in the proportion of 5 to 1. The abnormal aperture is more often in the muscular that in the tendinous parts of the diaphragm. Herniæ not infrequently occur through a gap close to the xiphoid cartilage, and between the costal and sternal portions of the diaphragm. The rupture has passed through the œsophageal opening, but never through that for the aorta or the vena cava.

The contents are most often the stomach, then the tranverse colon, then the small intestines. Next in order of frequency come the spleen, liver, pancreas, and kidneys (Leichtenstern). The hernia may cause no symptoms, or it may end fatally almost directly after its formation, or it may pass into a chronic state, giving only occasional trouble. The affection is very difficult to diagnose. In marked cases there is prominence of one half of the chest, a displacement of the heart to the right side, a tympanitic area in the thorax, with an absence there of respiratory sounds and vocal fremitus. There is pain in the chest and abdomen, together with attacks of dyspnœa, especially after eating or straining, constipation, dyspepsia, &c.

FREDERICK TREVES.

DIGITAL COMPRESSION. *See* ANEURISM; FEMORAL ANEURISM.

DIPHTHERIA OF WOUNDS.—True diphtheria of wounds is a very rare affection. The skin is far less liable than mucous membrane to the disease, and, when covered by normal epidermis, is never attacked. Slight excoriations of skin, leech-bites, &c., are most liable, but granulating surfaces are not exempt. Direct contact may produce it; e.g. the introduction of a cut finger into the throat of a child with diphtheria has led to the local development of diphtheria, attended by severe constitutional symptoms, and followed by paralysis. In rare cases, the disease has attacked excoriations, or skin-lesions such as favus, by infection, has led to diphtheria of the air-passages, and has been communicated to others with fatal results. The local process strongly resembles the disease miscalled 'hospital' gangrene, and is usually associated with phagedæna; but, strangely enough, tracheotomy wounds do not seem to be attacked.

Symptoms.—The skin attacked becomes red and swollen; an infiltrated, highly inflammatory area extends around, and serous fetid discharge escapes. The edges of the wound are raised up; vesicles form around the margin, break with discharge of fetid serum, coalesce, and develop into fresh sores. The surface is covered with thick, membranous, semi-transparent rinds like wet washleather, which adhere deeply but can be peeled off, though they are rapidly reproduced. The infiltrated tissues break down in shreds, but the sloughing does not usually extend to any great depth. The history of a possible contagion or infection will confirm the diagnosis.

Treatment.—The local treatment consists in peeling or scraping off the rinds, and then applying caustics. Solid caustics are usually best, such as potassa fusa diluted to half its strength with caustic lime, applied freely to the base and edges of the wound; but constant irrigation, which must be persisted in for a considerable period, answers well at times. Acid nitrate of mercury in solution, or strong tincture of iodine, has been used with benefit. The freest ventilation should be accorded, some stimulants, and the most nourishing diet possible. Salicylated cotton-wool should replace sponges, and be burnt, with all dressings, directly after use. Every precaution must be taken to prevent infection of mucous membrane, especially of the mouth, from the wound. Conversely, it must be remembered that in diphtheritic cases excoriations of the skin, and especially blisters, are liable to be attacked.

A more common, but still rare (in this country), affection of wounds resembles the above in its local symptoms, but is unconnected with true diphtheria, and will not give rise to it. It attacks the same class of lesions, especially granulating surfaces. A buff-coloured exudation covers the wound

like a rind: it may be peeled off easily, and the raw surface, if treated with a stick of nitrate of silver or tincture of iodine, will usually soon heal. The local disease may remain long stationary or spread extensively, but it remains local. The granulations may slough, and then the condition simulates true diphtheria of wounds. If there is doubt about the diagnosis, it should be regarded as the severer form. The local treatment would be the same.

C. T. Dent.

DIRECTORS are blunt instruments, grooved to allow a bistoury to pass along them, and thus ensure an incision being made in the right direction. A steel director is useful for dissection among veins, as in tying the subclavian artery, but should never be employed where an artery is superficial and can be readily exposed with the scalpel. A German-silver director, especially if probe-pointed, is valuable in operating for fistula in ano, because it can be curved as required. A broad steel director is often employed in dividing the stricture of a strangulated hernia.

DISLOCATIONS.—A dislocation is a displacement of the articular surface of a bone from the position it normally occupies in a joint. Such displacement is rendered possible by giving way of the ligaments which maintain the bones in apposition, and it is frequently associated with laceration of muscles and contusion of the soft parts in the vicinity. When the injury producing the dislocation is severe, other complications may be present, such as paralysis from pressure upon, or rupture of, large nerve-trunks, and tearing of the main artery or vein of the limb. Proportionately, however, to the number of dislocations, such complications are very infrequent. Some dislocations, as those of the ankle and elbow, are not uncommonly associated with fracture of bone, whilst others, as those of the hip and shoulder, are very rarely complicated with fracture.

Dislocations are divided according to their origin into *congenital*, *pathological*, and *traumatic*.

Congenital dislocations are met with at birth, and the mode in which they are produced is a matter of conjecture. *See* Congenital Dislocations.

Pathological dislocations are such as follow disease or inflammation of joints, and will be treated of under the heading of joint-disease. *See* Joints, Diseases of.

Traumatic dislocations, or those which are produced by violence, constitute by far the greater number, and are of chief importance to the surgeon. The violence which causes the dislocation may be *direct*, that is, applied to the bone in the immediate vicinity of the joint, as when a person falls on his shoulder and drives the head of his humerus out of the glenoid cavity; or *indirect*, when the force is transmitted from a distance—for example, a dislocation of the elbow caused by a fall on the palm of the hand. Apart from external violence, bones are occasionally dislocated as the result of sudden *muscular action*. This is more likely to occur if the joint has been previously the subject of dislocation from injury. Many cases are on record where the humerus has been dislocated at the shoulder by muscular action, the result of some sudden violent exertion, such as throwing a cricket-ball or wielding a club; and a case is mentioned by Holmes of a patient who dislocated his shoulder by suddenly turning when lying in bed. Another joint which is liable to be dislocated by muscular action is that of the lower jaw. The patella is liable to be dislocated outwards by the action of the rectus muscle, and this is especially the case in knock-kneed persons, because the anterior prominence of the external condyle, which in normal joints serves to counteract the oblique pull of the rectus, is no longer efficient for that purpose when the deformity renders the direction of the force still more oblique. Complete primary dislocation from muscular action, is, however, a rare accident, and very exceptional at any other joints than those mentioned. Dislocations occurring in partially paralysed limbs from irregular muscular action, and those resulting from disease, have sometimes been incorrectly spoken of as *spontaneous dislocations*.

The effect of muscular action is occasionally found to change the character of a dislocation. Thus a subglenoid dislocation of the humerus may be converted into a subcoracoid, and a sciatic dislocation of the femur into one on the dorsum ilii. Such dislocations are spoken of as *consecutive*, to distinguish them from those resulting immediately from the injury, which are called *primary*. The surgeon, by ill-directed efforts to reduce a displaced bone, may bring about a consecutive or secondary dislocation. The writer once saw all the regular dislocations of the hip produced, in succession, by attempts made to reduce a dislocation on the dorsum ilii, before the head of the bone was finally lodged in the acetabulum.

A dislocation is spoken of as *incomplete* or *partial* when, the capsule being only

partially torn, or the ligaments being of abnormal length, the articular surface of one bone is not completely displaced from the articular surface of the other. Partial dislocations frequently depend on a general laxity of ligaments, such as is artificially produced in those trained to become clowns and tumblers. These persons acquire the power of distorting their joints in a manner closely resembling dislocations, but without tearing their ligaments, which are unduly elongated. These are, however, not true dislocations, but abnormal movements permitted by abnormal ligaments. Partial dislocations are very readily reduced. When occurring as the result of injury at the shoulder or hip, the ligaments are partially torn, and the head rests on the margin of the glenoid or cotyloid ligament, which may cause an indentation in the articular cartilage of the displaced bone. Arthrodial joints are more liable than others to be partially dislocated. When the displacement is lateral at the knee or ankle, the dislocation is generally incomplete, and when at the elbow not infrequently so.

As with fractures, dislocations may be *compound* or *simple*, the word 'compound' being used to indicate that the skin is torn over the joint, and its interior exposed to the atmosphere. Those joints which are covered in by muscles, as the hip and shoulder, are far less liable to compound dislocation than joints such as the ankle, wrist, and elbow, which have little more than skin to cover them. A compound dislocation is a very serious but not necessarily fatal accident. The danger lies in the fever, suppuration, and septicæmia which may follow acute traumatic arthritis; but if care be taken to thoroughly cleanse and purify the wound, and afterwards to keep it septic, little or no fever may follow, and the joint may recover even without limitation of movement. The writer has seen all the heads of the metacarpal bones of the fingers dislocated through a transverse wound in the palm, the result of a fall on the fingers, yet the patient recovered without any loss of power or motion in the hand. Compound dislocations are frequently associated with severe laceration of the skin and soft parts, and in these cases, as well as in those where the bones are splintered or the vessels damaged, it may be necessary to amputate the limb without delay. It is often a difficult question to decide, and one of great gravity, whether in the case of some compound dislocation an attempt to save the limb is advisable. Fibrous or bony ankylosis may be expected to result, should suppuration follow the injury.

Predisposing causes.—Dislocations from violence are rare at the two extremes of life. In children, injuries near joints are apt to produce separations of epiphyses; in old persons, fractures. Adult males, from exposure in their occupations, are more liable than females to dislocations. Paralysed limbs are more prone to dislocation than sound, and persons of weak muscular system than those who are strong. As illustrating the power of the muscles in supporting the joints, Astley Cooper cites the execution of Damien, who was sentenced to dismemberment. Four horses pulling for fifty minutes failed to tear away his limbs, which only yielded when the soft structures were divided. Some joints are more liable to dislocation than others, and the shoulder-joint, from its exposed situation and shallow socket, is more often dislocated than any other.

General signs, symptoms, and diagnosis of dislocation.—As the joints of the extremities are those which furnish nearly all the instances of dislocation, and as a symmetrical displacement is of extremely rare occurrence, a comparison of the sound limb with the one injured will generally afford immediate evidence of deformity when a dislocation has taken place. An experienced eye will detect the loss of contour in a moment, and a surgeon may often feel certain in his diagnosis before touching the patient. The angular appearance of the shoulder resulting from a dislocation is so characteristic, that a diagnosis by sight will often prove correct. Again, the position of the limb may be very suggestive of dislocation, as in dorsal dislocations of the hip, when the limb is shortened and adducted, so as to lie in front of the other; and as in the commoner dislocations of the shoulder, when the elbow projects from the side. There are, then, two signs of dislocation which may be detected by the eye, viz. (1) a deformed appearance of the joint, and (2) a peculiar position of the limb. The patient himself experiences severe pain in the injured joint, and a loss of voluntary movement.

These two symptoms are both present, though to a less extent, in cases of sprain. But in the case of dislocation there is a mechanical impediment to the natural movements, which will become more evident when an attempt is made to produce passive motion. A limitation of the normal movements is an important

sign of dislocation. On the other hand, movements before impossible may, from the laceration of ligaments, become capable of being produced; thus a ginglymoid joint may, after dislocation, admit of lateral movement. But fixation is a far more constant and important sign than the occurrence of any new movement. When a careful examination is made, an abnormal projection, caused either by the bone displaced or that from which it has been dislodged, will almost certainly be felt, even if there be no deformity evident to the eye. Manipulation will further determine the absence of crepitus, and thus distinguish the injury from a fracture near the joint. A certain amount of synovial crepitus, from effusion of lymph and serum into the tendon-sheaths about the joints, is common after a dislocation, but this is easily distinguished from bone-grating. Another sign arrived at by comparison of one limb with its fellow is an alteration in the length of the injured extremity. Most frequently the dislocated member is rendered shorter, but in some cases, as in subglenoid dislocation of the shoulder, and thyroid dislocation of the hip, there is lengthening.

Besides the knowledge obtained by measuring the length of the two limbs, much information may be obtained by comparing the difference in the distances between two bony points in the sound and in the injured limb. Thus, the distance between the internal condyle of the humerus and the tip of the olecranon is unaltered in a case of supra-condyloid fracture of the humerus, whilst in dislocation backwards of the bones of the forearm this measurement is increased. There is greater tension in the muscles about a joint when a dislocation has taken place, than when there is a fracture; and a dislocation is reduced with a sudden jerk, and when reduced does not readily recur; whereas the deformity of a fracture disappears gradually under extension, and often has a tendency to be reproduced by muscular action immediately the extension is relaxed.

General treatment of dislocation.—It is important that the displaced bone should be reduced to its normal position in the joint with as little delay as possible, in order to limit the inflammatory effusion excited by its presence among the soft tissues, and in order that repair may at once proceed. Before discussing the methods of treatment, it may be well to consider the principal *obstacles to reduction.* First among these is muscular contraction —a fact readily proved by noting the ease with which a dislocation is reduced in a paralysed limb, and in a person under the influence of chloroform, or in a case of syncope. The capsule or ligaments of a joint may, in some instances, cause difficulty in reduction; thus, in the case of an enarthrodial joint, the head of the bone may not lie near the aperture through which it escaped, and in the case of a ginglymoid joint the strong lateral ligaments may escape laceration, and prevent the return of the end of the bone to its position between them. The intervention of a tendon between the joint-surfaces is a rarer, but even more serious, obstacle to reduction. It sometimes happens in the case of subastragaloid dislocation of the foot.

The complication of a fracture with dislocation may render reduction extremely difficult, or even impossible; as, for instance, where fracture of the neck of the femur complicates dislocation of the hip-joint. Happily such cases are extremely rare. The natural prominences around a joint may be found in certain instances to interfere with reduction; thus the coronoid process of the ulna forms an obstacle to reduction in dislocation backwards at the elbow, and the eminentia articularis of the temporal bone in dislocation of the lower jaw. The indications for treatment are to relax the opposing muscles or to overcome their opposition by extension; to manipulate the limb in such a manner as to return the displaced bone through the aperture in the capsule made by its exit; and to divide subcutaneously any ligament or tendon whose interference with reduction does not yield to properly applied extension or manipulation.

To overcome the resistance of the muscles, surgeons, before the days of anæsthetics, resorted to many expedients which would be regarded at the present time as barbarous. Nauseating doses of antimony or tobacco, hot baths, and bleeding till syncope was induced, were the favourite remedies to produce a constitutional effect; and then powerful pulleys were used to bring the bone into its place. By placing the patient under an anæsthetic, both voluntary and reflex muscular action are overcome, so that the surgeon is free to manipulate or extend the limb without exciting resistance or causing pain. It is only in the case of dislocations of long standing that he is ever likely to resort to mechanical aid; and then, if the patient be insensible, he must proceed with the greatest caution.

When a dislocation has been reduced, bandages or splints should be used to retain it in position till a certain amount of repair has been effected. At the same time, cold should be applied, first to check extravasation of blood and afterwards to allay inflammation. If the patient be confined to bed this is best done with an ice-bag or Leiter's coil placed over the joint; if he be allowed to walk about, evaporating lotions, containing ether or spirit, may be applied on lint. The joint should not be kept fixed longer than a fortnight or three weeks, lest difficulties in regaining movement should result from the formation of adhesions. Passive movements should be first commenced, and afterwards the voluntary be gradually encouraged. Friction, stimulating liniments, cold affusion, and galvanism may be employed, with benefit, to stimulate the muscles and absorbents of the part and assist in the recovery of movement.

Compound and Complicated Dislocations, Treatment of.—A compound dislocation—by which is understood one in which the articular end of a bone protrudes through the skin, or one where there is an open wound leading down to the displaced articular surface—offers grave considerations to the surgeon. Early in this century it was the rule to amputate in all such cases. Before the introduction of antiseptics, however, surgeons had discovered that by rigid cleanliness, rest, and free drainage, many of the limbs thus damaged might be saved. Still, the danger to life from prolonged suppuration, erysipelas, or septicæmia, was great. The stricter details of antiseptic surgery have done much to extend conservative surgery in this field. Each case is now treated on its own merits, and the question of amputation is decided by the accompanying complications. Severe laceration of soft parts and rupture of vessels would determine an amputation; comminuted fracture of bone generally either excision or amputation. Rupture of nerve would not of itself suggest amputation, for the nerve might be cleaned, refreshed, and reunited by means of catgut sutures. At the elbow, for instance, the ulnar nerve may be torn across, and yet the forearm may be saved and the function of the nerve be restored after suture. An instance of this kind has lately come under the notice of the writer.

In an uncomplicated case of compound fracture the surgeon should cleanse thoroughly the exposed articular surface with a solution of one part of carbolic acid in twenty parts of warm water, and should syringe out the joint-cavity and interstices of tissue with the same solution. The dislocation being then reduced, wire sutures may be used to bring together the skin; but it is most important that a free and dependent opening should be left for drainage. Carbolised gauze dressings should then be applied, and the limb be fixed upon a splint.

If these dressings are not at hand, irrigation of the joint, either with water or some weak antiseptic lotion, is probably the best way of purifying the wound and allaying extensive suppuration. When there is difficulty in reducing the dislocated bone through the skin and soft parts, it is often advisable to saw off its extremity. This has been done at the hip, shoulder, ankle, and wrist, as well as in dislocation of the head of the astragalus. Compound dislocation at the elbow may frequently suggest excision in order to save a movable joint; but such excisions run a far less favourable course than those undertaken for disease. A few years since the writer was called to see a compound dislocation of the elbow with separation of the humerus just above the condyles. The loose piece of bone was removed, and the ends of the radius and ulnar were sawn off. The patient recovered without any serious symptoms, and the hand was thus preserved, but a flail-like movement followed at the elbow.

In compound dislocations of the lower extremity it is scarcely advisable to make any attempt to preserve a movable joint. The wound having been cleaned and all loose fragments of bone removed, the limb should be fixed on an iron splint and retained rigidly in position by means of waxed, paraffin, or plaster of Paris bandages, till all inflammation and suppuration have subsided. A similar rigid fixation of parts should be secured in any case that the surgeon may have thought favourable for primary excision. Any abscesses which may result from the injury should be freely opened, and whilst the patient's strength is being drained by suppuration he should be supported by stimulants, quinine, iron, and such nourishing diet as he may be capable of taking. If it is evident that he is gradually losing flesh and strength, the surgeon must interfere at the proper time, and insist on the necessity of amputation to prevent further strain on the constitution and consequent death from exhaustion. After such amputations, provided there is no general septicæmia, patients often recover rapidly.

Extension and counter-extension in the treatment of dislocations.—Rotation, as a

method of reducing dislocations, being only of service in the case of enarthrodial joints, extension of the limb will continue the method most generally applicable for the restoration of displaced bones to their proper positions, though, with the aid of chloroform, the power exerted need be comparatively little, save in the case of dislocations of long standing. *Extension* may be applied directly by the surgeon grasping the limb in his hands and pulling upon it, or indirectly through a round towel secured by means of a clove-hitch to the limb. The advantages of the towel are that it gives a firmer hold, and that it enables more than one to aid in making extension. It should be applied above the elbow for dislocation of the shoulder, and above the knee for dislocation of the hip, so that traction may not be exerted on any other joint than the one dislocated. To protect the skin from injurious pressure it is well to first apply a few turns of a damp flannel or linen bandage. Additional force may be obtained by the employment of pulleys, or such mechanical contrivances as Bloxam's dislocation tourniquet and Jarvis's adjuster; but since the introduction of chloroform these appliances have been altogether discarded for recent dislocations, and are but rarely employed for those of long standing.

Counter-extension is the force used in the direction of the patient's body, to prevent him from being dragged away by the power used in extension. It is seldom that the weight of the patient is alone sufficient for counter-extension when reducing a dislocation, though in the case of fracture the patient's inertia is thus frequently made use of. Counter-extension is sometimes made by the surgeon himself, as when he places his heel in the axilla or foot upon the perinæum for the reduction respectively of the shoulder and hip. At other times, when greater force is required, the counter-extension is entrusted to assistants; but when pulleys are used it is necessary to fix the pelvis or shoulder girdle by means of a padded leather strap, a round towel or sheet, attached above to some fixed point. However applied, it should be understood that counter-extension ought to be of a passive kind, continuously acting in one direction, whilst extension, which is more immediately under the control of the surgeon, may be modified both in force and direction according to the requirements of the case.

Unreduced Dislocations. — When a dislocation has been overlooked or left unreduced, the deformity occasioned by the displacement becomes gradually more evident than at the time of the accident, first from the absorption of extravasated blood, and afterwards by the wasting of the disused muscles around the joint. Loss of motion, however, seldom remains absolute, the movements gradually improving after a time, and sometimes becoming extensive. This is especially the case in dislocations of enarthrodial joints, such as the hip and shoulder. Here the displaced bone will hollow and form for itself a new cavity on the surface where it rests; new ligaments are formed from the connective tissue cells of the surrounding structures, and a fairly well-formed joint results. The process by which this new adaptation is effected is not a mere passive absorption occasioned by the pressure of the displaced head of bone, but an active sub-inflammatory change, whereby new bone is produced where required to resist pressure, and new ligaments of great density are developed to complete the joint. Meanwhile the cup, from which the dislocated bone has escaped, undergoes atrophy, decreasing in depth and diameter, and becoming filled partly with bony undergrowth and partly with fibrous tissue. A good specimen of unreduced dislocation of the head of the femur upon the pubes, illustrating these changes, is to be found in the museum of Guy's Hospital. The dislocated head resting against the anterior inferior spine of the ilium had there excited such activity in the periosteum and its fibrous connexions, as to form for itself a shallow cup, whilst the acetabulum is seen to be contracted and shallow.

The chronic inflammatory changes brought about by the displaced bone give frequently to the new joint an appearance similar to what is met with in osteo-arthritis, plates of bone being formed in the fibrous structures around, whilst the cartilaginous surface becomes worn off, and replaced by a porcelain-like lamella. This loss of cartilage does not, however, always take place, as is proved by a case dissected by Cadge sixteen years after upward dislocation of the hip. The new joint was remarkably complete, and lined by a dense, pearly-white tissue resembling fibro-cartilage, whilst the head of the femur was still covered by its cartilage. Thus it will be seen that in some cases a new articular surface—framed on the model of the original joint—new ligaments, and new synovial membrane may be developed to take the place of a joint destroyed by dislocation. But the displaced bone does not always

accommodate itself in this way to its altered relations, and ginglymoid joints, when dislocated, often become permanently fixed by fibrous or even bony ankylosis. Much will depend upon how soon after the injury movements are commenced, and with what perseverance they are continued.

Treatment.—The reparative and pathological changes which have been described as occurring in the neighbourhood of a joint long dislocated, should be borne in mind by a surgeon contemplating the reduction of any such dislocation, and he should ask himself whether the benefit likely to accrue sufficiently justifies the risks to which the patient may be subjected in attempts made to replace the bone. The opposition of fibrous bands of great density, of rigid and contracted muscles, of displaced tendons and intervening capsule, will have to be encountered, as well as the obstruction resulting, in cases of long standing, from altered bone-surfaces. No fixed rule can be laid down as to the time when it ceases to be justifiable to attempt reduction, as reparative activity will vary with the individual, and will not progress evenly with time. Astley Cooper's oft-quoted rule is given in his own words, to show that even he, writing before the days of anæsthetics, was not so rigid in his views as has been represented. 'I am of opinion,' he says, 'that three months after the accident for the shoulder, and eight weeks for the hip, may be fixed as the period at which it would be imprudent to make the attempt at reduction except in persons of relaxed fibre, or of advanced age. At the same time I am fully aware that dislocations have been reduced at a more distant period than that which I have mentioned; but in many instances the reduction has been attended with the evil results which I have just been deprecating.'

Among the evil results of prolonged and forcible extension, carried out with the object of reducing a dislocation, the following may be mentioned as having occurred in attempts to reduce old dislocations of the shoulder:—Severe subcutaneous lacerations resulting in extensive blood-extravasations; rupture of the axillary vein or artery, with subsequent traumatic aneurism; tearing through of the pectoralis major or cords of the brachial plexus; fracture of the humerus, glenoid cavity, or axillary ribs; rupture of the skin, and in one case recorded by Guérin, the limb itself was torn off at the elbow-joint. In attempts made to reduce old dislocations at the hip, the large vessels are less exposed to injury, though they have not always escaped; but fracture of the femur is an accident which has happened on several occasions, and diffuse suppuration has frequently followed forcible manipulation, and has sometimes ended in death. At the elbow-joint, rupture of the brachial artery and damage to the median nerve have resulted from force used to reduce an old dislocation. In spite of the warning of these accidents, cautious attempts at reduction may be made after lengthened periods, especially in persons of slight muscular development, and those in whom, the dislocation having been overlooked, splints may have been applied, and no previous attempts have been made to replace the bone. Should, however, sufficiently free movement have been obtained in the dislocated position to render the limb of service, it may be doubted whether any attempt at reduction is then advisable.

For the reduction of long-standing dislocation, an anæsthetic should invariably be administered till complete muscular relaxation is obtained. The surgeon should then take the limb, flex, extend, abduct, adduct, and rotate it till all the fibrous adhesions are broken down. In addition to this he may find it necessary to divide, with a tenotomy-knife, bands which cannot be broken, or displaced tendons which obstruct the return of the bone. Having overcome all resistance to the free movement of the bone, he next proceeds to manipulate it in a manner best calculated to restore it to its proper position. He must not expect to hear it return with a jerk and snap as in recent cases, but must be content to see the limb restored to its normal length and position as sufficient indication that the bone has returned to its cavity. Having obtained this result he should secure the limb in this position by means of splints, and apply over the joint an ice-bag or Leiter's coil to subdue any inflammation that may have been excited. The head of the bone, when lodged over the spot it should normally occupy, will gradually cause absorption of any capsule, fibrous or muscular tissue intervening between it and the socket. In the *Guy's Hospital Reports* for 1884, there are, related by Cock, several cases of dislocation of the shoulder which could not be reduced, owing, as it was supposed, to the intervention of capsule; but good results were eventually obtained by retaining the humerus in position by means of an air-pad in the axilla, till absorption had taken place and new ligaments had been formed.

For description and treatment of individual dislocations, *see* under Ankle; Elbow; Hip; Shoulder, &c.

R. Clement Lucas.

DISSECTING ANEURISM. *See* Aneurism.

DISSECTING WOUNDS. *See* Poisoned Wounds.

DISTAL LIGATURE. *See* Aneurism.

DORSALIS PEDIS ARTERY, The, is a continuation of the anterior tibial, from the middle of the ankle in front, to the interval between the bases of the first and second metatarsal bones. The guiding line is taken between the points mentioned.

The coverings are: skin; superficial fascia, with a plexus of veins and the musculo-cutaneous nerve; deep fascia; just before it ends it is crossed by the innermost tendon of the extensor brevis digitorum. Inferiorly it rests on the astragalus, the scaphoid, the internal and middle cuneiform bones. Externally are the innermost tendons of the long and short extensors. Internally, and serving as a guide, is the tendon of the extensor proprius pollicis. The nerve is on the outer side; venæ comites accompany the artery.

Branches.—(*a*) The tarsal, running outwards on the bones, to anastomose with the anterior peroneal, external plantar, and the metatarsal artery. (*b*) The metatarsal runs across the bases of the metatarsal bones; it has similar anastomoses to the tarsal. (*c*) Dorsalis hallucis. (*d*) Communicating with the external plantar, passing downwards between the first and second metatarsals. In the sole the communicating gives off (*e*) the anterior magna pollicis.

Ligation.—Make an incision in the guiding line two inches long; cut through skin and fasciæ, and feel for the pulsations of the artery; recognise the innermost slip of the extensor brevis digitorum on the outside and the pollicis on the inner side; and, pulling the former outwards and the latter inwards, open the sheath and pass the needle from without inwards, to avoid the nerve. Sometimes the artery is absent.

James Cantlie.

DRACUNCULUS. *See* Filaria or Dracunculus Medinensis.

DRAINAGE is the system by which the surgeon carries off liquid accumulations from the body, as the agriculturist does from the land. Both know that, while some moisture is essential to nutrition and growth, its excess leads to decomposition and waste. Drainage was the intention of the old surgical practice of counter-openings, tents, and setons; and John Hennen went so far as to draw a woollen thread through an accumulation of pus '*to perform the part of a syphon.*' But it was not until 1855 that Chassaignac established drainage, as a general principle and practice of surgical therapeutics. He was not only influenced by the idea, but followed the method, of agricultural drainage, substituting for tile drain-pipes perforated india-rubber tubes, which, after trial of metal and bone tubes, are still admitted to be the drain-pipes most generally applicable to surgical practice. The essential facts in Chassaignac's system of drainage are—that indiarubber tubes may be made to traverse and dwell in the muscular and bony structures of the limbs, the large joints, or the great visceral cavities, without producing irritation; and that, as they fill with discharge by capillary attraction, they do not give admission to air from without. Acting on these lines, the distinguished French surgeon and his earlier followers, employed drainage in evacuating purulent collections; but the method has been gradually, and most beneficially, extended to the prevention of suppuration, by carrying off serous effusions. These, if retained, are liable to decomposition, and, by mechanical tension and nerve-irritation, are potent causes of inflammation, which is opposed to healthy nutrition and repair, and is the prime factor in the chain of pathological events leading to blood-poisoning and death.

But though tubes be the most generally applicable instruments for drainage, it is important to bear in mind that they are not essential to it. The parallel between agricultural and surgical drainage holds good in the utilisation of natural, physical, and physiological resources for preventing the stagnation of liquids, and carrying them off when they do accumulate. In the flesh, as in the field, position both dams and drains.

To facilitate drainage by gravitation should always be the aim of the operating surgeon in planning the direction and extent of wounds, in the manner and time of closing them, and in placing the patient after operation. Thus, in amputation of the breast, a free incision, parallel with the transverse axis of the body, is most conducive to healing by the first intention, or favouring natural drainage outwards and downwards; all the more so if the patient's

bed be so made as to incline the body slightly towards the side operated on. One great advantage in Teale's method of amputating results from the facilities for natural drainage, offered by the position and shape of the rectangular flaps. When extravasation of urine attends stricture, a free dependent incision in the middle line of the perineum arrests mischief, locally and constitutionally, in direct proportion as it favours easy drainage. On the same principle is based the golden rule, that when it is determined to open an abscess the most dependent position should be chosen.

As position assists natural drainage, so does pressure; and, by a little ingenuity, pads may be adjusted to act as banks in directing outwards extravasated fluids, and preventing their permeation into healthy tissues. But however dexterously and economically natural resources be utilised, drainage is often impracticable without the employment of tubes. In introducing these, probes and trocars are useful adjuncts, but they may generally be dispensed with by just inserting the end of the drainage-tube into the wound, and passing it with a gentle corkscrew impulse. In the case of fresh wounds, the drainage-tube is laid where most convenient before the edges are brought together.

Drainage-tubes, like most other good things, are liable to abuse. They may often be dispensed with by lightly compressing wounds and their surroundings to check effusion. Dryness favours healing. A slight dependent opening is a useful safety valve, not always indispensable, but, in case of doubt, never to be neglected. When drainage-tubes *must* be used, they should be neither too fine nor too short for efficiency, nor so numerous, thick, and long as to act like foreign bodies, and prevent the contact of surfaces of which the coalescence is desired. For the same reason, drainage-tubes should be shortened as soon as practicable, and removed when they cease to be absolutely necessary. In case of doubt, a wire or thread may be left in the track of a removed drainage-tube, and used in drawing through another, if required. Meanwhile, the wound can be allowed to consolidate under pressure and absorbent dressings, which are always the complement, often the substitute, of drainage-tubes. To prevent the tube completely slipping into the wound—a not infrequent and rather troublesome occurrence—its outer end should be left of good length, or be secured by one or two loops threaded through its side, and fixed by adhesive plaster or bandage. Catgut and horsehair are often used as minor drains, but absorbent dressings and gentle pressure will dispense with their necessity in the great majority of cases.

To secure the combined effect of position, pressure, and drainage-tubes, in carrying off discharges, it is important to secure the freedom of the outer end of the tube. This may be done by passing it through a hole in the dressings next the body, or between the edges of two pads or folds of absorbent tissue, the bandage exercising pressure around the tube so as to direct fluid through it, and not over its orifice so as to close it. An absorbent pad, lightly secured over the outer end of the drain-pipe, acts as the receptacle of the drained products, and may be changed as often as deemed necessary, without prejudice to the great principles of rest and cleanliness. Thus utilised, drainage is, in itself, a great therapeutical resource, and in combination with other principles of treatment, more especially rest, position, and pressure, is a powerful factor in the physiological treatment of surgical states.

SAMPSON GAMGEE.

DRAINAGE-TUBES.—Of the materials used for draining wounds, the most widely employed is india-rubber tubing, but decalcified bone, glass, metal, and spiral wire tubes either are or have been used, and, under special circumstances, strands of horsehair, silkworm gut and catgut act efficiently. The size of the tubes will depend on that of the cavity to be drained; but for large surfaces, such as those of amputation flaps, two or three smaller tubes are preferable to a single large one placed across the wound, as they interfere less with the coaptation of the flaps, and favour the more uniform exit of the discharges. The depth of the wound should be ascertained with a probe or the sinus-forceps, and the tube cut to the required length, and also in such a way that the external aperture lies flush with the surface; for if left too long the pressure of the dressings may double the tube on itself, and obliterate its channel, or press the inner extremity of it against the tissues and irritate them. Care must be taken that the external end of the tube does not slip within the wound, and with this object a loop of silk or horsehair should be tied to each side of that end, so that the pressure of the dressing against these little anchors of silk or horsehair may maintain the tube in its place.

When tubes are placed in cavities such as the thorax, special care must be taken that they do not slip inside; the safest plan is to

fix the outer end of the tube to an india-rubber shield, thus:—Take a piece of sheet india-rubber and cut a hole in the middle of it of the size of the tube, then place the outer end of the latter through the hole, and cut the projecting piece longitudinally into four strips, and stitch each one down to the india-rubber shield. Drainage tubes do not, as a rule, need removing till the third or fourth day, by which time a track will be formed, which will facilitate their replacement. They will need shortening from time to time, according to the progress of the case. *See* EMPYEMA.

India-rubber tubes.— The red rubber tubes are the best, and the strength of the walls should be sufficient to maintain their patency against the pressure of the tissues; the size of them should vary from that of a quill up to that of the little finger. They should be perforated here and there with holes, extending over about one-third of their circumference; but when the tube has to pass some distance through the tissues before reaching the cavity to be drained, the outer part of it should not be perforated, as the granulations are liable to grow in and obstruct its calibre. The prepared tubes should be kept ready for use in a five per cent. solution of carbolic acid.

Decalcified bone tubes were introduced by Neuber, of Kiel; he used tubes drilled from ox-bones; Macewen, of Glasgow, advocated decalcified chicken-bones, on account of their cheapness. The tibiæ and femora, after being scraped clean, are placed in hydrochloric acid and water (20 per cent.) until softened; the marrow and endosteum are then removed, and the bones returned for a time to the acid; they are finally trimmed and perforated, and kept ready for use in carbolic acid and glycerine (1 in 10). The longest tubes are a little over three inches, and the widest over half an inch. In 100 observations, the time that these tubes resisted absorption was over eight days; if they be required to resist the tissues still longer, they should be kept in a chromicised instead of a carbolised solution. The advantages claimed for decalcified bone-tubes are that they are non-irritating, act as perfect drains, and are absorbed by the surrounding granulation-tissue when no longer required. On the other hand, it has happened that in some cases the wound has healed with the tubes enclosed and unabsorbed; whilst at other times they have been too quickly absorbed, and have collapsed before they have fulfilled their function.

Glass tubes have been introduced into ovariotomy practice by Keith; they are of various sizes, and have perforations at one end; through these apertures the fluid poured out into the peritoneal cavity, enters and rises in the tube, from which it is drawn off by a suction syringe.

Spiral wire tubes have been recommended by Robert Ellis as well adapted for draining circuitous tracts during long periods, on account of their bore not being diminished by bending, nor flattened by the contracting orifice of a sinus; they are made of fine brass or copper wire coiled into a spiral.

Strands of horsehair, catgut, or silkworm gut make efficient drains, so long as the discharge is serous, but when it becomes purulent they cannot be relied upon; they all act in a similar manner, viz. by capillary attraction or syphon action, the fluids passing along the fine capillary channels between the hairs, &c. The horsehair should be purified in alkali, and then kept in a solution of carbolic acid (1 in 20). The size of the drain should be gradually diminished as required, by the removal of a few strands from time to time. It is claimed for catgut that it serves its purpose and is then absorbed, and so avoids both the necessity for dressing a wound in order to shorten the tube, and the difficulty of knowing at what rate to do this; and that with it, as with the decalcified bone drains, the theoretical perfection of one dressing only from first to last is possible. It should, however, be admitted that owing to the swelling of the catgut, and its incorporation with the tissues, its efficiency as a drain may be interfered with too soon, whilst in other cases it remains unabsorbed after it has ceased to be required. BILTON POLLARD.

DRESSING OF WOUNDS. *See* WOUNDS.

DUCHENNE'S PARALYSIS. *See* PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.

DUGAS'S TEST is for dislocations of the shoulder, and depends upon the fact that, owing to the roundness of the chest-wall, it is impossible for both ends of the humerus to be in contact with it at the same moment. Hence a patient with a dislocation cannot place the hand on the opposite shoulder with the elbow touching the ribs. *See* SHOULDER, Dislocations of the.

DUPUYTREN'S CONTRACTION is that deformity of the fingers which is due to a gradually increasing thickening and contraction of the palmar fascia and its prolongations into the digits. It is almost unknown in females, but is common in

males after twenty-five years of age. Not a few instances can be traced primarily to injury, such as a punctured wound; some may be traced to the habitual use of instruments which cause pressure upon the palm, but in the majority no such cause can be ascribed, and the condition occurs in persons of gouty tendency or inheritance, although they may be exempt from other manifestations of the diathesis. It is very frequently hereditary. The contraction may be confined to the fascia of the palm, or it may be increased and even mainly arise from a contracted state of the palmaris longus. But the fact of most importance is that the tendons of the flexors of the fingers are unaffected and lie free in their sheaths and in their natural relations, and therefore removed from the bands, which are superficial and tangible. The joints also are unaffected. The ring and little fingers are most frequently implicated, but the middle, the index, and the thumb may be involved. Superficially the skin of the palm is puckered, and is bound to the subjacent ridge at the line of the transverse furrow, as well as at other spots, but is not closely attached throughout. The proximal phalanx is drawn down and cannot be straightened, and the two distal phalanges are similarly acted upon in proportion to the extent of the condition, which in extreme cases may be such that the tip of the finger is drawn down into the palm. Dissection proves that this is effected by the thickening and contraction of sections of the palmar fascia, which pass into the affected fingers, and of its prolongations, particularly those which are inserted into the periosteum of the first phalanx, externally to and along the borders of the sheath of the flexor tendons.

Treatment.—By far the most successful method of dealing with this condition is that of multiple subcutaneous incision, recommended by Mr. W. Adams. A fine short fascia-knife is introduced between the skin and the band, and the latter is divided from above downwards in several spots. The first incision should be above the transverse fold, the next between it and the web of the fingers, and others should divide the lateral band in the fingers. In the latter great care is needed that the point of the knife is not depressed, so as to injure the vessels and nerves. Each puncture should be covered by a pledget of lint, and the extended fingers bandaged to a padded metal splint on the palmar aspect of the hand. Subsequently, it is necessary that a metal apparatus embracing the wrist and extending along the dorsal surface of the finger, to the tip of which it is attached by a cap, should be worn for some time at night, and passive motion be used daily. Or, if immediate extension cannot be effected, it must be gradually brought about by means of a rack-and-pinion apparatus. Where this treatment has failed, or in cases where it is not applicable, a triangular flap of skin may be dissected up from the palm, and the contracted bands freely divided or even dissected out, the skin being readjusted and a splint applied. JOHN H. MORGAN.

DUPUYTREN'S SPLINT is a straight splint about four inches wide, reaching from the internal tuberosity of the tibia to four inches beyond the sole of the foot; it is notched at the lower end, so as to give the ankle-bandage a firmer grip of the splint. The pad, which should be thicker at the lower part, ought to reach only to the internal malleolus. It is used in the treatment of Pott's fracture, with much eversion of the foot. BILTON POLLARD.

DURA MATER, Wounds of the. *See* ENCEPHALITIS, MENINGITIS.

DYSPHAGIA — or swallowing with difficulty—is a sign either of paralysis or of spasm of the parts concerned, or of disease of the pharynx and œsophagus, or of disease in their neighbourhood.

1. *Paralytic dysphagia* may have a central origin in disease of the brain or cord, and occurs after diphtheria or some other fevers; or it may have its origin in nerve injury or disease, either inside or outside the skull. Or it may have a reflex origin, from thoracic or abdominal disease. In paralysis of the pharynx, the finger passed into it causes no contraction; there may be dilatation of the parts, with accumulation of food; if regurgitation takes place, it is not so immediate and violent as in spasmodic dysphagia.

2. *Spasmodic dysphagia*, usually of central origin, may be due to some special cause, as strychnia poisoning or tetanus or hydrophobia, or inflammation of the cervical cord. It may occur early in insanity, and in epilepsy. It may have a reflex origin, from intestinal or uterine irritation, and perhaps many spasmodic strictures are started by some local irritation. The ordinary spasmodic stricture is usually a disease of nervous girls and middle-aged women; it often exists with other signs of nervousness in the patient or her family; it is very rare in men. It is, in many cases, not continuous or progressive or consistent

in its symptoms; it is not marked by much pain, or craving for food, or emaciation, or cough. There is no swelling in the neck, no secondary growths, no hæmorrhage. Solids may go down better than fluids; the degree and position of the stricture may alter; it vanishes under an anæsthetic.

Among the slighter cases are those of 'stammering' in deglutition, those of globus hystericus, and those where swallowing is painful and difficult long after an obstacle has been removed. In more severe cases there is complete inability to swallow: 'the food is flung back by a spasmodic tube, not falteringly passed along a variable segment of a diseased one, or arrested as it nears the stricture to accumulate above its ring.' This immediate violent return of a mouthful of milk or food, and its forced ejection through mouth and nose, is a very important sign of spasmodic stricture.

Spasmodic stricture is often cured by electricity. In cases plainly due to nervousness, frictional electricity, drawing sparks from the neck, is likely to do good. In cases where the continuous current is used, the positive pole should be at the back of the neck, and the negative should be over the pharynx, or inside if the patient can bear it. Tonics or antispasmodics may be given; the mental and moral tone of the patient must be improved. The introduction of a bougie may be followed by a hysterical fit, and rapid recovery. But in grave cases, of many years' duration, the cure is tedious, and relapses are common.

3. Of diseases of the *pharynx and œsophagus* which cause dysphagia, the chief are as follows: of the pharynx, acute tonsillitis, and perhaps—at least in children—mere chronic enlargement of the tonsils without fresh inflammation; acute pharyngitis, pharyngeal erysipelas, retropharyngeal abscess and tumour, and spinal disease, naso-pharyngeal tumour, and ulceration just at the back of the pharynx, which may be hidden by the uvula. Of the œsophagus, there are inflammation, both erysipelatous and membranous, pouches, diverticula, valvular obstruction, and certain innocent tumours. But, above all these, there are ulceration, simple or syphilitic, and malignant disease. Hence come simple stricture and malignant stricture; but in many cases it is not possible to decide which of these two is present.

4. *Simple fibrous stricture* is due either to simple fibrous thickening of the parts, or to the scarring and contraction of ulceration, simple or syphilitic. Simple ulceration follows the swallowing of boiling water, or soap-lees, or strong acid—either at once, or not for some months after the accident. There is no tumour in the neck, no diseased lymph-glands; the emaciation is proportioned to the want of food; the stricture may bleed, but has no foul discharge; it may feel smooth to the bougie.

Its treatment is never free from risk of perforation, or of mediastinal inflammation even without perforation. The advice to pass bougies directly after the accident, without waiting to see whether stricture will occur or not, is wrong; they might just cause it. Only a little fluid food should be given, and nutrient enemata should be used for some days.

When the stricture has come, and instruments must be used, a black olivary catheter is useful. It may go more easily just after a mouthful of wine, and with the head a little thrown back. In a case under the writer's care, the patient, a girl of twelve, could pass the catheter herself, through a double stricture. A year may be spent before the stricture is dilated; and constant watching in after-life is absolutely necessary.

5. *Malignant stricture*, usually epithelial cancer of the upper or lower end of the œsophagus, is most common in men; it is very rare under forty. In most cases the dysphagia is gradual; but in some it comes without warning and with curious suddenness. The emaciation is usually more than is due to any mere want of food; the regurgitant food may be stained with blood; and, late in the disease, there may be a foul smell from the throat, frothy expectoration tinged with blood, and a perceptible fulness in the neck, with enlarged lymph-glands. Regurgitation, whether in fibrous or malignant stricture, takes about a minute; it may not occur at all. Pain even may be absent. With the bougie, and in some cases with the finger, a hard stricture is found, which may have a ragged feel.

In some cases, food may be given through a rubber catheter, or a fine tube may be worked down over a long catgut, and tied in; or Mr. Symonds' short tubes may be used, allowing the patient the pleasures of taste.

6. *Dysphagia* may be due to disease in the neighbourhood of the pharynx and œsophagus. Except some rare cases of dysphagia from advanced spinal curvature, or disease of the thyroid gland or hyoid bone, or mediastinal tumours, the diseases are usually laryngeal or arterial.

In laryngeal paralysis there may be dysphagia; for the larynx is raised, closed,

and covered, in deglutition; and thus paralysis either of the external or of the internal laryngeal muscles may, by want of co-ordination, cause dysphagia. In inflammation of the trachea swallowing is painful, and therefore difficult. In œdema of the glottis, acute or chronic, there is dysphagia, and food passes into the larynx; and in perforation of the trachea from ulceration of the œsophagus, there is very distressing dysphagia, with violent coughing-up of food. Whenever dysphagia is connected with cough or dyspnœa, the larynx must be examined.

Aneurism of the carotid or innominate or aortic arch, may cause dysphagia, with pain at the sternal notch. It is unwise in these cases to pass any instrument down the œsophagus.

7. Lastly, a foreign body may remain lodged in front of the epiglottis, or in the pharynx, or buried in the loose tissue behind the pharynx, in such a way as to elude observation and yet cause severe dysphagia.

STEPHEN PAGET.

DYSPNŒA, i.e. difficulty of breathing, is produced under all conditions which cause defective oxygenation and increased carbonisation of the blood, the anomalous composition of the latter acting in turn as a stimulus upon the respiratory centre, situated in the medulla oblongata.

Symptoms common to most forms of dyspnœa are: action of the accessory muscles of respiration; increased frequency, or possibly deepening and prolongation, of the respiratory movements; and—in higher degrees of difficulty of breathing—cyanosis, orthopnœa, dilatation of the pupils, and even general convulsions. In the most severe cases the action of the heart becomes irregular or arrested.

The very varied conditions under which dyspnœa may occur may be subdivided into:

Conditions preventing or impeding the entry of air into the air-passages.

I. *In the nose and naso-pharyngeal cavity.* (1) Acute catarrhal or inflammatory tumefaction of the mucous membrane (especially acute coryza in infants). (2) Neoplasms (mucous polypi, adenoid vegetations, naso-pharyngeal polypi, malignant growths). (3) Deviations of the septum nasi. With rare exceptions the dyspnœa in all these cases is not severe but characteristic. The mouth is kept open; respiration is accompanied by a snuffling noise, if the obstruction be situated in the nasal cavities proper; by more snoring sounds, if it be in the naso-pharyngeal cavity; the voice has a peculiar nasal timbre; the dyspnœa in the sucking child comes on when it takes the breast and in sleep, in cases of adenoid vegetations in sleep.

II. *In the pharynx.* (1) Acute tonsillitis and hypertrophy of the tonsils; (2) benign and malignant new-formations; (3) foreign bodies; (4) traumatic and œdematous pharyngitis; (5) syphilitic contraction; (6) retropharyngeal abscess. In these forms dyspnœa is accompanied by a rough, snoring noise, which is distinctly different from laryngeal and tracheal stridor, less distinguishable from the noise of nasal and naso-pharyngeal obstruction. The dyspnœa may be severe. The voice is thick, deglutition greatly impaired.

III. *In the larynx.* (1) Acute laryngitis in infants; (2) œdematous laryngitis; (3) abscess; (4) erysipelas; (5) laryngeal diphtheria (croup); (6) benign growths when large; (7) malignant neoplasms; (8) syphilis; (9) tuberculosis; (10) perichondritis; (11) ankylosis of the crico-arytænoid articulations, if the cords be fixed near one another; (12) lupus; (13) lepra; (14) fractures and dislocations; (15) wounds; (16) foreign bodies; (17) membranous occlusion (webs); (18) bilateral paralysis of the recurrent nerves (dyspnœa occurs on exertion only); (19) bilateral paralysis of the glottis-openers; (20) unilateral paralysis of a glottis-opener in infants; (21) spasm of the glottis; (22) perverse action of the vocal cords; (23) compression of the larynx by tumours, &c. Laryngeal dyspnœa is characterised by loud, stridulous, sometimes sonorous respiration, the inspiratory phase being, in most cases of laryngeal difficulty of breathing, solely or prominently concerned. It may, however, be purely expiratory (as in cases of pedunculated subglottic growths, driven during expiration against the lower surfaces of the vocal cords), or mixed (as in cases of compression of the larynx). It may be constant (as in paralytic affections), or intermittent (as in spasms); accompanied by disorders of the voice (as in most cases of laryngeal dyspnœa), or not (as in perverse action of the vocal cords, and in bilateral paralysis of the glottis-openers).

IV. *In the trachea.* (1) Benign and malignant neoplasms; (2) syphilis; (3) intra-tracheal stenosis, from syphilitic or traumatic contraction, foreign bodies, pseudo-membranous deposit, post-tracheotomic granulations; (4) compression of the tube by goitre, aneurisms, enlargement of cervical or bronchial glands; tumours of the œsophagus, emphysema of the cellular

tissue of the neck, diseases of the vertebral column or of the bones of the thorax, &c. In tracheal dyspnœa, respiration is accompanied by stridor similar to, but hardly ever as sonorous as, that of laryngeal dyspnœa, and the cough has a peculiar brassy character. A valuable differential symptom between laryngeal and tracheal dyspnœa is, that in the former the larynx makes considerable respiratory movements, whilst in the latter it stands quite still, however great the difficulty of breathing may be.

In all the cases under II.—IV., in which the narrowing is considerable, the respiratory movements are prolonged, and there is often inspiratory depression of the epigastrium and of the intercostal spaces. This drawing in is a valuable sign of the dyspnœa being serious. In such cases there is a tendency to œdema of the lung setting in. The degree of the dyspnœa does not only depend upon the degree of the stenosis, but also upon the quickness of the development of the latter. In equal narrowing of the lumen of the air-passages, dyspnœa is the greater the quicker it has become developed. For the differential diagnosis of the individual affections so far mentioned, the reader is referred to the corresponding articles.

V. *In the bronchi.* (1) Capillary bronchitis; (2) diphtheritic deposits; (3) foreign bodies; (4) intrabronchial tumours; (5) intrabronchial narrowing by thickening or cicatrisation in cases of syphilis, &c.; (6) compression of bronchi by aneurisms, mediastinal and pulmonary tumours and abscesses, enlarged bronchial glands, pericardial exudation, &c. In the cases mentioned under 3–6, there is on the affected side thrill and diminution of the thoracic expansion, full and high percussion-note, and absence or diminution of the respiratory sounds, which may be replaced—if the obstruction be only partial—by sibilant or rattling, often far-audible noises. The action of the other lung is often increased. The voice in these cases is clear, but may be weak.

VI. *In the lungs.* (1) Pneumonia and other inflammatory processes; (2) œdema; (3) collapse and atelectasis of the lungs; (4) diseases destroying the respiratory tissue (phthisis, gangrene, &c.); (5) compression of the lungs by pleuritic effusions or tumours; (6) hydrothorax; (7) pneumothorax. FELIX SEMON.

DYSURIA.—Difficulty in Micturition. *See* STRICTURE OF THE URETHRA.

E

EAR, EXTERNAL, Diseases of the. For convenience of description the ear is divided into three parts: external, middle, and internal.

EXTERNAL EAR.—*Methods of Examining the Ear.*—The best method of illuminating the interior of the ear is by means of reflected light from a concave mirror. Diffused daylight is the best, but failing this, lamp or gas light will serve the purpose. The mirror should be provided both with a handle and with some contrivance for attaching it to a head band, and should have a focal distance of about six inches. The patient should be seated between the light and the surgeon, with the affected ear turned towards the latter. The light should be thrown on the ear, and any abnormal condition of the pinna and the external orifice of the meatus noticed. The auricle should next be grasped with the fore and middle fingers of the left hand, pulled backwards and upwards, a speculum of the requisite size inserted with a gentle rotatory movement, and kept in position by the forefinger and thumb. Any flakes of epithelium or small masses of cerumen obstructing the view should be removed with a pair of angular forceps or by the syringe. If no exceptional obstacles are encountered, the entire osseous canal can be seen with the tympanic membrane stretching across its deeper extremity. This, in health, is of a delicate bluish-grey colour, and highly polished. The most prominent object to be seen on the membrane, near its upper border, is the short process of the malleus; projecting downwards and backwards from this, to a point somewhat below the middle of the membrane, is a white or yellowish-white streak—the handle of the malleus. Extending from the lower extremity of this, downwards and forwards, is a bright triangular reflection of light, called the cone of light, its apex directed to the manubrium. From the short process of the malleus can be noticed a ridge passing backwards to the periphery, called the posterior fold, and

a smaller and less sharply defined one—the anterior—is seen in front of the process. The part of the membrane above these two folds is known as the *membrana flaccida*. If the membrane be very thin, the long process of the incus can be observed as a whitish streak, parallel with and behind the upper part of the manubrium. Having inspected the membrane, the next step is to ascertain its mobility, and the perviousness of the Eustachian tube. This may be effected by Valsalva's or Politzer's methods, or by catheterisation.

(*a*) *Valsalva's method* of inflating the tympanum consists in forcible expiration, with the nose and mouth closed.

(*b*) *Politzer's method* is as follows:—The patient is directed to take a mouthful of water and retain it till told to swallow; the nosepiece of the air-bag is then inserted into one nostril, and the escape of air through the nose prevented by closure of both nostrils with the index finger and thumb. As the patient swallows the bag is forcibly compressed. The effect of this, unless there be great obstruction in the Eustachian tube, is to force air into the tympanic cavity. If the auscultation tube be used during this operation, the current of air is distinctly heard to strike against the membrane, and inspection of the latter shows an alteration in its curve, and very often injection of its blood-vessels.

(*c*) *Catheterisation.*—To introduce the Eustachian catheter, it is held between the thumb and forefinger and passed quickly but lightly along the floor of the nose with the point downwards, till this touches the posterior wall of the pharynx; the instrument being rotated outwards, is withdrawn till the point is felt to pass over the rounded projection of the posterior lip of the Eustachian tube, when a further slight rotation upwards, and a gentle onward pressure, will cause it to enter the orifice of the tube (Politzer). Another plan consists in withdrawing the catheter till the curve is felt to ride over the soft palate; the point is then turned upwards and outwards as before (Grüber). A third is to turn the point of the catheter inwards, and withdraw it till the beak hooks round the posterior edge of the nasal septum. The catheter is then rotated downwards and outwards, describing rather more than half a circle, when the point is usually at the mouth of the tube (Löwenberg).

When the catheter has been introduced, it can be retained *in situ* by being held between the thumb and index finger of the left hand. If the use of both hands is required, the catheter may be held in position by Bonnafont's nasal clamp. Air can be injected into the tympanic cavity either by the mouth, or by means of an india-rubber bag fitted accurately to the catheter. Force must be carefully avoided in introducing the instrument, lest the point should lacerate the mucous membrane, and a dangerous emphysema of the neighbouring parts result on inflation. Sometimes, owing to an obstruction in the inferior meatus, the catheter cannot be introduced; in such a case it must be bent to a greater curve and passed through the other nostril. During inflation, valuable information may be obtained as to the condition of the Eustachian tube and of the tympanic cavity by means of the auscultation tube. In the normal state of the middle ear, the sound heard is of a distinctly blowing character. If the mucous membrane is abnormally dry, while the Eustachian tube is patent, the sound is harsh; if the tube is narrowed, the air passes through with difficulty and is but faintly audible; if fluid is present, either in the tube or tympanic cavity, a bubbling or gurgling sound may be heard; and lastly, if the membrana tympani is perforated, the air is heard to hiss and whistle through the perforation. The patient's hearing should be tested before and after inflating the tympanum, either with a watch or by Politzer's *acoumeter*. The condition of the auditory nerve and labyrinth should next be investigated by means of the tuning-fork (*see* Deafness), and lastly the nasal and pharyngeal cavities should be explored (*see* Nose; Pharynx).

Among the affections of the External Ear the following are the most important:—

a. Eczema.—This occurs both in the acute and chronic forms. Sometimes it is primary, at others an extension of an eczematous condition of the face and scalp. Seldom affecting the entire auricle, it is often seen on the posterior surface or in the fossa of the helix. When eczema spreads into the external meatus, it may cause deafness by the swelling of the lining membrane, and by the accumulation of epidermic scales.

Treatment.—When the attack is confined to the auricle, the same treatment as for eczema elsewhere should be adopted; but when the disease involves the meatus, liq. plumbi subacetatis should be instilled into the ear during the early stages. Later, the epithelial accumulations should be wiped away by means of dry cotton-wool, and the surface brushed over several times

with a concentrated solution of nitrate of silver (Argenti nit. ʒj. ad aq. fʒj.), and after this treatment, to avoid relapses, anointed for some length of time with Unguentum hydrarg. subchlor. (ʒj. ad ʒj.).

β. Hæmatoma Auris consists of an effusion of blood between the cuticle and perichondrium on the anterior surface of the auricle. It may occur spontaneously or as the result of injury. It is of a bluish-red colour, hard to the touch and rarely fluctuating. When traumatic there may be pain, and a feeling of heat and fulness in the ear; when spontaneous, it is painless. It is not unfrequently found among the insane. This affection is best treated by cooling lotions, such as Goulard water, or by cold compresses. When pain, if present, is unrelieved by these remedies, the hæmatoma may be incised and the contents turned out, and a dressing of a weak solution of boracic or carbolic acids and compresses applied.

γ. Diffused Inflammation of the External Meatus.—This lesion is rare except as the result of injecting irritating substances, or mechanical and traumatic causes. The symptoms are: great redness and painful swelling of the cutis, with sense of fulness in the ear, followed by a serous or viscid exudation, On examination, the epithelial lining looks whitish and sodden, and, on syringing, comes away in flakes and even as an entire cast of the passage. The hearing is, as a rule, normal or only slightly impaired; occasionally the patient complains of noises in the head, and even of giddiness. Sometimes the meatus is so contracted by the swelling that it is impossible to get a view of the deeper parts. The pain is often violent, and is increased by pressure on the ear or movement of the jaw. When very severe, the inflammation sometimes terminates in perforation of the membrana tympani, or in ulceration of the osseous wall and the production of granulations. The diagnosis of primary otitis externa is difficult, where an uninterrupted view of the whole meatus and membrana tympani cannot be obtained. The prognosis is usually favourable, but is less so when the membrane is perforated, or when granulations exist. When the osseous walls are carious, there is danger of the inflammation spreading to the cranial cavity.

Treatment in the early stages should consist in the application of cold compresses over the ear, and a leech or two to the tragus; and as soon as secretion is established, the instillation of a warm alcoholic solution of boracic acid (gr. x. ad fʒj.) or liq. plumbi subacetatis and glycerine, equal parts. When the attack is obstinate, the meatus may be painted with a solution of nitrate of silver (ʒss. ad aquæ fʒj.), or powdered boracic acid may be blown into the ear.

δ. Circumscribed Inflammation of the External Meatus. — Furuncules. — The symptoms of this affection are usually very marked; there is great pain, often radiating over the side of the head, increased by pressure on the auricle and movement of the jaw. At first the hearing power is normal, but later there is often deafness. On examination one or more circumscribed swellings are observed, sometimes nearly closing the meatus; these are not generally reddened, but are exquisitely tender when touched. Eventually the abscess bursts and the pain subsides, often, however, only for a time, as no sooner has one furuncule run its course than another appears. In severe cases there is considerable febrile disturbance, and where there is a succession of furuncules, the patient is greatly exhausted by pain and sleeplessness. Notwithstanding, the prognosis is good, any permanent impairment of hearing being rare.

Treatment.—At the commencement of the attack, hot fomentations should be applied, and a warm alcoholic solution of boracic acid instilled into the ear. When the meatus is much narrowed by the swelling, a plug of cotton-wool, soaked in equal parts of glycerine and laudanum, often gives great relief; and should the pain be very acute, a leech may be applied to the tragus. In the later stages, free incision should be made into the swelling, but if the incision be made too early it only relieves the pain for a time.

ε. Otomycosis.— This is a chronic inflammation of the external meatus caused by the presence of a vegetable fungus, generally belonging to the species of aspergillus. The symptoms are—pain, tinnitus, and slight impairment of hearing. On examination a serous discharge is observed, and the membrana tympani and adjacent walls of the meatus are covered with a yellowish-white or black spotted membrane, and, on removing this by syringing, the tympanic membrane and meatus are found reddened and swollen.

Treatment consists in frequent syringing with warm water or weak carbolic acid, and then filling the meatus with an alcoholic solution of boracic acid. Occasionally the aid of forceps is required to remove the fungus. Other remedies recommended

are: chlorinated lime (gr. ij. ad aq. fʒj.), and hyposulphite of soda (gr. iij. ad aq. fʒj.).

ζ. *Foreign Bodies.*—Children are especially fond of putting a great variety of substances into the ear. Among the commonest are: peas, beads, cherry-stones, and bits of slate-pencil. In cases of neglected otorrhœa, flies and maggots are also sometimes found. The symptoms will depend very much upon the size, shape, and character of the substance introduced. Inanimate bodies give rise to no symptoms beyond possible deafness, unless pressing unduly on the membrane or walls of the meatus. Peculiar reflex phenomena are, however, occasionally observed, to be explained by irritation of the numerous nerve-filaments derived from the trigeminus and vagus. Thus, cases are recorded of persistent cough, vomiting, sneezing, giddiness, and even epileptiform seizures, which have ceased on the removal of the substance.

Treatment.—Having ascertained the presence of a foreign body, its removal should first be attempted by syringing in the usual way, or, this failing, with the head inclined downwards. Should syringing be unsuccessful, instrumental means must be tried. The form of instrument will depend much on the shape and size of the foreign body. Speaking generally, the most useful instrument for the purpose is one with a fine, blunt-pointed, hooked extremity. The surgeon should endeavour gently to insinuate this in the gap between the body and the wall of the canal, and special care must be taken not to drive the body deeper into the meatus. If the object is long and lying across the canal, it can most readily be removed by means of a fine pair of forceps. Failing other means, Löwenberg proposes applying to the object a small brush dipped in glue, and withdrawing it when the glue has dried. Syringing alone will not remove maggots; they must first be killed by dropping alcohol, chloroform, or olive oil into the ear. If the ear be inflamed from the presence of a foreign body, or by previous injudicious attempts at its extraction, the inflammation must be subdued prior to any operative measures being attempted.

Obstruction or Narrowing of the External Meatus.—Occasionally this canal is closed by membranous septa or cicatricial adhesions. These may be caused by the coalescence of granulations, or ulceration resulting from caustic substances, syphilis, &c., or by the continued contact of the abraded and thickened surfaces of the cutaneous lining.

Treatment consists in dividing the septa or cicatrices and introducing sponge-tents or cotton-wool plugs, to prevent union of the cut surfaces. More common than complete obstruction is narrowing of the canal. This may be congenital, or the result of inflammation or hyperostoses. Lastly, in old people, the external orifice may be reduced to a mere vertical slit, due to an over-flaccid condition of the fibrous tissue and skin of the cartilaginous canal. This condition rarely causes any appreciable deafness; should it do so, the introduction of a small silver or india-rubber tube will restore the hearing. *See* Aural Exostoses.

Injuries to the Ear.—Injuries of the external meatus affect the osseous more frequently than the cartilaginous portion; lesions of the latter are generally combined with those of the auricle. The osseous portion may be fractured by direct violence, as by some object being forcibly thrust against it; or by indirect violence, such as a blow or fall on the ear or head, or a blow on the lower jaw, driving the articular process against the walls of the meatus. Uncomplicated fractures either terminate in recovery or in caries and necrosis. More generally, however, they are complicated by injuries to the membrana tympani and tympanic cavity, the mastoid process, and even to the base of the skull. When the roof of the tympanum is implicated in the fracture, fatal meningitis may ensue. The membrana tympani may be injured by direct penetration of foreign bodies, by extension of a fracture of the base of the skull, or by sudden condensation of air in the meatus, such as occurs in a violent explosion. The prognosis in cases of injuries of the ear will depend on the complications which exist; thus a ruptured membrane will, in the majority of cases, quickly heal, with little or no impairment of hearing, provided the labyrinth be not involved in the injury. While, on the other hand, if the labyrinth is involved, the prospect of recovered hearing is extremely doubtful.

Treatment.—Injuries of the auricle and soft parts of the external meatus should be treated on general surgical principles. In rupture of the membrane, the introduction of fluids into the ear should be carefully avoided, unless suppuration is established. In most cases the membrane will speedily heal, but if inflammation ensues, cold compresses may be applied, and a leech or two to the tragus.

A. E. Cumberbatch.

EAR, INTERNAL, Diseases of the. The symptoms of disease of the internal ear are mostly subjective, and, where no lesion of the tympanic cavity affecting the labyrinth is present they are generally included under: (1) Deafness, (2) Tinnitus, (3) Giddiness or Auditory Vertigo, and (4) Nausea and Vomiting. Other symptoms, such as hearing a double sound, hyperæsthesia, &c., may be met with, but they are so rare that they do not require further notice here.

(1) *Loss of hearing*, when the acoustic nerve is involved to a marked extent, is shown by the acuteness being lessened both to aërial and osseous conduction, the latter being the test on which we mostly rely. If a nerve responds to a sounding fork by osseous conduction better than by aerial, and, compared with a normal ear, is equally or more sensitive by bone-conduction, the cochlear structures corresponding to the tone of the fork employed may be considered healthy. *See* DEAFNESS.

Cases arise in which the range of audition is limited either by congenital non-development or by disease, and this can only be determined by the use of numerous differently toned forks. Such cases are probably not rare in general nervous diseases, such as tabes dorsalis; but few investigations have been made on the point, and, as they are at present of more interest to the specialist than the general practitioner, they need not be further dwelt upon.

(2) *Tinnitus*, which may be continuous or intermittent, of all characters, localised in the ear, or extending over the cranium, is due to irritation of the acoustic nerve. It may be the only symptom present, but that is not usual.

(3) *Giddiness*, or *Auditory Vertigo*, is rarely followed by unconsciousness, comes on suddenly, causes the subject thereof to fall forwards or backwards, or to reel to one side. It is due either to labyrinthine pressure, or to reflex cerebellar irritation.

(4) *Nausea* is frequently associated with the above, but is not so common as any of the others.

It must be remembered that any of these manifestations may occur from changes outside, but acting upon, the labyrinth; and that the diagnosis can be effected only by the comparison of the perception of the bony with the aërially conducted vibrations, the history of the attack, the presence of any of the usual causes of labyrinthine affection, the symmetry of the loss, and the absence of any other change sufficient to cause a temporary impairment or abolition of function.

The *Causes* of the above symptoms are very numerous.

General Diseases of the System, and more especially the zymotic diseases, scarlet fever, variola, mumps, typhus, diphtheria, typhoid fever, either affecting or not affecting the middle ear, may cause such a condition of hyperæmia of the labyrinth that changes of a temporary or lasting character are induced. To anæmia, degenerative affections of the liver or kidney, disorders of the digestion, pregnancy, lactation, and menstruation, have been attributed prejudicial influences on the internal ear. But of all the general diseases causing abeyance or annihilation of the cochlear function, syphilis, either congenital or acquired, is the most frequent.

Acquired Syphilis is generally preceded by some mucous membrane affection of the ear, but it may attack the internal ear suddenly. It occurs in the secondary or tertiary stage, usually affects both ears, and commonly produces the three great internal ear symptoms—deafness, tinnitus, and giddiness. The worst cases of internal ear affection arising from this cause seen by the writer have been marked by the absence of severe secondary symptoms, and the accompaniment of retinal changes.

In *Congenital Syphilis* the external affections of the ear are ordinarily preceded by affections of the external tunics of the eye, and the malady of the cochlea is generally heralded by visible choroidal and retinal changes. *See* CONGENITAL SYPHILIS.

The origin of the malady may arise *in the cranium*, either from vascular changes therein, such as aneurism of the basilar or internal auditory arteries, atheroma, emboli, or hæmorrhages; or from obstruction in the venous circulation of the labyrinth, through changes in the superior petrosal sinus or other venous channels passing from the skull. Meningitis, cerebral or epidemic cerebro-spinal, cerebritis, apoplectic conditions, tumours, or abscesses may, and do, cause alterations at the auditory centres, in the course of the portio mollis, or in the labyrinth. Many *medicinal substances*, especially quinine, opium, alcohol, and salicine, produce abnormal conditions of the labyrinth, followed by tinnitus and deafness.

Diseases of the Middle Ear, by causing a rapid or continued pressure on the labyrinth, either directly on the fenestral membranes or by indirectly initiating reflex vasomotor labyrinthine changes; or, as in purulent middle-ear disease, by inducing caries or necrosis of the walls thereof, may

effect a transient or permanent alteration of the delicate structures therein contained.

Sudden loud and unexpected noises, such as the firing of heavy artillery, or continuous and repeated concussions, as in boiler-making, often give rise to enervation of the acoustic, by causing a congested condition of the parts. Any condition, by which an excessive or decreased tension of the fluids of the labyrinth arises, will act prejudicially on the fragile membranes therein contained, and cause a diminution of the acuteness of hearing.

A primary affection of the internal ear, in which all the symptoms usually found are present, without marked cerebral, spinal, or middle ear complications, has been described by M. Menière, and received his name. The sufferer is attacked by sudden giddiness, causing an inclination to fall in one particular direction, accompanied by nausea, retching, pallor, and sweating. These may be attended with deafness and tinnitus at the time, or they may come on afterwards. Unconsciousness is rarely present, and the vertigo passes off while the tinnitus and deafness remain. These attacks generally return at varying intervals, each being succeeded by an increase in the deafness and the sounding, till even the latter is lost, and the acoustic insensibility is complete. When this occurs, the other symptoms may not return. The pathological conditions found have been accumulations of reddish lymph in the semicircular canals, without any recognisable cerebral lesion.

The *labyrinthine changes* found are numerous, and include the following, viz. tumours—fibro-vascular or cholesteatomatous—hæmorrhagic or serous extravasations, anæmic or hyperæmic conditions, suppurative inflammation, caries, necrosis, exostosis and non-development of the fenestræ, vestibule, semicircular canals, or cochlea.

Under the term *tinnitus aurium* are included all subjective noises causing an irritation of the nervus acousticus from whatever cause they arise. The kinds of tinnitus complained of are as varied as the causes assigned for them, and they may arise in any aural disease which produces a change of tension or of circulation, or an irritation of the acoustic directly. They may be occasioned reflexly by changes in distant organs, as in the stomach, liver, or teeth. The nerve may detect alterations in the muscular contractions of the muscles of the middle ear or Eustachian tube, or in the blood-flow through the vessels which surround it or supply it. These are, in reality, objective sounds, but are usually included among the subjective, and have been described as subjective entotic tinnitus.

The hallucinations of hearing of the insane are, in some cases, connected with peripheral aural disease, and disappear with the cure of that affection.

Deaf-mutism generally results from congenital non-development of the organ, or destruction of the hearing function, in children who have not yet learned to read. In the former cases heredity plays a weighty part, and, in these, the curtailment of the visual sense is frequently seen, especially *retinitis pigmentosa*, which should always be looked for in deaf-mutes, the offspring of consanguineous parents. The abnormal conditions found in the ear are complete absence of the labyrinth, non-development of the semicircular canals, absence of the fenestræ, or defective sound-conveying apparatus. It is found that 40 per cent. of such cases hear some sounds or even words, and it is the cultivation of this little remnant of hearing which has given rise to the boasted remedies for such sufferers.

Treatment.—It will be seen from the above that the causes of affections of the internal ear are not always discoverable, and that many which are recognised are beyond the skill of the surgeon. Of those which may be alleviated, the cases arising from middle ear affection stand first, and in these the local treatment of the affection is usually followed by amelioration or cessation of the labyrinthine symptoms.

In *hyperæmia* vesication over the mastoid process, by repeated applications of linimentum iodi or cantharides, local depletion of the stylo-mastoid supply by leeches or Heurteloup's artificial leech, combined with purgatives and abstinence from alcohol, tobacco, and excitement, are to be recommended.

In *anæmia*, fresh air, regular exercise, nourishing food, and the exhibition of ferruginous tonics embrace the treatment.

In *syphilitic affections* large doses of iodide of potass, and mercurial inunction, are frequently followed by diminution of the symptoms. Counter-irritation of the mastoid, and subcutaneous injection of from 5 to 10 minims of a two per cent. solution of the muriate of pilocarpine are advocated by some.

To relieve subjective tinnitus, bromide of potassium in 20-grain doses thrice daily, hydrobromic acid in 15 to 20-minim doses as frequently, and the chloride of ammonium in 10 to 20-grain doses have been found more useful than other internal remedies. Counter-irritation of the external

meatus or mastoid, the injection of chloroform or sulphuric ether vapour through the Eustachian tube, the hypodermic injection of morphia, and the incising of the membrana tympani, have all been extolled, but, though sometimes beneficial, are generally found wanting.

In *acoustic paralysis*, the use of strychnia or phosphorus is occasionally serviceable. The continuous galvanic current has been often employed, and has met with varying success.

In *Menière's disease*, gentle purgatives, rest in bed, and slight counter-irritation to the neck, are all that are required for a short time. Should the symptoms continue, large doses of quinine—5 to 10 grains three times daily—are given by Charcot, while digitalis, the bromides, and the actual cautery to the mastoid, are employed by others.

In *deaf-mutism*, with the treatment of any lesion which can be detected, the education by lip-reading and the articulate speech system, which strengthens the organs of speech and breathing, and places the sufferer in a position in society far above what could have been hoped for before the system was introduced, is to be carefully carried out under experienced teachers.

W. Laidlaw Purves.

EAR, MIDDLE, Diseases of the.—*Acute Catarrh.*—Whatever causes acute congestion of the naso-pharyngeal mucous membrane, such as severe cold, the exanthemata, &c., may give rise to acute catarrh of the middle ear. The attack begins with a sense of fulness in the head followed by pain, which may be severe, though not usually so. There is dulness of hearing, which soon increases to more or less marked deafness. Sometimes tinnitus is present, and even giddiness, and in severe cases there is some febrile disturbance. On examination the meatus usually presents a normal appearance, or is but slightly congested superiorly, close to the membrane; it is rarely narrowed by subdermoid effusion. When the attack is slight, the membrane shows but little change beyond a dimness of its polished surface, but if more severe, there is redness of its upper posterior segment, or even of the entire surface. The cone of light is altered in position or may disappear. Sometimes the effusion of fluid into the tympanic cavity is so great as to cause bulging or even rupture of the membrane. When the latter occurs, the perforation speedily heals when the tension is relieved. The Eustachian tube is either narrowed or closed by the swelling of its lining membrane and by accumulation of mucus. The termination of the case will depend very much on the severity of the attack and the condition of the patient's general health. When mild the attack often subsides without treatment, but severe cases, if neglected, either end in the formation of an abscess or lapse into the chronic form of disease.

Treatment.—If the attack is not severe, confinement to the house for a day or two, astringent applications to the throat, and the use of Politzer's air-douche, will be sufficient to effect a cure. In severe cases, in addition to this treatment, a leech should be applied to the tragus and warm fomentations to the ear, or warm water with a little laudanum should be instilled into the meatus. If the membrane is distinctly bulging, great relief will be afforded by puncturing it with a double-edged cutting needle. When there is free secretion from the naso-pharyngeal cavity, a warm nasal douche (Boracis et Sodæ carb. āā gr. v. ad Aq. f℥j.) should be used for a few days.

Chronic Catarrh.—Various pathological conditions are included under the term chronic catarrh of the tympanum; but as in so limited a space it is impossible to describe all the symptoms met with, only a general description of the disease can be given. It probably never commences as a chronic affection, but is the result of repeated and slight subacute attacks, or of a single acute one. Even in the case of boiler-makers, engine-drivers, &c., a low form of inflammation is probably started by repeated concussions of the membrane. Constitutional syphilis, gout, rheumatism, gestation, and heredity are predisposing causes. The symptom generally first observed is hardness of hearing, particularly in general conversation; this is soon followed by tinnitus, although this symptom may be noticed by the patient before any difference in the hearing power is detected. The deafness often increases so gradually that it has probably been in existence some time before the patient notices it, especially when one ear only is affected. The hearing power varies in many cases with the state of the weather and the patient's health, being worse in cold damp weather or after fatigue; pain is rarely present, and is never severe. Sometimes the patient complains of giddiness, or actually falls when walking, and this even where there is no proof of organic lesion in the labyrinth. Sometimes there is a sense of tightness in the head, and a feeling as of the ears being closed by some foreign body. In certain cases patients can hear better in a noise, as when driving in a

cab or railway carriage. On examination the meatus appears dry and shining; occasionally it contains impacted cerumen, the removal of which, however, does not improve the hearing. The appearance of the membrane varies greatly; sometimes unaltered, it more generally is whitish or brownish in hue. No congestion is visible, unless a slight subacute attack be present.

At times the anterior segment is depressed, in which case the handle of the malleus is sharply defined; at others the entire membrane is depressed and the handle of the malleus is tilted backwards and inwards. Opacities, calcareous deposits, and thin spots, the result of atrophy of the membrane, are occasionally seen. The cone of light becomes more horizontal, or is broken into one or more points. Rhinoscopic examination may show the Eustachian tubes obliterated by cicatricial bands, variously distorted and drawn out of place, or simply narrowed. The pharyngeal mucous membrane is swollen and congested, granular, or dry and pallid; in children adenoid vegetations in the roof of the pharynx are often found. The prognosis of chronic catarrh is not altogether favourable. Much depends on the age of the patient, the duration of the disease, and the liability to frequent subacute attacks. If the patient is gouty or rheumatic, if deafness is hereditary, or if the disease has extended to the labyrinth, the prognosis is unfavourable. Patients who hear better in a noise, in the writer's experience, never improve under treatment.

Treatment.—The nose and pharynx must first be thoroughly investigated, and, where necessary, restored as far as possible to a healthy condition (*see* NOSE; PHARYNX), and any disorder of the general health rectified. Astringents should be applied to the throat in the form of spray, lozenge, or gargle, and the tympanum inflated every third or fourth day, by means of Politzer's bag or the Eustachian catheter. In the writer's experience, the introduction of lotions and vapours into the tympanic cavity is very rarely of any benefit, and frequently does harm; while making an artificial opening in the membrane, incision of the posterior fold, division of the tensor tympani, &c., are operations to be undertaken only by experts, and are rarely attended with success. Under appropriate treatment some cases of chronic catarrh are greatly improved and others slightly so, whilst a large percentage unfortunately derive no benefit. Some cases improve for a time under treatment, but relapse as soon as this ceases.

Acute Purulent Catarrh is separated from the non-purulent variety, mainly for clinical convenience. It arises under the same conditions, and the symptoms of the two are undistinguishable at first; indeed, it is often impossible to say, at the outset of an attack, whether it will end in suppuration or not. In the suppurative variety the symptoms are generally more severe, and the pain greater. After a while the abscess bursts through the tympanic membrane, and the pain subsides or ceases. Examination of the ear, after cleansing, discovers a perforation in the membrane, which is usually single, but may be double. At first irregular in shape, it soon becomes more or less circular, and varies greatly in size and in situation. The epithelial lining of the meatus and tympanic membrane is whitish, sodden, and often shed in places; where this has occurred, the dermis is of a bright red colour. Occasionally, owing to some abnormality of the meatus or to the swelling of its walls, the perforation cannot be seen; when such is the case, the peculiar whistling sound heard on auscultation, during inflation of the tympanum, will prove the existence of a perforation.

Treatment.—The patient should be confined to the house at first, and a simple saline aperient administered. The pain should be combated by hot or cold compresses and warm instillations, or, these failing to afford relief, by leeches applied to the tragus. Politzer strongly recommends the application to the side of the head of a piece of cotton-wool, sprinkled with a mixture of equal parts of olive oil and chloroform. When the throat is affected, as is usually the case, an astringent gargle should be ordered, or the throat painted with nitrate of silver (Argenti nit. gr. xv. ad Aq. f℥j.) or chloride of zinc (Zinci chlor. gr. xx. ad Aq. f℥j.) If the membrane is distinctly bulging, immediate relief is afforded by incising it, and so assisting the escape of matter. When there is swelling and tenderness over the mastoid process, which are not relieved by leeching, a free incision may be made down to the bone. After the first severity of the attack has subsided, the ear should be syringed night and morning, and some astringent lotion used. (Some of the most efficient lotions for this purpose are Zinci sulph. and Acidi boracici āā gr. iv. ad Aq. f℥j.; Acidi boracici gr. x. ad Alcohol f℥j.; Liq. plumbi subacetatis and Alcohol, equal parts; Zinci sulph. gr. v.; Acid. carbol. gr. ij. ad Aq. f℥j.) Inflation by Valsalva's or Politzer's method, previously to syringing, will greatly facilitate the remova

of the discharge from the tympanic cavity. This inflation serves also to preserve the patency of the Eustachian tube.

Chronic Purulent Catarrh.— This affection is the result of the previous acute form, and is very common in young people. The discharge is often profuse and offensive. The perforation in generally large, and at times almost the entire membrane is destroyed, in which case the malleus and incus have disappeared. The mucous membrane of the tympanic cavity can be seen, red and swollen. Often polypi are present, either springing from the cavity or from the meatus, or both. If the perforation be small, and the membrane is denuded of epithelium, red, and œdematous, this may be easily mistaken for a polypus.

Treatment.— The ear must be kept scrupulously clean, being syringed two or three times a day, according to the copiousness of the discharge; after each cleansing, the meatus is to be dried, and powdered boracic acid blown into it. (The barrel of a quill, with a piece of india-rubber tubing attached, makes a very convenient apparatus for this purpose.) If powdered boracic acid fails, some astringent lotion should be tried, and where the mucous membrane of the tympanic cavity is much swollen, absolute alcohol is the best application. This should be diluted, at first, with an equal quantity of water, and gradually increased in strength. Inspissated pus clogging the meatus and tympanum, and not readily removed by syringing, may first be softened with a warm solution of carbonate of soda (gr. x. ad Aq. f℥j.) Narrowing or obstruction of the Eustachian tube must be dealt with by means of Politzer's bag or the catheter.

The Artificial Drum.—After curing the purulent catarrh, should the perforation not close, and marked deafness remain, the hearing may often be greatly improved by means of the artificial drum. Without stopping to discuss the *modus operandi* of this drum, it may be stated that there are two varieties, Yearsley's and Toynbee's; all others are but modifications of these. The former is made by moistening a piece of absorbent wool and rolling it into a thin plug, about an inch long. This is passed, with a pair of forceps specially made for the purpose, till it is in contact with the membrane. When the right spot is discovered, against which the plug should press, the patient is at once conscious of an improvement in his hearing. Several trials are usually required before success is attained. Toynbee's drum consists of a thin circular disc of india-rubber, fastened to a piece of silver wire, long enough to allow the disc to reach the membrane, the disc being cut of the requisite size and shape before introduction. When a satisfactory result is obtained, the patient must be instructed how to adjust the drum for himself. The cotton-wool has the advantage over the india-rubber of being less irritating to the ear, and can be moistened with various astringents in cases where the discharge has not quite ceased; but, if used, it must be changed daily.

Complications.—Various complications may arise in the course of chronic suppuration of the middle ear. I. Polypi. II. Mastoid disease. III. Caries and Necrosis. IV. Meningitis and Cerebral Abscess. V. Phlebitis and Pyæmia.

I. *Polypi.*—These may arise during an attack of acute inflammation of the meatus, but more frequently during chronic purulent catarrh of the middle ear. They usually spring from the tympanic cavity, the membrana tympani, or the external meatus. Varying in colour from greyish-pink to bright red, smooth or raspberry-like on the surface, pedunculated or sessile, they vary greatly in size.

Treatment.—Small polypi, arising in the external meatus, can be readily extracted with a small pair of urethral forceps; when larger, with Wilde's snare. Those arising in the tympanic cavity may be removed with various instruments; but, on the whole, Wilde's snare is the best. Fixing the patient's head, insert the largest speculum possible, and throwing a strong light on the ear, pass the loop of wire over the tumour, till the resistance due to the wire reaching the pedicle is felt, and then cut through the growth. Should there be a difficulty in severing the pedicle, owing to its toughness, it is better to rotate the instrument several times, and, dividing the wire close to the ear, withdraw the snare, rather than run the risk of snapping the wire by putting too great a strain on it; in a few days the tumour will slough. The simplest method of removing a large firm polypus is to seize it with a pair of small dressing forceps, and twist it off at the pedicle by rotating the instrument.

II. *Mastoid Disease.*—This occurs in two forms: *α.* periostitis, *β.* muco-endostitis.

α. The symptoms are—great pain, often radiating over the side of the head, redness and swelling behind the affected ear, which often stands out more prominently than the other; there is also some febrile disturbance. After an interval, fluctuation

can be detected. Occasionally the abscess bursts into the mastoid cells, in addition to opening on the surface. Sometimes the abscess will burrow beneath the muscles at the back of the neck, and may reach as far as the foramen magnum; at others it will track downwards beneath the sterno-mastoid muscle as far as the root of the neck.

β. This affection may be primary, although it is usually a complication of middle ear disease. The symptoms are deep-seated pain and tenderness only on making firm and prolonged pressure; swelling and redness are not marked symptoms, and may be absent. When severe, indications of cerebral irritation may exist, such as giddiness, tinnitus, squint, vomiting, &c. Sometimes the abscess makes its way through the mastoid process; at others it bursts into the cranial cavity. Rarely, instead of an abscess forming, the inflammatory products ossify, and the mastoid cells are converted into solid bone (osteo-sclerosis.)

Treatment.—If matter can be detected, the abscess should be freely opened; but if not, leeches should be applied to the mastoid process, and these failing to afford relief, an incision down to the bone must be made. Sometimes the meatus is much narrowed by œdema or by the pressure of matter which has burrowed posteriorly beneath the periosteum; in either case the right treatment is free incision. The discharge from the tympanum should be encouraged for a time by hot fomentations and syringing with warm water, and if a polypus be present it should be removed without delay. Should symptoms of brain-mischief supervene, the mastoid process must be trephined; in doing this, great care must be taken to avoid wounding the lateral sinus.

III. *Caries and Necrosis.*—This is also another not uncommon complication of chronic suppuration. Almost any part of the temporal bone may be attacked; the mastoid process, the tympanic cavity, the meatus, the boundary wall of the lateral sinus, or the petrous portion containing the labyrinth. Often the diagnosis is readily made, as when the mastoid process, or posterior wall of the meatus, is affected; but when the deeper parts are involved, it may be impossible to ascertain, with certainty, the presence of dead bone, although this may often be suspected. There are no special symptoms indicating dead bone, but paralysis of the portio dura in the course of a chronic purulent catarrh, a watery and offensive discharge, and polypoid granulations in the ear, resisting treatment, are all suspicious signs. Where it can be done with safety, dead bone should be removed.

IV. *Meningitis and Cerebral Abscess.*—Cerebral abscess has been found, *post mortem*, in cases of otorrhea, where no sign of caries or necrosis could be detected. More frequently, however, a diseased condition of the temporal bone is the exciting cause. When, in the course of purulent middle-ear catarrh, there is a rise of temperature, with headache, photophobia, optic neuritis, and vomiting, there is strong presumption that intracranial mischief has supervened, the symptoms of which need not here be further detailed. *See* Encephalitis.

A. E. Cumberbatch.

EBURNATION. *See* Osteo-arthritis.

ÉCRASEUR.—This is an instrument for removing growths or diseased parts by the gradual tightening of a loop of wire or other material. The parts are crushed through, and vessels of considerable size may be divided without any hæmorrhage whatever. The essential part of the instrument is a loop of wire, wire rope, or chain, which can be reduced in size by a mechanism in a suitable handle. The ends of the loop are passed through a canula, or an eye at the end of the handle. Thence the wires are conducted to the handle, one end being attached to a fixed point, the other to a button connected with a screw, by turning which the wire is drawn down, the loop diminished, and the encircled parts constricted and divided. The length of the canula and handle and the play of the movable button will depend upon the size of the loop required, and the depth of the cavity in which the growth is situated.

Two modes of reducing the loop are in use—one, as mentioned above, where by the turning of a screw the movable end of the wire is drawn down, and the other a rack movement. The handle in the screw form is a revolving bar or wheel; in the rack form a bar working by a side-to-side tilting movement, which tightens the chain link by link. Where the part to be removed can be surrounded, as in a pedunculated tumour, the loop is either placed over the growth, or one end guided round the pedicle. Where this cannot be done, as in removing portions of the tongue, the wire is carried through at the desired point or points by a needle or canula, and the parts severed in one or more places. The loop may be prevented from slipping by transfixing the part with stout harelip pins, or a sort of pedicle formed by dividing the mucous membrane,

for example, at the side of the tongue. The loop must be tightened slowly, and after every few turns the action must be for a few moments stopped altogether, to allow time for coagulation to take place, and for the slower division of the parts. In this way no hæmorrhage need occur at all, and the wire is less liable to break.

Somewhat modified, the écraseur is used in removing polypi from the ear and nose, the instrument being called a snare.

CHARTERS J. SYMONDS.

ECTHYMA.—At a time when skin-diseases were regarded solely as forms of eruption, without taking fully into consideration their other important features, ecthyma was regarded as a definite pustular disease. This is, however, no longer the case, and the name 'ecthyma' might with advantage be dropped out of our nomenclature. It is, however, still used to indicate a large pustule, forming a conical scab, and somewhat resembling a superficial boil. It is met with among the poor and badly fed, in such diseases as scabies, phthiriasis, and eczema.

ROBERT LIVEING.

ECTOPIA VESICÆ and EPISPADIAS. — The peculiar deformity of the bladder here treated of is always attended by a deficiency of the anterior or upper wall of the urethra, constituting the deformity of epispadias. Slighter degrees of the latter deformity are frequently found without the ectopia, but all the cases of *ectopia vesicæ* in the male which the writer has seen, amounting to between sixty and seventy, have been coexistent with epispadias. Many of these cases have been present in sickly-looking children and youths, not infrequently the subjects of tuberculosis. The proportion of females to males is very small —not more than one in ten cases.

Sometimes there are evidences of degeneration of the kidneys similar in its pathology to the ordinary surgical kidney, with cystic degeneration, and dilated pelvis and ureters. This condition is brought about by granular growths on the mucous membrane of that portion of the deformed bladder upon which the ureters open, causing obstruction to the flow of urine. The papillary orifices are irritated and inflamed by the friction of the clothes, and often present a warty appearance, with a rough surface discharging muco-pus, a condition resembling somewhat that of granular conjunctiva induced by entropion in the eyelids. These growths and thickening of the papillary orifice produce the ordinary effects of obstruction in the urinary passages, first shown by dilatation and hypertrophy of the ureters, and secondarily affecting the pelvis of the kidney. Sometimes a muco-purulent secretion issues from the orifice. In these cases a degree of albuminuria greater than is accounted for by the local cystitis is found.

But frequently no such signs of the condition of the secreting structure of the kidney are to be found, and great circumspection is required before the surgeon should attempt to relieve this deplorable condition of the patient by operation. In the experience of forty cases operated on by the writer, a fatal result chiefly from this cause, previously undetected, has occurred in four cases.

The condition of *ectopia vesicæ* is perfectly compatible with life prolonged to a considerable length, and even, it is said, with the power of procreation. The writer has seen cases in which the patient has reached the age of fifty to sixty years. Females thus affected have, in some cases, borne children.

Not uncommonly the sex of the patient has been mistaken, and partly from this error, and partly from the greater convenience of the dress, the miserable patient has been brought up as a female—the smallness of the testes, placed in a large labial fold of skin, leading to ignorance of their presence and meaning. This serious mistake is further promoted by the great width of the hips, and the waddling gait induced by the pelvic deformity, and by the feminine mode of micturition rendered necessary by the open bladder, in cases where the urine is retained for a short time in the dilated ureters.

The patient is usually first seen by the surgeon during infancy or childhood. In the hypogastric region the site of the *mons veneris* is occupied by a red vascular-looking projection, presenting a mistakable similarity to a nævus or malignant tumour, and reaching down to and involving the dwarfed and epispadiac penis. In the female it ends in a split clitoris, and merges into the *labia minora* on each side. But it will be observed that, when the child coughs or cries, the tumour will become tense and protrude in the way of a hernia, and probably a spurt of urine may jet out of two prominent conical elevations at the lower part, just above the stunted penis. When the jet is decided, this indicates always a certain amount of dilatation of the ureters. The jet of urine may also be produced by

depressing the penis and thus clearing the uretal orifices. It will be noticed, also, that there seems to be a total absence of the navel cicatrix, rendering the upper and middle regions of the abdominal wall very peculiar in appearance.

Careful examination will show that just on the upper margin of the red protruding mass is a crescentic border of cicatricial tissue, which really represents the upper or omphalo-mesenteric part of the umbilicus. Above this will be seen and felt, in the median line—especially when the recti abdominis are put into action—a flat surface, hard and resisting, of from an inch to two or even three inches wide, bounded on each side by the recti muscles, and tapering upwards to the ensiform cartilage. This is the widened and expanded linea alba, and the structures covering the peritoneum here are sometimes very thin, although tough and resisting. The skin over this interrectal interval is smooth, and usually free from hairy growth. The recti are separated by the whole extent of the wide divergence of the superior rami of the pubes from the median line.

The penis is flattened out and stunted in length, and is applied closely to the lower surface of the exposed bladder between the uretal papillæ. On depressing it will be seen the urethral groove, showing the various urethral ducts and follicles, including those of the prostatic urethra. The prepuce is usually somewhat large, and depends like a dewlap, with the frænum preputii in the centre attached to the lower part of the corona of the glans penis. The scrotum is wide, shallow, and generally large, and often the testes are normally placed. But sometimes the dartos development is small and deficient, and the testes are in the groin. On each side of the penis and exposed bladder is seen an elevation or protuberance, which is caused by the forward projection of the pubic angles and their incomplete symphysial surfaces. Under the penis and below these projections can be felt a resisting ligament, which is found on dissection to be the strengthened and largely developed lower or suburethral fibres of the triangular ligament of the urethra. The subpubic ligament and upper or supra-urethral part of the triangular ligament are, of course, wanting. Frequently there is found, on one or both sides, an oblique inguinal hernia, with the testis below, either in the scrotum or above it. This additional abnormality necessitates great care in dissecting up flaps while operating over the sac of the inguinal rupture.

The perinæum in these cases is short, and the anus placed somewhat more forward, and with a more anterior direction at the orifice, than is natural. The thighs are seen to be more separated from each other, and the pelvis and perineum wider than natural, giving an appearance and gait similar to that of a largely developed female pelvis. The pelvic skeleton in these cases is so peculiar that any of the bones forming it can be easily and separately recognised by the anatomist as affected by this deformity. The pubes are separated to the extent of from two to four inches, the superior rami shortened and directed forwards, and the obturator foramen diminished in size, narrowed, and turned outwards. The iliac bones are straightened out more than normal. The sacrum is very peculiar. The lateral curve, instead of being concave, is flattened out or even convex, with the ilio-sacral facets turned more outwards than normal, while the vertical curve is straightened.

The patient suffers much from the constant flow of urine, together with the friction of the clothing upon the exposed and inflamed surface of the bladder. When from errors of diet or hot weather the urine is rendered irritating, the suffering is greatly increased, and the unhappy patient is truly an object of commiseration and pity.

Treatment for the relief of ectopia vesicæ:—Some years ago Mr. John Simon proposed an operation for the relief of this deformity, which consisted in making a communication from the base of the imperfect bladder between the ureters into the rectum. The intention was to make this communication permanent, and then to cover the bladder entirely with skin. Mr. Lloyd also performed this operation upon a patient. The patients operated on in this way died without the permanent communication having been established, from extravasation of urine and peritonitis. Mr. Thomas Smith, in one case, detached the ureters from the bladder and passed them through an opening in the rectum, with the hope that they would become permanently adherent, and that the rectum would assume the functions of the bladder. This patient also succumbed to the irritation and diarrhœa produced by the constant presence of urine in the rectum.

It had been felt by surgeons since the modern revival of the art, that if a covering of skin could be provided for the bladder, the suffering would be much alleviated, especially if the flow of urine could also be directed over the grooved penis, and

confined to that spot. Dr. Ayres, of New York, seems to have been the first to operate to relieve in this way a female patient in whom the clitoris was split and the vagina and bladder formed one large cloaca. He turned down a large flap of skin from the abdomen, with its raw surface uppermost, and endeavoured to get this to cicatrize and heal. The result was not very encouraging. Dr. Pancoast, of Philadelphia, tried in the case of a male patient to accomplish this end by turning over a lateral flap with its skin surface towards the bladder, and placed over it another lateral flap twisted so as to place its raw surface undermost upon the other. The surfaces adhered, but an opening remained upon the abdomen, above the flaps, through which the urine flowed, and this resisted all attempts to close it. Trouble was also experienced from the growth of hair into the bladder from the reversed flap. It was found in process of time, however, that the hairs finally ceased to grow, the bulbs being destroyed by the constant irritation of the urine. The operation does not seem to have been followed up in the United States by either of these surgeons or by others. Mr. Holmes, of St. George's Hospital, was the first to follow a modification of Pancoast's method in this country, in 1863, and in two of his cases was successful in making the patient more comfortable. About the same time the writer had his first successful case at King's College Hospital. His operation consisted in making lateral flaps of skin and uniting them, without reversal or superimposition, in the median line. Trouble was experienced in closing up the opening in the median line above the bladder, but after one or two unsuccessful attempts this was overcome, and the patient lived for nearly a year, wearing an india-rubber urinal comfortably, and then died of bronchitis. The parts were secured, and are now to be seen in the museum of King's College. The deep surface of the reversed skin, forming the new anterior wall of the completed bladder, is seen through an opening made in the hinder wall to be covered with smooth mucous membrane.

After several attempts, with variable success, the writer improved his operation in two directions—first, by having recourse to a reversed upper or umbilical flap, and by laying the two lateral transplanted flaps upon it. Since that plan was adopted, the upper opening, which formed at first such a difficulty, has been always closed by the first operation, or nearly so. But a fresh difficulty arose. From the constant hernia-like pressure of the abdominal contents upon the loose and flexible hinder vesical wall, the opening above the penis had a tendency to get larger and wider, and the bladder to protrude as the cicatrices contracted. To remedy this, a second operation, based upon M. Nélaton's operation for epispadias, was devised. The essential part of Nélaton's procedure was the raising of a bridge or double-rooted flap from the front of the scrotum below the penis, and passing the penis under this bridge so as to protrude below. A long narrow flap was reflected from the linea alba above, and laid over the grooved urethra with its skin surface downwards, and the bridge of scrotal tissue was then stitched upon it. The hair which afterwards grew upon the reversed flap from the site of the mons veneris, and blocked up the urethra, was a serious drawback to this method of procedure.

In the second or supplemental operation of the writer, the reflected flap for union with the superimposed scrotal bridge is obtained from the margin of the arch over the penis, formed by the union of the lateral or groin flaps, and the sides of the penile groove were also reflected so as to form a raw surface for the reflected flap to adhere to. The cases thus operated on, now amounting to forty in number, were rendered much more comfortable; and in one which was exhibited at King's College Hospital many times since, the patient has been successful in retaining the water for a short time when he lay down, by the use of an india-rubber nipple placed over the penis and the surgically-formed prepuce, so as to constrict them somewhat, and thus arrest the flow of urine. On coughing or sneezing powerfully, however, this is apt to slip, but answers its purpose on the whole pretty well. Other cases have worn an india-rubber urinal similar to that in use in railway travelling. Various modifications of this operation have been performed by different surgeons. A very successful one in a female child was lately published by Mr. Robson, of Leeds, in the *British Medical Journal*, January 24th, 1885.

The following is a description of the writer's operations for the relief of *ectopia vesicæ* and *epispadias*.

1. The first operation, i.e. for the *Ectopia*. The lower part of the abdomen and the genitals are first carefully cleaned and shaved. In cases where the hair is unusually abundant it is best, in the first instance, to remove it by some depilatory and by applying previously a drop of strong nitric acid to the several groups of hairs at

successive intervals, the bladder and other parts being carefully protected by a mixture of olive oil and chalk laid on freely. When the skin has healed, after the action of the acid, the parts should be well washed with a 2½ per cent. solution of carbolic acid, in which all the instruments used in the operation should be steeped. The patient being anæsthetised and laid flat on his back, the flaps should be marked out by a pen-and-ink mark.

The upper flap should be figured by a line extending along the side of the bladder-surface vertically upwards as far as the measured distance from the root of the penis to the upper margin of the bladder, and then carried in a rounded curve across the 'linea alba' at this point to join another vertical line of equal length on the opposite side of the bladder. The two groin flaps for superposition are to be made of a rounded lancet-shape, with their roots downwards and inwards at the base of the scrotum, and continued along the side of the urethral groove for about half its length. These flaps should be long enough and detached enough to meet in the median line for their whole length, and no sharp angles should be left in their outline. The incision for making them should join that of the lateral border of the first or umbilical flap at about its centre. In raising the umbilical flap, care must be taken not to make the skin too thin, which is apt to be done in the centre of its base near the upper margin of the bladder. At this point there is little or no subcutaneous tissue, and the aponeurotic and tense linea alba is thin and easily injured by the knife, consequently the greatest care is required to avoid opening into the peritoneum or subperitoneal fascia. This accident, in one case in Paris, under M. Follet (a pupil of Nélaton's), caused the death of the patient from peritonitis. The urine could not be prevented from passing afterwards into the wound.

It is better to lay hold of the flap with the fingers than to use the forceps, which are apt to damage the vitality of the edge of the flaps, upon the direct union of which a good deal of the success of the operation depends. In raising the lateral or groin flaps the superficial external pudic vessels are divided, and are often large enough to require ligature. After being raised the flaps should be folded back, so as to lay bare the raw surface, which should be suffered to become glazed, after all bleeding has ceased, and all clots are removed with a saturated solution of boracic acid in the form of spray. The upper or umbilical flap should first be dealt with, folded evenly down with its skin surface to the bladder, its corners being stitched with thickish wire sutures to the cut edge at the root of the penis on each side. The ends of the wire should be left so long as to project, with a view to their easy removal. A single half-knot tied on them in the usual manner, and held by a sharp bend back at both ends, is the best way of securing the wire (the thickness of which should be enough to hold the bend or kink without untwisting). The groin flaps should then be placed upon the raw surface of the umbilical flap, with their inner edges held in contact along their whole length by six closely-applied wire sutures. The bases of these flaps should pretty closely embrace the root of the penis. The raw surface left by the reflection of the umbilical flap can be easily covered by drawing its edges together with three or four strong and long harelip pins, which have the effect of relieving any strain which may affect the reflected flaps. At this stage of the operation the patient's shoulders should be well raised and his knees bent and adducted, to diminish the stretching of the abdominal parietes. The upper borders of the groin-flaps may be held upwards by one or two thick wire sutures, but the site of the groin flaps should be left to heal by granulation.

During the operation the knife should be kept carefully in hand, especially if a cough or uneasiness under chloroform affects the patient and causes sudden bulging of the bladder. The latter should be repressed by holding a soft sponge firmly upon the flaps. This pressure has the additional advantage of squeezing out the urine and causing the sticky, glazed surfaces of the flaps to adhere together. On being removed to bed, the patient must be kept doubled up, and never allowed to stretch himself out. He should be placed on a waterproof in a sitting posture, with his shoulders well propped up behind, a thick bolster under his knees, and a bandage passed round the knees and over and across the shoulders and back, to maintain the flexed position while being removed. The wounds should be painted over with collodion, and a few drops of oil put into the urethral opening, to spread over the bladder surface and promote the free passage of urine.

In the female the umbilical flap should be large, and the incision for the groin flaps on each side should be carried well down, so as to have their roots in great measure connected with the labia. When

they are placed together and stitched upon the umbilical reversed flap, the vagina should be almost closed up by them, with but a small opening to allow the passage of the urine. Through this opening a very large india-rubber drainage-tube should be kept in the vagina, and be changed and cleaned daily.

As the cicatrix contracts in the male patient, the urethral opening may become considerably enlarged by the hernia-like protrusion of the hinder wall of the bladder, already alluded to, distending the aperture and depressing the penis. This change may be accelerated by repeated coughing or crying on the part of the patient. But the bladder and uretal openings are more or less effectively protected, by their deepened position, from the friction of the clothes.

As a supplemental procedure in the male, the following operation for the *epispadias* which remains, and for a preputial covering for the penis, will usually be found necessary:—

2. *Operation for Epispadias*, modified from that practised by Nélaton.

The patient must first have all the hair-bulbs, which are likely to give trouble afterwards by growing into the urethra, destroyed by strong nitric acid, as before described. When the skin is sufficiently healed, the parts must be carefully cleansed by washing wth a 40 per cent. solution of carbolic acid. The patient being anæsthetised, and placed flat on his back on the operating table, the surgeon makes an incision parallel to and half-an-inch above the arched cicatrized urethral border of the covering of the bladder, and then turns down by dissection a fold of the skin, with its skin surface placed upon the penis. The incision should be carried well along the sides of the urethral groove, so that the side of the penis is well denuded, and the urethral groove completely covered by the meeting of the inverted flaps in the median line. A cold soft sponge is pressed firmly by the assistant upon the bleeding surface with the penis firmly stretched out.

Then another curved incision is made below the root of the penis at the junction of the penis and scrotum, meeting the incision already described on each side. A third curved incision is then made along the lower border of the scrotum, longer than the former and with a downward projection in the middle to form the point of the prepuce. The intervening skin of the scrotum is then dissected up from the testes, leaving the bridge of skin, with pedicles three-fourths of an inch wide, thus formed, attached on each side to the top of the scrotum. The point of the penis is then depressed and pushed under the bridge of skin. The scrotum will then be found to cover the penis like a hood. The bleeding should be quite stanched by the pressure of an iced sponge, or by the application of thin catgut ligatures. The folds of skin which were first formed for the deeper covering of the urethra, are then turned with the skin-surface downwards upon the urethral groove, and stitched together in the median line with a continuous or glover's suture of tolerably stout wire, which is to be cut off long at both ends, so as to be withdrawn easily when no longer required. Over the freshly-denuded surface thus presented, the scrotal bridge of skin is placed, raw surface to raw surface. The upper margin is then stitched by closely applied interrupted sutures both along the upper and lower borders of the bridge-flap.

A large sized india-rubber tube, well oiled, is to be placed in the groove of the urethra, passing well into the bladder. It can be held in place by wires, fastened on each side to the silver sutures applied to the scrotum. Finally the lines of sutures should be covered freely with collodion, and the urethra well oiled. The patient should be placed in bed, sitting bolt upright, with his knees placed close together, and quite flat upon the bed. A mackintosh should be arranged under him so as to catch the flow of urine, and drain it off to the side of the bed, where a dish can be placed to receive it. A mild opiate may contribute to keep the patient quiet. He should be fed on milk, eggs, and beef-tea with bread sops.

In all these plastic operations on the bladder and urethra, it is essential that the sutures should be left absolutely untouched until they are clearly useless. It will be found to be more convenient to take all away that have not dropped off, at one *coup*, with the patient under an anæsthetic. This prevents a great deal of crying and straining, which try very much the newly-formed adhesions. About a fortnight after the operation will usually be found the best time for doing this. The silver sutures do no harm, set up no irritation, and keep quite clean.

If the flaps get hot and swollen about two or three days after the operation, much benefit will be obtained by irrigation with boracic acid lotion—a semi-saturated solution. The cradle used to keep off the bedclothes forms a convenient support for the irrigating vessel, and the fluid passes off

by the mackintosh which conducts the urine away.

A modification of the operation just described has been found by the writer successful in a good number of cases of slighter conditions of *epispadias*. In many of these (as is usual), there was also incontinence of urine, from the groove in the urethra extending backwards into the prostatic portion, in the manner of a harelip, and preventing its grasp upon the neck of the bladder. This has been in many cases much improved by carrying the incisions well up to the prostate below the pubic symphysis (which is also frequently imperfect here). An india-rubber cap placed over and slightly constricting the penis and newly-formed prepuce, has, in some cases, been effective in retaining the urine for a considerable time, so as to keep the patient dry at night. In still slighter cases of *epispadias*, without incontinence of urine, the appearance of the penis has been improved by transplanting in the same way the redundant prepuce, which is nearly always found hanging below the penis like a dewlap.

By reversing this procedure, and placing under the penis the hoodlike termination of the prepuce, many cases of *hypospadias* —some of a severe kind—have, in the writer's practice, been much improved, and the urine conducted to the end of the penis, so as to render micturition more cleanly and comfortable. *See* Hypospadias.

John Wood.

ECTROPION, or Eversion of the Eyelids.—There are two forms, the acute and the chronic.

(1) Acute Ectropion is generally the result of the swelling and protrusion of the mucous lining of the lid in acute conjunctivitis. Occasionally, in children suffering from purulent ophthalmia, the upper lid may be completely everted. At first the lid may be easily replaced, but later, ulceration occurs in the crease of the skin, and this is followed by cicatrisation, so that the lid is permanently fixed in its everted state.

Treatment consists in relieving the conjunctivitis by appropriate remedies, such as nitrate of silver, and other astringent and antiseptic solutions.

(2) Chronic Ectropion may be due to disease or injury of the lids or adjacent textures, such as chronic conjunctivitis, chronic ciliary blepharitis, lupus, syphilitic and other forms of ulceration of the skin, and cicatrisation following wounds or burns of the lids, or caries of the orbit. Ectropion of the lower lid may result from paralysis of the orbicularis. One or both lids may be affected, and the eversion may be partial or complete. Besides the deformity, the patient suffers from overflow of the tears, consequent upon the displacement of the lacrymal puncta. If the eversion be of such a degree as to leave the cornea permanently uncovered, there is the superadded risk of inflammation of the conjunctiva and cornea, which may lead to intractable ulceration of the cornea. In chronic cases the exposed conjunctiva may become dry and semi-cuticular, or it may become thick, exuberant, and rough.

Treatment must be directed towards relieving the subjective symptoms and correcting the deformity. For the relief of the overflow of tears, one or other lacrymal canaliculus should be opened, and for the prevention or cure of conjunctivitis, or of ulceration of the cornea, mild astringent antiseptic lotions, as Lot. acidi boracici, gr. iij.–vj. ad f℥j., or Lot. quiniæ sulph. gr. ij.–iv. ad f℥j., should be gently used two or three times a day. In the intervals the lids should be protected by a light compress, smeared with boracic acid ointment (gr. x.–xx. ad ℥j.) In cases of eversion dependent upon, or associated with, hypertrophy of the conjunctiva, the exposed membrane should be gently touched once or twice a week with a stick of nitrate of silver, or a strip of the thickened conjunctiva may be excised. In eversion due to the formation of cicatricial bands in caries of the orbit, the adhesions may be freely divided subcutaneously with a tenotome. With a view to prevent recurrence of eversion after this, and the operative procedures to be enumerated below, it may be necessary to pare the edges of the lids and stitch them together, leaving them united till all risk of a recurrence of the eversion has passed. If the edge of the lid be elongated, and the skin fairly loose, the tarsal border may be shortened by the excision of a V-shaped piece, combined, if necessary, with a closure of the external canthus (tarsoraphia). In severe forms a plastic operation may be required (blepharoplasty), such as division and detachment of the cicatricial tissue which holds the lid back, or the introduction of a piece of new skin, either by a process of gliding, or interposition, or transposition of adjacent skin, or by transplantation of skin from more remote parts. For ectropion of the lower lid, due to paralysis of the orbicularis muscle, electricity should be used.

John Tweedy.

ECZEMA.—*Definition.*—Eczema is a simple, non-contagious inflammation of the skin, a characteristic feature of which is the formation of dry and red scaly patches, or, more commonly, of papules and vesicles or pustules, which break and leave excoriated surfaces, discharging a sticky, serous fluid, which dries into crusts and scabs. The disease is attended with more or less swelling and infiltration of the skin, and much itching.

Symptoms and Pathology.—The name 'eczema' is now used in a broader, though more exact, sense than formerly, and includes many conditions of the skin which were, until lately, regarded as distinct diseases, and classed respectively with erythema, lichen, pityriasis, or psoriasis, according to the degree of development or decadence of the eczema. The earlier writers of the present century held that a visible exudation or discharge was essential to constitute an eczema. More extended observation has led to the conclusion that this view is too restricted, and that the disease is often unattended with any visible exudation whatever. Eczema may consist of irritable red patches, or groups of scattered papules, or slightly raised and scaly spots, as well as of its more typical forms of vesicles or pustules with inflamed and excoriated surfaces; and any, or all, of these lesions may be present at one and the same time. This variable or polymorphic character of the disease is, indeed, one of its most distinctive and remarkable features. Eczema, as a rule, does not produce scars, and, as stated above, is non-contagious; nevertheless, *pustular eczema* is inoculable, and does occasionally, though very rarely, produce superficial scars.

Subjective sensations are always present in eczema, though they vary much in degree. Large excoriated surfaces give rise to severe smarting and burning pains, while the drier forms of the disease are often associated with intolerable itching, which is aggravated on exposing the skin to the air, and also at night. There is no part of the surface of the body which is exempt from attacks of this malady; it is, however, especially liable to appear on the flexor sides of the limbs and about the mucous orifices; in infants, the head is the part most commonly affected. Eczema attacks the skin for the most part symmetrically; it is, for example, rare to find one member suffer and the opposite member entirely escape. There are few exceptions to this rule, unless the inflammation is kept up on one side of the body by some purely local cause, such, for example, as varicose veins in the leg.

Etiology.—Eczema is by far the most common disease of the skin, and is met with at all periods of life from infancy to old age. It is rather more common in males than in females. The causes of eczema may, for convenience, be divided into (1) general or constitutional, and (2) local; of these causes the former are the more important. Most observers recognise the existence of what is called an hereditary tendency to this disease, but when we have to deal with a malady which is so common as eczema, it is not easy to arrive at an exact conclusion as to the degree of heredity; few families are entirely free. That some individuals have a strong tendency to attacks of eczema, and that others have no such tendency, is undoubtedly true, but the origin of this disposition or diathesis is often very obscure. The *exciting causes* of the disease vary somewhat with the age of the patient. In infancy there are three well-recognised and common causes—(1) the process of teething, (2) injudicious feeding, and (3) too frequent washing. In childhood especially, improper food plays an important part in the perpetuation, if not in the production, of eczema. Apart from an injudicious diet, a weak and imperfect digestion is a fertile source of chronic eczema in those who are predisposed to it. Constipation, and a general neglect of the action of the bowels, is another cause likely to perpetuate the malady. The most common exciting cause is, however, anxiety and mental worry, acting probably through the organs of digestion and assimilation. Among the less-defined exciting causes may be mentioned overwork, prolonged lactation, and the abuse of alcohol.

The best known local causes of eczema are (1) the application of irritating substances to the skin; this is met with in certain trades, such as those of barmen and bricklayers, where the hand is brought into frequent contact with irritating matter. Another example is seen in the effect of the aniline dyes on some sensitive skins. (2) Excessive sweating is very apt to produce an eruption of papular eczema on the chest and back; this is commonly observed in stokers, and is occasionally seen as the result of a Turkish bath. (3) Exposure to the sun, particularly in the tropics, is a well-known exciting cause of an eruption similar to eczema. (4) Excessive washing, especially with medicated soaps, is perhaps the commonest of all local exciting causes of

the malady. (5) Mechanical irritation from rubbing and scratching plays a very important part in the extension, if not in the production, of eczema.

The diseases with which eczema is sometimes complicated or associated are chiefly gout and rheumatism, bronchial affections, and especially asthma, dyspepsia and catarrh of the stomach, boils, and varicose veins. Sometimes eczema alternates with attacks of gout, and at other times both are present at the same time; similar remarks apply with regard to asthma and stomach catarrh. Boils are often a troublesome complication, but usually yield to the kind of treatment which is suitable for the eczema, though in some instances they last for a long time after the latter is cured. The presence of sugar in the urine is very common in these cases.

Differential Diagnosis.—A typical case of eczema cannot be mistaken for any other disease. Acute eczema of the head, in which there is much swelling of the face and closure of the eyelids from infiltration, bears a very close superficial resemblance to erysipelas, and is often mistaken for it; in erysipelas, however, at the outset, the eruption is often one-sided, and the temperature is always relatively high; the pulse is quicker, and the tongue more furred than in acute eczema. Again, in erysipelas there is always loss of appetite, headache, and often wandering delirium at night. Acute eczema of other parts of the body is less likely to be mistaken for erysipelas. Dry, scaly spots of eczema, especially when they occur on the extensor sides of the limbs, are easily mistaken for poorly-developed spots of psoriasis; a previous history of eczema or psoriasis may aid the differential diagnosis in this case.

An acute or subacute attack of eczema of the palm often gives rise to the formation of blebs; this must not, of course, be confounded with pemphigus.

A dry and cracked eczema of the palm is often miscalled *psoriasis palmaris*. Strictly speaking, there is no such thing as psoriasis palmaris—that is, psoriasis which is limited to the palms; but eczema affecting the palms only is common enough, and from its dry and scaly appearance it is naturally mistaken for psoriasis; but sufferers from this malady, if they subsequently develop any eruption on other parts of the body, almost always develop eczema, and not psoriasis. Dry eczema of the palm may be distinguished from the well-known syphilitic eruption which it closely resembles (1) by the itching which is always present, (2) by the fact that it generally attacks both hands at the same time, (3) by the absence of any syphilitic eruption or symptoms in other parts of the body. For the differential diagnosis between eczema and 'the itch,' *see* Scabies.

The question is often asked of the surgeon, Is it always safe to cure eczema? In discussing this question it is admitted that an obstinate eczema sometimes disappears almost suddenly, and that coincidently with this disappearance of the eruption there may appear a catarrh (possibly an eczema) of the stomach, bowels, or bronchial tubes; it is reasonable, therefore, to ask—Is this so-called metastasis the result of treatment? We have the following reasons for believing that it is not:—(1) It sometimes happens in cases of eczema that are not under any treatment whatever. (2) It also occurs where the treatment has been of the simplest kind, and not altered perhaps for weeks before the metastasis occurs. (3) The same changes in the eczema often take place at the onset of well-defined febrile disease, such as measles, which could not be produced by any treatment, however heroic. (4) The disappearance of the eczema often distinctly follows (not precedes) the disturbance of the mucous membrane. Altogether, the cases in which the treatment has anything to do with the metastasis are so rare that they may be left out of practical consideration. But in cases of this kind, whether or not the cure of an eczema has caused internal catarrh, it is certainly both easy and wise to start the eczema again over a limited area by means of counter-irritants, and thus relieve the internal organs. Those who have had the largest experience in the treatment of eczema agree that they have more cause to regret the inefficiency of their remedies, than reason to fear their potency.

Acute Eczema.—*Treatment.*—The general treatment of acute eczema is simple and does not admit of much variation. In severe cases, where a large surface of skin is involved, the patient must be confined to the bed or couch; as the more acute symptoms pass away this rule may be relaxed. Free purging is always an essential part of the treatment, unless some exceptional circumstances contraindicate it. The best purgatives are sulphate of magnesia or sulphate of soda, or some of the natural mineral purgative waters in common use. When the attack is distinctly of gouty origin, the purgative treatment should be supplemented by the administration of alkalies, either with or without

colchicum, according to circumstances. In the *local treatment* of acute eczema, ointments, especially those of a stimulating kind, must be strictly avoided. Usually the best and most soothing treatment is by water dressing, or a weak lead lotion may be used instead of water; but in no case must the dressing be allowed to get dry. During the daytime, when the dressing can be easily kept moist, it is usually better not to cover it with thin gutta-percha or oil-silk, but at night this plan may be adopted, in order to prevent the lint drying quickly. Some patients derive more comfort from linseed-meal poultices, which have the advantage of retaining the moisture longer than water dressing; otherwise the principle of treatment is the same in both cases. When the acute symptoms have a little subsided, the linimentum calcis may be used.

Sub-Acute or Chronic Eczema.—The *general treatment* of sub-acute or chronic eczema is more or less common to all forms of the disease, and is independent of the particular region attacked; the *local treatment*, on the other hand, requires special adaptation to the stage of the inflammation in the part affected. In determining what form the general treatment should take in any particular case, it is necessary first to find out whether there is any other disease present which may tend to modify our treatment or guide it into the right channel. For example, when an attack of eczema is associated with gout or dyspepsia, the best plan of treatment is to cure the gout or dyspepsia, and treat the eczema by local means alone. In the great majority of cases, however, eczema exists as a malady *per se*, and is uncomplicated with other diseases. Under these circumstances, arsenic is by far the most valuable remedy, and this is especially the case when the patient is young. The best mode of administering arsenic in chronic eczema is, to give small doses with alkalies and some aromatic or bitter infusion just before or after each meal. Sometimes the mineral acids, combined with arsenic, are more beneficial than alkalies; no definite rule can be given on this point, but usually when the tongue is furred alkalies suit best. In children between the ages of one and three years one-drop doses of liquor arsenicalis three times a day are usually sufficient. The routine practice of treating eczema at this age with cod-liver oil and vinum ferri generally ends in failure, particularly when the eczema is of an irritable kind; in cases, however, where iron is especially indicated, the arsenic may be combined with the vinum ferri or the syrupus ferri phosphatis. In all forms of eczema great attention should be given to the proper action of the bowels; the malady is not infrequently associated with constipation, even in those who are not usually constipated, and unless this be overcome all other treatment will fail. The best form of purgative will vary with the circumstances of the case and with the age of the patient; in infancy, fluid magnesia in milk is one of the best; in childhood, sulphur powders in milk, or some effervescing saline purgative, are most suitable. In middle life, a morning draught, containing sulphate of magnesia or sulphate of soda, with some aromatic or tonic effusion, is usually the best form of purgative. Lastly, in old age, an aloetic pill at night is indicated.

Diet.—A well-regulated diet is of the first importance in the treatment of eczema. By a well-regulated diet is not necessarily meant a very abstemious diet; whether the diet should be abstemious or not will depend on the circumstances of the case. For example, pustular eczema in children generally requires a liberal meat and fish diet, with beer or wine; on the other hand, a dry, irritable, gouty eczema in the middle-aged is often benefited by a reduction in the usual amount of meat and stimulants. There are, however, certain kinds of food which are generally objectionable in eczema of all kinds and at all ages; these are coffee, sugar in all its forms, highly salted meat, and red pepper.

Local Forms of Eczema.—*Eczema of the Scalp.*—In severe cases of eczema of the scalp, especially in children, the hair should be cut short and the head well oiled, and covered with a warm poultice for a few hours so as thoroughly to soften the scabs. The scalp should then be well fomented and cleaned with warm water. When all the crusts have been carefully removed, the head should be thoroughly dried, and when quite dry, dressed with an ointment consisting of acetate of lead gr. x., zinc ointment ʒij., calomel gr. xx., nitrate of mercury ointment gr. xx., vaseline ʒij., benzoated lard ʒss.; or the white precipitate ointment diluted with an equal quantity of lard or vaseline may be used. When the eczema is of a very chronic, dry, and scaly kind, with no tendency to discharge, the best application is the red oxide of mercury ointment one part, vaseline or benzoated lard three parts. If the eczema of the scalp is subacute instead of chronic, and the head hot and irritable, a lotion should

be used instead of an ointment; the head should be covered with lint soaked in lead or sulphate of zinc, or weak carbolic acid lotion (1 in 100). The lint should be kept in position by means of a thread or cotton nightcap; when the inflammation and discharge have subsided an ointment may be used.

Eczema of the Nostrils.—If any crusts are present, they should be removed by means of oil and warm water. Subsequently the diluted citrine ointment, made quite soft, should be carefully introduced with a small camel's-hair brush night and morning.

Eczema of the hairy parts of the Face. This is one of the most troublesome forms of eczema to deal with locally. All crusts should be carefully removed by means of oil and warm water, or a poultice may be used for an hour or two to soften them. In severe cases the hair must be cut short with a sharp pair of scissors, but never shaved. If the eczema is pustular, it is generally better, after the crusts have been removed, to dry it up as quickly as possible by painting the skin with a calamine and oxide of zinc lotion. The crusts, under this plan of treatment, form again quickly and must be again removed in a day or two by means of warm water as before; but, as the eczema improves, the crusts should be removed less frequently, especially when they are firmly attached to the skin. The hairs which pass through pustules should be pulled out; they come out easily and almost without pain, a little pus escaping. In dry forms of eczema of the hairy parts, the diluted citrine or red oxide of mercury ointment is usually the best local application.

Eczema of the Auditory Meatus.—Any crusts should be removed by syringing with warm water; this should be followed by using, two or three times a day, a tepid sulphate of zinc lotion (gr. iij.–vj. ad f℥j.), or a weak carbolic acid injection (1 in 100) may be used. In some instances the injection of a nitrate of silver lotion (gr. iij.–iv. ad f℥j.) is useful, or a rather stronger solution may be painted over the walls of the meatus by carefully inserting a camel's-hair brush. When the eczema is of a dry kind, or when all discharge has ceased, citrine ointment, diluted with four parts of oil or vaseline, is the best local remedy; it should be inserted with a small camel's-hair brush or dropped into the ear.

Eczema of the Scrotum, Labia, and Anus.—In dealing with subacute eczema in this region, the parts should be kept covered with lint well soaked in lead lotion. A pair of thin cotton bathing drawers will often be found useful in keeping the dressing in its place. As soon as the more acute symptoms have passed away, the parts may be dressed with either zinc ointment or with the compound lead ointment of the old London Pharmacopœia, made quite soft by the addition of more oil. The addition of a small quantity of tar or creosote ointment to either of these is very useful in dealing with chronic eczema about the anus. In *pruritus ani*, which is generally a form of undeveloped eczema, it is best to sponge the parts freely with a strong lead or boracic acid lotion, to which has been added two or three per cent. of the liquor carbonis detergens; the parts should then be dabbed dry with a handkerchief, and some ointment applied. In pruritus of the labia, painting with a solution of nitrate of silver (20–30 gr. to f℥j.) generally gives relief.

Eczema of the Legs.—The special indication in the treatment of chronic eczema of the legs is always to bandage them when this is possible; it has the double advantage of keeping the dressing in its proper place, and at the same time exercising a little pressure on the superficial vessels of the leg, which is very beneficial in most forms of eczema. Sometimes the solid india-rubber bandages are very useful, but they do not suit all cases.

Eczema of the Hands and Feet.—Chronic eczema of the hands, especially of the palms, is one of the most obstinate forms of the malady. This arises (1) from the natural thick condition of the cuticle, which becomes brittle and cracks with the movement of the parts, leaving troublesome fissures; (2) from the functions of the organ, which is never at rest and frequently washed, both which conditions are very unfavourable to the cure of eczema. Therefore the first rule is to rest the hand as much as possible, and to forbid all ordinary washing with soap and water. Soft gloves should be worn constantly during the day; this serves the double purpose of keeping the hands clean and the dressings closely applied. The lead ointments, or oleate of zinc ointment (℥ij. ad ℥j.), are very useful in the treatment of this form of the malady. In some very chronic cases, where the cuticle is much thickened, a saturated solution of salicylic acid in flexile collodion is an excellent dressing for removing the hard cuticle; subsequently, when this is thoroughly removed, the hand may be dressed with some oleate of zinc ointment in the usual way. India-rubber gloves and finger-

stalls are sometimes useful in the treatment of chronic eczema of the hand. As a rule, eczema of the feet should be dealt with in the same way as eczema of the hands, but the toes should always be kept apart with small pieces of lint. Fissures both in the hands and feet are best treated by painting along the bottom of the fissure a solution of nitrate of silver with a very fine camel's-hair brush. In acute eczema of the hand, the arm must be placed in a sling and the hand dressed in the usual way with water dressing, followed by linimentum calcis.

Eczema of the Nipple.—Paget's disease of the nipple was, until lately, regarded as a form of obstinate or incurable eczema; it is now, however, generally believed to be a form of inflammation distinct from eczema. *See* NIPPLE, Diseases of the.

Washing in Eczema.—In the treatment of eczema, perhaps more mistakes are made with regard to washing than on any other point. In all cases of eczema, except those that are very chronic and psoriasis-like, ordinary washing with soap and water must be strictly forbidden; and, in the case of infants with general eczema of the body, all bathing must be discontinued. The new and delicate cuticle which forms over a healing eczematous surface is quickly macerated and destroyed by water, and thus the process of healing is indefinitely prolonged. ROBERT LIVEING.

ELBOW, Diagnosis of Injuries and Diseases of the. *See* ARM and FOREARM.

ELBOW, Excision of the. *See* JOINTS, Excision of.

ELBOW-JOINT, Amputation at the. Amputation at the elbow-joint is one not often selected by surgeons, although some operators of eminence, notably Professor Gross, have expressed themselves strongly in favour of it.

In performing the operation, difficulty may be avoided by bearing in mind the oblique direction of the articulation, such obliquity arising from the inner condyle being lower than the outer, the difference in level being nearly half an inch.

The operation may be performed by

I. The antero-posterior flap method (Dupuytren).

II. The single oval flap method (Baudens).

III. The circular method (Velpeau).

IV. Long anterior flap (Malgaigne).

V. Single lateral flap (Stimson).

VI. Double lateral flaps.

VII. Long single posterior flap (Holmes).

VIII. The rectangular method (Teale).

Of these methods the first and the third appear to the writer to possess the greatest merit. The former may be done either by transfixion or by cutting from without inwards. The anterior flap, at least two and a half or three inches in length, should have for its base a transverse line drawn three-quarters of an inch below the condyles. In making this flap the forearm should be flexed, so as to bring the articular surface of the humerus on a line with the edges of the coronoid process. Some operators make the base of the flap on a level with the condyles; but the advantage derived from making the base at the situation already indicated is, that the risk of subsequent projection of one or other of the condyles through the wound is diminished. The joint is then opened, the ligaments connecting the radius and ulna with the humerus being divided, and the triceps is then detached close to its insertion. The posterior flap is formed by passing the knife behind the olecranon and head of the radius, and cutting from within outwards; or the division of the structures forming the posterior flap may be effected by cutting from without inwards. The posterior flap in large muscular subjects may also be made by transfixion. Leaving the portion of the olecranon to which the triceps is attached was a method recommended by Dupuytren, with the view of minimising interference with that muscle. This can be effected with either bone-forceps or a small resection saw. Velpeau was opposed to this modification, but it has been warmly advocated by Gross, who also, to improve the shape of the stump, states that the 'inner trochlea' may be cut off on a line with the other surface.

In operating by the circular method, the incision should commence at least three inches below the condyles. This incision must not involve more than the skin, which should be dissected back half the length of the flap. The superficial muscles should be divided and retracted, and then the deeper ones. Next, the articulation—as in the previous operation—should be opened, and disarticulation effected. In this operation—in the writer's opinion the one to be preferred—the edges of the flap can be brought together, so that union may take place either in a horizontal direction, or from before backwards. The latter plan is usually adopted, as the cicatrix then falls between the condyles. Another plan, which has the alleged special merit of promoting

facilities for drainage, consists in uniting the edges of the wound somewhat in the form of a leech-bite, a method the older surgeons used to advocate in other amputations.

The single and double lateral flap methods do not appear to possess any special advantage over those already mentioned. In operating by the first of these Stimson recommends the external flap, which should be four or five inches in length, to be 'made by transfixion from a point in the middle line, in front, a finger's breadth below the bend in the elbow; or from without inwards by an incision beginning at the same point and ending half an inch higher on the posterior face of the ulna. A second incision is made transversely across the inner side of the arm about an inch below the upper end of the first. The radio-humeral joint is opened, and the disarticulation completed.' Mr. T. Holmes has performed the operation by making a long skin flap from the back of the limb, a transverse incision dividing the anterior tissues, and the resulting stump was satisfactory.

The statistics of the operation when performed in cases of extensive injury, such as are produced by gunshot wounds, are not unfavourable. In the American war it was ascertained that there had been thirty-nine cases, with only three deaths, giving a mortality of 7·6 per cent.

William Stokes.

ELBOW-JOINT, Diseases of the.—This joint is frequently the seat of both acute and chronic inflammation; the acute being usually rheumatic, traumatic, or septic, the chronic most often being of scrofulous origin.

Acute synovitis of the elbow gives rise to pain, heat, swelling, and restricted mobility. The swelling is most manifest at the back of the joint, where it obscures the natural outline of the olecranon; pain is much increased by movement, especially in the direction of extension.

The first essential of *treatment* is to ensure rest to the joint, by fixing it to a splint, which is most comfortably applied on the inner aspect of the limb; the forearm should be flexed to rather less than a right angle, and in a position of semi-pronation. If the inflammation be very acute it is best to keep the patient in bed, and to place the arm on a pillow or swing it in a cradle; in less severe attacks the arm can be supported in a sling, and the patient allowed to be up. Leeches, cold, or other antiphlogistic remedies, can thus be easily applied.

Rheumatic inflammation in this, as in other joints, is very apt to lead to firm adhesions; and it must be remembered that the utility of the limb, should ankylosis occur from any cause, will depend greatly upon the position in which the joint becomes fixed, which should always, if possible, be at rather less than a right angle.

Chronic inflammation of the elbow-joint is attended with the usual thickening of the synovial membrane, which can be felt as an elastic swelling, filling out and obliterating the natural hollows of the joint. It is frequently of scrofulous origin, and then tends to progressive degeneration of the synovial membrane, destruction of the cartilages, and caries of the surface of the bones; or the disease may begin as an articular ostitis. When suppuration occurs, and matter makes its way to the surface, much inflammatory growth takes place in the tissues around and outside the joint, accompanied with corresponding wasting of the muscles.

Treatment.—In the earlier stages of simple chronic inflammation of the elbow, much good may be obtained from repeated small blisters, the actual cautery lightly applied, and the inunction of stimulant ointments. But when suppuration has occurred and the bone-ends are exposed and carious, as so often happens in the scrofulous cases, it is better as a rule to resort at once to excision; for the results of this operation are usually so satisfactory, and the utility of the limb so much greater than if ankylosis results, that it is justifiable at a much earlier stage of treatment than in the lower extremity.

Loose cartilages are occasionally met with in the elbow-joint, but are not usually productive of sufficient inconvenience to call for removal.

Osteo-arthritis also affects the elbow, giving rise to aching pain, impaired movement, crepitation in the joint, and alteration of the shape of the bones. Warmth, friction, the douche, and the internal administration of fatty foods do good in the earlier stages of the disease. Splints and apparatus of restraint should be avoided.

J. Warrington Haward.

ELBOW-JOINT, Dislocations of the. Dislocations of the elbow-joint, unlike other dislocations, are common in young persons, usually in boys between the ages of ten and fifteen, but are most frequent between the ages of fifteen and thirty-five. Displacements at the elbow include disloca-

tions of the radius and ulna together, or of either bone separately. The former only will be described as dislocations proper of the elbow-joint.

The bones of the forearm, held together at their upper extremities by the orbicular ligament, may be dislocated in four principal directions—*backwards, forwards, outwards*, and *inwards* — the enumeration being given in the order of their relative frequency.

Dislocation backwards includes three varieties—(1) the dislocation *directly backwards*, which is by far the most common displacement at the elbow-joint; (2) *backwards and outwards*; and (3) *backwards and inwards*.

(1) *Dislocation directly backwards* is usually caused by falls on the palm (in boys often occasioned by leap-frog), and sometimes by blows on the back of the arm when the hand is fixed. The symptoms are fixation of the forearm at an angle of from 135° to 115°, and pronation of the hand. The forearm is shortened, and at the bend of the elbow is a rounded projection caused by the lower end of the humerus pressing forward the brachialis anticus and biceps muscles. Behind, the olecranon projects as a sharp angle, to the extremity of which the outline of the triceps may be traced, whilst on either side of this muscle there is a well-marked depression. The cup-shaped head of the radius may be seen and felt immediately behind the humerus on the outer side, and be made to rotate during pronation and supination. The amount of displacement backwards and upwards varies in different cases. According to Malgaigne, the most common dislocation is an incomplete one, the tip of the coronoid process lodging beneath the trochlear surface, the olecranon remaining about on a level with the condyles of the humerus, and the cup of the radius being only partly felt beneath the skin. This scarcely accords with general experience. In many cases—probably the majority—the coronoid process drops into the olecranon fossa, or at least lies behind the trochlear surface; and in a few this process has been found drawn up above the fossa, when dissected after death.

Some resemblance exists between the appearance of supra-condyloid fracture of the humerus and dislocation backwards at the elbow, but the distinctions between them are not difficult. In fracture the anterior prominence is angular and just above the bend of the elbow, so that the forearm is not shortened. The posterior projection is less angular and includes the condyles, to which the radial head and olecranon bear their normal relations. The movements of the joint can be obtained, though limited by pain. Crepitus is elicited on extension. Measurement between the external condyle and tip of the olecranon, which in dislocation is increased, in fracture is normal; and the distance between the external condyle and acromion, which in dislocation is normal, is shortened by fracture. Lastly, the deformity may be made to disappear under extension, but has a tendency to recur as soon as extension is relaxed.

Blood-effusion into the bursa over the extremity of the olecranon causes a projection at the back of the elbow not unlike dislocation backwards, and the writer has known this condition mistaken for dislocation, and force applied with a view of reducing it. The freedom of the movements of the elbow will serve to distinguish this accident from one of luxation of the joint.

The effect of dislocation backwards is to cause rupture of the anterior and lateral ligaments, laceration of some of the fibres of the brachialis anticus, together with a displacement forward of this muscle, the biceps, the brachial artery, and median nerve. In children, partial or complete separation of the epiphysis of the humerus may be a complication, and a very careful prognosis as to the future of the joint is in these cases necessary. Fracture of the coronoid process of the ulna is a complication occasionally met with, which may render the dislocation easy to reduce but difficult to retain in position. It was found associated with a vertical fracture of the head of the radius in a dislocation caused by a fall from a great height, the specimen of which is in the Museum of St. George's Hospital. The radius and ulna have been occasionally found dislocated backwards, but separated from each other.

Reduction of dislocation backwards is not often difficult. It may be effected in many cases by simply pressing the humerus back with one hand, whilst extension is made at the wrist by the other. Where more force is required pressure with the knee is usually employed. The patient sits in a chair, and the surgeon, resting his foot on the seat beside him, places his knee in the bend of the dislocated elbow; then, seizing the arm with one hand and the forearm with the other, he bends the joint across the front of his knee, and the bones slip into position. Some, with Guy de Chauliac, consider the pressure should be directed against the humerus, others follow Astley Cooper in pressing chiefly upon the

bones of the forearm. The effect of force in the latter direction will be to draw the bones of the forearm below the humerus, and in the former to press the humerus back over the coronoid process. It is probably better that these two objects should be carried out simultaneously. A modification of the same method is to carry the arm round a post or through the back of a chair, and then make traction and flexion. In any case of difficulty the surgeon should employ an anæsthetic.

(2) *Dislocation backwards and outwards* is caused by the patient falling first on his palms, then on the inner side of his forearm, by which means the bones are carried first backwards, then outwards. The forearm is semiflexed, shortened, and usually strongly pronated, but in a case recorded by Velpeau it was said to be supinated. The coronoid process is lodged behind the capitellum, and the radial head projects behind and external to the outer condyle, there being a deep hollow above it, whilst the inner condyle is unduly prominent, and the olecranon projects boldly behind. A typical case observed and sketched by the writer occurred in a boy aged ten, who, when running at the game of 'touch,' was tripped up by one boy and fallen upon by another. The dislocation was easily reduced by extension and manipulation. It would seem reasonable to attempt to press the bones inwards before using traction to bring them forwards into place. In a case related by Debruyn, where forcible traction combined with flexion was tried on more than one occasion, the result was to convert the dislocation into one directly outwards, but no force would reduce it inwards. Amputation became necessary, and the brachialis anticus, biceps, artery and nerve were found behind the external condyle, the nerve and vessel having been ruptured by the attempts at reduction.

(3) *Dislocation backwards and inwards* is usually caused by a fall, in which the weight of the body is received first on the palm, then on the outer edge of the forearm or elbow, so that the bones are carried first backwards, then inwards. It has also been caused by a fall on the back of the wrist and forearm. The forearm is slightly flexed, shortened, and usually supinated. The external condyle is abnormally prominent, whilst the internal is obscured. The coronoid process is lodged at the back of the internal condyle, and the radial head rests behind the trochlea. The olecranon projects posteriorly, and is at a greater distance than normal from the external condyle. Astley Cooper, who first described this dislocation, reduced his case by forcible extension, when, he remarks, the brachialis anticus and biceps pressed the humerus back into position. It would appear advisable to press the ulna outwards before making extension, in order that the coronoid process may pass round the projecting margin of the trochlea before being drawn forward. However extension is made, it is probable the bones will tend to travel back along the same track by which they escaped.

Dislocation forwards is rare, but rests on well-authenticated cases. It is caused by falls on the elbow when the forearm is flexed. The olecranon passes forward and lodges on the anterior surface of the trochlea, in consequence of which the forearm is lengthened to the extent of this process. The head of the radius can be felt anterior to its normal position, and there is a fossa between it and the humerus. The condyles of the humerus are more prominent than usual, and there is a depression between them where the olecranon should be lodged. Generally the forearm has been found flexed and supinated, but in one case extended. In a case of complete dislocation recorded by Monin, the bones of the forearm rose in front of the humerus, causing the upper arm to appear shortened. If the forearm be extended, the coronoid process and head of the radius distend the skin in front of the elbow. Reduction is to be accomplished by flexion of the forearm on the arm. In a case of difficulty an assistant should fix the hand whilst the forearm is flexed, and the surgeon, locking his hands on the upper part of the forearm in front, and resting his thumbs on the condyles of the humerus behind, should draw the bones of the forearm downwards and backwards, at the same time that he presses the humerus forwards with his thumbs.

Dislocation outwards is more frequent than dislocation inwards, owing to the latter being in a great measure prevented by the prominent inner margin of the trochlear surface. It is caused by a fall on the inner side of the forearm and elbow, or by a blow on the outer side of the humerus when the forearm is fixed. A case recently seen by the writer, in a man aged twenty-four, was caused simply by slipping off the curb and falling on the inner side of his elbow. The ulna is carried outwards, so that its greater sigmoid cavity rests between the outer margin of the trochlea and the capitellum, whilst the radial cup projects below and external to the outer condyle. The forearm is semiflexed, displaced outwards, and strongly pronated, whilst the inner condyle is ab-

normally prominent. The dislocation, as described, is complete only as regards the radius and as a luxation of the elbow-joint is *incomplete*, but very occasionally the ulna passes external to the capitellum, and the dislocation is then *complete*. Reduction is usually easy. The forearm should be seized at the wrist with one hand and supinated, by which means the pronator teres is made to draw the bones of the forearm towards the inner condyle; at the same time the elbow is grasped by the other hand in such a way that the fingers are used to draw the radius and ulna inwards, whilst the thumb presses the inner condyle outwards. Failing this, the knee may be applied over the inner condyle, whilst the forearm is supinated and drawn inwards.

Dislocation inwards is usually caused by a fall on the outer side of the elbow. The greater sigmoid cavity of the ulna embraces the under surface of the internal condyle, and the radial head lies against the inner margin of the trochlea. It is, therefore, incomplete. The forearm is slightly flexed, directed inwards, and pronated. The external condyle is unduly prominent and the internal obscured. To reduce this form of displacement the upper arm and hand should be fixed by assistants, and the surgeon should then draw the bones of the forearm outwards with one hand, whilst using the other to press the humerus inwards.

In a few cases the ulna has been found dislocated backwards, at the same time that the radius was dislocated forwards.

For the dislocations of the radius or ulna singly at the elbow *see* Radius; Ulna.

R. Clement Lucas.

ELECTROLYSIS.—The chemical decomposition produced by the passage of electricity may, under certain conditions, be applied to the treatment of disease. All forms of electricity cause electrolysis, and, although the voltaic current is at present the most convenient and effective, it is likely that other modes of developing and storing electricity may ultimately be preferred. The amount of decomposition is proportioned to the *intensity* of the current, that is, the quantity of electricity which passes through the electrolyte. The intensity is determined by the amount of electricity generated, and by the resistance offered to its passage. This resistance, inversely correlating the power of conduction, is composed of external and internal resistance, or that which lies in the electrolyte and conducting wires, and that which resides in the battery itself. Hence Ohm's law $I = \frac{E}{R_1 + R_2}$, in which I = intensity, E = electromotor force, R_1 = external, and R_2 = internal resistance. It is evident, therefore, that the work done will largely depend on the relative value of R_1 and R_2. If R_1 be relatively great, means must be taken to increase the penetrating power or tension of the current. This is done by multiplying the cells of a battery. On the other hand, R_2 is diminished by increasing the size of the cells. By reference to these facts we determine the form of battery to be used in the different applications of electricity in medicine and surgery.

In the process of decomposition by electricity there are two actions. One consists in the primary separation of the electrolyte into its components. These appear at the poles of the battery, that is, at the points where the conducting wires come in contact with the electrolyte. The substances which appear at the positive pole are called electro-negative ions, at the negative pole electro-positive. The same substance may vary in this respect according to its associations, but in a general way it may be said that oxygen, acids, and their allies appear at the positive, while hydrogen and bases appear at the negative pole.

The second action consists in the chemical changes which these nascent products bring about in their surroundings.

In organic electrolytes this secondary electrolysis is more important than the primary. Theoretically we should expect, and practically we find, that the effect of electrolysis on the tissues is mainly due to the chemical action of the nascent ions. With blood as the electrolyte, there is produced at the positive pole a tolerably firm dark coagulum adhering strongly to the electrode and of acid reaction; at the negative a pinkish white somewhat sticky froth, enclosing bubbles of hydrogen, while the remainder of the blood, according to the strength and duration of the current, assumes more or less the appearance and consistence of thin tar. On the solid textures a similar acid and alkaline reaction is produced, viz. at the positive pole a dry slough of small size with a contracting cicatrix, at the negative a livid, large, diffuse, soft eschar, the one resembling the effect of nitric acid, the other of caustic potash.

Therapeutic Uses.—Electrolysis has been employed for the cure of aneurism, for the destruction of tumours and other morbid products, and for the disintegration of urinary calculi.

Aneurism.—In aneurism our aim is to coagulate the blood in the sac. We may desire to accomplish this end at once, or we may think it better to produce only a small quantity of coagulum for the purpose of provoking the subsequent deposition of laminated fibrin. On this point there is divergence of opinion. Experience shows, however, that it is not more dangerous to attempt the full coagulation; and since deposition of fibrin subsequently is at least as likely after such an attempt, the bolder appears the better method. In most cases, however, it will be found impossible at once and permanently to occlude an aneurismal sac. It has been done, but the rule in successful cases is, that pulsation recurs for a time, even after its complete abolition. The froth occupies less space as the gas becomes absorbed, and the living current is again admitted in so far as the aneurismal wall may not have contracted with corresponding rapidity.

The constant current from a battery of considerable electromotor force should be used, that the work may be done in a reasonable time. Blood is a good conductor. The greatest amount of work, therefore, with the least shock and pain to the patient, is got from three to six cells of a size between those used for the cautery, where quantity is desired, and the ordinary medical batteries, where tension is necessary to overcome the resistance of the cuticle. As the effect is produced only at the point of contact, it is necessary to introduce needles into the blood. One needle should be connected with each pole. A larger number increases the risk of irritating the sac. Success has followed the insertion of one pole only, while the other has been applied to the skin; but with both poles inserted, the work done is more effective and accurate, and is painless. The needles should be insulated where they lie in contact with the tissues, to prevent pain, inflammation, and risk of hæmorrhage. Vulcanite was found many years ago by the writer and Dr. Fraser to be by far the most convenient insulator. The needles are usually made of steel; but to avoid destruction by acids, the one attached to the positive pole may be made of platinum or gold. The duration of the operation will be determined by the effect produced in diminished pulsation and increased tension through the formation of gas. From half an hour to an hour and a half is necessary.

If the operation be properly performed, it is free from risk. Inflammation of the sac is prevented by taking care that the exposed point of the needle does not touch it. Embolism has never occurred, and the hæmorrhage from the needle punctures is easily checked by gentle pressure, if the puncture be made where the wall is thick.

This operation has been most frequently used in aortic aneurism, after the failure of other treatment. In some cases, chiefly Italian, complete success has been attained; in others, marked amelioration. The writer has not been fortunate in obtaining a cure in aortic aneurism, but in several instances has averted for long periods impending death from external hæmorrhage, and has frequently produced diminution of size and amelioration of symptoms. On the other hand, in one or two instances he has thought that more rapid spread internally has followed the occlusion of the external sac by electrolysis.

In surgical aneurism it has been fairly successful, but it cannot be preferred to compression or ligature, and although safer in most cases than opening the sac, and in all than coagulant injections, such opportunities for its use do not frequently occur.

Blood-tumours.—In these forms of disease electrolysis finds its most complete success. It brings about a cure first by cauterising the tissues, and secondly by causing directly and indirectly coagulation of the blood. These products are then slowly absorbed. To get its best results it is absolutely necessary, by insulation of the needle and care in operating, to guard against the slightest cauterisation of the skin. Then the infinite division of the caustic prevents it from being carried into the circulation, its nascent form insures its energy, and its perfectly subcutaneous action avoids all possibility of inflammation or hæmorrhage, and all trace of scar.

For cirsoid aneurism it is the treatment *par excellence*. With perseverance and decision it will not fail. In aneurism by anastomosis it is less certain. It is difficult to occlude the huge caverns communicating with large veins and arteries so perfectly as to prevent the blood finding its way into them. It can be relied on only in examples of small size.

Whenever it is important to cure a nævus without a scar, electrolysis is absolutely certain and perfectly safe. The objection is that it is slow. Several operations are generally required, and it is of little use operating under intervals of six weeks. As much induration should be produced at a sitting as is possible without injuring the skin, or so overtaxing the absorbents as to lead to suppuration. With these precautions and perseverance, the effect is admirable in

safety, precision, and absence of mark or scar. It is of course impossible by this or any other method to cure a simple port-wine stain without leaving traces of operation. It is to the subcutaneous and partly subcutaneous forms that the operation is applicable.

Goître.—The vascular kind of goître is amenable to electrolysis. The operation requires frequent repetition, but is probably as safe and effectual as any other form of local treatment. If the tumour be causing symptoms too dangerous to brook delay, electrolysis must give place to excision. It is not to be relied upon in the cystic and fibrous varieties.

It has been employed by Schuh and others in varix. It will cure, but is inferior to other plans of treatment.

Solid Tumours.—The use of electrolysis proposed by Beard and Rockwell for the open as distinguished from the subcutaneous removal of abnormal growths, presents no advantage whatever over other methods by knife, cautery, or caustic. Consequently, after several trials, the writer has abandoned its use for malignant tumours, even when they are highly vascular. On an average the increased growth produced by irritation outweighs the absorption of the part destroyed. Doubtless electrolysis is capable of procuring the disappearance of many simple tumours, but in most it is less certain, far more tedious, and, from the necessity of anæsthetics on each occasion, not more safe than the knife. In some chronic hypertrophies and inflammations, however, it may often be useful. If pus have not already formed, and there be no persistent local cause, enlargement of lymphatic glands may be treated by electrolysis perhaps as hopefully as by any other local application. Success has followed the use of electrolysis in hydatid and other cysts.

John Duncan.

ELEPHANTIASIS ARABUM.—*Definition.*—A chronic hypertrophy of the skin and subcutaneous tissue, occasioning enormous enlargement and deformity, the result of repeated attacks of inflammation of the lymphatics and skin.

The term 'elephantiasis' is generically applicable to any hypertrophy of the skin, to whatever cause it may be due, whether to varicose veins, chronic eczema, ulcers, lupus, or syphilis; or to any condition producing compression of the veins and lymphatics, such as exostosis, enlarged glands, bone-disease, or old-standing dislocation. It is equally applicable to any hypertrophically enlarged limb, though it be merely a congenital deformity. But although any of these local causes can produce elephantiasis—the hypertrophic condition of connective tissue and morbid anatomical appearances of which are identical with those observable in the disease under consideration—elephantiasis arabum signifies far more, and differs altogether from simple hypertrophy as seen in this country, while at the same time it must not be confounded either with elephantiasis græcorum, which is true leprosy, or with elephantiasis italica, another name for pellagra.

Elephantiasis arabum is dependent on a variety of climatic conditions, and is endemic in tropical countries, chiefly in India, China, Egypt, Arabia, Barbadoes, and other islands of the West Indies, and in South America. Some authorities believe that it is commonest near the sea-coast, others that it occurs in damp and humid regions, while others again hold that it is to be found most frequently in a malarious district. It is said to affect males rather than females, the poorer and ill-fed classes rather than those who, well-clothed and nourished, obey the ordinary hygienic laws of life. It is considered that the variety of elephantiasis arabum known as lymph scrotum most frequently attacks the natives who habitually wash in stagnant, dirty water, and that the legs are affected in those who walk barefooted. No race of men is entirely exempt from this disease, which is, however, far more common among the dark than the fair races, and but seldom attacks pure Europeans.

Course and Symptoms.—The disease is usually ushered in with fever—aptly called 'elephantoid'—resembling ordinary intermittent fever, in the regularity of its recurrence, sometimes at monthly intervals, but differing from it in its duration. Inflammation of the lymphatics, either preceding the fever or appearing at the same time, produces general swelling of the part attacked. The skin becomes red, tense, tender, and burning, often vesicles or bullæ are formed, which discharge a serous or chyle-like fluid, the attack presenting, as a whole, all the characteristics of an attack of erysipelas. The general constitutional symptoms accompanying the fever are, as a rule, headache, malaise, nausea or vomiting, and severe lumbar pains, with the addition of dragging and tenderness in the groins and spermatic cords when the scrotum is the seat of mischief. After awhile, both the fever and the local inflammatory symptoms disappear, and the patient is, for the time

being, restored to health. At the end of this interval of rest the fever returns, together with a renewed erysipelatous attack of greater severity, the lymphatics becoming more involved, swollen, and twisted. Again the acute symptoms abate, but the affected part, though free from heat and pain, remains swollen and distorted. The meshes of the corium and subcutaneous tissue are distended with lymph, from which the connective-tissue elements draw excessive nourishment and become hypertrophied. The condition of the part after the first few attacks is like œdema from dropsy, causing pitting on pressure with the finger; but after several attacks of fever and local inflammation, the part feels dense and hard, and even much force will not produce the slightest indentation. After some years—Mr. V. Richards says as many as eleven and a-half—the attacks of fever cease, and the part becomes uniformly and permanently swollen. If the region affected be the leg, the appearance produced is one of monstrous deformity. For, although the enlargement rarely occurs above the knee, and there is always a constriction around the ankle, the foot and leg become one shapeless mass, like an elephant's leg, hence the name of the disease. The outline of the ankle is obliterated, no bones can be felt, and the toes are entirely hidden.

The severity of the constitutional symptoms varies; in some cases there is little or no rise of temperature, while in others the fever is intense. The pain also varies, being sometimes comparatively slight, in other instances so severe during the inflammatory attack as to prevent the patient walking. Itching is occasionally a great additional torture.

The appearance of the skin in the hypertrophic stage differs considerably in individual cases, and also in different parts of the same limb, At times, and in certain parts, it is hard, dark, and scaly, or again it may be smooth and tense, in which condition it is often attacked with eczema; or, yet again, it may be rough and tubercular. Another variety presents an appearance resembling ichthyosis, the epidermis being thickened and dirty-looking. Lymph may exude upon the skin from vesicles or small soft swellings, or the surface may be warty, or broken up by deep, foul, discharging ulcers.

Elephantiasis scroti generally commences, according to Pruner, in the form of a hard kernel under the skin, usually at the bottom of the left side of the scrotum, and is attended with severe fever and constitutional disturbance, similar to that already described. The skin becomes thickened, indurated, furrowed, and wrinkled. The abdomen alters in form, the skin being drawn down so as to assist in enlarging the scrotum. The penis also increases in size, but becomes hidden in the enormous overgrowth beneath it. As the tumour enlarges, which it may do to the size of 100 lbs. or more, the lymphatics become varicose and often burst, the discharge from them drying and forming crusts. A condition called 'lymph varix,' described by authors under various names, is said to occur chiefly in China, and is most often associated with elephantiasis scroti. It presents the appearance of a soft tumour which, when punctured, exudes a pinkish or whitish fluid like chyle.

The parts most commonly attacked by elephantiasis arabum are the leg, usually one only, and the external genital organs, male and female. It also assails the arms, scalp, ears, and tongue, showing a preference for the parts in the order named.

Morbid Anatomy and Pathology.—To the naked eye a section through a limb affected with elephantiasis arabum presents an appearance of layers of enormous thickening in the corium, subcutaneous tissue, fasciæ, and periosteum; and, while the bones are hypertrophied, the muscles are wasted from long-continued pressure. There is much exudation of lymph, and to the touch the section is tough and unyielding.

Under the microscope the horny layers of the epidermis are seen to be in some places thickened and rugose, in others they are hardly more than normal. The connective tissue of the corium has a swollen gelatinous appearance. The subcutaneous tissue is in one part dense and fibrous, in another soft and jelly-like. The lymphatic vessels are much dilated, and contain lymphatic cells in fibrin (Cornil). In one of Sir Joseph Fayrer's cases of elephantiasis scroti, Mr. D'Arcy Power found the outer layers of the epidermis but slightly thickened, the rete malpighii remarkably so. The subcutaneous tissue was very greatly thickened and contained a large amount of unstriped muscular tissue. The blood-vessels were very numerous and of large size, the lymphatic channels fairly numerous, and some of them of considerable diameter. In another case there was a large amount of lymphoid tissue, and in the subcutaneous tissue small highly refracting angular bodies, staining deeply, supposed to be filariæ.

Simple hypertrophy of connective tissue is the result of over-nutrition of the parts, arising from inflammatory or mechanical occlusion of the lymphatics. Some authorities maintain that though there is a local inflammation, the result of lymphatitis, the disease itself is due to some special dyscrasy, which is probably more or less induced by undue exposure to great alternations of temperature in humid and hot climates. Others trace it to exposure, whereby the part is brought into direct contact with some poison which penetrates the skin. Some have attributed it to malaria also, and others again believe that the whole pathology is to be explained by the fact that a minute animal known as the *filaria sanguinis hominis*, blocks the lymphatics and sets up the inflammation. The theory of the relations between the filaria and elephantiasis arabum is both ingenious and interesting. As long ago as 1866 Wucherer, of Brazil, detected the embryos of a special entozoon in the urine of a patient suffering from chyluria. Unaware of this discovery, Lewis, of Calcutta, in 1868, called attention to his own observations of a like kind, and in 1872 announced that he had found filariæ in the blood of a person suffering from elephantiasis arabum, and gave them the name of filaria sanguinis hominis, and claimed to have found in them the cause of the disease. In 1875 Patrick Manson advanced the opinion that the inflammation caused by the presence of the adult filariæ in the blood produced obliteration of the lymphatic trunks—perhaps even of the thoracic duct—and, arresting the lymph-current, consequent hypertrophy. In 1877, a still further step was made. Some eminent authorities, among them Bancroft and Spencer Cobbold, came to the conclusion that there was evidence that elephantiasis arabum was propagated by the mosquito, and, rightly or wrongly, this is now the generally accepted theory, and it certainly seems to harmonise with many of the facts. It was found that the filariæ reposed in some organ of the patient during the day, and appeared in the blood only at night, which is the time when the mosquito feeds. It was further known that, after laying its eggs, this insect makes its way to the water and there dies, and so liberates the filariæ. Bathing in water thus contaminated, the natives expose the legs and genitals to contact with the filariæ, which either effect an entrance through the skin, or are swallowed in drinking the water. According to the most recent opinion, the female filariæ live in the lymphatics, but beyond the glands, lay their eggs which are carried with the lymph to the ganglia, where being too large to pass, they are hatched, and as embryos follow the lymphatics, and so find their way into the blood. Facts, however, seem to show that elephantiasis arabum may exist without the presence of filariæ, and *vice versâ*, so that we can hardly feel full confidence in the theory without some more satisfactory evidence. *See* Filaria Sanguinis Hominis.

Treatment.—1. Inflammatory stage.—Rest in bed, with the part raised, if it be the leg or scrotum. Salines and aperients at first, to be followed with quinine or arsenic in full doses, to mitigate the severity of the fever, and opium to relieve pain. Poultices, either hot or cold, should be applied locally.

2. Of resulting enlargement and constitutional condition.

a. Local. — Some authorities advise blistering the enlarged inguinal glands, rubbing iodine ointment into the swollen leg and bandaging it evenly and firmly, while using constitutional treatment. Blistering is said to be of particular value directly the inflammation has subsided. Others prescribe cataplasms and tepid baths or oils to soften and remove the epidermis and crusts, followed by inunctions of mercurial ointment and careful bandaging, to be repeated when the bandage gets loose. The limb to be kept horizontal.

Elastic Bandage.—The use of Martin's elastic bandage has been followed by the greatest success in the prevention of the hypertrophy. It should be applied firmly from the foot upwards immediately after the inflammatory symptoms have subsided, and should be worn for months.

Electricity. — Though not infallible, there is little doubt that electricity is one of the best forms of treatment at present known. A galvanic current of 40 to 60 Trouvé elements, applied from five to thirty minutes, with the *positive* pole on or near the sound part, and *negative* pole on different parts of the affected regions, has been tried with success. Either or both forms of electricity may be used at the same sitting.

Compression of the Main Artery.—The results obtained from digital compression have been satisfactory.

Ligature of the Main Artery.—The best authorities disapprove of this mode of treatment, which is held to be but temporarily ameliorative. In one case, however, cure was effected by this means in six months.

Amputation of the Leg.—This has occasionally to be resorted to, in consequence of the enormous size.

Removal of the Scrotal Tumour.—The spermatic cord, testicles, and penis are dissected out, and no attempt should be made to preserve flaps of integument either for penis or testicles, as it is found unnecessary and seems to be followed by recurrence. Healing is effected in from two to four months. At times removal of the whole tumour, testicles and penis included, has to be performed, but when possible the genitals are preserved, not only to avoid mutilation, but also from fear of sudden and extensive hæmorrhage, and contraction of the urethra. By careful bandaging the operation may be made almost bloodless. *See* Scrotal Elephantiasis.

b. Constitutional Treatment.—Quinine and arsenic, or quinine and iron, or iodide of potassium, give the best results, but drugs have but little power either to prevent recurrence of the disease or to check its progress. Change of climate is the most potent remedy, often arresting an attack in its early stages. Europeans should return to Europe and natives remove to a drier district.

Malcolm Morris.

ELEPHANTIASIS GRÆCORUM.—*Synon.* Leprosy, Lepra.—*Definition.*—An endemic, chronic, constitutional disease, analogous to syphilis, varying in its morbid manifestations, according to whether the brunt of the disease falls on the skin, nerves, or other tissues.

Etiology.—This must be considered as regards its production and propagation. Concerning production, neither climate, soil, race, malaria, diet, bad hygiene, nor antecedent diseases, such as syphilis, yaws, or ague, can be regarded as anything more than predisposing influences which favour its onset and development, mainly by lowering general vitality and, therefore, resistance to disease. As regards climate, while it is certainly most prevalent in tropical and sub-tropical countries, it frequently occurs also in cold climates, such as Norway, Iceland, and New Brunswick; in short, it may be found from the poles to the equator, from the east to the west. As for soil, it may occur in high or marshy lands, in town or country, by rivers and seas; and though it is true, in the main, that the home of leprosy is in the vicinity of water, even this must not be said without reservation. Climate seems, however, to have an influence on the form of the disease, as tuberculated leprosy is most common in Europe, probably from the influence of cold checking the action of the skin, and non-tuberculated in warmer climates. Eating fish, especially if putrid, is supported by some high authorities as the cause of leprosy, the idea having, probably, arisen from fish being a staple article of diet in tropical and subtropical countries where leprosy is endemic; but since in many countries leprosy is rife where (either from religious prejudices or other circumstances) no fish is eaten, this theory must be regarded as untenable.

Propagation.—Intermarriage plays a certain part, and in some places, such as the Cape, Provence, Asturia, and Galicia, leprosy is limited to certain families who intermarry.

Heredity has an undoubted influence, and Norwegian authorities consider that it may be transmitted collaterally as well as directly, and that it may even skip a generation, the second and fourth being worse than the first and third. The mixed form is the kind most frequently transmitted, and often only one member of a family is attacked; the disease may, however, be latent many years, until developed by some depressing influence, and congenital cases are very rare; for these reasons many think that, like phthisis, only the predisposition is transmitted. The question whether leprosy is contagious or not, is answered, by the College of Physicians' Report, in the negative; but there is much evidence in favour of its being inoculable even by vaccination, while coitus, prolonged contact, and even breathing the same atmosphere for a long period, seem to have produced it in some instances. The invariable presence of bacilli in the tissues of the tuberculated form, and the fact that the prevalence of leprosy in Norway has been diminished fifty per cent. in twenty years by strict segregation, are circumstances which are also in favour of the contagious theory.

Varieties.—The disease presents itself under three aspects: the tuberculated, the non-tuberculated, and the mixed tuberculated lepra. Tuberculated lepra is the most common in Europe, non-tuberculated in the tropics, and mixed tuberculated is always less common than either of the others. Although one pathologically, they are clinically so distinct as to require separate description.

Tuberculated Lepra.—Five stages may be recognised: (1) deposit with prodromata and fever, (2) eruption, (3) tuberculation, (4) anæsthesia (not always), (5) ulceration.

The prodromata which are nearly always present are: debility, depression, dyspepsia, diarrhœa, and drowsiness, a frequent sense of chilliness, profuse perspirations, with marked greasiness of skin, especially in the dark races; frequent vertigo, and recurrent epistaxis which temporarily relieves the vertigo. After a variable time, and, in some cases, without the prodromata, the febrile symptoms set in with a rigor and a rise of temperature, sometimes reaching 104° F., the pyrexia is nearly always of a remittent type, and with the sweatings, simulates ague; but the drowsiness is now very marked, and is very significant in a leprous district; the tongue is red, the pupils sluggish, and the pulse quick and feeble. Then, after a variable period, the exanthem, or 'leprous spots,' appears, coming first with œdema of the eyelids, on the prominent parts of the face, and then on the limbs; it is erythematous in appearance, but attended with deposit from the beginning; it is slightly raised, defined at the edge, from one to several inches in diameter, and distinctly hyperæsthetic at first; in colour it is purplish or mahogany red in fair people, but of a brighter red and shining in the dark races. The spots may come and go for weeks and months, each time with febrile symptoms, and then tuberculation sets in, as a rule, six months from the onset of the disease.

The tubercles come out in crops in the same places as the erythematous eruption, which by this time has faded; they vary from a pea up to a hen's egg in size, and may coalesce into an infiltration, diffuse or in clear-centred circles, or the infiltration may arise directly from the erythema which gradually thickens into this condition, without the intervention of the tubercles. The colour of the infiltration and of the tubercles is from a yellowish to a dark brown in fair, and blacker than the black skin in the dark races. As the tubercles and infiltrations develope, the hyperæsthesia gives way to diminished sensibility or even anæsthesia, which, in this form, is limited to the sites of the eruption, and is due to the pressure of the leprous infiltration on the ends of the nerves.

While tubercles may come anywhere except on the scalp and glans penis, the face, limbs, breasts, scrotum, and penis being the usual sites, the mucous membranes do not escape, and, when tubercles involve the air-passages, they often endanger life.

Ultimately, the tubercles either resolve, leaving stains, or atrophy, leaving scars, or they may break down and form indolent, sharply-defined, red glazed ulcers, with yellow, glairy discharge of a peculiar odour. At first, these ulcers can be healed by appropriate treatment, but as the disease advances they extend, and may involve almost the whole body. When the disease is fully developed, the face gets the characteristic leonine appearance, from the thickening of the skin over the brows between the natural wrinkles, the cheeks look full and pendulous, the lips are swollen and everted, and, with the nose and chin, are covered with tubercles; the ears project, and, even at an early stage, are often much thickened and covered with tubercles, and the lobe is specially enlarged, soft and pendulous. The hair of the scalp is preserved, but is lost elsewhere, and the nails also go or are represented by horny pegs. In the male the testes atrophy and the breasts enlarge; women become sterile, the voice is reduced to a croak, from the tubercles in the larynx, they snuffle from the thickened nasal mucous membrane, and blindness may ensue, from corneal tubercles or keratitis.

At varying intervals—often at the change of the seasons—exacerbations, with fever, occur, with enlargement of the lymphatic glands—especially the femoral—and after each one fresh tubercles appear, and so each attack is a milestone on the downward course.

Ulceration eventually sets in, slowly as a rule, but sometimes phagedænic, and from its extent exhausts the patient, or he may die from interference with the air-passages, extensive internal deposits, or from renal and lung complications, and less frequently from diarrhœa, anæmia, &c. In hereditary cases, before the disease developes, it may be noticed that ordinary sores are indolent and unhealthy, the lymphatic glands are enlarged, the aspect is cachectic, the features coarse and the head large, and the patient is deficient in vigour, both mental and bodily.

The special symptoms in such cases generally come out between the ages of ten and twenty, rarely under three years, and only one or two instances of its being congenital are known.

Non-tuberculated Lepra is the most common tropical form, constituting two-thirds of all the cases. Three stages may be recognised: (1) development, (2) spreading, (3) permanency.

The first lasts one or two years, and includes the prodromata, the eruption and the commencement of atrophy; there are no febrile symptoms with the prodromata, but frequent chilliness is experienced, with

malaise and other ill-defined symptoms, but the most characteristic are pain and tenderness in various places, general hyperæsthesia of the skin, and shooting pains down certain nerves, especially the ulnar, the median, and peroneal, accompanied by a burning sensation and tenderness along the course of the nerves; frequently an eruption of small bullæ occurs on the extremities where the nerves are affected, and sometimes 'glossy skin' is developed. Weakness of grasp and numbness in the course of the nerves are early symptoms, and the ulnar is generally the first to suffer.

Within a year the more special eruption breaks out, the most frequent positions for it being the back, shoulders, back of the arms, thighs, round the knees, the elbows, on the face, and sometimes in the course of nerves, especially the musculo-spiral. The spots or patches come out singly as a rule, are one or two inches in diameter, well-defined but not raised, of a pale yellow in fair, but bright yellow in dark races; they may itch or burn, but are not hyperæsthetic and rarely anæsthetic at this stage, but the sweat secretion is absent in them. From time to time fresh patches come out, but unattended by special symptoms; sometimes some of the muscles waste, and there is contraction of the little finger, while sensation in the course of the affected nerve is gone by this time, if it has not before, and the second stage supervenes.

This stage is marked by the spreading of all the patches, except those on the neck, at their periphery, forming irregular circles, ovals, or gyrate figures; the border is now distinctly raised, a quarter or half an inch broad, of a yellowish-brown colour, highly sensitive at the spreading edge, which may be papular or vesicular, the centre is atrophic, preternaturally white, or yellow in dark people, thin, wrinkled, hairless, scar-like, and dry, often covered with a powdery desquamation, and always more or less anæsthetic. The anæsthesia in the course of certain nerves also is always slowly extending its area, and the patient frequently suffers from burns and other unconscious injuries in consequence, while perforating ulcer of the foot is very apt to occur in those who walk barefoot. In cold weather solitary large bullæ very often come on the anæsthetic extremities, leaving an indolent ulcer. Paralysis is usually a late symptom, and is accompanied by wasting of muscles and flexion of the fingers, giving a claw-like aspect to the hand, which drops helplessly at the wrist. Next, interstitial absorption of the phalanges ensues, leaving the nail still attached to the stump, or a larger necrosis may occur; but on the whole, with the exception of sleeplessness, the general health continues good, and often improves when the third or permanent stage is reached, which is in about ten years from the commencement. From henceforth the eruption remains stationary, though by this time nearly the whole body-surface may have been traversed by it, so that the whole skin is atrophied, and white or yellow according to the race. Other nerves, such as the third and seventh, or some nerve of the leg may get paralysed; ulcerations are common, and, though less extensive, are deeper than in tuberculated cases; moist or dry gangrene often occurs, and, spreading until it reaches a joint, a line of demarcation is produced, and a natural amputation is performed. Although the same process is often repeated, it is slow and not extensive each time; the strength is, on the whole, wonderfully preserved, and, unlike the other form, sexual power is retained up to a late period.

Ultimately, however, the ulceration, gangrene, marasmus, and general debility from the leprous poison produce the inevitably fatal result, about two-fifths of the cases thus dying directly from leprosy; muco-enteritis is the immediate cause of death in nearly as many more, and the rest reach their end through various complications, but nephritis is not especially frequent, as in tuberculated lepra.

Mixed tuberculated lepra is the least common form, constituting about one-sixth of all cases, about half are hereditary, and often each parent has had a different form.

It begins sometimes with tuberculated and sometimes with non-tuberculated symptoms, but most frequently the non-tuberculated symptoms take the lead for a few months, and then with fever and the usual phenomena tuberculation occurs. Destruction of the cartilages of the nose sometimes ensues, and the soft palate may also be destroyed by ulceration, and these incidents constitute special features of this form. For the rest the symptoms are a compound of the other two varieties.

The prognosis is bad, and if the tuberculated precedes the non-tuberculated form the progress is more rapid. The diagnosis requires care sometimes, to distinguish leprosy from syphilis, but the presence of anæsthesia would be a certain criterion.

Pathology.—Modern research is strongly in favour of the disease being one of constitutional origin, closely analogous to

syphilis, in which special bacilli, either directly or indirectly, by their presence set up inflammatory changes in the tissues, to which many of the lesions are due; they also specially modify by their presence the exudation cells, and the endothelium of the lymphatic and blood vessels forming the so-called 'lepra cells' and giant cells, which impart specific characters to new growths which would otherwise not differ from ordinary granulation tissue, except that the infiltration is in foci instead of being diffused, and is poorly supplied with vessels.

Morbid Anatomy.—The essential features are infiltration of the skin or mucous membranes by foci of small round cells, which are especially abundant round the vessels, and where these are most numerous, viz. round the follicles and glands; interspersed in this infiltration are larger cells called 'lepra cells,' of which there are all gradations, from those little larger than a leucocyte up to the multi-nucleated giant cells. It is in these lepra cells that the bacilli are placed, and the large cells are most abundant in the deeper and peripheral part of a tubercle; there is every reason to believe that the lepra cells grow from the leucocytes or connective-tissue cells under the irritative or stimulating influence of the bacilli, one or more of which may often be seen in a leucocyte-like cell, and many in the lepra cells. The giant cells appear to be derived from the endothelium of the blood-vessels or lymphatics, and also contain bacilli in abundance.

These bacilli can best be brought into view by staining the section or fluid containing them by the Weigert-Ehrlich process for tubercle bacilli; but they require a higher power, a tenth or twelfth immersion, to see them satisfactorily, as they are much smaller than tubercle bacilli. For clinical purposes the fluid from the débris of a broken-down tubercle, or the serum obtained by squeezing a tubercle in a clamp, as Manson recommends, and then pricking the blanched tubercle, should be dried on a cover-glass and stained by the above-mentioned process; the bacilli then appear as red, straight rods, not larger than half or three-quarters of the diameter of a red corpuscle, contrasting with the blue ground. That they are really morbific agents is evidenced by their invariable presence in every case of tuberculated lepra examined, no matter whence it may have come; by their presence coinciding with the development of the lepra cells; and, though inoculation has failed to produce the general disease, a localized leprosy has been produced in dogs.

In non-tuberculated lepra foci of cells are infiltrated between the fibres of the nerve, penetrating from without inwards, until ultimately most of the nerve-fibres become pressed upon individually as well as collectively, but inasmuch as the infiltration is in foci some fibres escape, and this accounts for the oases of sensibility in anæsthetic areas. Bacilli have not hitherto been demonstrated in this form of lepra. Besides these lesions in the skin, mucous membranes, and nerves, tubercles may be found in the pleuræ, but no specific leprous changes have been found in the lungs, liver, spleen, or kidneys, nor even in the enlarged lymphatic glands which are mainly fibroid. The testes, like the sebaceous and sweat glands, atrophy by pressure of the small cell infiltration between the tubules or acini of the glands. Although there is nothing specific in the lardaceous infiltration of the liver, spleen, and kidneys, it is a frequent sequel to the prolonged ulceration, and fatty kidneys are also rather common in the tuberculated cases.

Prognosis.—Almost invariably bad; but existence, though too often in a very miserable state, may be prolonged for many years. The form of the disease exercises a most important influence, the tuberculated averaging seven or eight years, the mixed ten, and the non-tuberculated fifteen years. In all cases heredity, youth, and mental depression have a bad influence on the course of the disease.

In tuberculated cases, unfavourable elements are frequent febrile exacerbations, the extensive implication of the air-passages or internal organs, and the supervention of lardaceous disease from prolonged suppuration; whilst, if the patient comes early under treatment, if the exacerbations occur only at long intervals, if the infiltration is diffuse rather than tubercular, and his general surroundings are good, considerable amelioration of his condition and arrest of the disease for some time may be hoped for. In non-tuberculated lepra the extent of the nerve-implication is a good guide; arrest of the progress of the disease may be produced when this is limited, if there are no serious complications and the patient is seen at an early stage.

In mixed lepra the accidents of both occur, but it is usually intermediate to the other two in duration.

Treatment.—This, unfortunately, can only be palliative or preventive, the number of so-called specifics bearing testimony to the incurability of the disease. Of the

many recommended, only two have stood the test of long experience—namely, Chaulmoogra oil, from Gynocardia odorata, and Gurjun oil, from Dipterocarpus lævis. These oils are taken internally, and rubbed in externally. Both are very nauseous, and are best given in emulsion or pearls, beginning with small doses. The Chaulmoogra oil should be begun in doses of three minims, or one pearl, three times a day, after meals, and gradually increased up to the limit of the patient's endurance. Seldom more than a drachm a day can be tolerated, nausea, vomiting, and diarrhœa ensuing if the dose is too great for the individual. Gynocardic acid, in pills, has also been recommended, in doses beginning at half a grain and gradually increasing it up to three grains three times a day. The oil also should be well rubbed in, in the form of an ointment consisting of equal parts of the oil and lard; the friction should be thorough and prolonged, where possible for two hours twice a day, rubbing off the old oil with fuller's earth, or a warm bath may be given.

When Gurjun oil is employed—and it is spoken of most highly by practitioners in the tropics—it is given internally in an emulsion consisting of lime-water three parts and Gurjun oil one part, half an ounce being given twice a day; at the same time a liniment of equal parts of the oil and lime-water is rubbed in, in the same way as the Chaulmoogra oil. The writer finds that in this climate the emulsion cannot be made by this formula, the oil being too solid. For the mixture it is found best to rub it up with powdered gum arabic and water, but English patients could not get to more than a drachm a day, and that only by raising it very gradually from a five-minim dose. The liniment can be made with olive oil instead of lime-water; in the writer's hands the Chaulmoogra oil appeared to be more useful than Gurjun, but in the tropics Gurjun is most valued. Simple oils are also useful for a liniment, and greasy applications always seem grateful to the leper. Besides direct medication, frequent baths are to be used, and strict attention to general hygiene should be paid. Sulphur baths are strongly recommended by some, and since scabies is a very common complication it has a double advantage. The patient should be well and suitably clad, according to the climate, and chills carefully avoided, as they frequently seem to determine a fresh exacerbation.

When the febrile exacerbation is present, full doses of quinine should be given, such as gr. v. of the hydrochlorate every four hours; the strength should be carefully supported by highly nourishing diet, and hot baths are here specially useful; cod-liver oil, after the febrile symptoms have subsided, is beneficial. It is an exploded error that there is any disadvantage in healing the sores as soon as possible, and they should be treated on general antiseptic principles, iodoform and wet boracic acid lint, e.g., are good applications, but when ulceration is very extensive, finely carded oakum over a simple dressing is cheap and efficient, and prevents the fœtor which too often poisons the air of asylums. Most authorities recommend a change to a temperate climate, and certainly patients should be removed from districts where the disease is endemic. There can be but little doubt, however, that cold and variable climates have an unfavourable influence by increasing the liability to chills. In some cases of non-tuberculated lepra, stretching the affected nerve has been beneficial, the anæsthesia and paralysis having been relieved by it. As preventive measures, strict segregation is the only effective plan, and it is probable that the disease was stamped out of England and the greater part of Europe by this means, and the same result will probably be attained eventually in Norway by this procedure.

Those who have to dress the sores of lepers should be very careful if they have scratches or abrasions, and not neglect carbolic acid ablutions afterwards.

H. Radcliffe Crocker.

ELLIS'S SPLINT, for fracture of the clavicle, consists of a well-padded crutch for the axilla, which is supported in position by straps passed from its lower extremity over the opposite shoulder; the arm is held to the side by a transverse strap, and the forearm is supported in a sling.

Bilton Pollard.

EMBOLISM.—The plugging of a vessel by clot or foreign substance set free from some distant part of the circulation.

The process is to be regarded as one of the most important in pathology, not only on account of its direct effects, but from the *rôle* it plays in the occurrence of metastatic or secondary deposits in septic and malignant diseases. It differs from thrombosis in occurring mainly in internal organs and in the arterial system. Venous embolism is met with almost solely in the portal circulation.

Origin and Nature of Emboli.—1. Venous thrombosis is by far the most

common source, parietal clots being the most dangerous. Such emboli are usually made up of laminated clot, a careful examination of which will often allow their primary origin to be determined. In some cases they may be found to correspond exactly with the broken end of a coexistent thrombus. Venous emboli commonly originate from the femoral, iliac, pelvic, renal, or jugular veins.

2. Arterial thrombosis.

3. Vegetations detached from the cardiac valves, or portions of clot broken off from coagula formed in the auricular appendages or the spaces between the muscular trabeculæ.

4. Vegetations detached from the surface of the large arteries in advanced atheromatous disease, or portions of clot set free from the interior of an aneurism.

5. Blood-clot developed as a result of intravascular injections in surgical treatment.

6. Portions of new-growth set free in the general circulation.

7. Parasitic cysts, particularly hydatids, developed in the liver, and passing by the inferior vena cava to the lungs.

8. Fat set free by extensive laceration of adipose tissue. *See* Fat-Embolism.

9. Air entering by a cut vein. *See* Air in Veins.

Emboli may be simple, septic, or malignant. Simple emboli only will be treated of here; for further details respecting septic or malignant emboli the articles on Pyæmia and Malignant Disease must be consulted. They may be single or multiple; and primary and secondary emboli are spoken of, the latter taking their origin from the thrombus developed around the primary one. The origin of an embolus, as a general rule, determines its destination. Those from the veins or right heart are commonly arrested in the pulmonary circulation, those from the left heart or arteries in the systemic circulation, and those from the portal system in the liver. Exceptions to these general rules may occur; minute emboli may traverse the pulmonary capillaries, and, gathering clot as they go, become arrested in the systemic circulation; and this is a more probable explanation of hepatic abscess in septic cases, where the origin of the process is in the systemic veins, than the gravitation theory; or larger emboli may, rarely, pass from the pulmonary to the systemic circulation, as a result of congenital deficiency, as a patent foramen ovale. The bifurcation of a vessel, where a sudden decrease of lumen occurs, is the most common point of arrest; this may, however, depend on the shape of the clot: a rounded clot usually lodges in a single vessel, but an elongated one may ride on the bifurcation, only becoming an obstructing embolus when fresh clot has been deposited. Where a large artery breaks up into several branches of about the same calibre (e.g. pulmonary), two or three may be thus, at first partially, then completely, occluded.

Results of Embolism.—These are twofold in nature: 1. Local, consisting (*a*) in changes in the vessel itself, and (*b*) in the area supplied by it. 2. General, due to disturbance of the general economy from interference with the function of the organ or part supplied. The process is to be regarded as much more serious than thrombosis because of its sudden nature, which, even under the most favourable circumstances, renders anæmia of more or less extended duration inevitable. The results vary according to the size, number, and character of the emboli, also as to the importance to the general economy of the part or organ affected, and to the existence of a competent collateral circulation. Size is of importance chiefly in regard to the calibre of the vessel occluded and the consequent extent of the area affected; number has a similar import; but the character of the embolus is much more serious, as the principal determining point in the changes likely to ensue.

(1) *Local changes* (*a*) *in the vessel itself.* The more or less serious nature of these depends in great measure on the character of the embolus. The first change is secondary thrombosis, extending backwards and forwards to the next collateral branch, or in terminal vascular systems as far as the capillaries. This is followed by an endoarteritis of varying intensity and character. If the clot be of a simple nature the thrombus may organize, and, passing through the usual stages, the vessel either becomes permanently occluded, or its lumen may be more or less perfectly re-established, with a varying amount of thickening of the wall. If the embolus be derived from a clot undergoing regressive change, more extensive inflammation, involving periarteritis, may result; or, if it be septic, an abscess is the constant sequence, without necessarily precedent formation of an infarct. A rough or irritating embolus may, from the local injury or inflammatory softening induced, serve as the origin of aneurismal dilatation.

(*b*) *Changes in the area supplied.*—These are threefold in degree: 1. More or less transient anæmia; 2. Infarction; 3.

Necrosis. The most important factors in the determination of the degree of damage seen in the area supplied are the richness of the collateral blood-supply, the strength of the general circulation, and the tendency to degeneration of the special tissue contained. Where the collateral circulation is free, as in the extremities, a temporary anæmia similar to that seen after ligature is in most cases the only result; but this fortunate termination is, as in the case of ligature, dependent on the force of the cardiac action and the capability of the collateral vessels to enlarge; if either of these factors is defective, extensive arterial thrombosis may follow, leading to partial or total gangrene. Certain organs, however, are furnished with a so-called terminal circulation. This arrangement, met with in the spleen, kidney, brain, and lung, is the chief determining influence on infarct formation, the gradual or sudden occurrence of occlusion being rendered irrelevant, as no sufficient collateral channels exist for the re-establishment of the circulation. Congestion and infarction may, however, be hindered or prevented in these cases if the distal veins be provided with valves, in the case of the large veins, by the weight of the column of blood, by distal thrombosis preventing regressive flow, or if the embolus be not completely obstructing. In organs mainly supplied by one artery the blood-pressure in the corresponding main vein is too low to allow a regressive current to develop; and here necrosis may be due to pure anæmia without hæmorrhagic infarction.

Infarcts may be red (hæmorrhagic) or white. The red infarct, met with most commonly in the lung, consists of a wedge-shaped area of dark red congested tissue, within which a considerable escape of blood-elements has taken place by diapedesis. The base of the wedge is at the surface, the apex corresponds to the obstruction. It is developed in the following manner:—The first effect of the occlusion is anæmia of the supplied area; the arrest of blood-supply, with the consequent removal of the *vis-a-tergo* normally exerted on the blood in the veins, is followed by a retrogressive flow of venous blood, the stasis thus induced being succeeded by the escape of blood-elements through the vascular wall, probably rendered more easy by changes in it dependent on its deprival of properly oxygenated blood. In the white infarct met with in the kidney and brain, congestion and hæmorrhage take no part; the colour here depends on local anæmia and the loss of natural transparency due to the condition of coagulation-necrosis induced by want of blood-supply. Further changes take place in either variety of infarct; in vascular tissue, as lung, a considerable amount of reactive inflammation, running on to suppuration, may occur; and in this or other tissues necrosis may follow. In cases of septic embolus necrosis and suppuration are inevitable. In cases of simple infarction, however, the changes, if the lesion has not been so considerable as to cause death, are of a gradual regressive character. The infarct becomes enclosed by a wall of inflammatory new-formation, and the framework of the wedge itself becomes permeated by infiltration of a similar character; where a secreting organ is affected the special cells die and eventually disappear. The process having reached this stage, vascularisation and development of connective tissue usually follow, and this is succeeded by the cicatricial changes noted in other scars. In some cases, however, so high a degree of development not being reached, caseation or fatty degeneration takes place throughout the affected area.

2. The *general effects* of embolism furnish the symptomatology of the process. The symptoms naturally depend entirely on the organ affected; they are primarily those of interference with the natural functions, more or less transient, at times followed by signs of inflammation or necrosis, at others by permanent and complete loss of function. The artery affected determines the gravity of the symptoms in any given case. Thus embolism of the coronary or of one or more of the large pulmonary arteries may lead to sudden death, of the cerebral arteries to more or less permanent and extensive paralysis, of the arteria centralis retina to blindness; while the functions of the lungs, kidneys, liver, and spleen may be more or less interfered with. Embolism of the spermatic artery is of special surgical interest, from the fact of its so commonly being followed by infarction and gangrene of the testis.

Treatment.—No general rules can be laid down for curative treatment, which will depend entirely on the organ affected. In the case of gangrene of the limb following embolism, and consequent arterial thrombosis, time should be given for the restitution of the vascular lumen before amputation is decided on. The more important general point is that of prophylaxis—that is, to observe the greatest caution in disturbing vessels in which clots exist; for instance, to avoid all unnecessary handling in cases of fracture of the thigh or leg in which

thrombosis of the deep veins may have followed the injury; to follow the same rule in cases of phlebitis or of aneurism; to be careful that patients do not make active use of muscles after operations for varicose veins or varicocele; and in any case where injections of fluids capable of coagulating the blood are used, to employ compression on the distal side of the circulation.

G. H. Makins.

EMMET'S OPERATION or TRACHELORRHAPHY.—These terms signify the repair of a laceration of the cervix uteri by a plastic procedure similar, in many respects, to those which have long been employed by surgeons for the cure of ruptured perineum and vesico-vaginal fistula. The discomforts produced by these latter conditions are well known, and can be remedied by plastic operations. The advocates of Emmet's operation believe that many severe pelvic symptoms, and many morbid conditions of the uterus, are produced and aggravated by laceration of the cervix; and they further declare that the operation in question effectually remedies the evils which they believe to be caused by an unhealed rent in the cervix uteri. It has been asserted that when the cervix has been torn during labour, subinvolution of the body of the uterus will almost inevitably ensue, with concomitant hypertrophy of the cervix, since the solution of continuity in the cervix seems to interfere with the absorbents, and to arrest the metamorphosis of tissue necessary for a proper involution.

Retroversion is believed by many to be an almost equally constant result of laceration of the cervix, which is said to destroy the symmetry of support given by the attachments of the uterus, the body of which organ being, in such cases, in a condition of subinvolution, becomes topheavy and liable to fall backwards. Dr. Emmet himself holds the theory that the condition once known as ulceration, and now generally held to be abrasion of the os uteri, is really laceration of the cervix, with consequent ectropion of its mucous membrane. The constant friction of the everted tissues sets up much local irritation and discharge, and, if long continued, may cause epithelioma. Here it must be observed that very high authorities have described undoubted cases of cancer of the uterus beginning on a lacerated surface on the cervix, although it is far from true that malignant disease of that part of the uterus arises solely from lacerations. The precise significance of the ectropion described as a result of laceration, as well as the true relation of subinvolution, retroflexion, and uterine discharges to that lesion, have been the subject of much dispute, and the arguments on these questions, and on the advisability of Emmet's operation, will be found in current British and American text-books on diseases of women, and in the recent reports of obstetrical societies.

Some of the advocates of Emmet's operation recommend, as in the assumed homologous cases of ruptured perineum, that if laceration of the cervix be diagnosed after labour, it should at once be washed, and its edges carefully united by wire sutures. This proceeding is said to check hæmorrhage, to lessen the chances of puerperal fever through absorption of discharges by the raw surfaces of an ununited laceration, and to save the patient from much unnecessary trouble, as she may thus recover from parturition and trachelorrhaphy at the same time.

It is when a laceration of the cervix not only exists, but is associated with ectropion of the mucous membrane, and other signs of local uterine disease, that Emmet's operation is considered advisable and justifiable by its advocates in this country. The patient should wear a Hodge's pessary for a short time before operation, and a hot-water injection should be administered every morning and evening. For the operation, it is advisable that the patient should lie almost on her left side, but with her face and abdomen turned somewhat downwards; the knees are then drawn up, the right rather higher than the left. A Sims' speculum is then introduced, so as to elevate the posterior wall of the vagina, the anterior wall falling forward by gravitation, owing to the position of the patient; a Sims' depressor will aid in pushing the anterior wall still further forwards. The attitude in which the patient is placed is known as 'Sims' position.' Many operators, however, prefer the more familiar lithotomy position. The lacerated flaps are then seized by tenacula, and, holding one of these instruments in the left hand, the operator makes a perfect raw surface on one flap, cutting up to the angle made by the divergence of the flaps. The opposite flap is then treated in the same manner. Hæmorrhage must be checked by pressure, and the flaps approximated. The sutures are then introduced, from above downwards, by a special needle, which should be entered at some distance from the margin of one flap and brought out through the opposite flap; it bears a loop of silk, by

means of which a silver wire is drawn backwards along the back of the needle. The sutures are lastly twisted, one by one, beginning from above, and bent downwards before the ends are cut short. When the laceration extends to both sides of the os, the flaps must be vivified on both those sides, care being taken to leave untouched a strip of tissue running along the middle of each flap, from the free edge up to the opening of the cervical canal, so as to form an os externum.

When there is much hypertrophy of the tissues of the lacerated surface, the overgrown cicatricial tissue must be freely cut away, so that the denuded flaps may be readily approximated. In the case of multiple or stellate lacerations, the mucous membrane may be cut away in such a manner as to form one raw surface on each side of the os, as in the case when a bilateral laceration is vivified, the precautions with regard to the os being remembered.

After the operation the vagina must be cleansed daily by antiseptic injections, the bowels kept open, and the sutures removed at the end of a week, beginning with the uppermost; the lower may be left in for a week longer if necessary. In a successful case, the cervix will appear, after the patient's recovery, like that of a virgin, or nulliparous woman. Statistics are as yet wanting to prove whether the repair of the cervix be, as a rule, permanent or only temporary, not resisting subsequent natural labours. ALBAN DORAN.

EMMETROPIA. — The condition of normal vision, when the eye is fully capable of being readily focussed for both near and distant objects.

EMPHYSEMA.—In surgical writings, by 'emphysema' we understand the extravasation of air into the areolar tissues of the body. It must not be confounded with the medical term 'emphysema of the lung,' which is a dilatation or rupture of the normally existing air-vesicles of the lung, whereby they become greatly increased in size. Surgical emphysema may be recognised by the swelling of the affected part, and by the crackling sensation communicated to the fingers on placing the hand upon it and making gentle pressure in different directions. It is mostly produced by a wound of the lung, bronchus, or trachea; but is occasionally found in non-penetrating wounds of the thorax.

Emphysema is occasionally, but rarely, seen in wounds of parts other than the chest. Thus in the limbs, in wounds of a crushing or lacerating character, air is sometimes forced into the tissue at the time of the accident. The feeble vitality of the crushed tissue, together with the extravasation of air, makes these cases of more gravity than the nature of the wound would indicate; but if vital parts be not injured, they mostly do well in the end. Such emphysema must be distinguished from the emphysema of decomposition, which is occasionally seen in similar cases, as a preliminary to acute gangrene taking place in the part. In such cases the prognosis is exceedingly grave. The one condition may pass into the other if the injury be severe, and thus the recognition of the state may at first be rendered difficult. But the swollen, dark red appearance of the part affected with the emphysema of decomposition, together with the speedy formation of livid patches upon the surface, will dispel any doubt that may be entertained. Very free incision into the part so affected is the very least that can save the patient, and if it be a limb in which the condition occurs, the expediency of immediate amputation will have to be considered.

Emphysema also occasionally occurs from wounds or fistulæ in connection with the alimentary canal. Thus the writer has seen it occurring very extensively about the buttock in a case of ordinary anal abscess. In such a case there is usually an ulcer through the wall of the rectum, and the peristaltic movement of the intestine forces some of the intestinal flatus through this aperture into the areolar tissue of the ischio-rectal fossa, from which it spreads to the surrounding integuments.

But by far the most frequent cause of emphysema is fracture of one or more ribs, by which the lung has been wounded. It is occasionally complicated with pneumo-thorax—i.e. air in the pleural cavity—and sometimes even with hæmothorax. In such cases, in the movement of inspiration, air gets sucked into the pleura, and in the succeeding act of expiration is squeezed into the subcutaneous cellular tissue. Emphysema produced by such a cause is of moderate extent, and generally absorbs rapidly and completely. But emphysema often occurs without the complication of pneumo-thorax. This most frequently takes place in young people, especially when the wound of the chest is small, and has a valvular character. It is produced by the wounded surface of the lung becoming opposed to the wound in the pleura, so that, in the movement of expiration, the air

is squeezed directly out through the pleural wound under the integuments. Where the lung is fairly healthy the tendency to retraction is but small. Thus, even in an extensive incised wound of the thorax, where the lung has been exposed, pneumothorax is not necessarily produced. In such cases the lung has been seen moving, in each act of respiration, against the thoracic parietes, and the pleural cavity remaining free of air. The cases of hernia of the lung are also illustrations of the same fact.

Sometimes the emphysematous condition of the tissues is not found at the seat of injury, but at the root of the neck. This is generally considered as a sign that the root of the lung has been injured, and that the air has extravasated into the posterior mediastinum, and has thence travelled upwards into the root of the neck. Although this may be a correct interpretation of the facts in some cases, it does not appear to be so in all. In some cases emphysema at the root of the neck appears to be due to rupture of the air-vesicles at the upper part of the lung, directly under the dome of the pleura, this being the direction of least resistance when any violent expulsive effort is made upon the chest-cavity. When adhesion exists in the pleural cavity, as is frequently the case, the direct passage of the air from the injured lung to the surrounding areolar tissue is rendered easy, without the possibility of the formation of any pneumothorax. But without this aid, in severe compression the force will often be sufficient to rupture both lung and dome of pleura, and thus extravasate air into the root of the neck.

Emphysema may vary most immensely in amount, from those slight cases in which only a little crepitation is felt under the skin, to those extreme ones where the whole body is blown up like a sausage, threatening death every instant from the difficulty of respiration, and from impeded action of the heart.

Treatment.—In the great majority of cases the emphysema is best left alone. The most extensive extravasations will absorb and get well of themselves, if left quietly to nature. Only in those cases in which death is impending from suffocation, or impeded action of the heart, is surgical interference called for. In such cases, however, it should be prompt; it may be sufficient in some cases to puncture the skin in many points with a fine trocar and canula, and thus allow the air to escape; but in others this will not be quick enough in the relief afforded, and in these it is better to make several small incisions through the skin in different parts of the body, so as to allow of the rapid exit of the air. The relief thus afforded is very great; the swelling rapidly subsides, and the patient returns to his normal appearance.

The *prognosis* in all these cases is very favourable. Even in the very severe forms above described, where surgical treatment is necessary, the incisions heal, and the patient gets well very rapidly.

H. G. Howse.

EMPROSTHOTONOS. *See* Tetanus.

EMPYEMA.—The word 'empyema,' though it has sometimes been more loosely employed, should only be used to describe a collection of pus in the pleural cavity.

It is essential for the surgeon to appreciate the various causes which may give rise to this condition, because his treatment to some extent, and his prognosis very largely, will depend upon this consideration; but it would be beyond the scope of a surgical work to give more than a brief enumeration of these causes.

Causes.—1. *Traumatic.*—Two kinds of injury may be followed by empyema—a penetrating wound of the chest, with or without injury to the lung, and a contusion of the chest-wall, with or without fracture of rib or injury to lung. The former includes gunshot wounds, thus possibly involving the presence of a foreign body in the pleura, and results most likely in a septic empyema; it may be accompanied by the presence of gas in the pleura—pyopneumothorax, due either to the entrance of air from without through the external wound, or from within, owing to a wound of the lung, or to the presence of the gaseous products of putrefaction. The latter arises in some not easily explained manner, and is a rare sequence of such injuries; it is probably, in most cases, the consequence of a serous effusion or hæmorrhage resulting directly from the injury, and may, if the lung is injured, be a pyopneumothorax.

2. Empyema may be the outcome of a simple serous effusion, occurring, perhaps, as a result of exposure to cold or wet, or during or after any of the acute fevers, or in the subjects of the rheumatic, and, still more, the tubercular diathesis; but it seldom or never follows the dropsical effusions which accompany some diseases of the heart and kidneys. Under this heading, perhaps, should be included the purulent effusions that occur in the

course of attacks of septicæmia, which are often bilateral.

3. It may be caused by an extension of inflammatory mischief from the lung; this may be of several kinds—e.g. the pleurisy accompanying acute pneumonia, or that which forms around the embolic abscesses of pyæmia; or the rupture of a gangrenous patch in a pneumonic lung, or that of a tubercular vomica, or, again, it may be the result of the presence of a foreign body which has been inspired into a bronchus.

4. An empyema may be the consequence of rupture into the pleura of morbid materials from other situations; such, for instance, as a hydatid of the liver, a hepatic or a pericæcal abscess, or an abscess connected with disease of the ribs or sternum, the cervical or dorsal vertebræ, or a mediastinal gland; or it may result from the burrowing downwards of pus after cut-throat or tracheotomy, or after injury or disease of the œsophagus, or of other structures in the neck.

Varieties.—An empyema may be universal or localised—that is, the collection of pus may be free in the pleural cavity, or it may be circumscribed by adhesions between the visceral and parietal layers of the pleura. In the latter case there may be more than one collection on the same side of the body, e.g. one between the base of the lung and the diaphragm, and one in another part of the chest. The signs will thus vary in different cases; but the typical ones, all or some of which may be present, are (*a*) a general distension of the affected side, with bulging of the intercostal spaces, so that the outline of the chest on the affected side becomes more circular than normal; (*b*) more or less immobility of that side; (*c*) dulness on percussion over the position of the fluid. This dulness is fixed in a localised empyema, but if it be not localised will vary with the position of the patient unless the collection of fluid is very large, in which case the chest will be completely dull both in front and behind. (*d*) Absence of breath-sound, vocal fremitus, and resonance over the fluid. The first of these is a very untrustworthy sign, especially in children, bronchial breathing being often heard over the whole of the dull area. It is important to notice that the breath-sound on the affected side is almost always decidedly weaker than on the sound side. (*e*) Displacement of the viscera —i.e. of the heart away from the affected side, and of the liver or spleen downwards. (*f*) More or less dyspnœa, generally relieved by placing the patient on the affected side. (*g*) A varying amount of fever, the evening temperature being usually much higher than that of the morning, but the total amount of elevation being very inconstant. (*h*) If gas be present in the pleural cavity there will be the usual signs of pneumothorax; and (*i*) if there be an opening between the pleura and the lung, there will be more or less purulent expectoration. (*k*) In old cases retraction of the side occurs without any evacuation of the contents, as a result of the absorption of some part of the pus. This retraction is not inconsistent with the presence of a large quantity of pus in the pleural cavity.

Diagnosis.—It will thus be seen that the diagnosis of an empyema from a simple serous effusion or hæmothorax, or from certain pulmonary conditions, is often very difficult. In all cases, but especially in doubtful ones, the surgeon should clench his diagnosis by inserting through an intercostal space the needle of a small exhausting syringe, or—what answers the purpose equally well—a fine exploring trocar. This, if the skin and the instrument have been efficiently purified by an aqueous solution of carbolic acid (1 to 20), can do no harm; but if this precaution be not used, or if reliance be placed on that very untrustworthy material, carbolised oil, a simple serous or sanguineous effusion, or an aseptic empyema, may be converted into a collection of fœtid pus. An advantage claimed for the exhausting syringe over the exploring trocar is that sometimes the withdrawal of a small quantity of fluid has seemed to start the process of absorption, which afterwards has continued until all the pus has disappeared. It is obvious that the presence of pus should be placed beyond doubt before any operation for its evacuation is attempted.

Age at which it occurs.—Empyema may occur at all ages, and is a common disease of children.

Contents.—Empyemata vary very much in the nature of their contents. Sometimes the fluid is thick, often very thick, pus; sometimes it consists of a turbid material mixed with flakes of lymph, and in the instances where serous effusions become in time purulent, it is clear that all the stages between serum and pus must be passed through at one period or another. Again, while the contents of an unopened empyema are mostly free from putrefactive smell, those of one which communicates with the lung or with the exterior of the body, or which has arisen by the burrowing of pus from around

the cæcum or other localities, may be septic in the highest degree. It is not improbable that many cases of turbid effusions containing flakes of lymph undergo spontaneous absorption, and it is certain that the same process may occur, and possibly does so, more often than we suspect in cases where the fluid is true pus. Still, the occurrence is not common enough to warrant the surgeon in ever waiting for it to take place. It is not intended by this to state dogmatically that all empyemata should be opened or even aspirated; for it appears that, in some phthisical subjects, such a proceeding actually accelerates the disintegrating process that is going on in the lung. In these cases, however, the collection of fluid is left alone, though not in the hope that it will be ultimately absorbed.

There are, however, other conditions in which delay is recommended: namely, those in which an internal opening for the exit of the pus has been formed; such cases follow sometimes, though not always, a very favourable course. The directions in which a spontaneous rupture may occur are as follows: (*a*) into the lung, in which case the empyema may be expectorated; (*b*) into the stomach or intestine, when it may be passed with the stools; (*c*) behind the deep fascia of the abdomen, when it may burst into the peritoneum, or, as is more likely, may point through the abdominal wall or at the groin, or even at a lower point in the lower extremity; (*d*) the most common position, viz. through the thoracic parietes. The opinions of various observers differ very much as to the commonest seat of spontaneous rupture, some assigning the second or third interspace in front, some the fifth interspace near the junction of the rib and cartilage, and others still farther towards the back. The writer has seen examples of all, but perhaps more high up in front than in any other place.

Treatment. — If spontaneous rupture have not occurred, no time should, in the great majority of cases, be lost in evacuating the fluid, for the longer it is left the more will the lung be disabled by compression, and the less will its expanding power be able to come into play. For this there are two methods — *aspiration* and *free incision*. There are strong arguments both for and against aspiration. In favour of it, it may be said that a certain number of cases, especially in children, are undoubtedly cured by this method, sometimes by a single tapping, but more often after it has been repeated two or three times; and, if it do succeed, the cure is more rapid, an open wound is avoided, and a complete collapse of the lung is possibly prevented. It should be remembered that a cure taking place by this means almost necessarily involves the absorption by the pleura of a certain amount of pus; for it is clear that unless the lung be at the time of aspiration capable of complete expansion—a not very likely condition—it is almost impossible, by the most forcible exhaustion, to empty the chest completely. And, indeed, the operator should not make this his object, but should stop the exhaustion if the patient begins to cough, or if any blood appears in the syringe. If, after aspiration, the fluid steadily reaccumulates, the operation should be repeated after a not longer interval than a week, and if after two or three aspirations a cure does not seem to be taking place, the writer would advise that a free incision should be made without delay. Against aspiration it may fairly be said that in the majority of instances it is unsuccessful, and, if it fail, precious time, as regards the condition of the lung, will have been wasted; and it should be added, that in the cases in which it is most likely to succeed, viz. children, the free incision is a highly satisfactory operation.

Aspiration.—It is not necessary to give the details of aspiration, which will be found under Aspiration and Aspirator. The following practical points may, however, be mentioned:—The surgeon, will, of course, be careful to carbolise, not only the skin, but the outside and the inside of the canula. The latter object is best attained by drawing some carbolic acid solution through the syringe. Care must also be taken to avoid wounding the lung with the point of the instrument. At the end of the operation it is not unlikely that the canula may be obstructed by contact with the lung; if this occur, its point should be directed downwards and backwards towards the lower part of the chest. It will be found most convenient to employ the bottle aspirator, and to continue the process of exhaustion as the fluid flows, rather than to make several successive vacuums, so that an excessive negative pressure may not be exerted at any time upon the contents of the pleura. A long canula and trocar, so arranged that a blunt plug can, if necessary, be substituted for the trocar, for the sake of clearing the canula without allowing the entrance of air, is recommended in preference to a perforated needle. Such canulæ, which cannot injure the lung as it expands, are supplied with many of the French aspirators. In some

cases it will be found convenient to make a minute puncture in the skin with the scalpel, so that the canula may be introduced without a jerk. The puncture is afterwards to be closed with collodion, or if oozing take place, an antiseptic dressing is to be applied.

Free incision.—If it be decided to make an incision into the chest, all are agreed that the opening should be a free one; but opinions vary very much as to the best way of making this opening.

1. *Position of opening.*—If the matter be already pointing, it is well to evacuate the subcutaneous collection, whether a second opening be made or not. If the surgeon be free to choose the spot, he may select that which in modern text-books is described as the seat of election, viz. the sixth or seventh interspace, just in front of the posterior fold of the axilla; or that recommended by Mr. Marshall, viz. the fifth interspace, just external to the cartilages (following, according to the wide experience of this surgeon, the most common seat of spontaneous rupture); or he may select a point further back, as was done by the older surgeons, viz. the eighth or ninth interspace, slightly external to the line of the angle of the scapula. This is the position which, in the writer's opinion, is—always in children, and usually in adults—the most advantageous. Or, lastly, he may make the opening low down behind, in the tenth or the eleventh interspace. There are obvious objections to the last of these plans. 1st. The lower limit of the pleura behind is liable to considerable variation. 2nd. This part of the cavity is sometimes obliterated by adhesion of the two pleural surfaces, although the upper part of the space is filled with fluid. 3rd. The lower part of the pleura is that which in successful cases is the first to close, and, when this occurs, the efficiency of the drainage-tube and its easy introduction is much interfered with by the upward direction imparted to it by the pressure of the diaphragm. No rules can be laid down for the position of opening a localised empyema.

2. *Method of incision.*—A free opening may be obtained either by making a long incision in an intercostal space, or by making a shorter incision and removing a portion of rib. The former is rather the simpler operation, and is recommended in cases where the intercostal space at the point selected is sufficiently wide, and should, if possible, be adopted if the matter is putrid; the latter has considerable advantages, which will be stated below.

The patient should be placed at the extreme edge of the operating table, and as nearly as possible on his back. If he be rolled on to the sound side, the breathing may be seriously interfered with if he be under the influence of an anæsthetic, and if there be a communication between the pleura and the lung, there is danger of the expectorated pus passing into the bronchi of the healthy side, and setting up serious mischief there. The writer prefers chloroform to ether for the anæsthetic, on account of the occasional inconvenience, or even danger, from the excessive secretion of bronchial mucus which may sometimes result from the latter. The arm should not be raised to more than a right angle with the trunk, as otherwise the skin is inconveniently displaced. By drawing it up to this level the skin will be slightly raised; the operator should notice the extent to which this has happened, and must make his preliminary incision proportionately above the intercostal space; he may, in most cases, divide the structures with one sweep of his knife down to the rib above the space. If this precaution be neglected, the opening will be found to be inconveniently valved when the arm is depressed.

The incision should be two or three inches long, the length depending upon the size of the patient. If, after the deep incision has been made, it is found that it does not quite correspond to that in the skin, the after-treatment will be greatly facilitated by making the latter T-shaped, the vertical cut being made upwards or downwards as the case may require. After the hæmorrhage has been stopped in the superficial parts, the intercostal space is explored with the finger, and the knife is directed to the rib bounding it below, and is carried along its upper border through the intercostal muscles and the pleura. In this way the intercostal vessels which occupy the groove on the under surface of the rib are effectually avoided. If more convenient, the deep incision may be made short in the first place, and afterwards enlarged by expanding the blades of a pair of dressing-forceps inserted into it. The finger is then passed through the intercostal space, to explore the cavity and ascertain that there are no flakes of lymph obstructing the rest of the pus, or other peculiarities of the case requiring attention, and then the matter is allowed to escape freely. It is well, if the operation be performed antiseptically, to place a piece of rag soaked in carbolic solution over the wound during the escape of the pus. If an intercostal artery be

wounded, one of two courses may be pursued; either the finger may be pressed upon the wounded vessel, which will arrest the hæmorrhage in the course of a few minutes, or the surgeon may at once proceed to the removal of a portion of the rib behind which the artery is situated, as will be described in the next section, and the artery will be secured without further difficulty.

3. *Removal of rib.*—The operation of removal of a portion of rib is performed in this way. The incision is made as before, but at a somewhat higher level, through all the soft parts, including the periosteum and the rib. The transverse cut is in this case almost essential. The periosteum is then raised from the rib by means of a periosteum-elevator, a very convenient form being that of a short chisel, with a transverse steel handle. A very blunt and slightly curved periosteum-elevator is then slipped between the deep surface of the rib and the periosteum, without rupturing the latter, and when by this means a piece of rib 1½ inches long has been completely denuded, and is pressed forward by the elevator held beneath it, the denuded portion is cut away, either by means of strong bone-pliers alone, as may usually be done in a child, or after first sawing it pretty deeply with a small saw, as is sometimes necessary in the adult. A special forceps for the purpose has been introduced by König, having one blunt and grooved blade for slipping beneath the rib, and the other a sharp blade, which, when the blades are closed, fits into the groove on the deeper one. After the portion of rib has been removed, the periosteum can be divided at leisure, and exactly in the required position, without any fear of wounding the intercostal artery. If the periosteum be very thick, a short vertical cut upwards will free the opening in a most satisfactory manner.

In urging this method of procedure as a uniformly good plan in children when the opening can be made behind, and in all cases where the ribs are close together, the writer simply maintains — 1st. That an opening is obtained sufficiently large to enable all flakes of lymph and solid material to escape, and to allow of the introduction of the finger, with the object of ascertaining the state of the cavity and the possible presence of other localised collections of matter in the immediate vicinity of the incision. 2nd. A drainage-tube of large size can be introduced, and on future occasions it can be removed and reintroduced without discomfort to the patient. The operation is not recommended from any idea that it will favour the falling in of the chest, such a result being quite out of the question. The continuity of the rib is re-established within a few weeks, and the writer has not, after considerable experience, found any inconvenience from non-union of the rib or excessive formation of callus. The latter condition has, however, in the hands of some surgeons occasionally led to difficulty in the performance of other operations which have been deemed necessary—a difficulty, however, which has been easily overcome.

Drainage-tubes.—Much space would be required to describe all the varieties of tube which have from time to time been devised and recommended. The writer always employs a very simple tube first recommended by the late Dr. Baxter, which anyone can make for himself, and which will be found invariably efficient. The end of a piece of indiarubber tubing, varying from a quarter to half an inch in diameter in accordance with the size of the cavity, is split into four pieces. These four pieces are drawn through a hole rather larger than the tube, cut in a piece of caoutchouc $\frac{1}{10}$ to $\frac{1}{12}$ inch in thickness, and about 1½ inch square; they are then turned down and each of them is fixed to the flat piece by a stitch of silver wire, the ends of the wire being twisted and turned down flat. A flanged tube is thus produced, the flange serving the double purpose of keeping the tube in position and preventing the possibility of an untoward accident that has occasionally happened, viz. the slipping of the tube into the chest. Flat tubes, double tubes, and solid tubes, made of silver or vulcanite or celluloid, have their special advantages in certain cases, and may be devised to suit particular conditions. The length of time for which the tube should be retained depends upon the amount of discharge; when this becomes very small, a tube of smaller calibre may be substituted for the first, but no definite rule with regard to time can be laid down in adults. In a simple, uncomplicated case in a child, it will often be found advantageous to withdraw the tube either at the expiration of, or soon after, the end of the first fortnight; but if, after doing so, the temperature should rise or the discharge increase, the tube should be reintroduced without delay.

Sometimes a second opening seems desirable, either at first or when, after a time, it is found that matter continues to collect at the posterior and lower parts of the

pleura. Such a second opening may readily be made by passing a stout and long probe or metal bougie from the first opening to the selected spot, and cutting down upon its end, which is made to project through an intercostal space.

If the temperature remain normal, the patient should not be kept in bed after granulation is fairly established; the change of position, and the greater movement of the chest-walls resulting from the alteration of position favouring the complete evacuation of the contents of the pleura.

The treatment of old cases of empyema, with contracted chest-walls and greatly thickened pleura, often presents almost insurmountable difficulties. If little or no falling in of the chest or expansion of the lung have occurred after the lapse of months, it may be said at once that almost any line of treatment will be unsuccessful; but if the pleura be reduced to a small cavity at the top of a long sinus, much may be done if it be remembered that it is the upper and not the lower part of the pleura which presents the obstacle to healing. In order to close the lower part great advantage may be gained by removing three or four inches of several (four or five) ribs with the subjacent thickened pleura. A flap, including all the soft parts, surrounded by a suitable angular or curved incision, must be turned off the rib, and then each one must be removed separately, following the directions given above for the removal of a single rib; the thickened pleura may then be freely snipped away with scissors, any vessel which is divided in the process being at once secured. But the bleeding, which is often free whilst the ribs are being exposed, in these old cases is generally quite insignificant during the later steps of the operation. The tube must then be placed in the upper part of the incision, and carefully maintained in this position. There will, however, generally be left a space included by the first or the upper two ribs, which cannot, owing to the structure of the parts, contract. The most satisfactory results under these circumstances will be obtained by making an opening at the first or the second interspace—a somewhat formidable and difficult operation. The cavity is thus reduced to a minimum, and is effectually drained by a short straight tube, which the patient himself can change without difficulty.

If an empyema have reached the chronic stage, and no advance is being made, or if the discharge be persistently putrid, great good may be obtained by injecting the pleural cavity with some stimulating or antiseptic material, of which, perhaps, the best is a solution of iodine. But great care must be employed in using this remedy, as many cases have been recorded in which sudden death has occurred during the process. For this reason injection should not be resorted to unless there seems to be a decided need for it. The safest and most satisfactory plan is to use an irrigator, best made from a glass bottle, with a hole admitting a cork in the side near the bottom. Through the cork is passed a rigid tube, communicating by means of an indiarubber tube some feet long, with a piece of gum elastic catheter, not large enough to fit tightly into the sinus. After introducing the catheter into the cavity, the bottle is to be raised very slightly above the level of the bed, and, if the catheter be not too large, the lotion will presently flow to some extent alongside it from the orifice of the sinus, and thus undue pressure will be avoided. But, if the patient begin to complain of a sense of distension, the catheter must be at once withdrawn and the fluid allowed to escape. The solution should be used warm, and if tincture of iodine be employed it should be made of about the colour of sherry. Condy's fluid, boracic acid and other preparations find favour with some surgeons, and in some hands the employment of the last-named drug methodically in the early stages of the treatment appears to have been followed by very satisfactory results.

No description will be given of the methods of dilating old sinuses by means of sponge-tents and other dilators, because such methods are seldom of use; nor will other plans of dividing ribs in these cases, with or without removal of a considerable portion of the centre, be detailed, because the writer has no experience of them, and the exact method of performing the operation will be suggested to the surgeon by the particular case. It is also only necessary to mention the fact that sponge-grafting has been said to have given satisfactory results, when employed with the object of filling up cavities which have proved very obstinate.

Prognosis.—As to prognosis, it may be said that, 1st, *cæteris paribus*, the longer the case has lasted the smaller is the chance of the lung expanding. 2nd. A localised empyema is more favourable than a general one. 3rd. The presence of lateral adhesions between the lung and the chest-wall is a good sign. 4th. The more rigid the chest-walls, the less chance is there of a

cure; hence, as well as for other reasons, the prognosis is almost always favourable in a child, and generally unfavourable in those above middle age; hence, also, it is a good sign when the shoulder begins to drop and the chest to fall in. 5th. Tubercular cases are bad. 6th. Stinking cases are less favourable than those which are aseptic; though it must be owned that, especially in children, they often do equally well. 7th. There is a general impression, perhaps unsupported by sufficient evidence, that a right-sided empyema is a more serious affair than one on the left side. 8th. It does not seem that the previous bursting of the empyema into the lung has much influence in the prognosis; nor does rupture into the intestine necessarily prove a serious complication. 9th. Empyema on both sides of the body at the same time is almost necessarily fatal, unless one or the other be localised; except in those cases in which the purulent contents are absorbed. If a general empyema have been opened, and another form on the opposite side, it is obvious that the only surgical treatment for the second collection is by aspiration.

In speaking of prognosis, it must be borne in mind that an unfavourable result does not necessarily imply an immediate or even rapidly fatal issue. The result cannot be said to be favourable if a sinus remain, communicating with a cavity constantly discharging pus, though the patient may live in comparative comfort for many years, and only fall a victim at last to the gradual development of albuminoid changes. The writer has under observation a strong man whose empyema was opened nine years ago; he is now doing a good day's work as a costermonger, and is only recently beginning to show, by his somewhat pallid colour and clubbed fingers, that some of the changes hinted at are probably in progress. This peculiar pallid or earthy appearance may be noticed at much earlier stages of the disease.

Many empyemata, on the other hand, are much more rapidly fatal. Some of the tubercular cases die of rapidly advancing tubercular changes, or more rarely develop an empyema on the opposite side. The latter accident occurs in some of the septic cases, and these are also liable to die from the direct effects of blood-poisoning. A curious complication of septic cases must also be hinted at, viz. cerebral abscess, which, though it is difficult to trace any causal connection between the two conditions, has happened in a sufficient number of instances to make it impossible to overlook the possible association of one with the other.

Not the least common cause of death after empyema, however, is a slow process of exhaustion, in which the patient gradually sinks under the effects of the prolonged suppurative discharge. Two other very serious and not very uncommon complications of empyema are the occurrence of pericarditis and peritonitis.

It is impossible to conclude this article without expressing the belief that, although great advance has been made in recent years, we have not yet arrived at the best possible method of dealing with old chronic cases of empyema.

RICKMAN J. GODLEE.

ENCEPHALITIS, MENINGITIS, and ABSCESS OF BRAIN.—Traumatic inflammation affects either the membranes or the substance of the brain. Meningitis is the term applied to the former, encephalitis to the latter. When it is wished to differentiate inflammations of the dura mater from those of the pia mater, the term 'pachymeningitis' is applied to the former, and 'leptomeningitis' to the latter. All inflammations of the surface of the head, arising either from idiopathic or traumatic causes, may lead to intracranial inflammation; but injuries of the brain itself are most likely to give rise to encephalitis.

MENINGITIS takes its origin from superficial lesions, such as inflammations of the scalp, injury to the bones and brain-membranes, the inflammation spreading inwards. Perforating injuries of the skull, involving the dura mater, are frequent causes of inflammation of these membranes. Caries of the petrous portion of the temporal is one of the most frequent causes of external pachymeningitis, and it ends, as a rule, in suppuration. It is said that when the dura mater has been detached from the interior of the skull by effusion of blood, inflammation is frequently set up in that membrane. The writer considers that pachymeningitis arising from such a cause must be rare, unless when the dura mater has been subsequently exposed to the unpurified air.

ENCEPHALITIS (traumatic) may arise in either of two ways: from injury to the brain-substance, such as contusion and laceration, or it may be secondary to meningitis. Inflammation, beginning in the brain, does not generally extend beyond the pia mater, and any effusion which might take place more superficially would be subarachnoid and not subdural, unless the inflammation were very severe. On the

other hand, in pachymeningitis, the inflammation does not generally extend deeper than the arachnoid, the subdural space being more or less distended with turbid fluid. As a rule, the inflammatory action, commencing in the brain, affects the membrane next to it; and inflammation commencing in the scalp or skull affects the dura mater.

Meningitis may arise by the extension of inflammatory processes from the scalp to the interior of the skull. Erysipelas and diffuse inflammation of the scalp are in this way regarded seriously, as they are liable to lead to intracranial mischief. In fatal cases of this kind the upper portions of the hemispheres are found affected; the brain-substance and the pia mater being deeply congested, and this is accompanied by sub-arachnoid effusion of turbid fluid. These may be all the morbid changes that are seen. In chronic cases, such as may originate in caries or necrosis of the bone, the inflammatory processes may have gone no further than the dura mater, which has become thicker and more vascular than normal, and which may be adherent to the bone. Should the osseous inflammation extend, or become more acute, the dura mater may become softened and separated from the bone by plastic exudation or by pus. Molecular disintegration of a portion of the dura mater may ensue or a slough may be formed. It is unusual for the inflammation to extend in the dura mater centrifugally, or much beyond the area of the original injury, such as the affected bone, although it has been known to extend to the base. It is quite otherwise with the arachnoid. Once the arachnoid has become involved, there is rapid spreading of the inflammatory action, frequently involving the whole of the upper aspect of the vault on the affected side, though rarely extending to the base. In such cases the cavity of the arachnoid becomes distended, more or less, with inflammatory effusion, which is generally of a purulent character. The inflammatory action may spread to the pia mater, and when it does so there is almost necessarily an involvement of the cortical substance of the brain, which becomes softened, of a darker colour than normal, and adherent to the pia mater. This membrane becomes much thicker and more vascular, and occasionally the inflammatory action, when chronic, has so altered the appearances of the parts by reduction of the cells to their embryonic condition and by plastic exudation, as to render it difficult to draw the line between the grey matter and the adherent pia mater.

The manner in which the inflammation spreads inwards from without the skull, is stated to be through direct contiguity of structure. It is also supposed to spread along the veins which establish communication between the intra-cranial circulation and that of the scalp. The chief of these are the emissary, which pass through the principal foramina, likewise the facial and those of the diploe.

In encephalitis arising from contusion of the brain the pia mater is much thickened and infiltrated, and any exudation which may take place will be found on the cerebral side of the arachnoid. In this it is like idiopathic encephalitis, the cavity of the arachnoid being free from effusion, unless in most acute forms of inflammation.

The inflammation of the pia mater generally spreads all over the upper and lateral portions of the affected hemispheres. When the encephalitis occurs in the white substance after injury, it generally arises in a portion of the brain which has been contused, and where at least punctiform ecchymoses exist. It is assumed that when encephalitis follows concussion it begins in such an area of punctiform ecchymosis. These patches become the seat of inflammatory new-formation, giving a peculiar saffron colour to the affected part. A general softening of the brain-tissue ensues, which may pass on to the formation of an abscess. Though the affected areas do not extend further, as a rule, than the original seat of injury, still there are occasions when the inflammatory action spreads greatly, the tissue becoming diffluent. When pus is present, it is usually of a yellowish or yellowish-green colour. Occasionally it is brown and fœtid.

Diagnosis. — The symptoms are very variable, no two cases following exactly the same course. One of the most constant, as well as one of the earliest, is cephalalgia, the pain being either diffuse or localised to a particular region of the head, often corresponding to the part struck, though at times situated at the opposite side of the head, when injuries of the brain from *contre-coup* may be suspected. Though the temperature is variable if the whole course of the disease is considered, yet at an early period (the initial stage) there is a pretty constant elevation. The rectal temperature is a much surer test than the axillary or oral, and whenever possible ought to be taken in such cases. The pulse is generally quick in the early stages. The patient loses his appetite, and becomes fretful, sleepless, and hyperæsthetic to external impressions, such as

light and sound. At the commencement the pupils are more or less contracted, though they are sensitive to light; occasionally slightly so.

At a later period, occurring immediately after the symptoms just described, or after a variable interval, during which the patient may even seem to improve, another series of symptoms sets in. The patient becomes drowsy, and soon exceedingly so, perhaps answering questions quite correctly, though with a dreamy, hazy aspect, or accompanied by a meaningless smile, and immediately thereafter passing into a profound sleep. The face is pale and earthy; sickness, accompanied by vomiting, is frequent. Twitchings of the muscles or even convulsions are present, which may point to the special part of the brain affected. These convulsions may be followed by paralysis of the affected muscles. Delirium is frequent at this period. The pulse and the temperature often undergo a marked and characteristic change. The pulse, which at the onset of the symptoms was quicker than usual, now becomes slow, often markedly so. In one case under the writer's care—a girl aged fifteen years of age—the pulse was not more than 40 per minute, with an occasional intermission. The temperature is likewise subnormal, 97° F. or even lower. The decrease in the temperature must not be mistaken for a sign of recovery.

These symptoms are generally succeeded by a very short stage, in which (it may be within a few hours) the temperature and pulse go up with a bound, the former to 104° F. or higher, the latter to 130 or more; the face becomes flushed, the pupils dilated, the sphincters relaxed, the patient comatose, and death rapidly ensues.

In some cases localised pain may be discerned on tapping over the seat of injury or disease. This requires to be done in a systematic manner, one part being compared with another. In others, the application of cold and heat, alternately, may reveal a tender spot, which sometimes corresponds to the seat of lesion.

Abscess of the Brain.—In abscess of the brain, the above symptoms may be the only ones present. In other instances there may be, in addition, vomiting, succeeded after a variable interval by shivering. Short of a distinct rigor, the patient often feels and acts as if he were cold. Twitchings, convulsions, or paralysis may ensue, and if these are isolated they indicate the area principally affected. Though surrounding such spots, diffuse encephalitis may be found. When abscess forms in the cerebral substance the membranes are prone to be affected, and occasionally, when the inflammation has been very acute, sloughs have formed in the dural covering. It is, however, much more likely that the dura mater has been perforated by molecular disintegration, owing to the ulcerative process set up by the extension of the walls of the abscess. Cerebral abscesses have burst and the contents have found their way through the external auditory meatus, or through the cribriform plate of the ethmoid. But it is questionable whether, in these cases, the pus was not extra-dural. The time when abscesses may be expected to form, after an injury to the head, is variable. They have been seen on the fifth day, most likely in such cases originating in a contused cerebral area. When arising from injury to the skull with suppuration of the bone, brain-abscess may be looked for two or three weeks subsequently. From caries of the petrous bone it may arise at any period, the patients being liable to abscess-formation as long as the caries exists. All lesions of the bones of the skull, whether traumatic or idiopathic, are much more prone to induce abscess in the brain when the parts so affected are permitted to become septic. From the nose, the orbit, the antrum of Highmore, inflammatory products have been transmitted to the brain, causing abscess. Disease in the middle ear and caries of the mastoid are apt to set up suppuration in the mastoid cells. As a rule, in such cases the membrana tympani is perforated, and a purulent discharge escapes. When suppuration is set up in the mastoid cells there is generally pain or tenderness behind the ear, and sometimes this is followed by redness and swelling. Headache is constant, and cerebral disturbance frequent. Twitchings or paralysis of the facial muscles, arising from irritation or compression of the facial nerve, frequently occur.

The symptoms characteristic of encephalitis ensue on extension of the inflammatory action inwards. It must be borne in mind that abscess of the temporal lobe may attain considerable dimensions without inducing localising symptoms; this part of the brain, not containing any direct motor tracts, and there being no case on record of disease of the cortex of the temporo-sphenoidal lobe having given rise to deafness. In such cases symptoms of compression are present, and if these are taken in conjunction with the existence of otorrhœa, and especially if they occur in children, a probable localisation in the temporal lobe may be made. When the base of the lenticular nucleus is involved, causing compression of the internal capsule,

various sensory disturbances may be induced, along with partial hemiplegia. Compression of the cerebral peduncle is sometimes found in such cases, as evidenced by paralysis of the oculo-motor nerve. The discharge from the ear frequently ceases shortly before the onset of severe symptoms. This may be accounted for by the swelling of the lining membrane, and, owing to the discharge not finding exit, the disease is apt to spread through the thin lamina separating the mastoid cells from the dura mater. The inflammatory action may also spread along the veins. The most constant of the emissary veins runs through the mastoid foramen, and connects the lateral sinus with the posterior auricular vein or with the occipital. It has been averred that inflammation of each portion of the ear is transmitted to a particular region of the brain. Thus inflammation of the external auditory meatus is said to induce suppurative inflammation in the cerebellum and in the lateral sinus; inflammation of the cavity of the tympanum to give rise to abscess in the cerebrum; and inflammation of the labyrinth to produce inflammation of the medulla oblongata. There are not sufficient data to warrant a definite conclusion on these points. It is true that abscesses of the brain arising from affections of the ear are found most frequently in the hemispheres, occasionally in the cerebellum, and rarely in the pons. When disease of the mastoid cells occurs in early life, abscess is most prone to affect the cerebrum; when it arises late in life the cerebellum is most apt to be the seat of disease.

The differential diagnosis between meningitis and encephalitis is in many instances difficult and in others quite impossible. Some information may be derived from the date of the appearance of the symptoms after the accident. When inflammation arises from punctiform ecchymoses and intense congestion following severe brain-shaking, as in some forms of concussion, the symptoms appear very early —within the first forty-eight hours. In contusion of the brain, especially when localised, the inflammatory symptoms manifest themselves in four to seven days after the injury; whereas in inflammation spreading from injury of the bone to the membranes, it generally does not manifest itself till a much later period, often weeks after the accident. But though this periodicity existing between the injury and the appearance of the cerebral symptoms does frequently occur, it cannot be implicitly relied on as a differential sign. Thus the writer has seen a case of compound fracture of the skull, giving rise to meningitis—as evidenced by symptoms—on the second day, and proving fatal within the first four days after the injury. A diagnosis may be made with greater probability between meningitis and encephalitis by ascertaining whether there are any external signs suggestive of the former. If there be a contusion of the scalp without a wound, one ought to ascertain the state of the bone underneath by making an aseptic incision on the appearance of inflammatory symptoms. If the bone be found bare, much contused, fractured, or otherwise injured, it is probable that the inflammatory symptoms are due to meningitis beginning in the dura mater. If any of these injuries are associated with wounds, they may then more readily give rise to meningitis. But if the wound is not aseptic, there is a probability of cerebral inflammation due to infective infiltration or pyæmia; and if the symptoms occur a week or longer after an injury there is reason to fear the presence of this serious affection.

Treatment.—The patient ought first to be thoroughly examined. Besides investigating the functions of the brain, those of the other viscera, especially the kidneys, should receive careful attention, as by so doing symptoms which otherwise might be obscure may be at once traced to their source and treated intelligently. If there be a wound it ought to be scrupulously attended to, the most rigid antiseptics being employed. The temperature ought to be carefully watched throughout, as it is a valuable guide to the patient's condition, a rise often heralding serious changes, such as convulsions. The patient ought to be kept in a quiet room and in a subdued light. In all cases the head may be shaven with advantage, as it relieves the headache, at least temporarily, and facilitates after-treatment. The head may be kept a little higher than usual, but this may be regulated according to the patient's desire. During the whole course of the disease the food ought to be of the lightest and simplest description, milk being probably the best. The bowels ought to be carefully regulated throughout; free purgation is one of the most important points, especially in the early part of the disease, the symptoms being often relieved by the administration of a brisk purge. For this purpose mercurial preparations, especially calomel, are very valuable, some ascribing to them a special action over and above their purgative property. Those who advocate this special action advise that they

should be pushed until the gums are touched. Many, however, believe that salivation is quite unnecessary, and with them the writer agrees. Croton oil is of great service in such cases, more especially when there is inability to swallow or insensibility, rendering the administration of other medicines difficult. One or two drops should be placed on the handle of a spoon and rubbed on the back of the tongue; or, if the patient can swallow, the oil may be given in sugar or other vehicle. Enemata also are of service as an aid to the purge. Then there are certain remedies the efficacy of which in such cases may be considered doubtful. These are stimulants, opium, blisters, the application of cold, and blood-letting.

Stimulants, if ever required, which may be doubted, ought to be given with the greatest circumspection. They are very apt to do harm. Opium has been advocated in certain delirious conditions ensuing in encephalitis. It tends to the production of internal congestions, and therefore ought to be avoided. Bromide of potassium, or even chloral, may be substituted when medicines of this kind are required; but the exhibition of such drugs is apt to obscure the symptoms, and that at a period when time is of great value. Blisters ought not to be resorted to in the acute stage. They are of service, however, in chronic encephalitis. It has been advised to place them over the nape of the neck. When applied in this position, the raw surface which is left is very apt to become irritated from friction, owing to the restlessness of the patient. It is, on the whole, better to put the blister on the vertex, and it is equally efficacious. The application of cold to the head is highly lauded. It may be applied in several ways, such as by evaporating lotions, by ice enclosed in bladders or in india-rubber hoods, or by a continuous current of water passing through a bag or coil of tubing. Evaporating lotions are often soothing to the patient, and are not likely to do harm. Ice applied to the head in bags is uncomfortable, and is frequently a source of great annoyance to the patient, both from its hardness and the frequency with which it has to be changed.

The best form of applying cold to the head is by some apparatus through which a constant current of water is passed, cold being substituted for that which has been slightly heated by contact with the layer next the surface of the head. For this purpose Dr. Robertson's water-bags are very suitable. They are made of thin india-rubber with an afferent and efferent tube attached to opposite corners. The former of these is inserted into a basin containing cold water, which may be iced if wished, and the current is established and maintained by syphon action. Leiter's tubes, of flexible metal, have subsequently come into use, and they answer the same purpose. When neither of these is at hand, the practitioner may substitute for the latter a piece of india-rubber gas-tubing, which may be formed into a coil and applied to the head. As these are usually lined with spiral wire, they do not collapse under the weight of the head. A string may be tied to one extremity of the tube to regulate the outflow by diminishing its calibre. Cold applied in any of these ways undoubtedly causes a contraction of the vessels of the scalp; but is it sufficient to produce the same action in the interior of the brain, and, if not, does the contraction of the superficial vessels not induce a greater turgescence in the interior of the brain? When one considers the large quantity of blood which is passing through the brain, it must be apparent that the local application of cold to the surface cannot have much effect on the deeper structures.

The employment of blood-letting in the early stage of brain-inflammation is almost obsolete, though some surgeons still believe in its value when judiciously used.

Treatment of intracranial suppuration.—Whenever the inflammation has passed into an acute stage, the surgeon should be prepared for the advent of suppuration. This may be indicated by symptoms of compression, convulsions, paralysis, &c., the careful observation of which may lead to localisation of the affection, this being the principal step toward establishing a correct treatment. If there is a wound leading to bare bone, or superficial signs of local injury or the existence of Pott's puffy tumour, it would be right to make out whether there is suppuration under the skull at that part by elevating the bone. But suppose the indications afforded by convulsive movements, by paralysis, or otherwise, should indicate that another brain-area is involved, which should the surgeon prefer as a guide: the superficial appearance of injury, or the motor or sensory signs, pointing to a lesion situated elsewhere in the brain? If the latter are distinct and show a precise localisation, they are much to be preferred. The writer has had cases illustrating this. One of them is as follows: A lad was seen by him suffering from cerebral abscess, with symptoms pointing to a localisation in the base of the third frontal

convolution, but with a superficial lesion situated in front of the brow. The abscess was found in Broca's lobe, and not near the point of bare bone, which was the seat of injury. Other cases of even more pronounced character have been seen, where the traumatism apparent on the surface did not guide to the area of cerebral compression, which, however, was marked by motor symptoms, pointing to another region. These would lead one to the conclusion that motor symptoms, when sufficiently pronounced, are more to be relied on than the mere appearance of injury on the external surface of the scalp as indicating the seat of the cortical lesion. When, however, such external indications are combined with symptoms localising the lesion at the same spot, the diagnosis is rendered the more certain. It must be borne in mind, in the absence of localising symptoms, that the brain may be injured at a part opposite to that of the external injury, arising in such cases from *contre-coup*.

Regarding the localisation of the lesion, twitchings and convulsions are of great service, especially when confined to a particular set of muscles, or to one limb, or even to both limbs of one side. But inasmuch as many convulsions, though at first limited and following a definite order, soon become general, and thereby their distinctiveness as motor localising elements is lost, it is necessary to have the onset of the convulsions closely watched. It will be fortunate if the surgeon can see the onset of these attacks himself. But he cannot always be with his patient, and if he leaves, even for a short period, a seizure may take place in his absence, and its valuable indications be lost. Under such circumstances, is there no method whereby these convulsions might be watched, or data from which their advent might be expected? Accurate thermometric observations will frequently give a forewarning of the approach of convulsions, as indicated by an acute rise in the temperature within a comparatively short time. An intelligent nurse, trained to watch such cases, and whose word can be implicitly relied on, is invaluable, not only in carrying out the treatment, but as an instrument of observation. She ought to be instructed to record the temperature every two hours, and she ought to be prepared to note down the order in which the particular parts of the body twitch or become convulsed. On any sudden increase of the temperature the surgeon should be at once apprised of it, so that he may be able to be present at the beginning of convulsive movements.

Suppose that the abscess be traced to a particular locality of the brain, is it to be left alone, or are its contents to be allowed to escape? If the surgeon has the ordinary antiseptic means at his disposal, he ought to evacuate the contents of the abscess as soon as its locality is clearly recognised. For this purpose the skull ought to be opened. Before doing so the head ought to be freshly shaven. The skin should be washed with soap and water—a flesh-brush being used. It should then be cleansed with turpentine to remove any greasy matter, and finally with the antiseptic which is to be employed during the operation. In such cases the writer has always operated under a carbolised spray, and the whole operation has been at all times carried out under antiseptic precautions. The bone may be elevated in several ways. Some have advised the use of a mallet and chisel—a most objectionable practice. Others saw a triangular or rectangular portion of bone, which they then elevate, leaving it attached to the soft parts at one side, which act as a hinge, and enable the bone to be folded back. The writer has used this method on two occasions. It is suitable for cases where a large portion of the brain has to be brought into view. It, however, takes longer than trephining, and is not free from other disadvantages.

Trephining—the removal of a disc of bone by a cylindrical steel saw—is the easiest method of removing bone from the skull. The surgeon should be in possession of crowns of various sizes, which he may use as the case requires. For exploratory purposes, and especially when he believes there is pus located between the dura mater and the bone, a disc mounted in a drill-handle, and measuring not more than one quarter of an inch in diameter, is very serviceable. A small aperture is made by this means, which may be readily filled up, and through which a meningeal abscess may be evacuated. But when the abscess is situated in the brain, a large disc of bone ought to be removed. The ordinary trephine used in this country is imperfect. An instrument of the nature of the French trepan is much preferable. Sinuses must be avoided. When a sinus has been opened by mistake, a plug of catgut may be introduced. Firm digital pressure on the walls of the sinus against the bone for five consecutive minutes has been in one instance effective in stopping the flow. When the dura mater has been exposed, if the abscess is superficial the dural membrane bulges into the aperture in the skull, and there will be no cerebral pulsations visible. Occasionally the dura mater

will be found to be already perforated by ulcerative action, and then the matter will ooze out or well away as soon as the disc is removed. But if this has not taken place, the membranes should be opened with a sharp bistoury. The pia mater, if inflamed, will be softened, and be of a dull leaden hue, and probably adherent to the cortical substance as well as to the external coverings.

Provided the localisation has been clearly made out, and the abscess is seated in the white matter, an incision ought to be made into it. Occasionally the brain-tissue in the vicinity of the abscess is softened to such an extent that the substance immediately fills up the incision made with the thin-bladed bistoury, so that the escape of pus is hindered. Most frequently the pent-up pus escapes with ease. A hollow needle might be employed when the abscess is deeply seated, as the pus might drain slowly through it. After the evacuation, the aperture ought to be carefully dressed, free drainage being established, the head being kept in the best position for that purpose. Subsequently the head should be dressed only when the temperature gives indications of mischief, or when the dressings show the slightest stain. The patient ought to be carefully attended to, the bowels kept regular, and the diet low. He should be kept quietly at rest in bed until the wound has thoroughly healed. He ought not to be allowed to move about sooner than a month under any circumstances. Any precipitancy in allowing the patient to go about, or any excess in diet, may lead to serious consequences.

WILLIAM MACEWEN.

ENCEPHALOCELE. *See* MENINGOCELE.

ENCEPHALOID CANCER. *See* CARCINOMA.

ENCHONDROMA.—When non-malignant, this class of tumour is composed of cartilage only, or, if mixed with fibrous tissue, mainly of cartilage. Cartilaginous tumours, when originating in bones, which are their principal seats, are found either as central growths or—much more frequently—as outgrowths; and in this latter form the tumour may be either single—in which case the part involved is usually near the end of one of the larger long bones—or multiple, when the smaller long bones of the hand or foot are affected.

Tumours consisting largely of cartilage occur occasionally in the testis, in the tumours connected with the salivary glands—notably those of the parotid—in lymphatic-gland and connective-tissue tumours.

Cause.—Seeing that so many of the multiple enchondromata are found growing in young patients, or can be traced back as having commenced in early life, it seems probable that the cause of these tumours is to be found in errors of development, of the nature either of over-production, or rather of an irregular overgrowth of the rudimentary cartilage-elements. Of those tumours which occur later in life, either as single tumours around a long bone or mixed with other tissues in glandular growths, no special cause can be given.

Pathology.—In minute structure cartilaginous tumours may be said to correspond almost exactly with fœtal cartilage, consisting of stellate cells embedded in a hyaline matrix. Single tumours affecting the ends of the long bones grow to an enormous size, yet but seldom invade the contiguous joint. In the area of their bases of attachment to the bone they are prone to ossification, and in other parts to undergo cystic degeneration, well-defined spaces being formed, filled with a viscid mucoid fluid. In the multiple enchondromata, on the other hand, growth seems after a time to be arrested, and, beyond the inconvenience or disfigurement, they cease to cause anxiety. The central tumours are encapsuled, and are surrounded by a wall of compact bony tissue.

A feature in the pathology of some enchondromata which is peculiar to these amongst the tumours regarded as non-malignant, is the fact that occasionally dissemination occurs, nodules and even large secondary growths being found both in the lymphatics and in the internal organs, which have in this way destroyed the patient's life.

Diagnosis.—In the cases of multiple enchondromata, or of the single ones about the hand, the diagnosis is simple, as there is no other form of tumour with which they could be confounded, being less hard than bone, and yielding often, upon firm pressure, a 'crunching' sensation, which, when it can be obtained, forms conclusive evidence of a tumour being cartilaginous; when pedunculated they can be made to rock. The larger single enchondromata require to be distinguished from those sarcomata which may be either ossifying or chondrifying, or undergoing both of these changes; but sarcomata of this type are more prone to occur in the pelvis and bones of the trunk, whilst the periosteal sarcomata, that are found in the situations which enchondroma usually occupies, are soft and smooth on the surface

and of rapid growth, cartilaginous tumours being usually of much slower growth, as well as being hard and nodulated.

Between a central cartilaginous tumour and a central sarcoma or a myeloid tumour a diagnosis cannot always be made. Of course, if the characteristic yielding sensation of cartilage can be obtained, the case is clear, but, failing this sign, the diagnosis rests upon the probabilities of age, duration, rapidity of increase, pain, and invasion of health. When cartilage enters into the composition of a glandular tumour the hardness and nodulated character of the tumour commonly render the fact evident.

Treatment.—Amputation of a finger or even of part of the hand may be necessary to relieve a patient of a member which, from the size an enchondroma has reached, has become a useless incumbrance; but we cannot say this procedure is required on account of the nature of the growth itself. So also eventually is amputation necessary when enchondroma of a large long bone has reached a size which puts a stop to locomotion or threatens life. For central cartilaginous tumours in bone the attempt should be made to enucleate the growth, and this will generally prove feasible, unless the surrounding bone has been reduced to a mere shell. A. Willett.

ENDOSCOPE.—The endoscope is an instrument designed for the direct exploration of internal organs and cavities by the sight. There is no portion of the human body, into which a straight tube can be introduced, in which it may not be employed profitably. By its aid we can examine the urethra, bladder, rectum, uterus, nasal fossæ, pharynx, larynx, external meatus auditorius, wounds, cavities of abscesses, and so forth. In its most perfect form curved tubes may be used as endoscopic specula.

This instrument, which is one of the numerous modern adjuncts to physical diagnosis, dates back to the early part of the present century, when we find Bozzini of Frankfort, in 1806, using his 'light conductor.' In 1824, Dr. J. D. Fisher, of Boston, devised an instrument not unlike that in use at present, and shortly after, Segalas, of Strasbourg, followed his example. Later on, Bombalgini, Avery of London, and Hacken of Riga, added their labours and experiences, thus far, unfortunately, unprofitable.

In the year 1865, Desormeaux, of Paris, published his remarkable essay on the subject of endoscopy, and from that date to the present time this mode of exploration has been used more frequently, scientifically, and fruitfully than before.

It will be right here to define what may be fairly considered the real value of the endoscope as a means of diagnosis and treatment. The writer holds that it is not an instrument needed for general use, but rather one for employment in cases of exceptional obscurity, in which its help will be found to make all the difference between blundering guesswork and absolute certainty.

The following may be taken as a general description of the instrument.

In the first place there is a tube or speculum, which is introduced into the canal or cavity to be examined; and at one extremity of this a mirror of polished silver, perforated in the centre, is placed at an angle of 45 degrees. The function of the mirror is to reflect the light, which is placed laterally, into the tube, so as to illuminate it to the end. As the calibre of the tube is usually very small, a most brilliant light is required, and, in order to obtain the best effects, it should be made to converge slightly upon the mirror. This convergence is obtained by interposing between the light and the mirror a plano-convex lens of suitable focal length.

The light being sufficient, the lens properly adjusted, the mirror bright, and correctly placed with respect to the speculum tube, it becomes a matter of facility for the eye of the observer, looking through the aperture in the mirror, to see clearly to the bottom of the speculum, and recognise whatever may lie there. Various specula are required for endoscopy. The urethral tube is the most generally useful, but special ones are needed for the examination of the bladder, rectum, nasal fossæ, auditory meatus, &c.

Various lights have been tried for obtaining the needful illumination—sunlight, ordinary daylight, the Drummond, magnesium, and electric lights. As a rule they are toys in endoscopy, and not practically useful. Desormeaux uses a gazogene lamp of minute dimensions, which gives a very insufficient view. After numerous and prolonged experiments the present writer has arrived at the conclusion that nothing equals, for the purpose, the intense light derived from the thin edge of the flat flame of a small paraffine lamp.

Before concluding, a few examples of the value of endoscopy, *in cases of obscurity*, may be here cited.

Case I. In the autumn of 1865, Dr. S. consulted the writer, by letter, relative to extreme irritability of the bladder, from which he had suffered for six months, and for which he had taken, in vain, the advice of two very eminent London surgeons, one of them a specialist of the highest skill in diseases of the urinary organs.

Dr. S. came to Dublin for examination, when the writer found him a hale man of about sixty years of age, in good health except for the irritable bladder, which necessitated his passing water every ten minutes, and totally disabled him from performing the duties of his profession. The urine exhibited, after standing some hours, a very slight deposit of muco-pus; otherwise it was healthy, of good specific gravity, acid reaction, and containing no greater amount of albumen than was accounted for by the minute quantity of muco-pus.

With the assistance of Dr. Robert MacDonnell the writer made a careful endoscopic examination of Dr. S. The urethra and bladder were found healthy, with the exception of a small patch of superficial ulceration, or rather abrasion of the mucous membrane, in the site of the trigone. This lesion explained the whole case. The moment the urine reached this spot the irritation began, and could not be assuaged except by emptying the bladder. The indication for treatment obviously was to heal up this abraded surface.

Local measures being far more likely to attain that end than drugs, an instrument was constructed (a canula open on the curved aspect) with which the writer easily conveyed a watery solution of nitrate of silver to the part (gr. x.–f ℥j). A few applications dulled the sensibility, and made Dr. S. more comfortable, and after a time he was allowed to return home, and directed a daily injection of the bladder (previously emptied) with a solution of nitrate of silver, (gr. j.–f ℥j). The case progressed steadily, and in four months a perfect and permanent cure was effected.

Case II. In the year 1866, the late Dr. Fleetwood Churchill, senior, asked the writer to examine a young lady who suffered from an extraordinary irritability of the bladder. Dr. Churchill had ascertained that there was no stone, and that the urine was perfectly normal. An endoscopic examination of the bladder demonstrated its perfect healthiness, the whole surface presenting the mamillated rose-red surface familiar to the trained endoscopist. The absence of bladder-disease led the writer to suggest an intra-uterine examination, which showed a closely contracted cervix, with diseased lining membrane.

To facilitate further investigation Dr. Churchill dilated the cervix with the sea-tangle bougie, and from that time the irritability of the bladder disappeared. In this case the perfect healthiness of the bladder, proved by the endoscope, suggested the reflex origin of the symptoms, and treatment of the uterine disease effected an immediate and permanent cure.

Case III. Mr. R., aged about forty years, had long suffered from rectal hæmorrhage, which latterly threatened to undermine his health. He had become markedly anæmic, breathless on exertion, and lost all appetite. Careful examination of the rectum with the ordinary speculum had already failed to discover the cause of the bleeding.

An endoscopic examination cleared up the difficulty, and enabled the writer, and Dr. Tegart, to see a bleeding growth, situated so high up in the bowel as to be beyond the reach of the ordinary speculum. Mr. R. was conveyed to Dublin, and on the 11th of April, 1876, assisted by Dr. Tegart and Dr. P. Hayes, the writer succeeded, with great difficulty, owing to its unusual position, in ligaturing the vascular tumour. The result was a perfect cure of the hæmorrhage, and in a few months Mr. R. completely regained his health and condition.

The three foregoing cases have been selected from amongst many, to illustrate the help which may be gained by the use of the endoscope, towards precise diagnosis and effectual treatment, in certain obscure ailments of the bladder, uterus, and rectum.

F. R. Cruise.

ENTERECTOMY, or excision of a part of the small intestine, has been performed for the relief and cure of the following conditions:—Simple and epitheliomatous strictures of the small intestine; occlusion of the bowel by adhesion and matting of the coils, of such a character that the deviation of the gut cannot be corrected; obstruction by non-carcinomatous neoplasms; gangrene due to the various forms of strangulation and to hernia; irreducible or gangrenous intussusceptions, and for the closure of fæcal fistula.

It will be seen that under certain of these circumstances the operation not only serves to remove the obstruction, but to cure the condition which produced it. In certain of the conditions named, such as in the various forms of stricture, in obstruction by large tumours, and in irreducible intus-

susceptions, the operation offers the only chance of cure, while other measures short of resection can only bring about a temporary relief.

There are two different methods of performing the operation. In the one the diseased segment is excised, the divided ends of the bowel are then at once united by sutures, the parts so adjusted are reduced into the abdominal cavity, and the wound in the parietes is closed. In the other, after the resection has been performed, the divided ends of the bowel are stitched to the margins of the wound in the parietes, and an artificial anus is established. After a certain interval, the artificial anus is closed by a second resection operation with immediate suture, or by some of the other measures available for the treatment of such abnormal apertures.

1. In the first mode of procedure the abdomen is opened by an incision in the linea alba below the umbilicus. The portion of gut to be resected is drawn out of the wound. The wound is then plugged round about the gut by means of warm carbolised sponges, so that, should the intestinal contents escape during the operation, they may not find their way into the peritoneal cavity. The bowel must now be occluded both above and below the part that is to be excised. This can be accomplished either by the fingers of an assistant, or by means of the various clamps invented for the purpose (Rydygier's, Bishop's, Makins', or the writer's). The portion of gut is now to be excised with scissors, and a triangular piece of the mesentery resected, the base of the triangle corresponding to the segment of bowel removed. The divided mesenteric vessels are secured, and the cut edges of the mesentery approximated by several points of suture. The divided ends of the bowel are now approximated and united by sutures. A number of sutures are first to be applied so as to unite the edges of the mucous membrane, that membrane being freely exposed by the retraction of the muscular coat. An outer line of sutures is then applied so as to bring the serous surfaces of the two pieces of gut into close contact. The best suture for this purpose is that known as Lembert's. In all, some 40 points of suture are required, 15 for the inner row and 25 for the outer. The best material for the purpose is the finest Chinese twist, and the needle used should be very fine, round on section, and so curved as to form half a circle. Hagedorn's needles are very well suited for the purpose. The clamps are removed, the bowel is returned into the abdomen, and the wound in the parietes is closed. After the operation the patient must be kept well under the influence of opium, so as to insure the absence of movement in the bowel. The patient may have ice to suck, but no food should be given by the mouth for at least three days, and then it should be given in small quantities, and in a fluid form. If necessary the patient's strength may be supported by enemata of brandy and peptonised beef-tea. Such enemata are, however, contraindicated if they induce undue peristaltic movements.

2. In the second mode of procedure, a portion of intestine and a triangular piece of the mesentery are excised, as in the method just described. The gap in the mesentery is united by a few points of suture, and the divided ends of the intestine are so adjusted to the margins of the wound as to establish an artificial anus. This fistula is subsequently closed by a second resection operation, followed by suturing of the divided ends and closure of the abdominal wound. Or it may be closed by any other of the measures applicable to the cure of Artificial Anus.

There is no doubt that in cases of intestinal obstruction the second operation is infinitely preferable to the first, and should be the procedure selected in such cases. It must be borne in mind that the patients' lives are threatened by reason of the obstruction, and it will be seen that the latter of the two procedures detailed above will give the most ready and complete relief. The sutured bowel, when returned into the abdomen, lies as a paralysed loop, and may well help to maintain already existing symptoms of obstruction. Besides, patients upon whom these operations are performed, are often in a critical condition, and not in a state to bear well so prolonged an operation as is the first-named. Moreover, to prevent fæcal extravasation at the suture line, the bowel should be as nearly as possible empty and in a fairly healthy condition. When the first-named of the two procedures is adopted in a case where obstruction exists, the operation is performed upon a bowel in a state of considerable distension, and upon tissues that are apt to be congested and inflamed, if not even on the verge of gangrene. The general mortality of resection operations is 50 per cent. Frederick Treves.

ENTEROCELE. *See* Hernia, Strangulated.

ENTEROTOME, Dupuytren's. *See* Artificial Anus.

ENTEROTOMY. — This procedure, sometimes known as Nélaton's operation, consists in establishing an artificial anus in the small intestine. The seat of the operation is the inguinal region, preference being given to the right side. An incision is made through the abdominal parietes parallel to, and from one inch to one inch and a half above, Poupart's ligament, and to the outer side of the deep epigastric artery. The incision is carried through the external and internal oblique and the transversalis muscles, and the peritoneum is divided. The skin incision should be about three inches long, but the deep incision, whereby the peritoneum is opened, need be no more than about one and a half inches in length. The abdominal cavity having been opened, the first *distended* coil of bowel that presents itself is gently seized and drawn into the wound. The gut is then fixed to the wound by a double line of sutures, which are applied in a row, one on either side of the skin incision, and which transfix the intestinal walls. An opening is finally made into the bowel between the two lines of suture, and the operation is completed. When enterotomy is performed upon the right side, as is usually the case, the part of the intestine opened is nearly always the terminal portion of the ileum.

This operation has been done for almost every form of intestinal obstruction. It affords relief, but it cannot become a means of cure since it leaves the cause of the obstruction untouched. If destructive changes are taking place at the seat of the obstruction at the time when the enterotomy is practised, they will continue to progress in spite of the procedure. The operation is performed in the dark, and is to a great extent independent of diagnosis. In several instances an artificial anus has been established in the ileum to relieve an obstruction which a subsequent autopsy showed to be situate in the sigmoid flexure. If it should so happen that a loop of jejunum is opened instead of ileum, death from marasmus will in time attend the establishment of a fistula so near the stomach. In any case much distress is apt to be caused by the accumulation of fæces between the fæcal fistula and the seat of the obstruction. There are certain cases however—as for example when obstruction depends upon the extensive matting together of coils of intestine—in which enterotomy offers the only means of saving the patient's life. Mortality:—Out of 61 recorded examples of enterotomy for non-malignant forms of obstruction, 20 are described as cured, while 41 died. Out of 48 examples of enterotomy for malignant stricture of the bowel, 6 are described as cured, while 42 died.

FREDERICK TREVES.

ENTROPION.—The edges of the lids are more or less inverted, so that the lashes are turned towards the eyeball. The lashes themselves may be regular, or they may be irregular, as in trichiasis. *See* EYELIDS. The inversion may be complete or it may be partial, and in either case it may be acute (spasmodic) or chronic (inflammatory).

ACUTE ENTROPION chiefly affects the lower lid, especially in old people (senile entropion). From the shrinking of the tissues in old age the globe recedes somewhat into the orbit, the lower lid loses support, and is turned inwards by the action of the marginal fibres of the orbicularis muscle. This is especially apt to occur when the eyes are bandaged. It not infrequently happens in old persons operated on for cataract that, when the eyes come to be tied up after operation, the lower lid becomes inverted, though previously there had been no inversion. Acute entropion may, however, occur in younger persons from injury or inflammation of the conjunctiva or cornea. In any case, the irritation of the lashes in entropion may set up inflammation and even ulceration of the conjunctiva or of the cornea. From the displacement of the lacrymal puncta there is a constant overflow of tears, which may lead to excoriation and inflammation of the edges of the lids.

Treatment.—In slight and temporary spasmodic entropion it may be enough to draw the edge of the lid outwards from time to time, or to fix it with collodion or strapping. In order to facilitate the drainage of the tears the lower canaliculus should be opened. Should these simple measures fail, an elliptical fold of skin may be excised from the outer surface of the lid and close to the margin. The size of the piece of skin will depend upon the amount of inversion and the length of time that it has lasted. After removal of the skin a strip of the most marginal fibres of the orbicularis may also be removed. Sutures may be applied, or not. In order to increase the effect of the operation, a snip, one-eighth of an inch deep, may be made on the edge of the lid close to the external angle. This divides those marginal fibres of the orbicularis muscle which are chiefly instrumental in producing the inversion. Many other procedures may be resorted to, as subcutaneous sutures, canthoplasty, or division

of the external canthus, Graefe's operation, &c.

Chronic Entropion.—In this form the edges of the lids are often thickened and red, and there is usually some trichiasis. The skin is not lax, as in the acute form, and the tarsus itself is generally incurved. There may be also contraction of the palpebral aperture (blepharophimosis), together with signs of chronic, especially trachomatous, conjunctivitis. The result of chronic inversion is irritation of the conjunctiva and the cornea, or even inflammation and ulceration of the cornea, with lacrymation and dread of light. Owing to the displacement of the lacrymal puncta there is epiphora. It may be the result of inflammations, or it may be traumatic and due to burns, especially with lime or ammonia. In extreme cases the conjunctival sac may be obliterated.

Treatment.—Canthoplasty may be done if the palpebral aperture be shortened; excision of an elliptically-shaped piece of skin, if there be no incurvation of the tarsus; but if the tarsus be incurved, as after trachoma, the operative procedure must be applied to the tarsus. Two methods are in use: one consisting of removing a V-shaped strip from the *outer* surface of the cartilage near the edge, 'grooving the fibro-cartilage' (Streatfeild-Snellen), the other consisting of making an incision through the tarsus from the *inner* side near the margin, and throughout its entire length (Bürow). The principle of the former is to correct the deformity by shortening the outer surface; that of the latter, lengthening the contracted inner surface. Another operation consists in splitting the margin of the lid throughout its entire length immediately within the row of eyelashes (Arlt). This procedure is especially indicated when the conjunctiva is greatly contracted. Each of the plans above mentioned attempts to retain the eyelashes; but in some instances it may be necessary to excise the lashes. J. Tweedy.

ENURESIS. *See* Incontinence of Urine.

EPHELIS. *See* Lentigo.

EPIDIDYMITIS. *See* Testis, Diseases of the.

EPIPHORA. *See* Lacrymal Apparatus, Diseases of the.

EPIPHYSES, Affections of.—These may be acute or chronic in their course, central or peripheral as regards their starting-point. They are essentially affections of infancy and childhood, though of course they may occur up to the age when the epiphyses unite with the shafts, which in some cases may be as late as the twenty-first year of life. As a rule, the acuter forms of disease are found among infants, the more chronic among older children; they are rarely primary; or, to speak more definitely, they depend either on some constitutional cachexia or on septicæmia. The diseases which commence at their line of junction with the shaft (peripheral) are more common than those which commence in the interior of the epiphysis (central). The so-called epiphysitis, in many cases is an inflammation along the line of junction with the shaft, and more often due to disease in the shaft than in the epiphysis; the integrity of the latter being shown by the continued growth of the diaphysis, and explained, probably, by the immunity which non-vascular structures enjoy over more vascular ones in early life.

Causes.—By far the commonest cause of the acute affections of the epiphyses is some congenital dyscrasia, especially inherited syphilis. Though much less frequently, acute rickets and scurvy also lead to acute inflammations at or near the epiphysial line, which may be followed or not by disease of the epiphysis. Septicæmia is another cause, and this variety of lesion, usually multiple, is more acute and more destructive than any of the foregoing. In all the forms, injury—traction on joints during parturition, sudden jerks, blows, falls, &c.—is often the more immediate cause. In the chronic forms, injury again plays an important part; occurring in later childhood, the strumous diathesis is often the predisposing factor. In a few cases, even in which there does not appear to be any constitutional dyscrasia, blows or falls set up acute or subacute disease in the ossifying centre of an epiphysis, apparently by detaching it from its connection with the surrounding part, or in consequence of hæmorrhage or of mere concussion; the centre either dies outright, or takes on subinflammatory changes which lead to abscess, or to arthritis.

Pathology.—The pathological anatomy varies within considerable limits, depending on the stage of the disease when examined, or on the acuteness of the process, and a little also on the nature of the initiatory lesion. In all the peripheral affections, at the line of junction with the shaft, and in the soft, most recently formed osseous layers there are hyperæmia and exudation of cells.

The amount will vary in proportion to the acuteness of the process. In congenital syphilis, this exudation may be so abundant as to allow the epiphysis to move freely on the shaft; in some cases the epiphyses appear to be quite separated; suppuration is rare, but sometimes occurs. As a rule this exudation-material is sanguineous, it is contained within the periosteum, and rarely shows any tendency to point externally, the adjoining part of the shaft not rarely participates in the disease; complete recovery may take place under suitable treatment. In acute rickets a very similar condition may exist, but it rarely assumes the same extent; the bones become extremely vascular and softened, so that fracture not infrequently results. In some forms of infantile scurvy also, an acute inflammation of the diaphyses of the long bones occurs, which may compromise the epiphysis. In septicæmia, the shafts of the long bones are often the starting-points of the disease, and the epiphysis becomes secondarily implicated; or, beginning within a joint, disease spreads to the line of junction, thence to the shaft if, as in the hip and shoulder for instance, the epiphysis happens to be within the joint-capsule. In all the foregoing cases the affection is more often multiple, the attacks not necessarily occurring all at once, but in rapid succession; sometimes the chief violence of the disease expends itself on one joint or bone, while the remainder are less profoundly affected.

Under the term 'acute arthritis of infants' Mr. Thomas Smith has described cases which include the septicæmic variety, and—as the writer of this article thinks—other and more distinctly epiphysial conditions, the feature in common being arthritis. In a few cases, epiphysial disease proper may be acute, and lead to arthritis or abscess; it is then mostly in consequence of necrosis or caries in the ossifying centre. But more generally the change is a chronic one, the centre becomes inflamed and caseous, pus forms slowly, and before making its way out, or towards the joint, it gives rise to chronic inflammation and to pulpy thickening of all the soft surrounding tissues. On making a section through such an epiphysis, a cavity is entered, lined with pale, semi-caseous granulation-tissue, and containing what remains of the ossifying centre as a loose sequestrum.

Symptoms.—The symptoms vary as much as the pathological conditions. A pseudo-paralysis of one or more limbs, coming on rather suddenly, attended with pain on handling, with swelling at or near a joint, and occurring in a syphilitic infant, would be almost pathognomonic. A similar condition, occurring in an older child without signs of syphilis, but with the history and evidences of improper hygienic surroundings, would almost as certainly indicate an acute onset of rickets. In young strumous persons, the affected epiphysis excites a little general infiltration of the adjacent soft structures, with a subsequent formation of pus, which is the not infrequent starting-point of joint-disease. In such cases, the acuteness of the process rather modifies the symptoms, and may even mask the disease.

Prognosis.—The syphilitic and rachitic and scorbutic varieties possess unbounded powers of repair under suitable treatment. Where necrosis has actually taken place, the subsequent growth of the limb will almost certainly be impaired: if the diseased epiphysis communicates with a joint, prognosis as regards joint-function must be guarded. In the septic, multiple forms the disease is often fatal both to life and limb.

Treatment.—Generally, for all forms, fixation and rest of the affected limb or limbs are of first importance. Many cases are fatal for want of early recognition of the condition, and as the result of raising the child by its limbs, or of allowing them to dangle as it is turned about; much of the actual separation which takes place is due to lifting or handling the child. In the syphilitic cases, a piece of flannel covered with mercurial ointment should be evenly wrapped round the affected limbs, and over this several turns of soft bandage to act like a splint: this dressing need not be disturbed for two or three days. The limbs should be fully extended and in their normal position; the child must not be carried about, but be allowed to lie on a soft pillow, and be moved as little as possible, or when moved, moved on the pillow. All unnecessary clothes and sleeves should be avoided. Mercurial inunction into the abdomen may be practised simultaneously. Improvement will generally be manifest within a few days; while the low constant cry of pain will probably cease from the moment that immobility of the affected limbs is secured. In rickets or scurvy, evaporating lead lotion made with milk should be substituted for the mercurial ointment, but the same immobility with soft bandages should be secured; cod-liver oil, fresh uncooked

pounded meat, fruit-juice, with attention to hygienic details, will effect a marvellous change in a few days. In the chronic cases, an attempt should be made to save the joint. If an abscess point it should be incised freely, and the diseased bone gouged out, if it can be detected with a probe. Not infrequently a central necrosis of the epiphysis will be found; after its removal, the cavity must be scraped out with a sharp spoon, and then filled with some dry absorbent antiseptic wool. Cod-liver oil internally, with change of air to the seaside, are powerful adjuvants in such cases. The secondary affections of joints, if not too far advanced, often subside spontaneously after the exciting cause has been removed; hence the indication is to temporise as long as possible in the hope of restoration without operation. ROBERT WILLIAM PARKER.

EPIPHYSES, Separation of. *See* SEPARATION OF EPIPHYSES.

EPIPLOCELE. *See* HERNIA, Strangulated.

EPISPADIAS. *See* ECTOPIA VESICÆ.

EPISTAXIS is the term applied to bleeding from the nose, on account of the tendency to 'drip' usually characteristic of the condition.

When *accidental*, the bleeding soon ceases spontaneously in most instances, at any age, especially if resulting from a fall or other blow on the nose, with or without fracture of one of the superior maxillary bones. In rare cases it attends fracture of the base of the skull through the ethmoid bone, as indicated by a subsequent discharge of serous fluid.

Under circumstances of *operation* for the removal of nasal polypus, necrosed bone, or foreign body, the epistaxis may be profuse to a dangerous extent, and require prompt arrest.

In *disease*, epistaxis is apt to accompany malignant nasal tumours, when ulcerated on the mucous surface.

Under other circumstances, *spontaneous* epistaxis varies in severity and danger. In young anæmic persons, or others liable to headache, and in women liable to suppressed menstruation, bleeding from the nose produces relief which more than counterbalances the inconvenience of the flow. Full-blooded persons benefit by a tolerably copious hæmorrhage of this sort; but in middle life and old age it sometimes proves intractable, dangerous, and even fatal.

Treatment.—Whatever be the cause, the arrest of copious or persistent epistaxis should be promptly attempted, except in cases obviously benefited by the occurrence. (1) The first, simplest, only instantaneous means, under all circumstances, at hand, is the adoption of the proper attitude of body. In the standing posture the general vascular tension is at its highest, less in the sitting, and least of all in lying down. In any posture the elevation of the upper limbs, with the hands at their highest, promotes the contraction of the arteries to the head as well as to the lower limb, and instantly arrests epistaxis in many cases. The lying, or at least reclining, posture, and elevation of the arms, should therefore be promptly enforced in the first instance.

Other means may be required, but this is the proper and only sensible thing to begin with, and may be enough if the patient can also be kept still, composed, and reassured. It is not essential that the head should always be kept low, for the head and shoulders can be raised sufficiently for all convenience without departure from the general reclining posture, the attitude of most perfect rest to the heart and blood-vessels.

The next most effectual means are (2) the irrigation of the nose with hot water (*see* NASAL DOUCHE); (3) the subcutaneous injection of ergotin (*see* ERGOTIN); and (4) plugging the nose, which should never be undertaken unless (2) and (3) have failed. For the last process, both efficiency and comfort have been attained by the use of little bags of india-rubber having a tube attached, and capable, on inflation with air or injection with water, of exercising effectual pressure on the walls of the nasal cavity and arresting the flow of blood. There are two or three varieties of nasal plugs, each of which is introduced, in a collapsed condition, into the nostril, and inflated when *in situ*, with an india-rubber ball, force-pump, or with the mouth. Dr. Wiglesworth's plug is passed behind the posterior nares, inflated, and pulled forwards till the aperture is stopped; the tube is attached to an ordinary plug of lint in the nostril.

The old-fashioned mode of plugging with lint is both difficult, disagreeable, and painful, but as a last resource it has sometimes to be done. A piece of lint, plain or steeped in perchloride of iron, solution or tincture, is folded to fit closely into the posterior nares, to which situation it is drawn through the mouth by a piece of string tied round its middle, and previously passed in at the nostril, round behind the palate, and out at the mouth. This manœuvre is effected with the aid of a urethral catheter, or by a

special contrivance called Bellocq's sound, resembling a curved metal catheter, and containing a flexible spring on a stilette, for protrusion into the mouth when the instrument lies in the nose and pharynx.

When the pharyngeal end of the nasal cavity is plugged, the nostril is then plugged with another fold of lint of suitable size, and tied there with the ends of the string attached to the posterior plug, one of which issues from the mouth and the other from the nostril.

The inconveniences and discomfort of this process are so great that it should never be undertaken if it can be dispensed with. RUSHTON PARKER.

EPITHELIOMA. *See* CARCINOMA.

EPULIS. *See* GUMS, Affections of the.

EQUINIA. *See* GLANDERS.

ERECTILE TUMOURS. — These curious swellings, known also under the names of vascular tumours, cirsoid aneurism, arterial varix, teleangeiectasis, and angeioma, may be shortly described as consisting of tortuous vessels or cavernous sinuses freely communicating with each other, and also with greatly enlarged arteries and veins. Occasionally they pulsate, and the skin is often 'stained.' Their customary sites are the scalp and face, often involving the external ear; and at the orifice of the female urethra. Although placed commonly near the surface, the deeper structures are liable to be affected.

Occurring usually in young patients, there are cases recorded of erectile tumours following injuries.

Cause.—The occasional skin-implication denotes their kinship to nævi, and in these instances there exists a common cause suggestive of an embryonic hypertrophy of the capillaries. In the case of the tumours commencing unequivocally in adult life, an hypertrophy due either to an idiopathic or traumatic cause must be the assumed explanation of their origin.

Pathology. — The tumour-like masses consist of a congeries of dilated blood-vessels supplied by numerous arteries, which usually can be traced running into the growth and emptying into large tortuous veins. Their microscopic structure is the same as that of the corpora cavernosa penis. A change, probably of a degenerative kind, is seen in the production of cysts; but the mode in which this is brought about is not clear. Whilst cellular tissue is the structure in which erectile tumours are commonly placed, other structures—notably, the muscles—are liable to be involved in deeply-placed tumours.

Diagnosis.—When placed on the surface, the varicose appearance of the part, its soft sponge-like feel, the subsidence and welling-up again of the swelling, as pressure is either made upon it or relaxed, with the abnormally large arteries in its periphery, unite in rendering a diagnosis easy; but, when deeply placed, the symptoms of aneurism or of a malignant growth may be simulated. The writer has seen the common femoral ligatured for the disease under consideration, the operator believing he was dealing with a case of aneurism of a branch of the profunda. In a patient presenting a tumour aneurismal in character, but not in the course of any arterial trunk, and in whom the health is not affected, nor can any secondary growth be detected, the existence of an erectile tumour is more probable than of either of the others; whilst in cases of pulsating tumours involving bone, the disease will almost certainly prove malignant.

Treatment.—When it can be prudently attempted, complete removal should be performed, as the only really reliable mode of treatment; but if this is, for any cause, unadvisable, electrolysis, steadily persevered with, offers the best prospect of cure. Moreover, it should not be forgotten that these tumours, equally with nævi, may undergo a spontaneous cure, or, at all events, an arrest of growth; whilst, if irritated by ineffectual treatment, they are prone to enlarge. It is well, therefore, to be satisfied that a necessity for interference exists before putting any plan of treatment into action. ALFRED WILLETT.

ERGOTIN, Surgical Use of.—Ergotin is an extract obtained from ergot of rye by a process introduced by M. Bonjean. From a surgical point of view its use as a hæmostatic is that which has mainly to be considered.

M. Bonjean's method of employing it for external use is as follows:—The ergotin is dissolved in five or six parts of water in ordinary cases; in three or four only where the hæmorrhage is severe; and pieces of lint saturated in this solution are applied to the part, previously well-dried, pressure being maintained with the hand until the blood ceases to flow; should the bleeding continue, the lint is kept constantly wet with the solution; the pressure should be firm, but not sufficient to interrupt the circulation. The lint should

not be removed for three or four days. Ergotin may also, of course, be administered internally; but all accounts seem to show that this is the most uncertain and least satisfactory way in which it can be used. Hypodermic injection is, beyond question, the best, and therefore the only method which the writer proposes to consider.

Hypodermic injection of ergotin has been practised, and according to reports with a certain amount of success, by Von Langenbeck and some other continental surgeons in the treatment of various disorders or diseases of the vascular system, such as aneurism, varix, hæmorrhoids; and in other tumours where the cutting off or diminution of the blood-supply appeared likely to favour cure. But it is in the treatment of various hæmorrhages that its practical utility has been most certainly demonstrated. In 1874 the writer had the opportunity of trying it in a case of epistaxis which had persisted for more than twenty-four hours, in spite of various remedies, and where plugging of the posterior nares appeared to be demanded. One injection of 3 grains of ergotin acted promptly and permanently. The bleeding had ceased before the writer left the house. Since then he has frequently used or prescribed this treatment in similar cases, and with satisfactory results, except in one instance; and there the cause of failure was no doubt due to an inferior drug, as was proved by the fact that all the injections made from this particular sample proved partial or total failures. In a case of alarming secondary hæmorrhage after the removal of a vascular growth from the base of the tongue, the writer injected 3 grains of ergotin with a like satisfactory result; a second dose was administered within the hour as a matter of precaution; the hæmorrhage never recurred, and the patient recovered. On several occasions the writer has made use of this practice to check free oozing after amputations and excisions, before closing the wound; and in some cases, the effects have been remarkable, resembling those which follow the use of the hot-water douche for the same purpose; the blood became darker, the flow more sluggish, and then in many cases the wound became studded with numerous dark points, no doubt denoting the mouths of capillaries and other small vessels.

Acting on this hint, he has for several years past been in the habit of prescribing a hypodermic injection of ergotin after operations in which, for any reason, oozing or intermediary hæmorrhage seemed likely to occur; always excepting cases where the vessels were atheromatous. To prevent failure, or subsequent inconvenience, two or three cautions may be given. In the first place, the drug should be obtained from a reliable source; for, as previously pointed out, some specimens of ergotin are worthless. Secondly, the risk of subsequent inconvenience, in the form of pain and perhaps inflammation at the site of injection, may be avoided, by thrusting the needle into *muscle*, not merely into the subcutaneous tissue; and, further, it appears advisable that the patient should lie down to receive the injection, for in one or two cases of epistaxis where the ergotin was administered while the patient was sitting up, vertigo or faintness occurred, perhaps from the sudden contraction of cerebral vessels. (It is hardly necessary to point out that the styptic action of ergotin is due to its physiological property of causing contraction in the involuntary unstriped muscular fibres of the middle coat of the blood-vessels.) The dose previously mentioned (3 grains) will in most cases be found sufficient, but may be repeated when necessary; and as this quantity is readily soluble in 10 minims of warm water, the injection is not of formidable bulk. More recently, an alkaloid of ergot (ergotinine) has been obtained, and used with very successful results; an account of which will be found in the Obstetrical Society's *Transactions* for 1882. CHAUNCY PUZEY.

ERYSIPELAS may be defined as a diffused and spreading inflammation of the skin, mucous and serous membranes, or of the connective tissue beneath them; accompanied, and usually preceded by, fever, and due to some poison introduced into the system.

Causes.—A. *Efficient.*—As to the exact nature of the poison, which may be looked upon as really producing the disease, there is considerable difference of opinion. By some it has been believed that there is a distinct and specific erysipelatous virus, similar to the specific miasma of smallpox, scarlet fever, and measles, and that the disease should be classed as belonging to the order of contagious exanthemata. The principal arguments which have been deduced in favour of this hypothesis are, that it is infectious; that it is sometimes epidemic; that the local affection is accompanied by fever; that it has, at all events generally, a period of incubation; that the appearance of the affection of the skin is preceded by an obvious disturbance of the general health,

and, lastly, that it runs a more or less definite course. But against this theory is the important fact that erysipelas differs from all other exanthemata in its liability to recurrence. It is an acknowledged fact that an attack of erysipelas predisposes to a second, and a patient who has once been attacked by this disease is more prone to have it again than one who has never suffered—a marked contrast to the comparative immunity which an attack of smallpox, scarlet fever, or measles undoubtedly confers on the individual. Other minor points in which it differs from these fevers may be also noted: thus the incubation is sometimes short or even altogether absent; occasionally there is no premonitory fever; the stages are by no means uniform, and the local affection is limited to portions of the skin.

Again, others have regarded erysipelas as a purely local disease, and have based their opinion on the assumption that, if it can be shown not to be a specific disease, therefore it must be a local one. But this is not borne out by facts, for though the inflammation usually starts from a local injury or wound, it may, and sometimes does, start from quite a different part of the body from that where the injury is situated. For instance, an amputation of the foot has been followed by erysipelas of the head and face, occurring a few days after the operation, and rapidly proving fatal. Or, indeed, the erysipelas may commence without the slightest wound or abrasion anywhere, though this is by no means common. Or, again, it may attack internal parts or organs. Furthermore, it is, undoubtedly, contagious. It is usually preceded by obvious constitutional disturbance and accompanied by well-marked fever. All these arguments are strongly against the theory of the local nature of erysipelas.

Of late years the belief has been frequently expressed, and has certainly been gaining ground, that erysipelas is due to the presence of bacteria in the system—the term 'bacteria' being here used in its widest sense, as signifying micro-organisms.

Nepveu, as long ago as 1872, found them in the blood of four patients suffering from erysipelas. Orth has found them in the bullæ of erysipelas. Lukomsky has found them in the lymphatic vessels of the skin affected with the same disease. Billroth and Ehrlich have found them, not only in the lymphatics, but also in the blood-vessels. More important, however, are the observations of Von Recklinghausen, who states that, in spreading erysipelas, micrococci were found in the lymphatic spaces and lymphatics belonging to them, where the process was recent and in progress; but that where the erysipelatous inflammation was in the retrogressive stage, no micrococci were present. In other words, they were present only in what may be termed the progressive zone, at the edge of the extending inflammation, and *not* in the tissues at a distance from the margin of extension. The discovery of bacteria in the tissues affected with erysipelas does not, however, substantiate the germ theory; something further than this is necessary. It must be proved that these organisms, which have been seen to exist in the tissues affected with erysipelas, are the true causal agents of the disease. This has been done by a series of conclusive experiments conducted by continental observers. Orth injected under the skin of a rabbit the contents of an erysipelatous bulla, in which he had satisfied himself, by microscopic examination, that there were numerous micrococci. This produced an inflammation entirely analogous to erysipelas in man. The œdematous fluid from the erysipelatous tissues of this rabbit was injected into a second, with the effect of producing a similar characteristic inflammation. In the affected parts of the skin of the second rabbit large quantities of micrococci were found.

Lukomsky has also found that an affection exactly similar to, if not identical with, cutaneous erysipelas, can be induced by the subcutaneous injection of fluids containing bacteria, or by the application of similar fluids to any raw surface; and, furthermore, that the contents of erysipelatous vesicles, *free from bacteria*, do not usually produce any morbid phenomena.

At the International Medical Congress in London, Dr. Koch showed photographs of micro-organisms which he had found at the periphery of erysipelatous tissue, and which he believed to be pathogenetic of erysipelas. These have since been proved, by a conclusive series of researches by Fehleisen, to be present in every case of erysipelas which he examined, to be capable of cultivation, and also of successful inoculation both in man and the lower animals. In every one of thirteen cases examined micrococci were found, which were identical with those figured by Koch in his photographs. Fehleisen succeeded in breeding the micrococcus to the fourteenth generation by cultivation of some small portions of skin in Koch's 'flesh-infusion pepton-

gelatine,' and he states that, though he found organisms in connection with other pathological processes, they never behaved in the same manner as regards their cultivation. He next proceeded to a series of experiments on rabbits. In every instance, except one (where there was only a slight rise of temperature), the characteristic erysipelatous rash appeared at the end of about thirty-six to forty-eight hours, being preceded by a rise in temperature. The disease ran a definite course of about six to eight days, the redness spreading to the root of the ear and thence to the head and neck, unaccompanied by suppuration, and terminated in recovery. In every case micrococci were found in the lymphatics of the affected part.

In addition to the experiments on the lower animals, Fehleisen tested the virulence of these organisms by inoculations in the human subject, on the principle that an attack of erysipelas has often a beneficial effect in such diseases as cutaneous tumours, lupus, and even malignant growths. In the first case he inoculated the gluteal region of a woman suffering from multiple fibro-sarcomatous tumours. On the evening of the same day there was a slight rise of temperature, and the following morning a rigor. On the morning of the fourth day there was a second rigor, and on the left buttock was found a sharply defined, slightly raised, reddened surface, having all the characteristics of erysipelas. The temperature was 105° F. The redness spread considerably during the day, and continued doing so until the seventh day, when the erysipelas occupied an area of a square foot. It then remained stationary for three days, and began to diminish in intensity. On the fifteenth day the temperature was normal. In six other cases Fehleisen inoculated the pure or cultivated micrococci, and erysipelas was induced in five of them, and ran a typical course to a favourable termination. As regards the therapeutic effects, in two cases only does any permanent benefit appear to have been derived. One, a case of lupus, was reported to have been almost entirely cured, and in another, an instance of cancer of the breast, which had already been operated on three times and presented several large tumours adherent to the skin, the erysipelas was followed by an entire disappearance of the cancerous growths which, up to the time of the report, had not reappeared.

Fehleisen also made some experiments on disinfection. He found that a three per cent. solution of carbolic acid, in forty-five seconds, rendered the organisms incapable of further cultivation, and the same effect was produced by a solution of corrosive sublimate in fifteen seconds. These researches appear to be quite conclusive, and should they be confirmed by other observers, the etiology of erysipelas may be considered to be fairly established, and the list of diseases due to a specific micro-organism is thus enriched by one.

B. *Exciting Causes.*—The poison of erysipelas being thus due to a materies morbi introduced from without, either through the atmosphere or by actual contagion, it is palpable that a wound must be a common *exciting* cause. Other exciting causes have been alleged to produce erysipelas, such as exposure to severe draught, a sudden chill, application of cold to the loins, and even fright. But these causes, even if they really exist, are by no means so potent as the presence of a wound. Some pathologists have believed that they have no existence. Billroth says: 'I am very doubtful whether erysipelas ever develops except from a wound, or from some pre-existing cause of inflammation.' Trousseau says: 'Observe with attention that the erysipelas described under the names of medical and non-traumatic has almost always a starting-point, which though it cannot, strictly speaking, be called a wound, is at least a lesion—a very slight lesion it may be in some cases.' Any wound of any size, in any stage of its progress, may be the exciting cause and the starting-point of erysipelas. Thus, a leech-bite, the sting of an insect, scarification of parts affected with œdema, the wound made in venesection, are all known as exciting causes of the disease. So, again, a perfectly recent incised wound, as in the removal of a sebaceous tumour of the scalp; or a contused and lacerated wound, as in a compound fracture of the leg; a healthy granulating sore, or an old sinus, may all be the starting-point of the disease. There seems, however, to be no doubt that erysipelas is more prone to attack a wound, when its secretions are retained and have become decomposed in the tissues.

C. *Predisposing Causes.*—These must be considered under two heads, either as affecting (1) the patient, or (2) his surroundings.

1. *In the patient himself.*—Believing that the efficient cause of erysipelas is due to micro-organisms, we know that the healthy blood is not favourable to their growth, and that the healthy body appears to be the most unfavourable habitation for them. Mr. Watson Cheyne and other observers have indeed asserted that in the

healthy state of the animal body there are no micro-organisms present among the tissues. Other pathologists again, though they consider it an accepted fact that these organisms may be present in the blood and tissues of healthy living animals, nevertheless assert that they are only to be found in very small numbers, and often only after the most elaborate preparation and careful examination. All, however, are agreed that the healthy living body is able to fence itself against the permeation of the blood and tissues by these organisms, unless, indeed, they be introduced in very large quantities. The investigations of Mr. Cheyne have an important bearing on this subject. He found that by lowering the system of an animal by the administration of phosphorus, he brought about a condition of system which permitted the introduction of micrococci in enormous quantities. The experiments of Professor Roshbach are also of importance in connection with this point. He found that by the injection into the blood of a chemical ferment, itself perfectly free from any organism, he produced such a change in the properties of the fluids of the body that bacteria were developed in immense numbers in the course of a very short time. The vegetable ferment used was papayotin, and having previously examined the blood of several rabbits to establish the absence of bacteria, he injected small quantities of a freshly-prepared solution of papayotin into a vein. Death of the animal took place in an hour or two, and the blood examined immediately after death exhibited, without exception, countless numbers of round and oval bacteria. In considering, therefore, the predisposing causes of erysipelas as regards the individual, we must believe that there are certain conditions of the blood in which bacteria become endowed with vitality and with reproductive powers.

The experiments of Mr. Cheyne, above alluded to, show that lowering the system will produce this result, and thus we find that a vitiated condition of the blood induced by habitual intemperance, or want of proper food, or by disease of the eliminatory organs, especially Bright's disease, or diabetes, or disease of the liver, are amongst the foremost predisposing causes of erysipelas, producing a condition of the system in which the poison appears to find a soil peculiarly favourable to its growth. A similar vitiated condition of the blood, rendering the patient prone to erysipelas, may be induced by over-exertion or long exposure to wet or cold, and in women by amenorrhœa. Mental emotions, and especially prolonged anxiety, no doubt through their general effect upon the system, may also be classed in the same group of predisposing causes. There are other causes, in which it becomes a question whether there is a special pathological condition of the blood, which renders it favourable to the introduction of bacteria. So great is the constitutional predisposition to erysipelas which some persons appear to possess, that the slightest cause produces an attack. And, again, there is the occurrence of a previous attack, which predisposes to a second. M. Verneuil records the case of a woman who had had seventy-nine attacks of erysipelas of the face; and some years ago a nurse in St. George's Hospital, who suffered from chronic eczema of the face, had an attack every spring and autumn. Again, the disease is said to be hereditary in some instances. Finally, erysipelas sometimes occurs in women at the menstrual period, and is stated to be more common in the female than the male. Age and occupation do not appear to have any influence on the disease.

2. *In the patient's surroundings.*—It is an incontestable fact that, under certain conditions, erysipelas is much more common and prone to attack wounds than under ordinary circumstances. Whether these conditions are atmospheric or not, with our present state of knowledge we are unable to say, though it has been asserted, but without any really reliable evidence, that the spring and autumn, east winds, a very moist atmosphere, and a low temperature, are conditions under which erysipelas is apt to occur as an epidemic. All that we can say at present is that the poison propagates and develops with greater vigour and energy under certain conditions or seasons than at others. More potent causes are bad ventilation and generally faulty hygienic conditions, and especially a vitiated atmosphere from the presence of decomposing vegetable and animal matters. It is well known that micro-organisms swarm in all putrefying solutions and mixtures of organic matter; the presence, therefore, of decomposing organic matter forms a hotbed for the production and growth of the special infective organisms of erysipelas, which become developed in such countless numbers as to overcome the resistance which the healthy living body appears to have to their reception, and they are admitted into the system either through an open wound, or by the respiratory passages or alimentary canal, or through the openings of the count-

less ducts, either cutaneous or mucous, and thus an attack of erysipelas is the result.

Pathology.—By an examination of the inflamed part, dilatation of the vessels of the cutis, with serous exudation into the surrounding tissues, can be anatomically demonstrated. Volkmann and others have shown that many white corpuscles are found collected around the vessels; and Hillier states that microscopic examination of the blood before death proves that many of the white corpuscles have undergone a process of degeneration, and become converted into highly refracting bodies. This change probably is only to be observed in the later period of the disease. It seems probable, from the manner in which the redness spreads in circumscribed patches, which are well defined, that the specific poison (micrococci) is introduced into the system by the lymphatic vessels; that it spreads along the superficial lymph-vessels of the skin, and more deeply through the subcutaneous vessels, giving rise to streaky redness and enlargement of the corresponding lymph-glands. This coincides with what has actually been demonstrated in numerous experiments. Lukomsky, for instance, found that when fluid, holding spores of fungi in suspension, was subcutaneously injected, it became widely distributed through the lymph canalicular system and lymphatics. Fehleisen, in the examination which he made of thirteen cases of erysipelas, found the micrococci in the superficial layer of the corium and subcutaneous tissue filling the lymphatics and lymph spaces, while the rest of the tissue showed cell-infiltration. He found no organisms in the blood-vessels, though other observers have stated that they have done so. When the subcutaneous tissue is involved in the disease (phlegmonous erysipelas) it is found, in the early stage, to be distended with serum, which soon becomes turbid, and, later on, is converted into shreddy sloughs, infiltrated with a puriform fluid. The post-mortem examination of cases of erysipelas presents nothing characteristic — merely those pathological changes which we are accustomed to associate with some altered condition of the blood, due to the absorption into it of some septic influence. Thus, the blood is fluid, thin, and uncoagulated, often black and pitchy, staining the lining membrane of the heart and its valves, and the large blood-vessels. The spleen is soft and diffluent, and the kidneys often congested. The lungs are also often highly congested; and, according to Busk, the smaller pulmonary vessels contain blocks of altered white corpuscles; and Bastian has described a similar condition in the vessels of the brain.

Symptoms and Diagnosis.—As a rule, erysipelas is preceded by considerable constitutional disturbance, sometimes of a very severe character, which ushers in the attack. At other times the amount of constitutional disturbance is very slight, so that it escapes the patient's notice, and thus the appearance of the local mischief is the first thing which attracts attention, and therefore it has been supposed that the disease may occur without any general symptoms. The severity of the premonitory fever is no indication, however, of the amount of local inflammation which is to follow. In some cases, where the early constitutional disturbance has been so slight as almost to pass unnoticed, the subsequent disease has proved to be of the most severe nature, and to be accompanied by a fever of the most marked and asthenic type; and in other cases where the premonitory fever has been severe, the following inflammation has been slight, and has terminated in resolution in the course of a few days. The disease is ushered in with a feeling of malaise, and general disinclination on the part of the patient to go about his ordinary occupations. There is a general chilliness, sometimes, though seldom, amounting to a distinct rigor, with headache and nausea, occasional vomiting and sense of oppression, and even pain in the precordial region.

The advent of these symptoms is generally sudden, and is marked by a rapid rise in the temperature, so that the chart will exhibit an increase of 4° or 5° between the morning and evening registrations. The skin is hot and dry, and the tongue coated with a creamy fur. In addition to these symptoms, occasionally a severe attack of epistaxis or, in children, convulsions, will usher in the disease. These general symptoms are followed usually, on the second or third day, by the appearance of the local inflammation; there does not appear to be any definite time for the characteristic redness to show itself; it may be within twenty-four hours of the first rise of temperature, or it may be delayed till the fifth or sixth day. Sometimes swelling and tenderness of the lymphatic glands in the neighbourhood of the wound, if there be one, precedes the appearance of any redness of the skin, and this becomes an important indication of the advent of an attack of erysipelas. That is to say, as has been pointed out by Frank, Busk, and

others, a sudden rise in temperature and general febrile disturbance, attended by pain and swelling of the lymphatic glands in any region of the body, are very often indicative of an attack of erysipelas.

After the appearance of the local symptoms the fever rapidly assumes a marked asthenic type. The pulse is quick and weak, becoming weaker as the disease progresses, though its frequency is maintained. By Nunneley, Hinckes-Bird, and Campbell de Morgan it has been asserted that if the pulse rises in frequency after the sixth or seventh day it is a bad sign, betokening a fatal termination. The statement, however, appears to require further corroboration, and certainly must not be looked upon as universally true. The temperature remains high during the whole of the time the local inflammation is extending, ranging between 102° and 105° F., or even slightly higher, every fresh access of inflammation being marked by a rise in the temperature. As soon as the redness ceases to extend the temperature falls, oftentimes very rapidly, so that it frequently becomes normal, or almost normal, some time before the tongue has cleaned and the pulse dropped to its ordinary standard. The tongue, which during the premonitory fever is generally coated with a creamy fur, speedily becomes brown and dry. The bowels are generally constipated, and the motions dark and offensive. Towards the termination of the case, when the disease is subsiding, an attack of diarrhœa not infrequently sets in. This, however, may be present from the first, and is sometimes attended by a yellowish or jaundiced tingeing of the skin—a variety of the disease to which the older writers were wont to apply the term of 'bilious erysipelas.' The urine is generally scanty, loaded with lithates, and very constantly contains a trace of albumen. When the disease is subsiding it may contain a large quantity of albumen, with epithelium from the renal tubules, due to a temporary congestion of the kidneys. In severe cases of the disease, especially where it attacks the head, the patient may suffer from delirium of a low, muttering type. This is due to the condition of the blood, not to any extension of the inflammation to the membranes of the brain. Dr. Bastian suggests that the delirium may depend upon the plugging of the small arteries and capillaries of the brain with embolic masses of white blood-corpuscles—conditions which he found to exist in the case of a man who died from erysipelas with delirium and stupor.

Erysipelas has been defined as a spreading inflammation of the skin, or of the cellular tissue beneath it. It is therefore convenient to divide it for the purposes of description into (1) simple cutaneous erysipelas, affecting only the skin, the subcutaneous tissue being only very slightly, or not at all, affected; and (2) phlegmonous or cellulo-cutaneous erysipelas, in which the inflammation affects, not only the skin, but the cellular and adipose tissues beneath, and often runs on to suppuration. A third variety is sometimes added to these—the cellular erysipelas, or diffuse cellulitis of Nunneley, where the inflammation is confined to the subcutaneous tissue, the skin remaining unaffected, or where the inflammation attacks cellular tissue in places where there is no skin, as in the pelvic cellular tissue, or the areolar tissue between muscles or beneath fascia. The name is often confounded with phlegmonous erysipelas, which should be avoided, as leading to confusion. It is considered under CELLULITIS.

I. *Simple Cutaneous Erysipelas.*—The local inflammation usually starts from a wound or abrasion. It may, however, commence at the point of junction of the mucocutaneous surfaces, a not unusual situation being the inner canthus of the eyelid, whence it spreads over the bridge of the nose. The angle of the mouth, the external auditory meatus, and the margin of the anus are also situations at which the disease occasionally commences. Lastly, it may commence on the mucous surfaces, notably those of the pharynx and nasal fossæ, and spread outwards to the skin. This is not a form of metastasis, as was formerly supposed, but a true spreading of the disease from the one surface to the other, the inflammatory redness, when the pharynx is the part first affected, spreading to the nasal mucous membrane and first appearing on the cutaneous surface at the orifices of the nostrils, and thence spreading to the nose, cheeks, eyelids, and other parts of the face.

At the outset the skin, as a rule, becomes of a bright red or rose-tint. The colour, however, may vary: sometimes there is a decided yellowish tinge, sometimes it is a deep livid red. The redness disappears on pressure, but immediately returns upon the pressure being removed. The affected part is also swollen and slightly œdematous, pitting on pressure. The limits of the inflammation are sharply defined, the redness not gradually fading away into the natural colour of the skin, but presenting an abrupt, though irregular, outline. On passing the

finger lightly over from the margin of the inflamed tissue to the normal skin, the swollen condition of the former will be plainly noticed by the marked elevation which will be felt at the line of junction. In the simple cutaneous erysipelas the œdema, as a rule, is not great, unless in situations where the cellular tissue is very loose and lax, as in the eyelids and scrotum; here there is generally very considerable œdema, which often runs on to suppuration; otherwise the formation of pus does not usually result from this form of erysipelas. In many cases the inflamed part is covered over with vesicles or even blebs. These at first contain clear serum, which in the progress of the disease becomes semi-purulent. They burst, and, drying, form scabs on the surface, which, however, separate without ulceration. Occasionally these bullæ will be found to contain reddish or purplish contents, from infiltration with blood-pigments. This is always an unfavourable sign, as indicating a weakened condition of the system.

At first there is stiffness complained of in the part, accompanied by tingling and itching; this is succeeded by a burning sensation and a feeling of tension. Occasionally we find that there is an entire absence of pain, but there is always more or less tenderness on pressure; sometimes there is a very exalted sensibility of the nerves, so that the application of even a piece of lint is distressing to the patient, and the slightest touch elicits an expression of pain. The redness spreads widely—in fact, it may spread all over the body, but always maintains the same defined margin; usually it spreads more in one direction than another, and especially along the course of the lymphatic vessels. The manner in which it spreads is worthy of observation. On carefully examining the margin of a spreading cutaneous erysipelas, there will often be noted to be circumscribed, reddened, and somewhat rounded patches, which spread until they become merged into the already diseased parts. This confirms the opinion that the poison travels principally by the lymphatic system, and that these isolated patches are certain lymph-vascular districts which become primarily affected, and thence merge into the general disease.

The characteristic tint will usually be found to be most marked at the borders of the spreading inflammation, the redness having a tendency to fade in the centre as it spreads at the circumference. The inflammation, though principally affecting the skin, is not confined to it, but the subcutaneous tissue is more or less involved; and where this is loose or lax, as in the face, very considerable swelling takes place, obliterating the features and giving to the countenance a bloated and hideous expression.

The duration of erysipelas is very uncertain. It usually lasts from two to ten days, but may be prolonged to the end of the third week, or even, in some rare cases, for a longer period, and nevertheless terminate in recovery. Coincidently with a sudden fall of temperature the redness begins to disappear and desquamation takes place, the epidermis peeling off, partly as a branny powder and partly in scales. With the disappearance of the redness the swelling usually subsides; should it persist, suppuration may be expected. When the disease attacks the scalp the whole of the hair may fall off, but speedily grows again. Even after a mild attack the patient's strength is much reduced, and relapses are by no means uncommon.

Although œdema is almost always more or less present in erysipelas, so as to produce a certain amount of pitting, yet in some states of the system the inflamed tissues become loaded with serum, causing them to be excessively œdematous, and giving rise to a condition which has by some been regarded as a distinct variety, and to which has been given the name of 'œdematous erysipelas.' This condition occurs in those who are debilitated by previous illness or whose constitutions have been broken down by visceral disease. The inflamed parts are much swollen, the redness, instead of being bright and rose-coloured, is of a dusky hue, and there is a greater tendency to run into gangrene. The condition is a serious one, not so much on account of the local mischief as on account of the constitutional state which has given rise to it.

Erysipelas has a tendency occasionally to assume an erratic form—that is to say, it will subside in one part of the body and break out in another. Closely allied to this is the 'metastatic' erysipelas of some authors, where the inflammation suddenly disappears from the surface of the body and simultaneously attacks some internal organ. This condition, however, is extremely rare.

Simple cutaneous erysipelas is not often fatal unless complicated with some visceral mischief, or when it attacks the head and neck. Instances of the former—where, for instance, a patient suffering from granular degeneration of the kidney is attacked by

erysipelas—are not uncommonly fatal; and, when the disease attacks the head and neck, fatal results may ensue either from congestion of the brain from the mechanical impediment to the return of the venous blood, or from the disease extending to the pharynx and air-passages and producing œdema glottidis, or from the spread of the disease to the interior of the chest.

After the eruption of erysipelas has become fully developed it is scarcely possible to mistake the disease. Prior to this, when in the progress of a case, either with or without any apparent change in the wound, there is a sudden rise of temperature with other febrile symptoms, attended with pain and swelling of the lymphatic glands in the neighbourhood, the advent of an attack of erysipelas may be suspected but cannot perhaps be confidently predicted. The appearance of the rosy-red sharply-defined blush establishes at once the diagnosis. We may hesitate for a moment as to whether it is a simple inflammation of the subcutaneous tissue or a lymphangitis; but the absence of the sharply-defined border in the one case and the course of the disease in the other will speedily determine the point.

II. *Phlegmonous Erysipelas.*—This form of erysipelas usually occurs in patients of broken-down constitutions, either the result of habitual intemperance or from some disease of the liver or kidney. It differs from the preceding variety in the degree of inflammation, in the depth to which the tissues are involved, and principally in the fact that it almost always runs on into suppuration and sloughing. For, whereas in the cutaneous form of erysipelas it has been shown that suppuration, except in places where the subcutaneous tissue is very loose and lax, rarely or never takes place, and, when it does, is not accompanied by sloughing; in the phlegmonous variety the involved cellular tissue for the most part falls into a condition of extensive suppuration and gangrene. The constitutional symptoms which usher in and accompany the inflammation are more severe. The invasion is marked by more pronounced general disturbance, a rigor being a frequent precursor of the local inflammation; and the accompanying fever, at first, of an active inflammatory character, often suddenly becomes asthenic. The temperature is high from the first, the thermometer often registering 103° to 106° F. The pulse, full and bounding at the commencement, soon loses power, becomes weak and quick, and, especially in fatal cases, irregular and intermittent. The tongue is dry and brown and the teeth become covered with sordes. Diarrhœa often sets in from the first and the motions are offensive. In the latter stages delirium, of a low, muttering character, and subsultus are present, the patient often lying in a semi-unconscious, wandering condition, from which he can be temporarily aroused, but into which he again speedily relapses.

The constitution often gradually gives way from the exhausting influences of the disease, and death supervenes; or a fatal issue may occur from some complication, as pneumonia or pleurisy. Should the patient survive the stage of sloughing, pyæmia or septicæmia not uncommonly supervenes; or hectic, with diarrhœa, may carry him off.

Phlegmonous erysipelas is generally the result of wounds penetrating the subcutaneous tissue. It is therefore not uncommon after scalp wounds involving the aponeurosis of the occipito-frontalis muscle, or in compound fractures of the extremities. It may, however, occur without any wound or abrasion. From the commencement there is marked œdema, so that the swelling is great and pits on pressure. The part is red, but the redness is of a more dusky hue than in the cutaneous form, and does not present the same well-defined abrupt margin. It is often covered with large vesicles or blebs containing sero-purulent fluid, sometimes with a sanious tinge. After a time the tissues become hard and brawny, and no longer pit on pressure; the redness becomes deeper. Pain of a severe burning and tensive character is complained of. The inflammation spreads, so that in a day or two the greater part of a limb may be involved. The redness becomes deeper and deeper, and purple patches appear. About the fifth or sixth day from the commencement of the inflammation an arrest of the symptoms appears to take place; the inflamed parts become soft and boggy, and pitting again takes place on pressure. If an incision be now made into the affected part the areolar tissue will be found to be loaded with an opaque fluid, giving a gelatinous appearance to the sides of the incision. This fluid speedily breaks down and becomes puriform, and the cellular tissue becomes the seat of suppuration and death. The purple patches on the surface become livid and break down. The pus which escapes is fetid. From time to time large masses of gangrenous tissue protrude from the openings and are discharged, or can be drawn out by the surgeon. The

skin around, being deprived of its proper blood-supply, perishes and gradually sloughs away. And thus, in extreme cases, a whole limb may be denuded, fasciæ and muscles exposed, joints opened and destroyed, and bones deprived of their periosteum and thrown into a condition of necrosis. If the patient survive, there will be tedious cicatrization of the deep cavities which have been left, often leading to such contraction and deformity as to render the limb permanently disabled.

As a rule there is no difficulty in distinguishing the phlegmonous from the cutaneous form of erysipelas, when the disease is fairly established. It must be noted, however, that the severer form of the disease occasionally presents at first the same appearances as the simpler form, and it is not until the greater swelling, with the brawny hardness, has appeared, that a definite diagnosis can be arrived at. These signs, with the absence of the well-defined margin to the redness, at once establish the formidable nature of the disease. Phlegmonous erysipelas may be mistaken for diseases with which it is frequently associated, as phlebitis and inflamed absorbents. In the former, however, as a rule, the swelling is confined to the course of the vessel, and the hardened vein can be traced; and even if this is not so, and the swelling is more diffused, still the amount of redness, which is much less in phlebitis than in phlegmonous erysipelas, is indicative of the nature of the disease. From inflamed absorbents, the condition of the glands, exquisitely tender and speedily running into suppuration, and the streaky character of the redness are the principal points which must be relied upon in coming to a correct diagnosis.

Erysipelas occasionally attacks the mucous membrane of the pharynx. It may occur here either by spreading from the face, or it may commence as a primary affection in this part, and extend outwards through the nasal fossæ, and appear on the face at the orifices of the nostrils. When it begins as a primary affection in the pharynx, there is much pain in the throat, a sudden rise of temperature, and considerable pyrexia, with enlarged glands about the angle of the jaw. There is vivid redness of the soft palate, fauces, and back of the pharynx, with considerable swelling. There is often huskiness or complete loss of voice. It may be mistaken for ordinary catarrhal sore-throat, but in these cases the symptoms are not usually so severe, the pain is less, the redness not so vivid, and the swelling not so great. The appearance of the characteristic redness at the orifice of the nostrils establishes the diagnosis. The danger of this affection arises from its tendency to spread downwards to the mucous and submucous tissues of the larynx, constituting *œdema laryngis*, and speedily threatening life from suffocation.

Erysipelas also sometimes attacks newborn infants (*Erysipelas neonatórum*). When it occurs during the first fifteen or twenty days of life, it is almost inevitably fatal. It generally begins to show itself about the pubes or umbilicus and rapidly spreads, accompanied by extreme prostration, terminating the life of the child in from five to seven days. Trousseau regards it as a *puerperal* erysipelas, and considers that the same epidemic influence affects mothers and their offspring. He says it seldom occurs except during epidemics of puerperal fever. There can be little doubt that puerperal fever is but an internal manifestation of erysipelas. The instances which have been recorded of the one disease exciting the other are too numerous to permit of any doubt of the intimate connection between the two.

Erysipelatous inflammation of serous membranes, especially of the peritoneum after operations for hernia and other wounds, is not infrequently met with. In these cases, after death the peritoneum is found to be injected, opaque, and covered with patches of greyish lymph, and the cavity contains a quantity of fluid mixed with shreds of lymph. This fluid is of an exceedingly virulent nature, inoculation of it producing the most serious and even fatal consequences.

Treatment.—The treatment of erysipelas naturally resolves itself into *general* and *local*. With regard to the former there can be no doubt that fresh air is essential, and that the first and strictest attention should be paid to the ventilation; at the same time, especially if the head and face be the part attacked, care must be taken that the patient be not exposed to any draught. All curtains and hangings about the bed should be removed, and every means taken to prevent stagnation of air around the patient.

It is essential, in all cases of erysipelas, that the bowels should first of all be cleared out by a brisk mercurial purge. Even though diarrhœa be present from the commencement, it is wiser not to omit this precaution. The diarrhœa may, and often does, arise from a loaded state of the bowels, the motions being dark and offensive, and

a free purgation will not only materially improve the patient's condition, but will also often prove the best means of checking the diarrhœa, and will enable the patient to take the necessary food and stimulants with greater advantage. It must be borne in mind that erysipelas is a disease accompanied by fever; this fever having a tendency either from the first to assume an asthenic type, or, at all events, speedily to fall into this condition. The medicinal treatment should, therefore, consist in the exhibition of salines and tonics. If there be much thirst and dryness of the tongue, the salines may be given in an effervescing form; and of all tonics the one which, in the writer's experience, appears to be the most beneficial is bark, which may be combined with the salines in the form of the compound tincture. The addition of ammonia, as a diffusible stimulant, appears also to produce a good result. The medicine should be administered in frequent doses, and if there is any tendency to constipation, this condition must be corrected by an occasional purgative. If, on the other hand, diarrhœa is present, small doses of grey powder and carbonate of soda, once or twice a day, will generally be found to correct it.

The diet must be entirely fluid, consisting of beef-tea or mutton-broth and milk, and must be given in such quantities as the patient can digest. Care must be taken not to overload the stomach. In erysipelas there is always more or less derangement of the digestive organs; the stomach often rejects large quantities of food. The sensations of the patient must be our guide in this matter; if there is a loathing for food and a tendency to sickness, it must be withheld or only given in very small quantities. Stimulants are almost always required in erysipelas, sometimes even from the commencement, and occasionally in large quantities. The amount must be regulated by the pulse. If there be any tendency to flagging, and especially if it rises in frequency after the sixth or seventh day, they must be given with an unsparing hand. If, on the contrary, they produce dryness of the skin, flushing of the face, and restlessness, they have been given in too large quantities, and their amount must be reduced. The amount required will no doubt be influenced by the previous habits of the patient.

Only two drugs have any especial reputation in the treatment of erysipelas. Perchloride of iron was first recommended, in 1851, by Dr. Hamilton Bell, as a specific in erysipelas if given in large and repeated doses. He states that in it 'we possess a certain and unfailing remedy.' The experience of surgeons on this point certainly differs; for while some have found the greatest benefit from its administration, believing that it cuts short the disease, others have found it to be altogether inert, or at all events apparently producing no effect on the ordinary course of the erysipelas. In the hands of the writer it has certainly failed, though he has given it in drachm doses every two hours. The only cases in which it has appeared to have any beneficial influence have been slight cases, where there has been no derangement of the digestive system, and a clean, or comparatively clean, tongue. The other remedy is aconite, which is stated by Dr. Ringer to cut short the attack if given directly the temperature begins to rise. He recommends that it should be given in minim or half-minim doses every quarter of an hour for one or two hours, and then hourly until the temperature falls and the skin becomes moist. Its administration must be carefully watched. Salicylic acid and its compounds have been employed of late years in the treatment of erysipelas, and appear to have been useful in reducing the temperature, but do not seem to exert any specific influence on the disease.

Local Treatment.—The number of local applications which have been recommended in the treatment of erysipelas is very large, many being employed in the belief that anything which would check the local action would have a tendency to remove the general disease. Thus Neudörfer recommends the injection of a two per cent. solution of carbolic acid into the neighbourhood of the inflamed part. Professor Petersen, of Kiel, states that he has thrice arrested the progress of erysipelas by injecting a concentrated solution of salicylic acid around the diseased part. Wilde recommends the injection of a solution of sulpho-carbolate of soda (one part in twelve). He states that, in five cases, on the evening of the first day the temperature did not rise. On the second day there was a fall and the redness had begun to disappear, and on the third day œdema alone remained. With a similar object of removing the general disease by checking the local action, astringent applications have been frequently recommended. The sulphate of iron, in the form of a lotion consisting of a drachm to a pint of water, or of an ointment, half a drachm to an

ounce of lard; a 30 per cent. mixture of nitrate of silver and perchloride of iron (gr. xx. ad ʒj.) in solution, have all been said to tend to shorten the disease. Collodion painted over the surface has also been recommended, and is stated to act as an astringent, diminishing and unloading the vessels. Broca recommended painting collodion around the margin of the inflamed tissue and over a space of at least six to eight centimetres in breath beyond it, and believed that in this way the disease might be arrested. Another favourite plan, which was highly recommended some years ago, but appears to be for the most part useless, is to apply a ring of lunar caustic to the healthy tissue some few lines from the inflamed part. This is said to arrest the progress of the disease when it reaches the ring. The American surgeons recommend very strongly the local application of the compound solution of bromine to an erysipelatous part. The solution is applied on lint and covered with oiled silk, and they state that, in from twelve to twenty-four hours after the commencement of the treatment, the erysipelas begins to subside. Other remedies, such as tincture of iodine, sulphurous acid in glycerine, boracic acid and glycerine, and creosote, have also been employed with the same object.

Various applications, whose aim it is to exclude air, have also had their advocates. Barwell recommends covering the surface of the inflamed part with a coating of ordinary white-lead paint, and states that the advantages derived from this plan of treatment are due to the exclusion of air. The dusting of starch and flour over the surface in a thick layer is a popular and favourite remedy, but is objectionable because it soon dries and cakes and acts as an irritant. Plain olive oil, or carbolic oil, are also remedies which have been frequently advocated. Sedative applications have also been recommended and are occasionally useful, especially when much pain is complained of. Of these, belladonna and poppy fomentations are the ones most frequently used. The belladonna may be employed either in the form of an ointment or of a paint consisting of equal parts of the extract and glycerine.

Whatever the application to the inflamed part, there are certain indications which should not be neglected. Cold must be carefully avoided; the part should be kept warm, and, as far as possible, of an equable temperature. Perhaps there is no better plan than the application of a thick layer of cotton wool, over which has been spread an ointment consisting of half a drachm of sulphate of iron to an ounce of lard or vaseline; or an ointment formed of equal parts of Ung. plumbi and Ung. calaminæ. Poultices should be avoided, and, as a rule, dry warmth will be found preferable to moist applications. Finally, strict attention should be paid to position, the inflamed part being elevated in order to relieve congestion, and this alone will often afford marked relief to the symptoms.

The local and general treatment of phlegmonous erysipelas is, in the main, the same as that of the cutaneous form of the disease as regards the earlier stages, except that support and stimulants require to be more freely given, and warm moist applications appear to be more suited to this class of cases. Later on, incisions will probably be necessary. As soon as there are signs of tension and the skin becomes brawny, they should at once be made. They should be each two or three inches in length, and carried down into the infiltrated tissues, and should embrace the whole extent of the tense parts. In the slighter forms of phlegmonous erysipelas the disease may terminate in resolution, under proper treatment, without incisions; it is not necessary therefore always to resort to them in the first instance, and if, under the influence of elevation of the part, warm fomentation, and a free purge, the skin begins to recover a paler hue, and presents a somewhat wrinkled appearance, they may be dispensed with altogether. T. Pickering Pick.

ERYTHEMA is the term used to express the clinical aspect of congestion of the skin, and may be defined as 'redness of the skin which disappears for a moment upon pressure.' Much confusion has arisen from its being employed indiscriminately for the symptom of redness, irrespective of the cause, and also for two groups of diseases —one the result of hyperæmia only, of which erythema simplex is the type, the other due to actual inflammation, represented by erythema exudativum. At the same time it must always be borne in mind that the line between hyperæmia and inflammation is a narrow one, and many of the affections which are here classed under hyperæmia are only entitled to be so in the majority of cases, while in others the process goes on to exudation. The distinction, therefore, is often one of clinical convenience rather than of pathological accuracy.

Group I.: Erythema Hyperæmicum.—In this class swelling is absent or insignificant in the congested areas, and the

tint of redness varies from the brightest red to a rosy or purple hue, according to the predominance of arterial or venous hyperæmia. There are two groups—I. Those of local distribution, due to external irritation; II. those of more or less general distribution, due to internal causes.

Sub-Group I. includes *E. Simplex, E. Pernio, E. Intertrigo, E. Læve, E. Paratrimma.*

Erythema Simplex is the congestive redness due to external irritation of moderate intensity. The size and tint of the red patches vary according to the irritant, the individual susceptibility, and the activity of the circulation in the affected area. The symptoms are generally a sense of heat, and perhaps tenderness and itching of varying intensity.

Etiology.—The causes are very numerous, and may be arranged under the heads of friction, heat, cold, and various irritants—animal, vegetable, and chemical.

Erythema Pernio (*Syn.*: Pernio, Chilblains) is the well-known congestive redness, the consequence of cold, which attacks the extremities, especially the heel and borders of the feet, in young persons and those with feeble circulation. It is accompanied by extreme itching whenever the limb becomes warm, and is often very tender. If neglected or exposed to friction, the congestive stage is soon passed, and vesication, superficial ulceration, and even a small slough, may be produced. The treatment consists in adopting every measure to keep up an active circulation in the limb; warm socks, stout lace-boots, and active exercise are the best means both for prevention and cure, unless there is ulceration. If seen in the early stage, calamine lotion (the formula is given under E. exudativum) applied three or four times a day and allowed to dry on, or tincture of iodine, should be painted on (if for the hands, it may be decolourised by Liq. ammoniæ); and if the chilblain is broken, the Ung. calaminæ (B.P.), or boracic lint and oiled silk, may be used, and the limb should be wrapped up in cotton wool. *See* Chilblains.

Erythema Intertrigo is produced in fat persons and infants by the friction and moisture of two adjacent surfaces, and occurs chiefly in the neck, under the breasts in women, and at the groins in adults; while in infants it occurs sometimes in the neck, but more often on the buttocks, from wet napkins caused by urine or fæces, especially when diarrhœa exists. The lesion is at first merely redness of the skin, but very soon the red surface is covered with a muciform discharge, which differs from that of eczema inasmuch as while it stains it does not stiffen linen. This stage is, however, termed by some 'eczema intertrigo.'

Diagnosis.—The diagnosis from eczema is not very important practically, and consists in the circumstances and position in which the affection occurs and the difference in the quality of the discharge. In infants it is of more consequence to distinguish between intertrigo and the erythema of congenital syphilis. Intertrigo is limited to the buttocks and genital region, while the syphilide extends much further down, even to the heel, and there are very often mucous tubercles at the anus or some ulceration, and some other specific symptoms would almost surely be present. Syphilitic infants are also more liable to ordinary intertrigo. *See* Congenital Syphilis.

Treatment.—This consists in carefully cleansing the parts and applying a dusting powder, such as oxide of zinc one part and starch or kaolin three parts, and placing a piece of lint between the adjacent surfaces. In infants wet napkins should always be removed instantly, and the parts washed with Castile soap, carefully dried, and dusted over with a powder such as above indicated; or where there is diarrhœa, boracic acid, gr. xx., to vaseline alb. ʒj. is often preferable, as the grease protects the buttocks from the moisture. Diarrhœa or other defects, whether in diet or general health, should receive special attention.

Erythema Læve is the term applied to the redness which often occurs in œdematous limbs, especially in the legs.

Erythema Paratrimma is the congestive redness over a bony prominence that precedes a bed-sore. Neither this nor the preceding term are much used at the present day.

Sub-Group II. includes *E. Roseola. E. Scarlatiniforme, and E. Fugax.*

Erythema Roseola, or 'roseola' as it is often called, comprehends a certain class of erythemas which are not of so bright a hue as the others—viz., rosy red. They may be idiopathic or symptomatic.

Idiopathic Erythema Roseola occurs mainly in infants and young children, from disorders of the alimentary canal. There is often some constitutional disturbance, a transitory elevation of temperature, sometimes amounting to 2° or 3° F., and perhaps some redness, without swelling, of the palate and fauces, but no catarrhal symptoms. After a short but variable period the eruption appears; it may be general

or affect only a single region; it is very variable in size and shape—in patches the size of the end of the finger, or faintly papular, in rings or gyrate figures; it may come at one place and go at another, and so last several days. Willan gave separate names to these phases of eruption, such as R. infantilis, æstivalis, autumnalis, annulata, but they are entirely superfluous and now almost obsolete. The eruption may occur in adults of both sexes, and the cause is often quite obscure.

Symptomatic Erythema Roseola is applied to those eruptions which precede or accompany the onset of the more characteristic eruption of vaccinia, variola, and syphilis, or which is sometimes seen in cholera, diphtheria, and miliaria (R. febrilis). It does not require a separate description, as it is only a part of these diseases.

Diagnosis.—This is the most important point in these affections, as the eruption may be mistaken for measles, rötheln, or scarlet fever; but the disease is not contagious, and not a part of an epidemic influence. There are none of the special prodromal symptoms of the exanthemata, such as catarrh, cynanche, &c., nor does the eruption appear at a definite time from the onset of symptoms, nor always begin in a special region; the febrile symptoms are more transitory and not in proportion to the eruption; the eruption is not concentric like measles, nor is it punctiform like scarlet fever, and it is irregular in form and arrangement. The diagnosis from rötheln is sometimes difficult, as there, too, the febrile symptoms are transitory, and there are no reliable differences in the eruption for all cases. But the contagious nature of rötheln, and the other criteria already mentioned, will assist in forming a correct conclusion; still, in a doubtful case, it is always best to act as if the disease were infectious.

Treatment.—As idiopathic roseola always gets well of itself in a few days, simple measures, such as a mild saline aperient, a bland liquid diet, protection from alternations of temperature, and the removal, if possible, of all sources of peripheral irritation, such as may arise from dentition, worms, &c., will be sufficient.

Erythema Scarlatiniforme is closely allied to E. roseola. The rash, as its name indicates, is almost exactly like the punctiform eruption of scarlatina, but is often defined at the edge with an interval of white skin between the erythematous areas. There are generally transitory febrile symptoms, such as a temperature of 101°—seldom more—and the rash subsides in from two to six days, and is often followed by copious desquamation.

Etiology.—The eruption may be of septicæmic origin. It is seen not infrequently after surgical wounds, though less often since antiseptic precautions have been generally adopted; where pus is shut up in a cavity—e.g. abscesses, tubercular peritonitis, empyema, in puerperal women; and preceding, or in the course of, enteric fever. A precisely similar rash sometimes follows the use of certain drugs, such as copaiba, quinine, belladonna, and salicylic acid. In these cases the eruption is probably due to irritation of the alimentary canal acting reflexly on the vaso-motor centre.

The rash itself requires no separate treatment.

Erythema Fugax is more closely allied to urticaria than to the other erythemata, and is characterised by transitory patchy redness upon the face and trunk, occurs chiefly in the young, and disappears after lasting a few minutes or hours. In children it is frequently due to irritating ingesta, worms, or other causes of irritation of the alimentary canal; it may also follow exposure to alternations of temperature or mental emotion, while frequently the cause cannot be traced. The treatment would be that for urticaria.

Group II.: Erythema Exudativum.

Definition.—Acute inflammatory diseases characterised by symmetrical, raised lesions of some deep shade of red, extremely diverse in size, shape, and degree of elevation.

This group includes E. multiforme, E. or Herpes iris, and E. nodosum.

Erythema Multiforme, as its name suggests, is very variable in its aspect, chiefly from differences in the size and shape and aggregation of the lesions, but also from the occasional formation of vesicles or bullæ upon, or the occurrence of hæmorrhage into, the primary lesion.

Etiology.—This is often obscure in the most important particulars; it may occur in both sexes and at any age, but is most common in the young. It is most frequently seen in the spring and autumn, but is not limited to those seasons, and recurrences often happen at the same time of the year in the same individual. Rheumatism appears to be a predisposing cause, and certainly previous attacks lead to others. Sudden alternations of temperature, especially when over-heated, are probably the most common agents in determining the onset, and the writer has known exposure to the sun and brine-laden winds to act as

a certain excitant in individual instances. Irritation of the urethra is another cause, so that it may occur in the course of gonorrhœa. It is seen sometimes in association with endocarditis or acute rheumatism or simple synovitis, and is then probably a consequence of some toxic element in the blood. In erythema or herpes iris the same general statement may be made, except that it is not so intimately related to rheumatism, and that occasionally errors in diet or, in rare instances, a local irritant, such as mercurial inunction, has determined an outbreak. Erythema nodosum commonly occurs in children and young adults, and for the rest, what is known of its etiology corresponds with E. multiforme.

Symptoms.—The onset of the eruption is usually preceded and accompanied by constitutional symptoms, sometimes of considerable severity, such as malaise, pain in the head, back, and limbs, especially the joints, leading sometimes to the suspicion of acute rheumatism; the temperature is raised to 100° or even to 104° F., with a corresponding pulse-rate, and perhaps gastric disturbance; on the other hand, in some cases these symptoms are absent, or so slight as to be scarcely appreciable. After a varying interval of from one to four days the eruption appears, usually upon the backs of the hands and feet, and subsequently in crops upon the face, trunk, and rest of the limbs, most abundantly round the most painful joints.

The extent of distribution is very variable, sometimes being pretty general, including even the mucous membranes; at others limited to one or more regions, but it is seldom absent from the back of the hands whatever other regions may be affected. The symmetry is not absolute, the eruption being sometimes later and less developed on one side. It commences in the form of deep red papules varying in size from a pin's head to a small split pea, slightly raised and obtusely conical or convex (E. papulatum). These may coalesce into large plateaux, but when discrete speedily enlarge to the size of tubercles (E. tuberculatum or tuberosum), and continuing to develop peripherally, the centre becomes depressed, of a purplish hue, and a ring is formed (E. circinatum, or annulare); still enlarging, and meeting adjoining lesions, the ring is broken and gyrate curves are produced (E. gyratum).

Closely allied to this is E. marginatum, which, beginning as a flat disc one quarter or half an inch in diameter, rapidly enlarges at the periphery, subsiding *pari passu* at the older part, and joining with similar lesions, the raised border rolls onwards, as it were, and traverses the circumference of a whole limb, or a large part of the trunk, leaving distinct, fawn-coloured pigmentation to mark its course. Whilst some of these changes are going on in the part first attacked, crops of papules may be coming out elsewhere and passing through the same phases as the older ones; thus it sometimes occurs that many of the variations in the appearance above described are seen simultaneously on different parts of the body.

As accidental features, vesicles or bullæ may form on the erythematous lesions (E. bullosum), or hæmorrhages may occur into them, and the affected extremities may be generally œdematous and livid. It must not, however, be supposed that the above description applies to all cases; generally the eruption stops short at one or other of the phases, and often the same kind of eruption occurs in each succeeding attack, and in these instances the separate names mentioned justify to some extent their existence. Erythema papulatum is the most, and E. marginatum the least common of these forms.

Herpes Iris.—This eruption is conveniently considered as a separate variety, because the vesicular eruption generally occurs independently of the other forms; but it is very closely allied to the annular variety of E. multiforme, which may present similar concentric rings of various colours, and is then called E. iris.

Symptoms.—The eruption is preceded by a stinging and itching sensation, usually at night, then a small, red, slightly raised, flat papule appears, and in about twelve hours is covered with a vesicle, surrounded by a narrow red line; the lesion spreads at the periphery, the centre first flattening and then becoming depressed. This is now of a violet hue; outside is a white raised border, evidently containing some fluid, and beyond this is a narrow red zone of hyperæmia. The patch may be from the size of a threepenny-piece up to that of a shilling, reaching its full development in about a week, and in mild cases goes no farther; but after remaining for a few days longer, the fluid is absorbed, the disc flattens down, and leaves only a purplish stain behind. In more severe cases a central bulla may remain, and there may be several concentric white and pink zones, separated by violet zones. The bullæ vary in size from a millet-seed to a walnut, and the patches, by coalescence, may attain considerable dimensions.

The eruption is symmetrical, though it may appear upon one side before the other; it occurs most frequently upon the extremities, especially upon the backs of the hands and arms, but may come on the face, the mucous membranes of the mouth, tongue, and eye, and in rare instances is universal, and may then be associated with hæmaturia. In another form a bulla is seen surrounded by a ring of vesicles, round which there may be a second and even a third concentric ring of vesicles, with a zone of a purplish hue between the circles. This is the form that gave rise to the term Herpes iris, but it is much less common than the other kind, though essentially of the same nature. The eruption by the evolution of fresh lesions may last three or four weeks, seldom longer, but is almost sure to recur, often at the same period in the following year; and some people have three or four attacks a year.

Erythema Nodosum is rarely seen in adults, but is not uncommon in children. The skin-lesion is often preceded by slight febrile symptoms, articular pains, and digestive disturbance. The lesions come out by two or three at a time, but seldom exceed a dozen, and are oval, nodelike swellings, from a hazel-nut to an egg in size, occurring mostly upon the arms and legs, especially over the tibia and ulna, with the long axis in the length of the limb. They appear sometimes quite suddenly, are firm at first to the touch, but soon give a semi-fluctuating sensation to the finger; but they never suppurate, and are very painful and tender. They are at first of a purplish red, but as they disappear, go through the changing tints of a bruise. The disease runs its course in from two to four weeks, and does not recur in the same way as the other exudative erythemas.

Pathology.—There are strong grounds for considering these affections to be of central vaso-motor origin, while the immediate cause of the lesion is an exudation from the blood-vessels of serum and leucocytes, and in some cases there is rupture and extravasation of blood into the inflamed tissue. In a patch of E. tuberculatum, excised from the neck, the writer found the upper part of the rete broken up, and the space filled with cell-effusion, very dense in some parts, and looser in others, as if separated by fluid; although the effusion was for the most part limited to the rete and upper part of the corium, it sometimes extended sparsely to the bottom of the corium, especially along the hair-follicles and sweat-ducts. In some places there was slight thickening of the rete, and the palisade-cells were stained with blood-colouring matter. All the phenomena of inflammation were thus present.

In Herpes iris the only difference from E. annulare or iris is that sufficient fluid is effused to make its way through the rete, and elevate the horny layer into a vesicle.

The pathology of E. nodosum is disputed; probably it is of much the same character as the others; but it has been ascribed to lymphatic inflammation, and to inflammatory infarction following embolism in the cutaneous vessels. There can be no doubt that the exudation, though usually serous, is often hæmorrhagic.

Diagnosis.—In a typical case the multiform lesions, the acute course and the special features of the lesions, as above described, and their association with articular pains, would prevent error. It is when there is only a single phase of the disease present that mistakes may arise.

E. Papulatum, coming out on the back of the wrists and upper part of the face, and attended with febrile symptoms, may give rise to a suspicion of modified variola, especially if there happens to be vesiculation superadded. The pain in the back, if any, would not be so severe as in variola, vomiting would be absent, the eruption would not appear on the third day from the onset, and would not have the shotty feel, or go on to the formation of the vesicle, pustule, and scab of variola. From measles it would be distinguished by the absence of the catarrhal symptoms, by the rash being more raised, not crescentic, and in many cases the papules would increase in size in a way those of measles never do. It differs from eczema papulatum in the large size of the papules, the duller red colour, their being convex instead of acuminate, and in the absence of severe itching. E. tuberculatum is somewhat like urticaria, but the absence of itching and burning, which is slight at the most, and the colour, which is much deeper than the pink stage of the wheal of urticaria, would certainly distinguish it. The large diffuse patches might be mistaken for erysipelas; but the symmetry and the eruption being more raised, and the constitutional symptoms not so severe, are sufficient points of difference. There can be no difficulty about herpes iris, as it is so very distinctive.

E. nodosum is also very characteristic. The lesions may, however, resemble syphilitic nodes; but they lack the hardness of the true nodes, and are symmetrical, while nodes of the tertiary period are not, and

the history and other symptoms of syphilis would be absent.

The *prognosis* is good for all forms of these erythemata, and the disease rarely lasts longer than from two to four weeks. In all but E. nodosum relapses are almost sure to recur sooner or later.

Treatment.—Since the disease tends to run spontaneously a short course towards recovery, active treatment is seldom required; a saline aperient may be given, and afterwards ferruginous tonics, the perchloride acting the best; in many cases, however, the disease runs its own course uninfluenced by drugs. Guarding the patient against changes of temperature is always desirable, and when cases hang on longer than usual, precaution and rest of mind and body are absolutely necessary, and are often followed by immediate improvement. For local applications, calamine lotion, consisting of Pulv. calaminæ gr. xl., Zinci oxidi gr. xxx., Glycerini ℥xv., Aquæ rosar. f℥j., applied three or four times a day, and allowed to dry on, is sufficient, or if there is itching present, Liq. carbonis detergentis ℥x. may be added to the above lotion.

In Herpes iris a lotion of Liq. plumbi subacetatis ℥x. to Aquæ destillatæ f℥j. allays the itching and burning; but internal treatment appears to have no direct effect on the eruption; tonics are, however, often indicated in patients who are attacked with this affection, and defects in health should be carefully sought for, and, if possible, removed.

In Erythema nodosum resting the limbs in a horizontal posture is necessary, and lead lotions afford some relief sometimes, being more grateful when applied warm. Iron is often indicated after any digestive derangement has been dealt with. Be the fluctuation of the swelling ever so marked, it should never be opened, as absorption invariably takes place.

H. Radcliffe Crocker.

ESCHAROTICS. *See* Caustics.

ESMARCH'S BLOODLESS METHOD of operating has, besides reducing the mortality of major amputations, rendered easy what were previously difficult dissections. He applies an elastic bandage to the limb from the toes or fingers upwards, to beyond the site of operation, with sufficient firmness to render the limb bloodless; and where the bandage ends he encircles the limb two or three times with an elastic tube. On removing the bandage, the limb is found so bloodless that operations may be performed upon it with the same facility as upon the dead subject.

Esmarch's elastic tube is provided with a hook at one end and a chain at the other; another method of fixing the tube is to have a tape attached to each end of it, by means of which a knot may be tied, which it is easy to undo. Foulis' catch is, perhaps, the best method of securing the tube; it consists of a vulcanite pad, perforated by two holes, somewhat less in diameter than that of the elastic tube; one of them opens on the surface by a slit, and the tube is threaded through the other; the pad is placed over the artery, and after the limb has been sufficiently constricted by the elastic tube, the ends of it are pressed through the slit into the tubular catch, by which they are securely held when the traction is removed. To avoid the severe constriction of the elastic tube in long operations, an india-rubber band, wound two or three times round the limb, may be substituted for it; for this purpose, Nicaise's belt, with a hook attached to one end, and a number of eyes fixed to the bandage behind it, is a good contrivance.

Some care is required in applying the elastic tube close to the trunk, as it is liable to slip. For operations involving the upper part of the thigh, it should be wound once or twice round the limb as high up as possible, the ends crossed in front of the groin, and then carried round the pelvis and fastened over the hypogastrium. For operations on the male genital organs, it should be wound round the root of the penis and scrotum together, and fastened as above described. For amputations or excisions of the shoulder-joint, the tube should be placed beneath the axilla, and the ends drawn forcibly upwards and fixed over the acromion by a Foulis' catch; it should be held in position by a broad hook, as there is a tendency for it to slip over the point of the shoulder. Esmarch states that previous to the introduction of antiseptics he had reduced the mortality of his amputations of the leg and of the thigh from thirty-six per cent. to eight per cent.; his method is, moreover, extremely useful in dissecting operations, such as the removal of deep-seated tumours, or the extraction of splinters from the hands and feet. It facilitates the examination of diseased joints and the removal of sequestra from necrosed bones; it renders major amputations possible without skilled assistance, and the elastic tube forms a good popular tourniquet, which frequently proves most effectual in the

hands of railway officials, as its use involves no anatomical knowledge.

A serious objection, which has been raised against Esmarch's method, is that it is followed by such copious oozing from the stump that the total amount of blood lost is not much lessened by it. This after-bleeding has been commonly attributed to vaso-motor paralysis; but Lister argues that this is hardly likely to occur when there is neither motor nor sensory paralysis, and states that when the more even pressure of an elastic band is substituted for the tube, it may be applied long enough to cause the afterblush without any affection of either motion or sensation. He therefrom draws the conclusion that there is a demand for blood in the tissues, and that this acts as a stimulant which causes the arterial relaxation. This explanation does not commend itself to the mind of the writer, and the more probable explanation appears to him to be, that the functional activity of the muscular fibres of the arteries is lowered on account of insufficient supply of blood, and that consequently they allow of more than usual dilatation under the pressure of the blood-stream when the bandage is removed.

Cold has been used to check this oozing, but, in America, Brown has recommended, as preferable to both cold and electricity, that the surface of the stump should be washed with hot water at a temperature of 160° F. Latterly Esmarch has adopted pressure and elevation. Before removing the tourniquet, he secures all the vessels he can find, stitches up the flaps, applies the dressing, and bandages the stump tightly; he then places the limb in an elevated position, and removes the tourniquet. By this procedure, Esmarch states that his method becomes absolutely bloodless. The free oozing after operations on bone can be easily controlled by pressure. It has been urged, on little or no evidence, that Esmarch's method favours sloughing of the flaps, and may cause paralysis or gangrene of the limb; and Weir, of New York, has credited it with a death which he attributes to overstrain of a fatty heart. It seems probable that clots might be dislodged from thrombosed veins, and foul discharges be forced into the cellular spaces and lymphatic vessels by the elastic bandage, so that it is better, in cases where either of these mishaps is possible, to substitute for it simple elevation of the limb.

Before the introduction of Esmarch's method, Lister had obtained the same bloodless condition of limbs by elevation, followed by the application of an ordinary tourniquet; and he has shown that there is another factor besides gravity which operates when the limb is raised, viz. that there is an active contraction of the arteries, which reduces their calibre to nearly that of extreme constriction. Lister's method, combined with the elastic tube, is, perhaps, the best for general application; and it is only in cases where it is desirable that the surgeon should see clearly all the parts involved, as in the removal of sequestra from bones and in deep dissections, that Esmarch's method offers special advantages. The use of an ordinary tourniquet is very advisable in amputations where the operator is short-handed of good assistants, since by it he can control the flow of blood in the arteries as he chooses. BILTON POLLARD.

ESMARCH'S INTERRUPTED SPLINT, for excision of the *Wrist*, consists of a plate of sheet iron for the palm of the hand and a tin splint for the back of the forearm, connected with one another by an iron bar which arches backwards from the front of the former to the front of the latter; the wrist is left quite exposed, and so allows of an efficient antiseptic dressing being applied. Esmarch's interrupted splint for excision of the ankle is made on the same principle.

BILTON POLLARD.

ESMARCH'S OPERATION. *See* JAWS, Closure of the.

ETHER-SPRAY.—Richardson's ether-spray apparatus has a narrow-mouthed 6-oz. bottle fitted with an india-rubber cork, pierced by two metal tubes lying close to each other. These are bent to a right angle, a short distance above the cork, so that one lies below and in front of the other. Each terminates above in a firm nozzle, that of the inferior tube being at right angles to the tube. The two nozzles are therefore at right angles, and their points are closely approximated. The anterior tube ends below almost at the bottom of the bottle, and is guarded by a fine strainer; the posterior ends just below the cork, above the ether. Through the latter tube a stream of air is kept flowing by means of a strong india-rubber ball-syringe (worked by hand or foot), and it is rendered constant by passage through a distended elastic bag, placed upon the pipe leading from the syringe to the posterior tube just above the cork.

The apparatus works as follows:—The bag is kept tensely filled with air by the intermittent working of the syringe, and forces a constant current into the posterior

tube. Here the stream divides, part passing down into the bottle above the ether and forcing the fluid up the anterior tube, but the chief part, passing upwards and escaping by the superior nozzle, blows the ether issuing from the lower one into a fine spray. The rapid passage of the current of air over the lower nozzle tends to produce a vacuum in the lower tube, and this alone is sufficient to cause the ether to rise to the point.

The sulphuric ether used should be absolutely pure, of sp. gr. 0·720–0·722, i.e. it should be that which boils at the lowest temperature, volatilizes most rapidly, and therefore abstracts heat most quickly from the body. As easy tests of its suitability Richardson gives that (1) it should be neutral; (2) a drachm or two poured into the palm of the hand, warmed by breathing through it, should boil briskly, causing merely a sense of coldness; (3) blotting paper wetted with it, and laid on a warm hand, should be dry in a minute, and should retain no stain or smell.

STANLEY BOYD.

EUSTACHIAN CATHETER.—This instrument is a tube rather more than six inches in length, made either of silver or vulcanite. One end is funnel-shaped, about a quarter-of-an-inch in diameter; the other is curved at an angle of 135° to the rest of the catheter for about its last inch. A ring is fixed to the side of the funnel-shaped extremity corresponding with the concavity of the curved end, and indicates the direction of the point of the catheter when it is in the naso-pharynx. Eustachian catheters are generally made of three sizes. The curve of the instrument can be altered at will to suit special cases.

EXANTHEMATOUS NECROSIS. *See* JAWS, Diseases of the.

EXCISION OF JOINTS. *See* JOINTS, Excision of.

EXFOLIATION. *See* NECROSIS.

EXOMPHALOS. *See* UMBILICAL HERNIA.

EXOPHTHALMIC GOÎTRE. *See* THYROID GLAND, Diseases of the.

EXOSTOSIS. — An exostosis is a limited outgrowth of bone from some of the osseous structures of the body. The diffused periosteal growth that is often left after chronic periostitis is not spoken of as an 'exostosis,' nor the osteophytic growths which occur around the joints in osteo-arthritis.

Causes.—Nothing is known for certain as to the causation of exostoses. In some cases—and these are nearly always of the multiple symmetrical variety—they are hereditary. These bony growths are of two kinds—the ivory and the spongy exostosis.

The *ivory* or hard exostosis is developed from the fibrous periosteum, and, as in the case of the bones of the skull, is due to ossification in membrane. It occurs chiefly on the flat bones, such as those of the skull, orbit, scapula, and pelvis. As its name implies, it is of very remarkable density, resembling in structure the cortical layer of bone from which it springs. It is generally single, and causes little or no inconvenience, except in rare instances when it encroaches on a cavity, such as that of the skull or orbit. An ivory exostosis growing in the frontal region of the skull may attain an enormous size, and is chiefly known by specimens in our pathological museums.

The *spongy* or cancellous exostoses occur mostly at the epiphysial lines of the long bones, are generally multiple and developed from cartilage, with a thin layer of which they are most frequently covered. When present in considerable numbers they are generally distributed symmetrically, and will be met with chiefly at the lower ends of the femora, at both extremities of the tibia, and at the upper end of the humerus. They are most frequently seen at puberty, and rarely, if ever, found after the age of twenty-five, and, with the above peculiarities, will often be found to be hereditary. They are composed of cancellous tissue, which is continuous with that of the bone on which they are situated, the cortical layer at the base of the tumour in each case being absorbed. They generally cease to grow when the growth of the bone to which they are attached is arrested. The thin cap of cartilage on the surface then ossifies, and becomes continuous with the cortical bone of the shaft upon which the tumour is placed. They sometimes, however, commence after the general growth has ceased, and then often attain considerable size, becoming large, irregularly lobulated tumours, with a comparatively small peduncle.

The *subungual* exostosis is also a spongy or cancellous bony growth, with a thin covering of cartilage. It occurs at the free border of the nail of the ungual phalanx of the great toe. It has occasionally been seen on the little toe, and a few instances are recorded on the distal phalanges of the

hand. It is of some clinical importance on account of the frequency with which it is still mistaken for an ingrowing toe-nail.

The *symptoms* of an exostosis need scarcely be given in detail. It is a hard, bony outgrowth, fixed to one of the osseous structures of the body. When it occurs on the extremities and at points of pressure, a bursa is not infrequently developed on the summit, which, with the other soft structures, is projected in front of the exostosis. The secondary symptoms which these bony growths produce are entirely due to the position which they may happen to occupy. An exostosis very rarely causes any pain or discomfort, and very slowly increases in size; but when it occurs about the frontal region of the skull, and in the neighbourhood of the orbit, it may so displace the eye as to produce a hideous deformity, and at the same time destroy the eyesight.

The cancellous exostosis in the neighbourhood of a joint may also so interfere with the movements of the articulation as to considerably impair the function of the limb, or if it be situated on the inner side of the knee, on either the tibia or the femur, it may so diminish the patient's power of grasping the saddle as to effectually prevent him from riding.

As regards their diagnosis from one another, the cancellous exostoses are generally known from the position they occupy, the age at which they appear, and from their number, whilst the ivory exostosis is generally single, occurs only on the flat bones, and is seen at almost any period of life.

Treatment.—From the above account it will be seen that in most cases an exostosis should be left alone. An ivory exostosis is sometimes so hard as to defy the best instruments, and the dangers of such an operation as an attempt at its removal involves, ought not to be lightly incurred. If, therefore, these growths are producing no inconvenience and no secondary symptoms, it is better not to interfere with them. But occasionally it becomes necessary to attempt some means of relief, and the records of cases tend to prove that the thorough exposure of the base of such a growth, and the application of some mineral acid or other escharotic to the peduncular part of the exostosis, is the best and simplest means of inducing necrosis.

An inflammatory action set up at the root of an ivory exostosis seems to be a surer method of eventually removing this dense structure than an attempt by violent means to detach it from the skull by the saw or chisel. Occasionally such an exostosis has a very small peduncle, and may be easily detached; but should this not prove to be the case, it is better to try the frequent application of some escharotic than to persevere for any length of time with surgical instruments.

The cancellous exostoses generally cease to grow when the skeleton is fully developed. It is therefore unwise and unnecessary to operate in these cases, except when, from the position of the exostosis, the function of the limb is seriously impaired—as, for example, on account of its proximity to the knee-joint, the articulation which is most frequently affected in this way. Or, again, in the case of great pain and frequent neuralgia from the pressure of the exostosis upon a nerve. For these reasons, and for the deformity which it occasionally produces, an operation for its removal may have to be undertaken. In most cases the excision may be easily and quickly accomplished, the base being of soft consistence and small dimensions; in others the point of attachment being wide and of great density, the removal may involve the use of many instruments and considerable force. The operator should provide himself with different forms of cutting bone-forceps, chisels and mallet, various kinds of small saws, and a chain-saw. Sometimes the pedicle has proved, on exposure of the growth, to be formed of tough, fibrous tissue, which, on account of its shortness and strength, has allowed no perceptible mobility to the exostosis till the soft parts have been divided and the tumour completely exposed. The scalpel will, in such a case, be the only instrument necessary to complete the operation.

In using instruments close to a joint or a large vessel, the operator must be careful to work with the cutting edge directed away from the point of danger.

The subungual exostosis should be removed with the gouge or sharp spoon after an incision has been made through the soft parts round its base, so that the horny cuticle and cartilaginous cap on its summit may be taken away at the same time. If this cartilaginous cap is not removed, the growth is likely to return.

The operations are now almost invariably conducted with antiseptic precautions, but the dressings may be of dry absorbent wool (iodoform or salicylic) or of wood wool (corrosive sublimate), contained in convenient bags made from muslin which has been similarly prepared. This application may be retained for a few days, and can in most cases, after the first change of

dressing, be left till the healing is complete, as the tissues generally unite by first intention.

There is now much less fear of dangerous consequences from these operations, which must, as a rule, involve the cancellous tissue of bone, than there was in former days. The dread of suppuration in the veins of the cancellous tissue led to the trial of the subcutaneous division of the neck of the growth, and also of fracture of its neck by external force without incision of the soft parts. The loose body was then daily moved to prevent its reunion. But the operation has fallen out of favour in recent years, partly because it not unfrequently failed, and partly because, with modern methods of operating and dressing, the free exposure of the bone and its section in an open wound are very rarely followed by suppuration of the medullary canal and its consequences. H. H. Clutton.

EXTENSION. *See* Dislocations.

EXTRACTION OF TEETH. — The roots of a great many teeth are of such a shape that, were they implanted in rigid, unyielding bone, they could not be extracted at all. The art of skilful extraction lies in a knowledge of the directions in which the bone around a normal root will best yield, and in quick recognition by the sense of touch of any alteration in this respect induced by abnormal curvatures of the roots. The blades of tooth-forceps should be thin, almost sharp-edged; they should be lightly closed upon the tooth, and then forcibly driven up so as to pass deeply between the tooth and the gum, right down to and a little within the edge of the socket. It is never necessary nor desirable to lance the gum previously, save in the case of lower wisdom teeth, to the necks of which a tough gum is sometimes strongly adherent and might be torn in the removal of the tooth. As the outer alveolar plate is much thinner, and thus more yielding, than the inner, the first movement should be inwards, so as to slightly disengage the outer portion of the root from its socket, and then much more extensively outwards, the extraction of the tooth being accomplished almost without any direct pulling. As exceptions, the four upper incisors, having cylindrical roots, may be best disengaged by rotation, and lower wisdom teeth will often move inwards more easily than outwards; their roots are often strongly curved backwards, in which case the elevator is the most appropriate instrument for their removal.

The bone of the alveolar borders is very intolerant of injury, and seems to have little recuperative power, so that the exfoliation of small fragments of the socket not rarely results, especially where unusual force has been used; an ostitis involving the whole socket and causing much pain is a less common sequela. Little can be done for these conditions save fomentation and the abundant use of disinfectants, such as Condy's fluid. *See* Alveolus, Fracture of the.

Such complications are more apt to ensue when there has been, prior to the extraction, acute inflammation; but it is quite a mistake to suppose that it is desirable to wait for the subsidence of all swelling and inflammation before resorting to the extraction of the tooth; for though the healing may be slower, nevertheless it is a far shorter road to relief than to wait for the inflammation to wear itself out and then to extract—a method of practice which results in much needless suffering.

The accidents most liable to happen are the fracture of portions of the alveolus, the accidental removal of more than one tooth, the passage of a root into the antrum, its escape from the instrument down the œsophagus or the trachea, or excessive hæmorrhage. Fractured alveolus pressed back into position commonly stays there without support, and reunites; a tooth removed by mistake and promptly replaced in its socket also, in the majority of cases, refastens; a root may generally be got out of the antrum by forcible syringing, after enlargement of the opening, and the swallowing of a tooth is not likely to lead to any harmful result. A tooth is very unlikely to get through the glottis unless the patient is under an anæsthetic; of the cases on record, most have terminated by the tooth being coughed up after a longer or shorter interval, but some few cases of serious and even fatal mischief having been set up in the lung have occurred.

Hæmorrhage is best treated by mechanical means, aided by astringents; strong caustic applications, like perchloride of iron, leaving a surface not capable of speedy healing, even if they do not create fresh bleeding surfaces more difficult to control than the tooth-socket. The extracted tooth itself makes an admirable plug, or the socket may be plugged with fragments of moistened matico-leaf, and firm pressure made upon it by a roll of lint held in position by the opposing teeth. If this be carefully done it is very rare for further measures to be called for. Charles Tomes.

EXTRA-UTERINE FŒTATION.—This term signifies the development of a fœtus either entirely beyond the anatomical limits of the uterus, or at least away from the true uterine cavity. Cases of fœtation in one horn of a bicornute uterus, or in a pouch forming a diverticulum from the cavity of the uterus, cannot be strictly considered as belonging to this pathological condition. In a very large majority of the recorded cases of extra-uterine fœtation, the Fallopian tube was the seat of the abnormal pregnancy, and some authorities believe that nearly all the other varieties are primarily tubal. The different forms of extra-uterine fœtation or gestation are :—(1) Tubal gestation, including the tubo-uterine or 'interstitial,' tubo-ovarian, and tubo-abdominal varieties. (2) Ovarian gestation, the existence of which, in the literal sense of the term, is doubted by many pathologists. (3) Abdominal and pelvic gestation, including all cases where the ovum is entirely, or almost entirely, disconnected from the uterus, tube, or ovary. This variety may include cases where the ovum lies between the two folds of the broad ligament. Systematic writers make separate varieties out of cases where the placenta has been found in the uterus, the fœtus lying in the Fallopian tube or in the abdominal cavity, the umbilical cord passing along the tube.

The occurrence of extra-uterine fœtation has been proved by actual dissection to be associated, in many cases, with obstruction of the canal of the Fallopian tube, and consequent arrest of an impregnated ovum by mechanical agencies, such as the pressure of inflammatory bands of adhesion, kinking or extreme angular flexion of the tube from various causes, and morbid growths either within the canal or at its uterine orifice. Various sexual and menstrual irregularities have been given as causes of extra-uterine pregnancy, but seldom on satisfactory evidence. It has been alleged that excessive manual labour shortly after conception may bring about this condition. After a twin conception, it is very probable that one of the ova may obstruct the other in its passage along the tube; as, in nearly four and a half per cent. of a series of five hundred cases, extra-uterine fœtation was coincident with uterine pregnancy. It has been maintained by some authorities that the uterus is the normal seat of conception, and that spermatozoa do not naturally permeate the Fallopian tubes in women, but, on the contrary, are prevented from entering them. According to this theory, it is only when chronic morbid changes in the tubes have brought about dilatation and changes in their mucous membrane, that the passage of spermatozoa along their canals is possible, and then one of these organisms may readily encounter an ovum, and impregnate it. The fertilised ovum immediately adheres to the mucous surface with which it happens to be in contact, and tubal pregnancy is the result. Extra-uterine fœtation is most frequent in multiparæ; but, in a considerable proportion of recorded cases, the abnormal gestation had occurred either at the first pregnancy and long after marriage, or at a long interval after a previous pregnancy.

TUBAL GESTATION.—As the ovum passes from the ovary to the uterus through the tube, it is not surprising that it should be arrested, under some of the above-mentioned conditions, in some part of the Fallopian tube, developing, if impregnated, into a fœtus. A more or less spherical tumour is then formed in some part of the course of the tube. It contains the fœtus, and generally the placenta, but is not lined with a true decidua. In rare cases the placenta has been found in the uterus, the umbilical cord passing into the tube. After the death of the fœtus, the placenta sometimes lives and hypertrophies. The uterus almost always enlarges, probably always when the pregnancy is at all advanced; a decidua forms within its cavity, and in the few cases where it has been reported absent, it had probably been passed unnoticed. The walls of the cyst containing the fœtus are thin and tense, and tend to rupture between the third and fifth months, not half the cases carrying the child to term. The nearer the cyst lies towards the uterine end of the tube, the earlier will be the rupture. The muscular tissue in the cyst-wall probably causes partial separation of the placenta by contraction, and the consequent hæmorrhage distends the cyst till it bursts. After rupture, life may be prolonged until a second or third recurrence of hæmorrhage; or the bleeding may cease, and the patient recover.

TUBO-UTERINE OR 'INTERSTITIAL' GESTATION.—These terms are, in reality, synonymous. An ovum discovered in the uterine wall can only have been developed in the uterine portion of the tube or in a uterine pouch. On the other hand, as the calibre of that part of the tube is very narrow, it is probable that, when a fœtus develops within it, partial rupture will soon occur, so that the fœtal sac will be brought into direct relation with the uterine wall. Six

specimens, described as 'interstitial' gestation, are to be found in London museums. In four out of these, the condition of the affected parts is intelligibly displayed, and in all these four the tubal origin of the 'interstitial' cyst is self-evident. A tortuous condition of the uterine portion of the Fallopian tube has been proved to be a predisposing cause of this variety of abnormal gestation. As the uterine tissue around this portion of the tube is thinner than in any other part of the uterus, rupture of a tubo-uterine cyst generally occurs very early. However, as the stimulus of gestation always causes a certain amount of hypertrophy of the uterine tissue, the walls of the sac are sometimes of considerable thickness. Although pathologically tubal, this form of abnormal gestation is, surgically, uterine; the removal of part of the cyst, or even mere incision, without wounding part of the uterus being, of necessity, impossible. As a part of the cyst bulges into the true cavity of the uterus, there is a possibility that the ovum may be discharged into the uterus, as certain clinical records would appear to prove; and should the abnormality of gestation be diagnosed, the surgeon will have the opportunity of incising the layer of uterine tissue which divides the fœtus from the uterine cavity.

Tubo-ovarian and Ovarian Gestation. The possibility of ovarian gestation has been much disputed. A fœtal sac, which is apparently in the outer or lower part of the ovary, may very possibly be tubal; for the Fallopian tube does not naturally lie entirely above the ovary. Its outer part, including the dilated portion close to the fimbriæ, descends and bulges behind the ovary; hence the fimbriæ lie on the outer surface of that organ, the lower even reaching its inferior aspect, whilst the longest, the 'ovarian fimbria,' actually ascends the surface of the ovary, instead of descending as represented in most diagrams. When the fimbriæ are matted together from morbid changes, and the tube obstructed and dilated, it will be found that half the dilated tube coils round the outer and lower aspect of the ovary. In the same manner, when a fœtus develops within the fimbriated extremity of the tube, it forms a tumour lying external to, or even partly below, the ovary, and often encroaches on ovarian tissue. Many observers, not cognisant of the above fact, have taken tubo-ovarian for ovarian pregnancy. The writer once dissected the uterus and appendages in a case where a patient had died from rupture of an extra-uterine cyst, the existence of which had been unsuspected during life, amenorrhœa having existed for a year, and the cyst having felt like a multilocular ovarian tumour. The ovarian ligament appeared to run from the uterus to the inner surface of the cyst; a cardinal proof, in most cases, that a tumour springing from the uterine appendages is truly ovarian. But on dissection it was found that the tissue on which the ovarian ligament ran was a small and distinct ovary, squeezed flat between the uterus and the cyst, to which it was soldered by adhesions. The cyst was distinctly tubal. This squeezing up of the ovary may be seen in early stages of tubal gestation. Hence the writer is compelled to distrust the evidence of several authorities as to the occurrence of cases of ovarian pregnancy in their practice, based on the fact that the ovarian ligament ran on the surface of the cyst. Tubo-ovarian pregnancy signifies gestation in the outermost part of the tube, and in this variety the tissue of the ovary is rapidly encroached upon by the sac.

Abdominal Gestation.—It has been doubted whether an ovum can drop out of the Fallopian tube after impregnation, and fall into the peritoneal cavity; and it is not certain that an unimpregnated ovum can be fertilised after straying on to the peritoneum, although it has been stated, upon good authority, that spermatozoa have been found on the surface of that serous membrane near the uterus, and that, in tubal pregnancy of one side, the corpus luteum corresponding in its degree of development to the abnormal pregnancy has been found in the opposite ovary. The great majority of cases of abdominal gestation arise from rupture of a tubal cyst. True pelvic or broad-ligament gestation must be included in this category. Rupture of the tube along its free surface is, as a rule, followed by hæmorrhage and death of the fœtus at least; whilst, should the fœtal cyst be rent between the two layers of the broad ligament as they pass under the tube, the embryo might readily escape into the cellular tissue of the ligament, which would offer resistance to hæmorrhage. Its life might then be spared, and it would develop in its new cavity, forming a tumour that would soon become partly abdominal. Should the fœtus survive rupture of the tube along its free surface, true abdominal gestation would occur. The placenta in these cases is sometimes found adherent to some of the abdominal viscera. When it becomes attached to the serous coat of the intestine, the mucous membrane of the latter tends to

become congested; and if the fœtus should die, the placental vessels may convey septic material from the intestines to the fœtal tissues. Hence, as Freund has pointed out, diarrhœa or dysentery followed by symptoms of septicæmia in cases of extra-uterine pregnancy, affords strong evidence that the placenta is adherent to intestine.

Symptoms and Diagnosis.—The existence of extra-uterine pregnancy has been repeatedly diagnosed before rupture of the cyst, but in many cases the symptoms have misled the most experienced authorities. In the earlier stages, it is the pregnancy that is most in evidence; in the later, the tumour. When a woman believes herself to be pregnant, or has ceased to menstruate for two or three months, and suffers from crampy or colicky pains in the hypogastrium, or in one iliac fossa, pains of marked severity, and more or less paroxysmal, there is always good reason to suspect extra-uterine pregnancy, especially if the woman has never been pregnant before, or not for many years. If there be characteristic changes in the breasts, with discolouration of the vulva, enlargement and partial displacement of the uterus, and the formation of a tumour which can be detected above the pubes, or on one side of Douglas's pouch, the diagnosis of extra-uterine pregnancy will be all but certain. Subsequent symptoms of abortion, with the discharge of a decidua, but no ovum, will be of grave import in such a case, being the harbinger of rupture of the cyst. If the abnormal pregnancy be advanced, a soft tumour, resembling a pregnant uterus, may generally be detected in the abdomen, the uterus being found on vaginal examination to be more or less enlarged, but separate from the tumour. Should a so-called 'placental' souffle, and, above all, the fœtal heart-sounds, be heard on auscultation over the tumour, the nature of the case will be very evident. Active fœtal movements, perceptible through the abdominal walls, do not, in themselves, constitute an important proof of extra-uterine pregnancy, as they are usually observed in normal gestation when the patient's abdominal walls are thin. Rupture of the cyst gives rise to severe pain, collapse, and all the symptoms of intra-abdominal hæmorrhage. It may, in rare cases, cause instantaneous death; more frequently the patient rallies for a few hours or days, and sinks under a return of the symptoms. Schröder and Freund have shown that spontaneous recovery is not so infrequent as was once supposed. In cases of fatal rupture of the cyst, murder or suicide, especially by poison, may be suspected when the true nature of the patient's case has been overlooked; but the real character of the accident may be proved with facility by a carefully conducted necropsy.

On the other hand, many of the above important symptoms may be masked or absent. Menstruation had ceased, in one case under the writer's observation, for twelve months before fatal rupture of a tubal cyst; and it has in several cases persisted—as in one instance where rupture occurred during coition, in a patient who was suckling, and in whom the catamenia had not been suppressed during lactation, the last period having ceased two days before the accident. Occasional hæmorrhage from the uterus is frequent during extra-uterine gestation, and has been mistaken for menstruation. The death of an extra-uterine fœtus at term causes symptoms of what is known as missed labour. When such symptoms as labour-pains and hæmorrhage from the uterus, with no subsequent expulsion of a fœtus, are observed, it must be remembered that retention of a dead fœtus in the uterus after term is not proven, whilst the retention of a dead extra-uterine fœtus in the abdominal cavity for months or years has been repeatedly observed.

The colicky pains are sometimes absent, especially in the abdominal and tubo-ovarian varieties of abnormal gestation; they are also met with in certain chronic uterine and ovarian affections. The changes in the breasts and vulva may be obscure or absent in the earlier stages of extra-uterine, as in the same periods of normal pregnancy. In several cases, of which accurate clinical records exist, the uterus was not enlarged, and was but little, if at all, displaced. The fœtal cyst is not always easy to detect, especially in stout subjects. In true abortion the ovum may escape undetected, and the presence of an enlarged ovary may mislead the practitioner. The tumour, when large, may readily be taken for an ovarian or a uterine growth, especially if the fœtus be dead, so that the souffle and heart-sounds are absent, and if the other physical signs of pregnancy be wanting. The co-existence of extra-uterine fœtation and abdominal or pelvic tumour, may greatly increase the difficulties of diagnosis. A souffle is occasionally heard in large soft uterine fibroids. In one case, an abdominal tumour and a gravid uterus were detected in the same patient. Fœtal heart-sounds could be heard on auscultation

of the uterus, but not when the stethoscope was applied to the tumour. The ultimate course of the case showed that twin pregnancy had occurred, the extra-uterine fœtus having died.

Rupture of the cyst produces pelvic hæmatocele in cases where the patient survives the accident for a few days; in one case, at least, a hæmatocele formed through another cause whilst tubal pregnancy existed. The absence of coma and dyspnœa distinguishes the symptoms of hæmorrhage after rupture of the cyst from intracranial and intrathoracic hæmorrhage, but its distinction from intra-abdominal hæmorrhage, due to other causes, will depend on a careful consideration of the history of each individual case, and is often impossible. Lastly, the symptoms produced by the retention of an extra-uterine fœtus beyond term are often very puzzling; there must of necessity be an abdominal tumour; and if the contents be discharged through a communication with the intestine, bladder, vagina, or abdominal wall, portions of the fœtus will be recognised. When, however, the fœtus has undergone degenerative changes, with simultaneous atrophy of the placenta, the tumour may resemble a uterine fibroid growth, a dermoid ovarian cyst, or even a malignant tumour of the omentum or abdominal viscera. A calcified fibroid tumour and a 'lithopædion' closely resemble each other to the touch. Here again, the surgeon must rely as much upon history as upon physical signs.

Treatment. — Extra-uterine fœtation is a very grave affection. Rupture of the cyst at or after the third month is the most frequent termination of the case; and this accident, though not so surely fatal as was once supposed, very frequently causes the patient's death. If the patient survive the full term, she must incur numerous risks through the presence of a dead fœtus in the abdominal cavity. Diagnosis is not always easy, as has been explained; but a simple exploratory incision through the abdominal walls—an operation which experience has shown to be almost free from risk when antiseptically performed—will prove the nature of the case; and it must be remembered that many diseases which have been taken for extra-uterine fœtation are equally or still more suitable for operative measures. Before speaking of the radical cure of this affection by removal of the fœtus through an abdominal incision, it must in the first place be observed that, when abnormal gestation of this class is suspected, the patient must be kept at rest as much as possible. To allay the crampy pains, opiates, especially hypodermic injections of morphia, are of high value. Inhalations of chloroform are not advisable, as the struggling before anæsthetisation, and the frequent vomiting afterwards, might cause rupture of the cyst. An abdominal belt, light diet, and a regular daily action of the bowels, are further requisites in cases of this kind. It is certain that these palliative measures have sometimes saved the patient, if we may trust the diagnostic powers of several obstetricians, the fœtus perishing early in the pregnancy and its sac shrivelling up.

Incomplete operative measures cannot be said to have yielded a favourable series of results, although all have saved life in a few cases. Among these measures are—killing the embryo by strong electric shocks or galvano-puncture, injections of narcotics into the cyst, puncture of the cyst in order to destroy the embryo by drawing off the liquor amnii, and removal of the embryo by section of the vagina with the galvanic cautery. This last operation is neither easy nor safe; it is done in a region which cannot be thoroughly exposed to light, and where manipulation is very difficult. A powerful electric shock, sufficient to cause the death of an adult by its stimulation of the inhibitory fibres of the pneumogastric nerve, might have little or no effect on a fœtus, which has no inhibitory apparatus. This form of electricity has, moreover, often proved a failure in recorded cases. Electrolysis has also failed in its object; in one case the fœtus survived its influence after tapping and morphia injections had been tried for the same purpose. A fœtus has survived the injection of two grains of morphia. Drawing off the liquor amnii is still recommended by distinguished authorities; it is not a difficult proceeding, but does not always kill the fœtus, however completely the fluid be removed, and it not unfrequently results in the death of the patient by hæmorrhage or septicæmia. If the fœtus be killed by any of the above methods, its remains will probably be discharged through fistulous communications between the sac and the rectum or vagina, during which tedious process the patient will be seriously invalided.

The removal of the fœtus by an abdominal incision is an operation which is yearly growing into greater favour, as the true course to be pursued when extra-uterine gestation is diagnosed. To expose a Fallopian tube ruptured at an early stage of extra-uterine fœtation, to clear out the

clots and fluid blood with which the peritoneal cavity is filled, and to remove the tube and its embryo-bearing sac, after ligature of the uterine appendages as in ovariotomy, is an operation of great difficulty; yet it is advocated by, and has been successfully performed by, Mr. Lawson Tait. When an unruptured cyst, in a late stage of pregnancy, is exposed by an abdominal incision, the operation is not so arduous; besides, the patient is, as a rule, in a less desperate condition. The abdominal wound must be made as in ovariotomy, and the sac opened cautiously, as the placenta is sometimes attached to its front surface. The sac should then be stitched to the margin of the wound, incised, and a small portion of its wall removed. The fœtus must then be extracted, and the umbilical cord divided. During these manipulations care must be taken not to disturb the placenta. The sac must then be well washed out with antiseptics, and a drainage-tube should be passed into it as deeply as possible; it must also be packed with antiseptic dressing. The placenta will come away in a short time, and the wound, after daily antiseptic washing and packing, may be closed when blood and broken-down tissue cease to issue from the tube. The operation has been successfully performed, both before term, and in cases where the fœtus had been retained for months beyond the normal period of gestation. The operator should not attempt to remove the cyst itself, as its precise nature, and its connection with other parts by adhesions, cannot always be ascertained by abdominal section, and when left behind and drained it atrophies, and causes no inconvenience to the patient.

In cases where the bones of an extra-uterine fœtus are discharged through a fistulous opening in the rectum, vagina, or abdominal wall, it may be necessary to enlarge the opening and thoroughly empty the contents of the abnormal cavity, employing antiseptic solutions and drainage. The cavity must be explored and syringed out with great care, lest any adhesions be disturbed.

Tubo-uterine or 'interstitial' pregnancy is not easily diagnosed; if it be detected during abdominal section, it is difficult to advise any other course than amputation of the uterus above the cervix. If diagnosed before operation by dilatation of the os uteri, the method already suggested in the paragraph on tubo-uterine gestation might be practised, as involving less risk than hysterectomy.

ALBAN DORAN.

EXTRAVASATION OF URINE.—The escape of urine from the urethra through rupture of the wall of the passage. This rupture is occasionally produced by accidental injuries, such as falls or blows on the perineum, which tear open the urethra in that situation. A more common cause is yielding of the urethra behind a stricture, which has long obstructed the flow of urine and gradually dilated the portion behind the contraction until complete, or almost complete, retention takes place. The weak expanded portion may give way suddenly during a violent effort to expel urine. In this case the patient feels a momentarily sharp, stinging pain, and then for a little while relief from the urgent call to void urine, through some of the contents of the bladder escaping into the cellular tissue around the urethra.

A more frequent mode is for the urine to penetrate into a small abscess that has formed in a follicle of the expanded urethra. In this case the escape of the urine is slow and limited to the track of the abscess, which then passes forwards and forms some variety of perineal abscess, ultimately reaching the surface of the body and opening a fistula for the escape of the urine from the urethra behind the stricture. Such gradual and limited escape, though a grave affection, is attended with far less constitutional disturbance and danger than the acute form, with extensive infiltration of urine into the cellular tissue.

If the extravasation is suddenly produced during violent straining, the urethra has given way at the membranous portion between the two layers of the triangular ligament (deep perineal fascia), where it is but little supported by the surrounding structures. The urine rapidly perforates through the anterior layer of the triangular ligament into the cellular tissue of the scrotum and penis, and thence beneath the integuments of the belly—sometimes as high as the nipple. The attachments of the deeper layer of the superficial fascia to the borders of the triangular ligament, to the rami of the pubes, and to Poupart's ligament as far as the crest of the ilium, prevent the urine from wandering down the thighs or backwards to the perineum. Occasionally the sloughing which follows this soaking in unhealthy urine causes the attachment of the superficial fascia to the triangular ligament to give way, when urine spreads to the ischio-rectal fossæ between the layers of the pelvic connective tissue, causing extensive sloughing of the nates and, if the patient survive, fistulæ

around the rectum and beneath the glutei muscles.

The local effects of the sudden escape of urine which has become decomposed by long retention in an unhealthy bladder are very destructive; gangrenous inflammation is excited wherever it reaches. The swelling spreads rapidly in the directions named, the skin grows dull red, brawny, or boggy, crackling, or even emphysematous. The skin sloughs over the scrotum, penis, and lower part of the abdomen, and exposes fœtid, dark-coloured layers of sphacelated cellular tissue soaked with urine and serum.

The constitutional effects are often very great and always serious. The patient is never in a healthy condition before the rupture of the urethra, and is quickly and greatly prostrated. He is anxious, restless, and in considerable pain. The pulse is rapid, small, and easily compressed, the tongue dry and brown along the middle. These symptoms are followed by wandering delirium, insensibility, increasing general prostration, and in many cases death. Should the patient survive, and this is more probable if the skin sloughs rapidly, thereby affording vent speedily to the pent-up putrid urine and so limiting the area of its infiltration, recovery is sometimes very rapid. The sloughs are thrown off, healthy granulations succeed them, and the exposed parts, testes, corpora cavernosa, or abdominal aponeuroses, are quickly covered with sound scars, while the urine escapes through one or more fistulæ at the lower part of the scrotum.

The immediate *treatment* of this affection consists in setting free the pent-up urine, establishing a short course for the urine from the bladder to the surface, and in maintaining the patient's strength by means of nourishing and stimulant diet.

As soon as indications of extravasation are given, the patient should be anæsthetised and put into the lithotomy position. Then, the left forefinger being kept in the rectum to draw it away from the knife, a sharp-pointed bistoury should be pushed directly backwards, one inch in front of the anus in the raphé of the perineum until the dilated urethra is reached. A Wheelhouse's small tapering gorget can then be passed through the wound along the posterior part of the urethra to the bladder, and by its means a catheter may be guided thither, when the catheter should be tied in, and the urine allowed to drain off continuously from the bladder. The further extravasation of urine being prevented, the liberation of that which has already percolated into the cellular tissue must be obtained by several free incisions of the brawny swollen areas as far as they have reached, and made in the scrotum and penis on each side of the mesial line. The division of the stricture which has caused the extravasation may be carried out at the same time: more commonly, however, it must be left until the patient has regained some of his strength. When the stricture is too narrow or too tortuous for a staff to be passed through it, it is better to delay the treatment of the stricture till the patient have recovered from the extravasation. But if the patient have a moderate amount of strength, and the extravasation be not extensive, and if a guide staff can be carried through it to the bladder, the stricture can be dealt with at once. This is done, after the perineal incision has given access to the bladder, by passing a Syme's shouldered staff through the anterior portion of the urethra and the stricture until its beak reaches the left forefinger placed in the posterior part of the urethra. An assistant then holds the Syme's staff steadily in the perineum, while the operator, using his left forefinger as a guide, cuts the urethra from behind the stricture forward to the shoulder of the staff along its groove. The rigid instrument is then withdrawn, and a flexible catheter passed on to the bladder with the aid of the tapering gorget if needful, and tied in for a few days after the operation.

In addition to the primary treatment by perineal and other incisions, the sloughy parts should be dressed with warm wet boracic lint or with lint soaked in carbolic oil 1 in 10 or 1 in 15; the sloughy surfaces freely dusted with iodoform, and the whole covered with tarred hemp wrung out of hot water. If the patient's strength permit, he can be most thoroughly washed in a hip-bath of warm, weak solution of Condy's fluid or other antiseptic, in which also the sloughs can usually be most easily removed. The patient will need from the first bark, opium, brandy, and strong beef-tea, or any other nourishment he can take, to enable him to withstand the exhaustion that follows the sloughing of the cellular tissue and skin.

BERKELEY HILL.

EXTROVERSION OF BLADDER.

See ECTOPIA VESICÆ.

EYE, General Examination of the.—The more important diseases to which the eye is liable will be made the subject of separate articles under appropriate head-

ings; and all that will be attempted in this place is to give a general view of the chief symptoms by which ocular maladies declare themselves. The transparency of many of the tissues of which the eye is composed, and the accessibility of most of them to various modes of examination, render it easy, in the majority of cases, to ascertain the precise facts with regard to any form of ocular disease or injury. It is therefore the more necessary to utilise in the most complete manner the advantages afforded by the structure and position of the organ, and to look at it in such a way, and with such attention, that nothing which exists can escape notice. Occasional errors of inference and interpretation are, perhaps, inevitable; but an error about a matter of fact can seldom arise excepting from haste or carelessness. There are many advantages in following a settled order of investigation, and it will usually be best to proceed from the superficial to the deeper textures.

The *eyelids* will thus come first under observation, and they may depart from the healthy state in many ways; by faulty position, by swelling, by redness, or by the condition of their margins or appendages. *See* Eyelids. Whenever there is any redness or irritation of the surface of the eyeball, it is not enough to notice the absence of coarse eyelid changes, but the state of the margins and of the cilia should be carefully scrutinised. For this purpose it is well to use a magnifying glass, and to look closely at the growth and position of the cilia, moving the eyelid a little way from the globe during the examination, so as to let the light fall at different angles from time to time. In this way fine semitransparent ingrowing eyelashes may be discovered, or sometimes a detached eyelash which has been carried into one of the lacrymal puncta and arrested there. The margins of the upper lids should be scrutinised in similar fashion, as well as the whole surface of the conjunctiva, both palpebral and ocular.

In order to examine the conjunctiva of the lower lid, the lid should be drawn down by the tips of one or two fingers, placed on the skin just above the inferior margin of the orbit. The patient should then look upwards as much as possible, and the lower retro-tarsal fold will be thrown forward and rendered prominent. In some persons a good view of the lower part of the conjunctival sac may be obtained by drawing the lower lid forward while the eye looks down. In order to see the conjunctiva of the upper lid, a somewhat less simple manœuvre is required. The lids being gently closed, the surgeon takes any slender instrument, such as a probe or a knitting-needle, and places it horizontally along the upper lid, just below the upper level of the tarsal cartilage. A slight pressure against the upper part of the cartilage inclines its lower margin a little forward, and this margin is then seized between the thumb and index finger of the disengaged hand, which obtain a light but firm hold of the cilia and the edge of the lid. The surgeon draws the lower part of the eyelid still more forward, and then with a quick movement turns it upwards round the probe, which is held immovable and acts as a fulcrum of rotation. At the moment when the upward turn is given to the lid, the patient, if not already doing so, should be told to look down, and complete eversion will be obtained.

The lid being everted, its inner surface must be examined; and it must be borne in mind that foreign bodies are especially apt to lodge on this surface, about a line from the margin. The upper *cul-de-sac* does not admit of being completely exposed, although, when the patient looks down, most of it may be brought into view. It is a not uncommon place of retreat for a certain class of foreign bodies, such as fragments of straw, or of the awn of barley; and it may be fully explored by the bent portion of a hair-pin or by a loop of wire. Eversion of the upper lid is not agreeable, and need only be practised when the history of the case, or the appearance of the ocular surface, points to the probability of some irritant being concealed beneath. Besides foreign bodies, such an irritant may be supplied by warty granulations of the palpebral conjunctiva, which are residual to chronic conjunctivitis, and are frequent causes of undue vascular development on the cornea, especially on its upper portion; while in the lower retro-tarsal fold we may find granulations of another kind—the so-called 'sago grains,' which consist mainly of aggregations of lymph-cells.

Conjunctiva and Sclerotic.— Obvious congestion of the ocular surface may be limited to the conjunctiva, or may extend to the deeper portions of the globe. Active congestion of the conjunctiva is readily produced by trivial causes, and, if these continue in operation, the congestion soon becomes chronic, from passive dilatation and loss of tone of the vessels. It may vary in degree, from a mere vascular network, with white interstices, to the production of uniform redness. Congestion limited

to the conjunctiva may be distinguished by the readiness by which the vessels may be momentarily emptied by pressure. If the tip of the index finger is placed against the cutaneous surface of the lower lid, and so used as first to raise the lid a little towards the cornea and then to make it glide down again over the lower part of the eyeball, the track of digital pressure, if the congestion is only conjunctival, will for an instant be left purely white, quite up to the corneal margin. The vessels refill as the finger passes on, and obliterate its track. But if the congestion reaches deeper parts, as will happen in cases of inflammation of the iris, cornea, or ciliary body, it will involve the fine vascular zone of the sclera, which surrounds the corneal margin, and which remains unaffected by pressure. The vessels of this zone are too small to be individually visible, even when overfilled; but their distension forms around the cornea a pink annulus, which is sometimes seen through the conjunctival vascularity, and is sometimes obscured by it, but which may always be brought to light by the effect of pressure, which then leaves a track that is pink near the cornea, and becomes white at some little distance from its margin. There is yet a third form of congestion, which is passive and subconjunctival, and is dependent upon some impediment to the free exit of venous blood from the interior of the eye. In this form the surface of the sclerotic is traversed by distended and tortuous veins, full of dark-coloured blood, which may be seen to emerge from the eyeball through openings not very distant from the corneal margin, and to pursue their course backwards. They are chiefly met with in cases of chronic internal inflammation or of increased tension, and are constantly present in fully developed glaucoma. *See* CONJUNCTIVA.

Cornea.—The chief characteristics of the cornea are its uniform transparency and its smooth reflecting surface, which, as a convex mirror, affords an erect but diminutive image of the objects in front of it. In the healthy state, the transparency of the cornea allows us to see the fibrillation and the colours of the iris with perfect distinctness; but it does not follow, because these are concealed, or seen only imperfectly, that the transparency of the cornea is impaired. The iris may be veiled by turbidity of the aqueous humour, due to the presence of blood or of inflammatory products in the anterior chamber; and we then judge of the condition of the cornea by its smoothness and reflecting power, and by the presence or absence of vessels running upon it from the conjunctiva. On the other hand, when the cornea itself is turbid, the turbidity is at first seldom uniform over the whole surface, and the more transparent portions will often allow us to see the condition of the aqueous humour and iris.

Slight opacities of the cornea, and even foreign bodies, such as pieces of coal or iron, embedded in its surface, are liable to escape cursory observation by reason of the direction in which the light falls upon them, or because they resemble in colour the background of iris or pupil behind them. In order to obtain the best possible view of the cornea, the patient should be seated opposite a large window admitting plenty of daylight, but not exposed to the direct rays of the sun. The eye under inspection should not only be turned successively in various directions, but the surgeon should also vary his own point of view, and, in cases admitting of any doubt, should employ two convex lenses—one as a 'bull's-eye,' to concentrate light upon the parts observed, the other as a magnifier, with which to examine the illuminated surface. The same thing may often be advantageously done by lamplight, and is then called 'focal illumination.' Inspection of the cornea may show that some foreign body is embedded in it, or that its surface is more or less cloudy, or irregular in shape, or ulcerated, or marked by the cicatrices of former ulcers. It may also be the seat of circumscribed abscess, or of suppuration between its laminæ, or it may be traversed by blood-vessels, arranged sometimes as two crescents, encroaching upon its upper and lower margins, sometimes in a fasciculus running to some single point, sometimes distributed more or less evenly over its surface. All these are conditions to be carefully noted as elements in diagnosis and as guides to treatment.

Aqueous Humour.—The parts which come next under examination are the aqueous humour, the iris, the pupil, and the portion of the crystalline lens lying immediately behind it. In health, the aqueous humour is perfectly transparent; but it may be rendered turbid by the presence of early inflammatory products, of pus, or of blood. Inflammatory products may be evenly diffused throughout the fluid; but pus and blood, unless they fill the anterior chamber completely, will tend to gravitate towards its lower portion. In this position, pus may be mistaken for a purulent infiltration between the layers of the cornea itself; but such an error would

usually imply a careless inspection. The upper boundary of an infiltration is, as a rule, irregular; while that of a collection of pus, unless so small in quantity as to be rendered crescentic by cohesion to the angle between the cornea and the iris, forms an even horizontal line, which may change its position when the head is laterally inclined.

Iris and Pupil.—When the cornea and the aqueous humour are both transparent, they allow the condition of the iris and pupil to be clearly seen. The chief characteristic of the healthy iris is its lustrous striated surface; the chief characteristics of the healthy pupil are its circular outline and its free mobility. If the iris be dull or discoloured, or if the pupil be irregular in shape, or contracted, or sluggish, these are facts on which important inferences may be founded. The lustre of the iris speaks for itself, but the determination of the mobility of the pupil requires care and attention. A sluggish pupil will still dilate and contract in unison with its healthy fellow, although not to the same extent; and hence it is necessary to protect from variations of light the eye which is not being examined. For this purpose, it should be closed, and the closed lids should be covered by a towel or handkerchief, folded into a sufficient number of layers to exclude light entirely, and then applied gently but closely by the hand. The eye under examination should not be touched, but only shaded by the hand of the surgeon, so placed as to intercept light as much as possible, and then once and again quickly moved aside while the pupil is steadily watched. In a healthy eye so treated, the pupil rather slowly dilates under the shadow of the hand, and contracts much more quickly when the shadow is withdrawn. Before concluding the inspection, it is proper to direct the patient to turn the gaze alternately to some near and to some distant object; because, in the healthy state, the pupil contracts during the effort of accommodation, and dilates again, independently of illumination, as the accommodation effort is relaxed. In certain diseases of the nervous centres, this function is perverted; and the pupil which varies under light may be stationary during accommodation, or *vice versâ*. In all cases the pupil should retain a circular outline while changing; and its area, up to about the age of fifty, should be of a clear bright black. After fifty, the black is usually exchanged for a more or less grey or yellowish tint.

Under the influence of disease the iris may be dull, or visibly vascular, or studded by nodules of lymph; and the pupil may be sluggish, or altogether fixed, or irregular in outline, contracting and dilating only at certain parts of its circumference, and its area may be more or less occupied by inflammatory products. For the full determination of some of these conditions, and also in order to inspect the crystalline lens, it is often necessary to obtain dilatation of the pupil by the aid of a mydriatic; and for the purpose of mere examination, the best which can be used is a solution containing one per cent. of homatropia hydrobromate in distilled water. The advantage of this preparation is that its action passes away within twenty-four hours, and hence does not entail the same degree of inconvenience as an application of atropia or of duboisia. A single drop of the solution, placed within the lower lid by means of a quill or a camel's-hair pencil, will usually produce dilatation in from twenty to thirty minutes; and any adhesions or irregularities of outline will then be rendered conspicuous. When the pupil dilates completely, or with a near approach to completeness, it becomes possible, by the aid of focal illumination, to see deeply into the crystalline lens, and even to recognise morbid growths, or effusions of blood or lymph, lying behind it in the vitreous.

Crystalline Lens.—Opacities of the lens may generally be made out very clearly, their grey or brown colour contrasting with the natural aspect of the pupil. For the inspection of parts deeper than the iris, focal illumination is at best a method supplementary to the use of the ophthalmoscope, an instrument which is in most cases essential to a complete examination, and which will be the subject of a separate article. *See* Ophthalmoscopy. But without the ophthalmoscope it is possible for anyone, who is acquainted with the anatomy of the eye and with the elements of pathology, to discover, by careful looking and by the exercise of common sense, what is the actual condition of all the more superficial parts of the organ. *See* Cataract; Crystalline Lens.

In order to examine these superficial parts completely, it is important that the patient should be able to assist the surgeon, not only by opening the eyes freely, but also by turning them in any required direction. There are some cases in which there is so much intolerance of light that the eyes can scarcely be opened at all, and in these it is necessary to resort to special expedients. A patient of sufficient age can often show the cornea by first directing the eyes to-

wards the ground, and keeping them fixed in that direction, while the surgeon gently lifts the upper lid. With a child, if the difficulty arises as much from fear and unwillingness as from photophobia, the little patient may be made to sit on the knees of a seated attendant, and with his back turned to the surgeon, who must also be seated. The surgeon then lowers the child's body to a horizontal position, with the face upwards, and fixes the head firmly between his knees, while the attendant restrains the arms and legs. If the eyelids cannot then be sufficiently separated by the fingers, a metallic retractor may be slipped beneath the upper lid; and, if the eyeball is rolled upwards by the superior rectus, so as to conceal the cornea, a little chloroform may be administered. It is almost always better to have recourse to this expedient than to permit the nature of the affection to remain in doubt.

Tension of Eyeball.—In addition to the most careful inspection possible, it is often necessary to ascertain by palpation the degree of tension of the eyeball; since this is often of high importance and is liable to vary greatly in many diseased conditions. In order to estimate tension, the patient should be told to look downwards, closing the eyelids gently; and the surgeon should place the tips of his two forefingers just under the upper margin of the orbit, so that, through the intervening lid, they may rest upon the deepest part of the globe which is accessible. One fingertip is then employed to steady the eye, while the other, by a gentle counter-pressure exerted and relaxed alternately, ascertains the degree of hardness. Under this manipulation, a healthy eye is felt to dimple a little, with a peculiar elastic resistance which is difficult to describe, but which the sense of touch soon learns to recognise, and for which the observer may usually take one of his own eyes as an approximate standard. The thinness, and consequently greater elasticity, of the sclera in children, in women, and in delicate persons generally, renders their eyes less resisting than those of adults, of men, and of the robust; and a certain degree of hardening is not unnatural in old age. Beyond the physiological limits tension may vary from a condition in which the eyeball is quite soft, so that its shape may be visibly altered by pressure, to a condition in which it feels as hard as stone. Such extremes are at once recognisable; and differences of opinion can arise only with regard to intermediate conditions. In cases which occasion doubt, it may be remembered that, as a general rule, the tension of the two eyes of the same individual will be alike originally, unless there is a congenital difference of refraction between them; and that abnormality of tension seldom proceeds with equal steps in both. A difference between the two eyes, therefore (and a very small difference may be recognised), should always be regarded with suspicion, and should at least lead to careful and repeated examination. Increased tension is generally associated with diminished acuity of vision (*see* Visual Acuity), and also with contraction or modification of the field (*see* Perimetry), as well as by some displacement of the plane of the iris, by some sluggishness and often by dilatation of the pupil, and by diminished sensitiveness of the surface of the cornea. All these points will be fully discussed under the article Glaucoma, which see.

The diseases of the interior of the eyeball include those of the iris, of the crystalline lens, of the ciliary body and choroid, of the vitreous body, and of the optic disc and retina, all of which will be the subjects of special articles. For many of them, *see also* Ophthalmoscopy.

Panophthalmitis.—The eyeball is liable to become the seat of general inflammation in various conditions of disease or injury. General inflammation, leading on, almost invariably, to suppuration, was a not very uncommon consequence of the method of cataract-extraction by the 'flap' operation, which has now fallen into disuse, and such inflammation is seldom seen after the employment of the more modern methods of procedure. It may follow any severe injury, either a contusion or a wound or rupture of the globe, and it is an occasional consequence of general pyæmic infection. The only treatment required, generally speaking, is to relieve painful distension by free incisions through the sclera, and, if the pain be not severe, nothing need be done beyond the use of such fomentations, or other soothing applications, as may be agreeable to the feelings of the patient. Inflammation of the eyeball, apart from the conditions in which it may originate, is seldom dangerous to life, although cases are recorded in which it has led to fatal meningitis, and, therefore, when an eye has been so severely injured that general inflammation may be expected, it is often desirable to perform enucleation early—to perform, in short, a primary amputation of the damaged organ, and thus to avoid suffering and danger. An eye should never be removed when in a state of actual or

manifestly impending suppuration; and, after suppuration is completed, its removal is seldom necessary. The shrunken globe which is left behind often forms an excellent stump for an artificial eye, and seems to have no tendency to excite sympathetic mischief. On this account, Von Graefe proposed to excite suppuration artificially as a substitute for enucleation, by passing a seton through the eyeball in cases in which the conditions were such as to render sympathetic ophthalmitis probable.

The symptoms of panophthalmitis are scarcely liable to be mistaken. In the course of pyæmic infection, or after an injury, the eyeball becomes tense and hard, the lids and conjunctiva swollen, and vision is early abolished. If the cornea retains its transparency, pus may often be seen upon the iris, or in the pupil. In traumatic cases the pain is generally severe, but in those which originate in pyæmia it is little complained of. When pus or inflammatory products obtain a free outlet, either by perforation or by incision, the pain soon ceases, and, at the same time, the eyeball becomes soft, and the lid-swelling gradually subsides.

R. Brudenell Carter.

EYEBALL, Excision of the.—Enucleation of the eyeball may be required on account of injury, especially to the ciliary body, or on account of the presence of a morbid growth. When the tunics of the eye are entire the operation is extremely simple, and the writer prefers what is called the 'Vienna method' of performing it. The patient being placed under an anæsthetic, a spring speculum is inserted between the lids and opened rather widely. The surgeon incises the conjunctiva, passes a strabismus-hook beneath the tendon of the internal rectus, and divides it, with the conjunctiva, at its insertion into the sclera. Seizing the stump of the tendon with forceps, he rotates the globe outwards, and, with scissors somewhat curved on the flat, divides the optic nerve. One blade of the scissors is then kept close to the eyeball within the wound, the other being external, and the blades are made to inclose and divide, at one stroke, the superior or inferior rectus with the conjunctiva covering it. The opposite muscle is divided in a similar manner, and the eyeball is lifted out of the orbit, a last touch of the scissors separating the external rectus, and any other tissues which may remain undivided. A pad of sponge should be instantly applied over the closed lids, and retained by a firmly-applied bandage, so as to compress the skin against the margin of the orbit, and to prevent leakage of blood into the subcutaneous tissue of the face. Unless this is carefully done, there is apt to be much temporary disfigurement from ecchymosis. After about four hours the tight bandage may be removed, and the subsequent dressing will only be to afford protection and to secure cleanliness. The muscles will fall together into a stump, and the wound will heal without trouble or delay. An artificial eye may be introduced in a fortnight or three weeks after the operation.

Another, but less expeditious method, is first to divide the conjunctiva just beyond the corneal circumference, then each of the four recti muscles separately on a strabismus-hook, then the optic nerve, and lastly the obliqui muscles with any remaining tissues.

When the eyeball is ruptured it can no longer be removed with the same facility, and must be dissected out with scissors as if it were a collapsed cyst, care being taken that none of the sclera is left behind.

In cases of injury, the optic nerve should be divided close to the eyeball, but, when the eye contains a tumour of possible malignancy, the division of the nerve should be at the apex of the orbit. Some surgeons advise the ordinary division, and that the rest of the nerve should be sought for and dissected out afterwards; but complete removal together with the eye is perfectly easy of accomplishment. The scissors used for this purpose may be straight, or curved very slightly on the flat, and should have sufficient length of blade to reach easily to the apex of the orbit.

R. Brudenell Carter.

EYEBALL, Injuries of the.—Many of the injuries of the eyeball will be discussed under the heads of the structures respectively affected by them (*see* Cornea, Inflammation of the; Conjunctiva, Injuries of the; Eyelids, Injuries of the); but others are of a more general character. Severe blows, as from a fist, a cricket-ball, or the cork of a champagne or soda-water bottle, may rupture the sclera, which generally yields at its thinnest part immediately behind the insertion of one of the recti muscles, may cause extrusion of the lens and prolapse of the iris, or even such hæmorrhage from the choroid as to detach the retina. In some instances, the lens has been driven through a scleral rent without rupture of the conjunctiva, and such injuries have been followed by good recovery. They should be treated by rest and cooling local applications until all risk of acute inflammation

is over, and only when the scleral wound has had time for union should the conjunctiva be incised, and the lens removed from its new position. When the conjunctiva participates in the injury, no hope of preserving a useful eye can, generally speaking, be entertained, and it is better to perform enucleation at once than to wait for further symptoms. The same principle will apply to cases in which a foreign body, such as a shot-pellet or a piece of iron, is lodged within the eye, but the fact of such lodgment is often very difficult to determine. The writer has met with instances in which the eyeball has been struck, or even scored, by shot-pellets, which yet have not penetrated, but which have for a time totally destroyed vision by internal hæmorrhage. With a fragment of iron, the diagnosis can always be cleared up by the use of a powerful magnet, which will act upon the fragment in such a manner as to cause pain, and which may sometimes be used to extract it. With shot-pellets, the surgeon must form the best judgment he can from a careful examination of the eye and of all the circumstances of the case, and, when doubt exists, it will be most prudent to wait the course of events. When there is certainty that a foreign body has entered the eye, even if there be a chance that it has passed out at the other side and made a lodgment in the orbit, enucleation should be performed at once.

Small incised wounds of the sclera, such as may be produced by a sharp penknife, or by a splinter of glass, are seldom dangerous unless they fall into the region of the ciliary body, but they will often require a suture. The movements of the eye tend to make them gape, and the consequent leakage of vitreous humour both prevents union and produces and maintains diminished tension. Sometimes we may have direct penetration of the vitreous chamber, sometimes a small hernia of uninjured choroid through the wound. In the latter case, in applying a suture, the hernia should be replaced by a fine spatula, and held back while the needle is passed through. A small curved needle is the best implement for the purpose, armed with a thread of fine white silk. The suture should pass through the sclera on both sides of the incision, and the suture may be cut and removed in thirty-six hours or sooner.

R. Brudenell Carter.

EYELIDS, Diseases of the.—Hordeolum, or Sty, is an acute inflammation of the wall and circumfollicular tissue of a sebaceous gland associated with a ciliary follicle. The ciliary follicle may become secondarily involved, or inflammation of a ciliary follicle may provoke a sty. In all respects a sty is identical with a boil. It begins by localised pain, redness, and swelling at the edge of the lid. In a few hours the whole lid becomes œdematous, the bulbar conjunctiva becomes more or less red and swollen, and a muco-purulent discharge exudes from the palpebral fissure. At first sight the case may be mistaken for purulent ophthalmia. The edge of the lid is extremely tender, especially at a point corresponding with the focus of the disease. In a few hours suppuration takes place, the parts are then less tense, and matter presents around the lashes as well as on the anterior margin of the lid. If the case be left to itself the skin at the margin of the lid ulcerates, and the contents of the sty escape externally. The subjective symptoms then rapidly disappear, and the swelling gradually subsides. If the sty be opened the contents will be found to be a semi-globular mass of thick and tenacious pus. When the sty affects the inner angle of the lids, it may simulate a lacrymal abscess, and, indeed, it is sometimes at first impossible to make out whether the sac be implicated or not. Sties, like boils, are apt to recur.

The *causes* of a sty are general and local. The general causes are debility and depraved states of the system, anæmia, diabetes, uræmia, chronic constipation, functional derangement of the system, and indeed any or all of those conditions which precede or underlie the furunculous diathesis, &c. The local causes are irritation by dust, wind, impure air, insanitary conditions, badly-fitting spectacles, chronic conjunctivitis, ciliary blepharitis, catarrh of lacrymal sac or duct, &c.

The *pathology* is the same as that of furunculus or boil. The change probably begins as a circumglandular inflammation of a sebaceous gland. It never begins in the meshes of the tissues.

Treatment.—The local treatment may be abortive or curative. When the sty is first forming, it is often possible to arrest the inflammation by plucking the lashes from the ciliary follicles in the midst of the diseased area, so as to allow of the escape of the sero-pus that may have been exuded into or around the sebaceous and ciliary follicles. After epilation, either hot fomentations with water or a solution of belladonna extract should be used, or a solid stick of nitrate of silver, or a drop of pure carbolic acid, may be applied, or the follicle

may be touched with the actual cautery. If the process have passed this primary stage, hot fomentations, or, if suppuration have begun, poultices may be used, and incisions should be made as soon as matter has formed. When the acute inflammation has subsided, astringent compresses, such as of lead, alum, or perchloride of mercury (gr. $\frac{1}{10}$ ad ʒj.), may be employed with benefit once or twice a day, and the edges of the lids kept softened with weak mercurial ointment—either the ammoniated mercury, or the yellow oxide, or the red oxide—each of a strength of about six to ten grains to an ounce. For the general treatment *see* Boils.

Meibomian Glands. — Though these glands are embedded in the tarsus, which is of mesoblastic origin, the cellular elements of the glands are involutions of the epidermis, and, consequently, of epiblastic descent.

Chalazion, or Tarsal Tumour, is a neoplasm connected with the Meibomian glands, and not, as commonly believed, retained secretion of these glands. It partakes of the nature of a non-infecting granuloma. It seems to begin as chronic inflammation in the cellular tissue immediately around the wall of the Meibomian follicles, and as it increases in size it causes atrophy of the tarsus, and makes its way into the acini of the glands themselves. It occurs in two chief forms, one having its seat in the substance of the lid, forming a hemispherical body which may attain considerable size; the other situated at the margin of the lid around the duct of a Meibomian gland. Marginal chalazia are usually smaller and less circumscribed than those occurring in the substance of the lids. In either form it may last for months, or even for years, without undergoing much alteration in size or shape, but its tendency is to grow until at length it encroaches upon the cellular tissue and forms a swelling under the skin, or it may lead to softening and ulceration of the mucous membrane, and finally to perforation and protrusion of the growth into the conjunctival sac. Even after this it retains its vascular connexion with the lid and continues to elongate, and may project outside the palpebral aperture like a polypus. Rarely, the skin itself may ulcerate. If the chalazion grow rapidly it encroaches upon the adjacent glands, and may set up acute inflammation and suppuration in them, or the growth itself may suppurate. Occasionally it undergoes degenerative changes, or it may, rarely, disappear spontaneously.

On everting the lids, a reddish-brown or buff-coloured patch is seen on the mucous membrane, with perhaps a slight depression at the seat of the growth. It is at this point that incisions must be made for the removal.

A chalazion consists of numerous round, pale, and slightly granular cells of variable size, and usually containing a pale spherical or sphero-ovoid nucleus; it also contains many giant-cells. The cells are embedded in a pale gelatinous and slightly fibrillar matrix; and scattered throughout the mass is a network of capillaries, along the walls of which the cells of the growth congregate and collect into groups. These collections occur especially at the places where these capillaries divide.

Diagnosis.—When situated near the margin of the lid chalazion may be confounded with chronic ciliary blepharitis; and if it inflame and suppurate, it may be mistaken for acute ciliary blepharitis or for hordeolus. A diagnosis may easily be made by observing the precise seat of the greatest swelling and redness. In ciliary blepharitis and in hordeolus this is towards the free margin of the lids, and there is always more or less crusting around the lashes; whereas in inflamed chalazion, or abscess of the Meibomian glands, the redness and swelling are towards the inner margin of the lids, and the lashes are free from crusts.

Treatment.—When small, and not causing much disturbance or inconvenience, the growth may be left alone or treated by means of simple astringent and detergent applications. If large or unsightly, it is best dealt with by everting the lids and making a crucial incision at the buff-coloured spot, and then gently evacuating all the contents, either by means of pressure or by the introduction of a small scoop or curette. It is not necessary to apply any caustic afterwards with a view of destroying the wall. Incision through the skin, or excision of the growth, is seldom, if ever, advisable. For the inflammatory thickening that remains afterwards, mild astringent compresses, with a slight irritation of stimulating ointments over the skin, or a weak solution of iodine, are useful. It is well to tell the patient beforehand that after the removal of the growth the cavity fills with blood, so that immediately after the operation the swelling may even be larger than before. The blood is, however, absorbed in a few days. Marginal chalazia are more obstinate; if they irritate the eye or disfigure the lid, they may be incised vertically, and the contents broken up and

removed by means of a broad needle or a 'spud.' With a view to prevent recurrences of chalazia, all causes of irritation and congestion of the lids must, as far as practicable, be removed. Errors of refraction and disorders of accommodation should be corrected by suitable lenses placed in properly fitting frames; using the eyes under unfavourable conditions of air, or light, or position should be discontinued, and the circulation of blood and lymph through the lids stimulated by means of douches, cold compresses, and gentle frictions with some form of weak mercurial ointment.

Abscess of the Meibomian Gland is usually a suppurating chalazion, though it may be the result of inflammation around masses of retained excretion. The pus should be evacuated by incisions on the conjunctival surface. *See also* Conjunctiva, Diseases of the.

Ciliary Follicles and Eyelashes.—The eyelashes are deeply embedded at the outer edge of the free margin of the lid. They are regularly shed and reproduced throughout life. According to the researches of Moll and Donders, each eyelash has an average period of evolution of about 100 days; and Unna has shown that little buds arise from the side of the follicles, and become themselves the sheaths of new lashes. These new lashes may take a different direction from the old ones, or may push the old ones out and assume their places. It is probable that a modification of this mode of generation may induce abnormalities of position of the lashes, or set up irritation or inflammation in the ciliary follicles.

Congestion of the Ciliary Follicles. The ciliary follicles are not infrequently irritated and more or less swollen in persons having tender and delicate skin, or who have to use their eyes excessively or under unfavourable conditions, such as in crowded, ill-ventilated, ill-lighted, smoky or dusty rooms and workshops; or who wear badly fitting spectacles, or use improper lenses. Congestion of the edges of the lids, accompanied by an accumulation of fine bran-like crusts about the lashes, is a common concomitant of uncorrected errors of refraction, and especially of hypermetropia, with or without astigmatism. With this there is generally also some follicular conjunctivitis. While this form of congestion of the edges of the lids may primarily be dependent upon weak sight, it becomes in its turn a cause of asthenopia, and may by slight causes be excited into actual inflammation of the follicles.

Treatment.—The predisposing and exciting causes enumerated above must be diligently investigated and, as far as practicable, removed. Locally, mild alkaline or astringent lotions and a simple ointment, or some form of weak mercurial ointment, may be applied. In slight cases, boracic acid ointment is an elegant and agreeable application.

Blepharitis Ciliaris, or inflammation of the ciliary follicles, is perhaps the commonest of diseases of the lids. It has been called by various names, some of which have reference to the appearances which the diseased lids present, others to various views of the nature of the pathology. The following are some of the commoner synonyms:—Belpharitis marginalis, lippitudo arida, psorophthalmia, tinea tarsi, ophthalmia tarsi, blear-eye.

The disease is an inflammation of the cellular tissue in and around the walls of the ciliary follicles. It is characterised by redness and swelling, together with the formation of papules, pustules, or ulcers at the margins of the lids. It may affect only one or two follicles, or it may involve all. It presents itself in one of three modes—either acute, sub-acute, or chronic; and there are three chief varieties—the simple inflammatory, the hypertrophic, and the suppurative or ulcerative.

(1). In *simple blepharitis* there are redness and swelling of the edges of the lids, involving the area occupied by the ciliary follicles. Only a few of the follicles may be affected, but more commonly the inflammation extends along the whole margin. Thin crusts form, under which are superficial excoriations, discharging ichorous fluid or actual pus. If neglected, simple blepharitis may develop into the more severe forms.

(2). The *hypertrophic* variety is characterised by great thickening of the edges of the lids. The margins of the lids are elevated, rounded, along the whole length of the tarsal border and for about from an eighth to a sixth of an inch of its breadth, embracing, in fact, the whole follicular area. The lashes gradually fall out or change their position. Even in this form there is some ulceration of the skin around the lashes, together with the formation of thin crusts.

As the fluid and cellular elements of the inflammation become absorbed cicatrization ensues, with displacement, inwards or outwards, of the edges of the lids and probable inversion of the lashes.

(3). The *ulcerative form* occurs especially in strumous persons. The inflammation

is more intense, and of a lower type, and there is early suppuration and ulceration. Pustules and purulent crusts form at or round the base of the lashes.

Sequelæ.—The follicles may be so much damaged that they grow only ill-formed lashes, which are generally turned towards the eyeball (trichiasis); or they may be completely destroyed, so that they cease to grow lashes at all (madarosis); cicatrization may lead to eversion of the edges of the lids, and consequent displacement of the lacrymal puncta and overflowing of the tears; or it may lead to inversion of the edges of the lids and eyelashes (entropion and trichiasis); or it may induce contraction of the palpebral fissure (blepharophimosis). In some cases persistent thickening of the edges of the lid remains (tylosis).

The *Causes* are general or remote, and local: *general or remote*, struma, uterine diseases, sexual disturbances, constipation, &c. Some races seem to be especially prone to it, as the Jews. Among the *local* causes are occupations which necessitate exposure to impure atmosphere, whether the impurity be mechanical, chemical, or organic. The presence of morbid secretions of the adjoining glands may set up irritative septic changes in the ciliary follicles. Retention of fluids in the lacrymal sac and their consequent decomposition, chronic conjunctivitis, or the presence of vegetable fungi in or around the lashes, may be the exciting local causes. The disease may be, however, due primarily to errors of refraction, or to badly-fitting spectacles and *pince-nez*.

Pathology. — The disease begins by changes in the circumfollicular tissue, the follicle itself being implicated secondarily. The cells of the root-sheath and of the hair-root undergo retrogressive changes; and at length the structures at the base of the follicle may be destroyed.

Treatment.—Local: removing the hairs from the diseased follicles and the clipping off the rest facilitates the application of remedies, which should consist, in the first instance, of alkaline lotions to soften and detach the crusts and lessen the discharge, and then mild astringent compresses, such as perchloride of mercury (gr. ¼ ad f℥j.), lead, alum, zinc, &c. The skin should be protected by ointment, such as zinc, lead, or boracic acid ointment, or diluted ammoniated mercury (gr. v.–x. ad ℥j.), or Hebra's ointment. In the later stages, when all the inflammation has subsided, stimulating ointments, such as sulphur, tar, and oil of cade should be used.

The complications and concomitants of blepharitis marginalis must be treated according to the indications enumerated elsewhere.

In the hypertrophic form, repeated puncturings with a broad needle, and the subsequent application of the mitigated stick or of a strong solution of nitrate of silver (gr. xv.–xxx. ad f℥j.), may be of service. Where there is much ulceration, after the crusts have been removed, and the loose lashes pulled out and the others cut short, the exposed ulcers should be carefully painted with a solution of nitrate of silver, or a solution of perchloride of mercury (gr. ½ ad f℥j.). The lids should subsequently be bathed frequently with lead or boracic acid lotion, and ointment kept applied in the intervals.

Appropriate internal treatment should be used in addition to local remedies: cod-liver oil, arsenic, iron, quinine. The sulphides, the sulphites, and hyposulphites are among the most useful medicaments.

Trichiasis and Distichiasis.—Though each of these may occur independently of the other, they are commonly associated. By the term trichiasis is meant an irregular and disorderly growth of the eyelashes, some or all of which turn towards the eyeball; while by the term distichiasis (δίστιχος, with two rows), is meant a growth of an appreciable row of lashes within the normal row. The second row may be short and consist of only a few hairs, or it may be longer and extend along the greater portion of the edge of the lid. The lashes in trichiasis may present normal appearances, but frequently they are fine, almost colourless, and twisted, so that they may easily escape hasty observation.

These disorders are usually associated with incurvation of the lid or actual entropion, and in turn the irritation set up by the lashes increases the entropion by inducing spasm of the orbicularis.

Trichiasis and distichiasis sooner or later produce inflammation and ulceration of the cornea, which, if allowed to go on unchecked, may ultimately destroy the eye. The ulceration is often extremely obstinate, and indisposed to heal even after the primary cause of the irritation is removed.

Treatment. — Epilation always gives present ease, but it is at best a temporising expedient. More radical procedures are needed in order to secure permanent relief. The bulbs must be destroyed or excised, or transplanted. Electrolysis is the most effectual means of destroying the bulbs if only a few be affected. A needle

attached to the negative pole of a battery is passed down the follicle, while the positive pole is placed on the temple. An eschar is produced and the bulb is destroyed. Excision is more suitable when more of the follicles are implicated, and when there is neither incurvation nor entropion. The edges of the lids being fixed in a clamp to prevent bleeding, an incision about one-sixth of an inch deep is made along the edge of the lids, just within the lashes to be removed. A similar incision is made in the skin outside the lashes. The intervening lashes and bulbs are then carefully and completely removed. Should any bulb escape, as indicated by the black point at the bottom of the wound, it must be separately removed.

Transplantation is generally reserved for those cases in which the trichiasis involves the whole length of the lid. The operation most commonly practised is that originally proposed by Jaesche, or some modification of it. The lid is split along the margin between the eyelashes and the Meibomian follicles. The intramarginal incision should be about one-sixth of an inch deep, so as to extend beyond the follicles. When the row of lashes has by this means been freed, an elliptical piece of skin is removed from the surface of the lid. Sutures are then inserted, and the row of lashes drawn away from the margin of the lid. *See* also ENTROPION.

EMPHYSEMA is due to fracture of the nasal, frontal, or ethmoidal bones, with laceration of their mucous membranes. It is usually due to direct violence, though it may result from violent sneezing or blowing of the nose. After the laceration, the lids may suddenly puff up when a strong expiratory effort is made; the swelling having the peculiar crepitation so characteristic of the presence of air. As regards treatment, moderate pressure is all that is needed, and avoidance of anything like violent expiratory efforts, such as occur in blowing the nose, sneezing, or playing on a wind instrument.

Emphysema of the lids and orbit is very serious if associated with fracture of the skull.

ABSCESS OF THE LIDS declares itself by the cardinal signs of redness, heat, swelling, pain. The redness in severe cases is often extremely dusky. The bulbar conjunctiva may be injected and much swollen (chemosis). In the early stages, in addition to a general œdema of the lid there is a localised swelling, which is at first hard and tense, and often feels like a solid growth. The lids cannot be opened, and the appearances may resemble those of severe purulent ophthalmia. In a few hours softening and suppuration occur in the indurated mass. Occasionally, especially in delicate children, the distended skin may suddenly become gangrenous, and eventually is thrown off in a slough. Great cicatricial contraction may follow, with more or less eversion of the lids.

The *treatment* is that of abscess occurring in other parts of the body—hot fomentations in the early stages, poultices when pus begins to form, and evacuation of pus as soon as discovered. The incision should be made with a fine knife, and parallel with the fibres of the orbicularis muscle. A fine india-rubber drainage-tube may be inserted for a day or two, to ensure complete evacuation,

MUSCULAR AFFECTIONS. — In the lids there are two kinds of muscular fibre—the striated and the non-striated. The striated comprises the orbicularis muscle, supplied by the seventh nerve, and the elevator of the upper lid, supplied by a branch of the third nerve. The non-striated fibres, innervated by the sympathetic, are usually named after their discoverer, Müller, and are connected with the proximal borders of the two tarsi. Both sets of muscular tissue are liable to the diseases common to kindred tissues, the chief pathological states being spasm and paralysis.

ORBICULARIS MUSCLE.—*Spasm* occurs in two forms, the clonic and the tonic. (1) In the *clonic* form (nictitation), there is repeated twitching and winking of the lids. It is especially common in children who have errors of refraction. It is likewise associated with chorea, epilepsy, hysteria, or diseases dependent on central change. It may be due to overstraining of the eyes under unfavourable conditions, as bad light. In slighter forms it manifests itself as a quivering of the lid, popularly designated 'live-blood.'

(2) *Blepharospasm*, or *tonic* contraction of the orbicularis, may be intermittent or continuous, lasting from a few seconds to some hours. It is usually intermittent at first, becoming continuous later on. In some cases it is so severe, and the spasm lasts so long, as to give rise to serious inconvenience and even to jeopardise the patient's life. A person may, for instance, be run over if seized with spasm while crossing a street.

In some cases the spasm may be arrested by pressure on one or other branches of the fifth nerve, the supra-orbital, infra-

orbital, temporal, malar, or mental. These are called 'pressure points.'

Causes.—Blepharospasm may be due to injury, disease, or irritation of the fifth or of the seventh nerve, from any cause whatever. Among the former may be reckoned foreign bodies on the cornea or in the conjunctival sac, wounds or inflammation of the cornea or conjunctiva, or ulcers of the cornea, and dental disorders. Gastro-intestinal disturbances may excite it, or it may be a symptom of a general neurosis, and is especially common as associated with facial tic. It may be due likewise to intracranial affections, especially at the base of the brain; or it may be dependent on diseases of the temporal bone, or on diseases outside the skull, as abscess of the parotid gland, &c. Or it may be due to syphilitic or rheumatic inflammation.

Treatment.—The first indication is to remove or correct the predisposing and exciting causes. The continuous current, faradic current, or blisters may be applied over the 'pressure points.' In obstinate cases section or excision of a portion of the nerve at the 'pressure point' may be tried. Division of the outer canthus of the lids is sometimes of service. Morphia, belladonna, or conium may be given internally. Eserine in doses of gr. $\frac{1}{60}$ to gr. $\frac{1}{15}$ is said to be a powerful remedy in blepharospasm. Later, tonics, as arsenic, phosphorus, strychnine, quinine, bromide or phosphide of zinc, iron, cod-liver oil, &c. *See* Facial Spasm.

Paralysis of the Orbicularis.—The prominent symptom is inability to close the lids (lagophthalmos). In addition there may be the other symptoms of facial paralysis—upraising of the eyebrow, and flattening of the corresponding cheek and nostril. Partly from the inaction of the lid and partly from the displacement of the edge of the lower lid, tears cannot get into the lacrymal punctum, and consequently overflow. In sleep, and in all attempts to close the lid, the cornea rolls upwards under the cover of the lid. Otherwise, the conjunctiva and cornea are constantly exposed, and are consequently liable to injuries from dust and other foreign bodies. There may be paralysis of all the other muscles supplied by the facial nerve, while the orbicular muscle escapes. On the other hand, this muscle is rarely paralysed alone. When recovery takes place in facial paralysis the orbicular muscle is one of the first to recover. Sometimes the external rectus is implicated in paralysis of the orbicularis. In such instances the lesion is probably situated in the pons varolii, or there may be hemiplegia of the opposite side. Sometimes the auditory nerve is also involved.

The *cause* may be injury or disease of, or pressure upon, any portion of the seventh nerve in its intracranial, temporal, or extracranial course, such as lesions in the pons, hæmorrhage, softening, meningitis, diseases or fracture of the temporal bone, wounds or other injury of the nerve outside the skull, or pressure of enlarged glands, nodes, &c. Syphilis and rheumatism are among the commonest predisposing causes, and a partial paralysis of the orbicular muscle occurs in true leprosy.

Treatment.—To obviate inflammation of the cornea and conjunctiva, the lids should be protected by means of a light pad smeared with boracic acid ointment. If this do not suffice, the edges of the lids should be pared and united by sutures. In addition, the treatment must be directed against the exciting and predisposing causes.

Levator Palpebræ Superioris.—*Spasm* of this muscle is rare. When it exists the eyelids cannot be closed either voluntarily or during sleep. It may depend upon direct injury or rheumatic irritation, or on reflex irritation of the fifth nerve, or, lastly, on central disease.

In *Paralysis of the Elevator* of the upper lid the most conspicuous symptom is drooping of the upper lid (ptosis). It may occur during intra-uterine life, at birth, or at any later period. If it exist at birth it may be the result of intra-uterine disease, or it may be the result of injury during parturition. In any case the paralysis may be partial or complete. When it is partial the lid can be raised to some extent; but when it is complete the lid hangs loose and motionless, is usually smooth, and slightly œdematous.

If the elevator muscle alone be affected, the movements of the eyeball are unimpaired; but not infrequently other branches of the third nerve are involved, so that when the lid is raised the eyeball is seen to lie towards the outer canthus, and the pupil to be semi-dilated. The movements of the globe inwards, upwards, and downwards may also be limited or entirely abolished. Ptosis is occasionally recurrent, though it may attack one side at one time and the opposite side at another.

Causes may be due to disease or injury of the third nerve, or of pressure upon it, either at the nucleus in the floor of the third ventricle, at any part along the course of the nerve at the base of the brain, in the sphenoidal fissure, or within the orbit.

Syphilis or rheumatism is a common constitutional cause.

Treatment.—As far as practicable, the constitutional and local predisposing and exciting causes should be discovered and removed. Iodide of potassium should be freely administered, and the continuous or the faradic current daily applied. If voluntary power to raise the lid do not return, the question will arise whether an operation should be performed or not. The answer will depend largely upon the presence or absence of paralysis of other muscles supplied by the third nerve. If the internal, superior, or inferior rectus be incurably paralysed, it will be inadvisable to correct the drooping of the lid, inasmuch as there will remain disturbing and distressing diplopia. If, however, the eyeball muscles be intact, an operation may be done. The simplest is the excision of an elliptical-shaped piece of skin and orbicularis muscle from the upper lid, so as to shorten the upper lid and enable the frontal muscle to draw it upwards. A subcutaneous suture may be inserted, so as to form a cicatricial band, by means of which the occipito-frontalis muscle can be made to act upon the lid.

Ectropion and Entropion will be found under their respective headings.

Ankyloblepharon is the adhesion of the edges of the upper and lower lids. This may be partial or complete, and may result from disease of the edges of the lids, or (more commonly) from injury. The inner portion of the palpebral fissure is more frequently affected than the outer.

Symblepharon, or adhesion of the lid to the eyeball, is usually the result of burns by fire or chemical solids or fluids, but it may result from diphtheritic conjunctivitis. The adhesion may involve the whole extent of both lids, or it may be confined to a much smaller area; it may affect only the sclerotic portion of the globe, leaving the cornea free, or it may occupy more or less of the cornea.

Symblepharon may be complicated with ankyloblepharon.

Treatment.—If there be only a narrow band of adhesion between the lid and the globe, it may be divided by scissors or by ligature: but if the adhesion be broader, this will not suffice, and the abnormal union must be severed by a more deliberate procedure. Transplantation in some form will be required, since reunion almost invariably takes place from mere division of the adhesion.

There are several modes of dealing with symblepharon; but the management of particular cases must to a large extent be left to the skill of the surgeon. The transplantation of a portion of rabbit's conjunctiva has been recommended, and Stellwag has suggested the employment of a portion of mucous membrane from the lips or from the vagina.

A simple and effectual way of dealing with symblepharon of the lower lid is to dissect the cicatricial band from the globe, and then, by means of a suture inserted at the apex, to turn the flap downwards towards the *cul-de-sac*, and fix it there, by passing the suture through the substance of the lid and attaching the thread to a quill or piece of rubber drainage-tube. By this means the cuticular surface of the cicatricial band is turned to the globe, while the inner surface contracts adhesions to the dissected wound in the conjunctiva. J. Tweedy.

EYELIDS, Injuries of the.—The principal injuries of the eyelids are bruises, wounds, and burns.

Bruises of the eyelids are usually unimportant though disfiguring, unless they are the result of injury to the orbit or base of the skull.

Wounds of the eyelids may be incised, lacerated, contused, punctured, or poisoned. They may not only cause deformity of the lids, but may be followed by paralysis of one or other of the muscles. Even permanent blindness may supervene on wounds of the eyelids.

Incised, *lacerated*, and *contused* wounds may involve the whole thickness of the lids, or only the skin and subcutaneous tissues. If the lid be completely divided, the edges of the wound should be brought together as early as possible by means of fine sutures or a very fine harelip pin inserted close to the margin. If this is not done, the lips of the wound will gape and become everted through the action of the orbicularis. In lacerated wounds and in incised wounds whose lips have become everted, it may be necessary to pare the edges before bringing them together. In wounds involving the lower canaliculus, an opening into the lacrymal sac should be secured before bringing the lips of the wound together. Simple incised wounds only need accurate adjustment by fine silk or horsehair sutures.

Punctured wounds of the lids may be complicated by fracture of the orbital bones or by the intrusion of foreign matter into the cellular tissue of the orbit, or even into the cranium. The prognosis should be guarded, and the treatment to some extent expectant.

Poisoned wounds may be due to bites, scratches, or inoculations with virulent matter, vaccinal, syphilitic, &c.

Burns may present every degree of severity, from slight redness of the skin to complete destruction of both lids. Burns which at first may not seem very severe may, by cicatrization, lead to complete eversion of the lids. *See* Ectropion.

Adhesion of the margins of the lids (ankyloblepharon) or adhesion of the lids to the globe (symblepharon) may follow burns.

See also Conjunctiva, Injuries of the; Cornea, Inflammation of the, and more particularly *Abscess of the Lids, Ankyloblepharon, and Symblepharon* under Eyelids' Diseases of the; Ectropion. J. Tweedy.

F

FACE, Fracture of Bones of the.—In extensive injuries lines of fracture may traverse the facial bones in various directions. The fractures are often compound and comminuted, or depressed. In some cases the whole framework of the face has been separated from the skull as far back as the sphenoid. Hæmorrhage, at first copious, soon ceases. The accompanying wound must be thoroughly syringed with carbolic lotion (1 in 40); adjustment must be accomplished either by the fingers or by elevators; no fragment should be removed unless completely detached and loose; drainage, when necessary, must be provided for; and the soft parts must be very accurately brought together by fine sutures. Some surgeons cover the edges of the wound with collodion. Swelling may be limited by ice or evaporating lotions.

Serum must not be allowed to collect; to evacuate it, the edges of the wound should be separated by a director gently introduced. Union occurs very rapidly, but the opportunity of removing any remaining displacement must be carefully watched for as swelling subsides. When the fracture extends into the mouth, frequent syringing with Condy's fluid should be employed. The fragment may sometimes with advantage be wired together or supported by vulcanite plates, now so skilfully made by dental surgeons.

Nasal Bones. — Fracture is due to direct, often to great, violence. The fracture is generally towards the lower edge of the bones, often transverse and depressed, or the sutures may be opened. There is frequently, also, fracture of the nasal processes of the superior maxillæ, or of the lacrymals. The nasal bones have been driven up so as to fracture the cribriform plate of the ethmoid, and lead to injury of the brain. The septum may be fractured or deflected. It may, if swelling have ensued, be difficult to reduce, or even to detect, the fracture. Ice will tend to diminish œdema and check bleeding, which may be troublesome. If examination is resisted, or the patient is nervous, an anæsthetic may be given. Necrosis may result, but it is rare. For replacement, a stiff director or a pair of closed dressing-forceps may be introduced into the nose, while the fingers are used externally. The fragments will often remain in position. If not, it is better to replace them when they slip, than to introduce plugs. In a day or two they will, as repair advances very rapidly, become fixed. It has been suggested that a hare-lip pin should be passed transversely under the fragments to support them. In cases otherwise intractable this method may be tried; a very fine drill, however, must be used, and care must be taken not to disfigure the skin. Erichsen suggests an india-rubber bag distended after introduction, as used for epistaxis; Hamilton, small pledgets of medicated wool, supplied with numbered strings, so that they may be removed in the order of introduction. Should deformity remain, Adams advises the forcible adjustment of the bones by strong smooth-bladed forceps, and the use of a screw clamp—one blade in each nostril—to support the septum. This method may be tried in even old fractures in which there is marked deformity.

Superior Maxilla.—This bone may be fractured, but only by great violence, through either its nasal or alveolar process, the antrum may be driven in or the bone may be extensively comminuted. The intermaxillary or other sutures are sometimes opened. These fractures are often compound, and attended with profuse hæmorrhage, or associated with serious injuries of the brain, and a guarded prognosis should therefore be given. Subcutaneous emphysema is often observed, which, however, soon disappears.

Treatment.—Displacement must, if possible, be at once corrected, for even slight irregularity may produce great disfigurement.

Hamilton suggests that an elevator with a cutting thread may be screwed into any depressed fragment in order to raise it. When the alveolar process is fractured, the fragments may be steadied by wiring together the adjacent teeth.

Malar Bone.—Fracture of this bone is very rare, and is produced only by great violence. It is almost invariably associated with fracture of the upper jaw or other facial bones. If, in comminuted fracture, fragments are driven into the temporal muscle, they should be removed. Displacement, if considerable (it is usually slight), should be corrected, a small incision being, if necessary, made for the passage of an elevator. Fragments once replaced will usually remain in position.

Zygoma.—Fractures of this process are very rare. They occur (*a*) from direct violence; (*b*) in association with fracture of the malar or superior maxillary bones; or (*c*) when a foreign body is thrust outwards through the mouth. Displacement is usually slight, as the surrounding bony structures steady the fragments. If depression is marked, so as to interfere with the temporal muscle, a small incision may be made, through which to introduce an elevator. The accident has been followed by stiffness of the jaw. The injury which fractures the zygoma may produce concussion of the brain. These cases therefore require close watching. Howard Marsh.

FACIAL ARTERY, The.—A branch of the external carotid, commences opposite the angle of the jaw and dips underneath the digastric and stylohyoid muscles to reach the submaxillary gland, from which it ascends over the lower jaw, two fingers' breadths in front of the angle. The artery then passes about three-quarters of an inch from the angle of the mouth up towards the nose and the inner angle of the orbit, where it ends.

Ligation.—The artery is tied, usually, as it crosses the jaw. Place the patient on the back, with a pillow below the neck; maintain the head at right angles to the neck, with the face looking towards the opposite side. Make an incision over the artery, the vessel being found, as stated above, two fingers' breadths in front of the angle, where it lies on the bone at the anterior border of the masseter muscle. The pulsations, however, are the best guide. The incision, one inch long, divides the skin, superficial fascia, platysma, infra-maxillary branch of the facial nerve, and the deep fascia. The artery is found lying on the bone, with the vein posterior to it. Pass the needle from behind forwards.

James Cantlie.

FACIAL CARBUNCLE. *See* Carbuncle.

FACIAL PALSY.—Paralysis of the muscles supplied by the facial nerve is a condition which occasionally comes under the notice of the surgeon. It may depend on a variety of causes:—first, central, including injuries or tumours of that part of the brain in which the cortical centres governing the muscles of the face are situated, or any other part through which the fibres are passing from this region to the facial nerve. Under this heading are also included the various general paralytic conditions which depend upon hæmorrhages, softening, and other causes, and belong more properly to the province of the physician. Secondly, intracranial tumours pressing upon the facial nerve in its course from the brain to the internal auditory meatus. Thirdly, injury to the nerve in its course through the temporal bone. This may arise from fracture of the skull, and may set in immediately after the accident, or at a subsequent period when the nerve is pressed upon by the new material thrown out in the course of repair of the bone. It should be borne in mind that the temporal bone may be broken without involving a genuine fracture of the skull. The more common cause of damage to the facial nerve in the bone is, however, the existence of suppuration in the middle ear and consequent invasion of the aqueductus fallopii. This condition is sometimes met with in the adult, and not very infrequently in children it is one of the causes of that very distressing condition, double facial palsy. Fourthly, damage to the nerve after it has left the stylo-mastoid foramen. This may arise simply from exposure to cold, or from accidental or intentional wounds of the face, the latter including division of the nerve, or of some part of it, in the course of the removal of tumours, the opening of abscesses, operations on the lower jaw, and other surgical procedures.

The characteristic appearance of a patient with facial paralysis need not be here described, but one sequela must be mentioned. The eyelids can, of course, be only imperfectly closed, though some slight movement of the upper lid usually, if not always, remains; the patient is thus obliged to effect the purposes of winking by turning the eye upwards, and an occasional result

of the inadequate cleansing of the surface of the eyeball is the onset of conjunctivitis; and if the fifth nerve be also paralysed so that sensation is abolished, sloughing of the cornea may result. To prevent this, it is sometimes necessary or advisable to stitch the margins of the lids together, after paring them, leaving only a small aperture in the centre of the ocular slit for vision, or the lids may be fastened together by a strip of plaster or other means.

No surgical treatment can be carried out for facial palsy beyond the application of blisters over the course of the nerve, with the object of accelerating the cure of the simple 'rheumatic' or peripheral variety. It is conceivable that cases may arise in which it might be possible to stitch together the ends of the divided nerve, but it is not known that this method has ever been put in practice.

RICKMAN JOHN GODLEE.

FACIAL SPASM (Tic Convulsif).—Spasm of the facial muscles varies very much in degree, and no doubt also very much in its cause. The simplest forms are such as the mild and transient twitching of the orbicularis palpebrarum, which is often associated with, and probably dependent upon, rectal irritation, or some other trivial cause; or the slight jerking of the corner of the mouth, or winking of the eyelid, which is apparently little more than a habit or trick which has become second nature. The most severe form is that in which all the muscles of one side, or of the whole face, are in a perpetual state of involuntary movement; the movements, though for the most part painless, being a source of intense and wearying annoyance to the patient, and sometimes only intermitting during sleep. Between these two extremes all sorts of varieties are met with.

As to causation but little can be said. Some are apparently what may be indefinitely called hysterical affections; some appear to depend upon reflex irritation, such as the presence of carious teeth, or the existence of wax, or other mischief in the ear, or of some disease of the eye; others, again, depend undoubtedly upon some cerebral lesion, though we are without data as to the nature of the lesion, and *a fortiori* as to its seat, but it may be assumed to be in some cases cortical and in others central. In one case, in which a post-mortem examination was made, an aneurism of the basilar artery pressing upon the facial nerve was found, but this can only be looked upon as a pathological curiosity.

In many cases the spasm is made worse by excitement, impairment of the general health, and exposure to the influence of cold winds or bright lights, while it is allayed by the opposite conditions; and in most, if not in all, the amount of twitching varies from time to time. In a severe case, affecting both sides, the eyes may be so completely closed at times that the patient is unable to see, while his head is being constantly bent forwards by the powerful contractions of the platysmata, and the angles of the mouth are being frequently drawn downwards and outwards into an ever-varying 'risus sardonicus.' Many cases are accompanied by painful affections of one or more branches of the fifth nerve.

Spasm of the facial muscles occurs in the course of other more general convulsive diseases; but these lie outside of the present subject. Closely related to 'tic convulsif' is the condition known as spasmodic torticollis, in which the spinal accessory nerve is sometimes apparently alone affected, though often a whole physiological group of muscles is affected by the movements, some being on one side of the body and some on the other—a sternomastoid, for example, acting with the opposite splenius.

The treatment of facial spasm involves a careful inquiry into the general health, and a minute search for, and, if practicable, removal of, all sources of possible reflex irritation. Galvanism appears to have been useful in a certain number of cases; and many others have in time disappeared spontaneously, not infrequently after they have resisted all known methods of treatment. The question of stretching the facial nerve has been carefully considered and several times put in practice; it appeared at one time to produce very encouraging results, for almost all the earlier cases were described as being relieved or cured. The reports were, however, published too soon. The writer, who has performed the operation on two patients, collected the statistics of all the cases published up to June, 1883, which showed that, in all but one, recurrence of the disease had taken place, although several patients had experienced a more or less prolonged relief from the troublesome symptoms. In one of his own patients the twitching returned some months after the operation, but a spontaneous cure subsequently occurred.

If the operation be decided upon, a curved incision should be made immediately below the attachment of the lobule of the ear, and another from the centre of this downwards for two inches along the edge of the sternomastoid; the parotid gland is then to be

separated from the sterno-mastoid, and the latter drawn back with a hook till the posterior belly of the digastric appears. Immediately above the upper border of this muscle the nerve may be easily found in its short course between the stylo-mastoid foramen and the gland. It is then to be forcibly stretched over a hook. This method of stretching a small nerve, like the facial, is a totally different process from that of pulling a large nerve, like the sciatic, out of its bed with the finger. It involves a partial destruction of the nerve at the point stretched, and a consequent total paralysis of the nerve beyond; but it also involves the certainty of the re-establishment of the conducting power of the nerve. While the nerve is paralysed the twitching is, of course, in abeyance, but in the course of from six weeks to three months the nerve regains its function, and at a variable time after this has occurred, in most cases in which the treatment has been adopted, the spasm has gradually redeveloped itself.

The patient may have six months' respite, or even longer, and in recommending the operation this must be put before him, as well as the fact that only one case, at the present time, remains, so far as is known, cured. The only other available surgical treatment is the division of the nerve; this unquestionably relieves the patient of his trouble for ever, but substitutes the not insignificant inconvenience of permanent facial palsy, and deprives him of the possible chance of a spontaneous cure.

RICKMAN JOHN GODLEE.

FÆCAL ABSCESS and FÆCAL FISTULA.—A fæcal abscess is one which communicates with the interior of the intestine. The pus from such an abscess will have a fæcal odour and contain fæcal matter. Pus from an abscess may have a distinctly fæcal smell, without being in communication with the intestine, without being, in fact, according to the above definition, a fæcal abscess. Thus, suppurative collections which are in close contact with the intestine, and especially with the colon, often acquire a most offensive fæculent odour, although they have at no time communicated with the gut, and contain no fæcal matter.

Fæcal abscesses form, as a rule, in one of two ways. By one method an abscess develops outside a normal segment of the bowel. In process of time it makes its way through the wall of the bowel, pus enters the gut, and fæcal matter the suppurating cavity. Thus perinephritic and iliac abscesses, purulent collections following pelvic cellulitis, and even abscesses arising from caries of the spine, have opened up some part of the ascending or descending colon, or of the cæcum. In the other class of case the bowel is perforated as a result of ulceration, gangrene or wound, the perforation is behind the peritoneum, the intestinal contents escape into the subserous tissue, and an abscess is set up. The perforation may in some cases be upon the peritoneal aspect of the bowel, and the extravasation be limited by extensive peritoneal adhesions.

The second form of fæcal abscess is the more common of the two. It is most frequently met with in the vicinity of the cæcum, as a result of ulceration of the cæcum or appendix, or of typhlitis. Foreign bodies which have become impacted in the bowel are not infrequently discharged by means of a fæcal abscess.

The fæcal abscess is apt to spread and produce grave symptoms. It may burrow among the abdominal muscles or extend down into the pelvis. It may open through the skin, or in rarer instances into the bladder or vagina, or even into some remote part of the intestinal canal. There is, therefore, scarcely any form of abscess which requires more active treatment, and which demands more early incision. The moment the condition is diagnosed, the suppurating collection should be evacuated by the freest possible incision, and the abscess-cavity well washed out with some antiseptic solution. The condition usually passes on to that of fæcal fistula.

The term *Fæcal Fistula* is applied to a fistula that communicates with the cavity of the bowel on the one hand, and with the integumentary surface of the body on the other. The species of abnormal opening to which this term is limited, and the arbitrary distinctions established between fæcal fistula and artificial anus, are alluded to in the account of the last-named condition.

A fæcal fistula is most usually the result of a fæcal abscess which has effected an opening through the integument. It may, however, result directly from deep, penetrating wounds and gunshot injuries, which have produced an opening in the bowel at some distance from the surface of the body. In the present form of fistula, the bowel opens indirectly upon the surface. A fistulous track intervenes between the hole in the intestine and the hole in the skin. This track is usually narrow, and is very often tortuous and most irregular. It may be interrupted by a large abscess-cavity which contains both fæcal matter and pus, and

discharges both at its integumentary orifice. To fistulæ which present conspicuously this mixed discharge, the term 'sterco-purulent' has been applied.

As a rule there is only one aperture in the skin, although there may be several openings into the gut. The amount of fæcal discharge varies, and is usually comparatively slight.

The serious element in the prognosis of fæcal fistula depends, not so much upon the premature discharge of the intestinal contents, as upon the fistulous track or abscess-cavity which intervenes between the involved bowel and the skin. The patient may die from exhaustion following the prolonged suppuration from the cavity of the abscess. The pus may burrow, may greatly undermine the skin, may penetrate between the layers of the abdominal muscles, may enter the pelvis, and may in this way produce an extensive area of inflammatory disease which in time exhausts the patient's strength. The pus in such cases is necessarily very foul, and erysipelas and pyæmia are not uncommon sequelæ of the condition.

The general treatment of examples of fæcal fistula consists in supporting the patient's strength, in keeping the bowels in good order so that their action is not too sluggish on the one hand nor too vigorous on the other, and in enjoining a careful diet composed of the most digestible forms of food.

As regards local treatment, the first and most important consideration is to provide a free discharge for all pus and fœtid accumulations. When an abscess-cavity exists, it should be very freely opened up, and thoroughly washed out with an antiseptic solution. It should be very frequently irrigated so that no matter be allowed to collect, and some antiseptic substance, such as iodoform or salicylic acid, should be kept constantly applied to the abscess-wall. When the escape of fæcal matter is slight, the cavity may be plugged by a material which will absorb the discharge as it escapes, while it will exercise at the same time an antiseptic effect upon the lining membrane of the cavity. For this purpose a sponge may be used, which—when dry—has been well impregnated with iodoform powder or salicylic acid. The sponge, or such other material as is used, must be very frequently withdrawn and replaced by a clean plug. Wood-wool will answer the purpose, or 'tenax,' or absorbent cotton-wool. Fistulous tracks should be opened up when possible, or dilated with a laminaria tent, or cut through with the elastic ligature when the knife seems inadmissible.

FREDERICK TREVES.

FÆCAL RETENTION. *See* INTESTINAL OBSTRUCTION.

FALLOPIAN TUBES, Diseases of the.—The Fallopian tubes are liable to stricture, to accumulation of serum (hydro-salpinx), of pus (pyosalpinx), or of blood (hæmato-salpinx), and to papillomatous disease of their lining membrane.

Stricture may arise from metritis, endometritis, or implantation of the placenta over the uterine end of the tube. It may merely cause obliteration of the uterine outlet, or it may close the tube at both extremities, and serum, pus, or blood accumulating in the tube, either of the three conditions named above may result. Gonorrhœa is said to be the commonest cause of pyosalpinx. Papilloma may either grow in an open tube, projecting into the peritoneum and setting up ascites, or it may grow in a tube already closed by inflammation. In the latter case a tumour will be formed, very difficult or impossible to diagnose from hydro- pyo- or hæmato-salpinx, or from tubal pregnancy.

A small hydro-salpinx is occasionally met with in performing ovariotomy. It may give rise to pain from spasmodic contractions of the tube, but more often gives rise to no symptoms, and is cured by reabsorption of the fluid, or by its escape either into the uterus or peritoneum. More rarely a tumour of considerable size is formed, and it may then be recognised as a sausage-like swelling in the pelvis, or as a cyst rising into the abdomen. In such a case its removal by abdominal section is justifiable.

Pyo-salpinx is a more serious condition, but is frequently cured spontaneously, by discharge of its contents through the uterus. It may, however, rupture into the peritoneum, and this is a very grave accident, and likely to cause fatal purulent peritonitis. A large pyo-salpinx may be diagnosed and removed in the same way as a hydro-salpinx; and the same rules apply to hæmato-salpinx or a papillomatous tube. It is impossible to formulate any rules for the differential diagnosis of these various pathological conditions.

Salpingotomy, the operation for their removal, differs but little from the operation of ovariotomy, and reference should be made to the full description given of that operation, for position of patient, instruments necessary, &c. *See* OVARIOTOMY.

It may be impossible to remove the distended tubes without some of their contents being spilt into the peritoneum; and, whenever this happens, the most careful and thorough sponging is necessary, for we can never be sure that the contents do not contain the causes of putrefaction. If it be a clear limpid fluid from a hydro-salpinx, careful sponging alone is necessary; but if pus or blood be spilt it will be advisable to introduce a Keith's glass tube. It is sometimes impossible to cut the uterine end of the tube through the strictured part, and a portion of the previously distended tube is left in the stump. When this happens, this portion of the tube should be thoroughly disinfected with pure tincture of iodine, and a drainage-tube should be used.

In most cases the ovaries are also diseased, or are so matted to the tubes by adhesions that their separation from them is impossible; but in other cases they are quite healthy and free, and may be left behind; the patient then continues to menstruate regularly, and suffers no inconvenience from the rupture of the follicles into the peritoneum. It is possible that in such a case the uterine stump of the tube might become patent again, and extra-uterine fœtation result; but this is very improbable, as the stump is usually very completely closed by the peritoneum growing over its raw surface. J. Knowsley Thornton.

FALSE JOINT. *See* Ununited Fracture.

FARCY. *See* Glanders.

FASCIA, PALMAR, Contraction of the. *See* Dupuytren's Contraction.

FASCIA, PLANTAR, Contraction of the. *See* Plantar Fascia, Contraction of the.

FAT-EMBOLISM.— The accumulation of fluid fat in the capillaries, consequent on extensive laceration of adipose tissue.

Causes and Pathology.—The process may be induced by any injury involving laceration of adipose tissue, its occurrence being favoured by increased tension in the region of the injury, and the presence of open vessels for the absorption of the free oil-globules. The latter enter the circulation chiefly by the blood-vessels, in part by the lymphatic system. The most favourable conditions for fat-embolism are presented in injuries to bone, the laceration of the medulla setting free large quantities of fluid fat, while the vessels are held open by their connections with the bony walls containing them. The tension consequent on blood-extravasation is another factor in its production, but not a necessary one, since the process frequently takes place in open fractures, and has been noticed in excisions and amputations. Fat-embolism is not uncommon after rupture of the liver or extensive subcutaneous injuries. It also occurs in acute osteo-myelitis, and is present in cases of diabetic coma. The fat collects in largest quantity in the pulmonary capillaries, to a lesser degree in the other organs. The fatal issue has been ascribed to the pulmonary obstruction alone, or regarded as due to the cerebral disturbance due to obstruction of the capillaries of the brain. The latter cannot be the cause of death in all cases, since in many the demonstration of extensive fat-embolism in the brain has not succeeded. Fat-embolism, in varying extent, seems to follow all fractures of bone, serious symptoms occurring in few cases only. Excretion of the fat is said to be effected by the kidneys. This does not commence at once, fat being usually not demonstrable in the urine prior to the third day, and then it does not proceed continuously, but often on two or three occasions with intervals of several days.

Symptoms.—The symptoms closely resemble those of collapse, accompanied by signs of acute pulmonary œdema. Their advent generally commences after the first twenty-four hours, usually after the patient has recovered from the primary shock of the accident. They consist in pallor, often with cyanosed lips, general muscular weakness, lowering of the bodily temperature, slow weak pulse, gradually becoming imperceptible, and respiratory embarrassment. In some cases extreme dyspnœa is observed, in others the shallow nature of the respiration is its chief peculiarity. General moist râles are to be heard throughout the chest; bloody expectoration has been noted. When the patient survives some days, oil-globules may be detected in the urine.

Diagnosis.—This may need to be made from shock, and from pulmonary embolism of the ordinary nature. In both, the period of occurrence is of importance, an interval usually intervening between the accident and signs of fatty embolism, while embolism from detachment of part of a venous thrombus is usually a much later complication than fat-embolism. The presence of oil-globules in the urine may be a useful diagnostic aid.

Prognosis. — This depends chiefly on the intensity and persistence of the symp-

toms; patients readily recover from the slighter degrees.

Treatment.—No specific treatment has been discovered. The ordinary treatment of shock may be supplemented by artificial respiration. G. H. Makins.

FATTY DEGENERATION is a pathological change which protoplasm may undergo, resulting in its conversion into fat.

Pathology.—It is well known from very many examples, which need not be repeated here but may be found shortly tabulated in text-books of physiology, that in the healthy body fat is continually being manufactured, as it were, by special corpuscles from the albumin and fat in the blood. Further, there is a great deal of evidence to show that fat as such is simply produced by metamorphosis of the proteid protoplasm of many corpuscles. It is this metamorphosis which reaches such a height in disease, and which then goes by the name of *fatty degeneration.*

Passing notice must here be devoted to the term *fatty infiltration.* By this expression two things are commonly understood—firstly, that corpuscles take up small globules of fat, as such, so that their protoplasm becomes crowded with fat-droplets; and, secondly, that the proper tissue-elements of a part are separated and pressed upon by ingrowth between them of adipose tissue. The latter of these conditions can be put aside at once, as foreign to the present subject; but true fatty infiltration, as contrasted with fatty degeneration, claims immediate attention. As described below, when we find an organ so fatty, by reason of its cells containing quantities of fat-particles, as justly to be considered pathologically altered, it is obviously an open question whether the protoplasm of the corpuscles is simply laden with accumulated fat brought to it as such (or in some preliminary form), or whether the proteid protoplasm is being converted into fat-droplets. Fatty infiltration, therefore, might be better termed fatty accumulation, and, accepting this view, we may examine the possible sources of the fat which a tissue may contain.

Accumulation.—(*a*) From fatty food; (*b*) from proteid food, e.g. the secretion of milk on flesh diet; (*c*) from carbohydrates.

Degeneration.— (*d*) from proteid protoplasm.

We need not here refer at further length to fatty accumulation, except to point out that this extremely simple process may be supposed to go on most readily in the liver and heart, which organs are most favourably placed for first receiving blood containing fat, as such, in a particulate state; and, further, that this clogging of the tissue-elements will tend to occur in those persons in whom oxidation-processes are sluggish and who lead an enervating life.

After these prefatory remarks, the causation of true fatty degeneration of protoplasm may now be discussed.

Etiology and Causation.—Fatty degeneration is now looked upon as a splitting of the proteid molecule into two unequal parts—one nitrogenous, and the other non-nitrogenous; thus:—

Proteid—*Nitrogenous*: terminating by further disintegration in *urea*, &c. *Non-nitrogenous*: terminating by further disintegration in fatty acids, &c.

An extreme instance of this disintegration is found in the formation of adipocere, or corpse-wax, as the Germans call it, which, according to Hoppe-Seyler, is simply a mixture of calcic palmitate and calcic stearate—the non-nitrogenous side of the protoplasmic proteid, the nitrogenous bodies having been mainly given off as compound ammonias. It is a similar change which is produced in the body as a result of disease, under circumstances to be mentioned immediately, and in which case the urea excreted by the kidneys is found experimentally to be greatly increased.

This state of things is produced most easily by poisoning with phosphorus, alcohol, arsenic, bismuth, antimony, chloroform, ether, iodoform, carbonic oxide, chromic acid, sulphuric acid, and nitric acid; by the action of febrile pyrexia, or the poison causing the same; by (experimental) continued exposure to a heated atmosphere; and as a consequence of many cachectic states, and more especially the condition produced by pernicious anæmia, and that which leads to acute atrophy of the liver. It will be seen at once that these reagents, and poisons of uncertain nature, all act powerfully on the blood-corpuscles; and it has been assumed, with some show of reason, that they owe their power of producing this lesion to their destructive influence on the red-blood corpuscles. Whether this be so or not, there can be no doubt that one factor in the disintegration of the protoplasm of the affected tissue is defective oxidation. The *rôle* played by oxidation in reducing fatty accumulation is of course obvious, and for the reason just given it is probable that the lack of the same process causes the fatty metamorphosis of originally

healthy corpuscles. At the same time it is to be remembered that in many instances where fatty degeneration follows the cutting off of the blood-supply to the part the loss is not only of the oxygen-carriers, but also of all the nutritive constituents of the blood. Moreover, fatty degeneration follows on loss of function simply, and where the oxidation and circulatory processes are not directly interfered with. Such instances are fatty degeneration of muscles which move joints that have become ankylosed, and others whose motor nerve has been injured.

Pathological Anatomy.—Macroscopically, the part affected is usually enlarged, with a smooth surface, and rounded outline; it is soft, cutting easily and smoothly, may be greasy to the feel, and smears the blade of the knife. Although the specific gravity is frequently very much reduced, still the defective oxidation, &c., leads to the accumulation of so many waste products that the organ is usually heavier than normal. The colour, pale in early stages, becomes gradually more and more yellow, until in a severe case it is of a bright yellow tint, which in some instances, such as in extreme cirrhosis, becomes orange. In a very advanced state the organ may have a nauseous oily odour.

Microscopically, the corpuscles of the organ or tissue affected are found to be slightly swollen and excessively granular. The granules are of various sizes and brightly refracting. In many corpuscles small oil-globules may have already formed, and, as such degenerated corpuscles frequently rupture in the preparation of specimens, the fatty particles and globules will be found effused into the surrounding tissues. The so-called compound granular corpuscles of Gluge are nothing more than collections of such fat-particles, and occur most frequently in the nerve-centres.

Virchow attempted to lay down, as a means of microscopical diagnosis, the dictum that when the fat was visible as fine granules it was the product of fatty degeneration or metamorphosis; but that when it was present in comparatively large droplets, it was then a result of accumulation or infiltration. This distinction, although partly true, is by no means absolutely so, since in many cases of acute fatty change from poisoning, and in the acute fatty degeneration of new-born infants (probably the result of a septic poison), the result is seen as large oily droplets in the corpuscles.

The subsequent changes in such an affected tissue are simply those of disintegration. Fatty degeneration, when it is a result of cutting off of the blood-supply to a part, assumes the special form known as caseation, and as such occurs frequently in infarcts, tubercular nodules, chronic abscesses, &c. In this condition of things the protoplasm of the corpuscles affected becomes cloudy and coarsely granular; the elements then fuse together so as to form an amorphous mass, which is of a dirty pale yellow colour, usually soft and pulpy, sometimes hard and tough from the coincident development of fibrous tissue in the part affected, and sometimes calcified.

Fatty degeneration may be best detected by examination of the fresh unstained tissue (1) in water, (2) in glycerine, when the fat-droplets show strongly by being highly refracting; (3) by treating the tissue with ether, when the fat particles are dissolved out, and (4) by prolonged staining with osmic acid, 1 p.c., and subsequent immersion for twenty-four hours in equal parts of alcohol and water; weak solutions of osmic acid are often powerless.

Symptomatology.—The symptoms of fatty degeneration are of importance to the practical surgeon in two ways, especially (1) as to a patient being in a fit state to undergo an operation; and (2) a patient's ability to take an anæsthetic. The symptoms of this condition will be best grouped under the headings of the different organs specially liable to be affected, and which possess the most practical bearing on the above points.

Heart.—A fatty heart is known by a tendency to, or actual attacks of, syncope; breathlessness on exertion; and occasional attacks of dyspnœa if the health be depressed in other ways. The pulse is usually feeble in severe cases, irregular, and easily quickened; and similar evidence is afforded by physical examination, which shows a weak impulse, and at the same time the heart's sounds are distant and indistinct.

Liver.—The organ is enlarged and may cause breathlessness mechanically, constipation of a mild and irregular degree, pale stools, anorexia, and in extreme cases dyspepsia.

Kidney.—Although an important condition, the fatty degeneration of this organ presents few special symptoms beyond diminution in the excretion of urine, and occasionally fatty débris in that fluid; so that diagnosis must rest upon the signs of a similar change in other organs of the body.

Prognosis.—Unfavourable, according to the progress of the degeneration.

Treatment must clearly be directed to the two points of (1) ensuring oxidation of the tissues without overwork and exhaustion, and (2) encouraging activity of visceral function and aiding excretion of all waste-products. The first can be obtained by prolonged moderate exercise in the open air, by the sea or on moors, &c., by driving, and possibly by the compressed air bath; while the second can only be reached by administering ordinary tonics, such as iron and quinine, &c., while the action of the different organs (especially the skin) and the activity of the circulation can be encouraged by the very moderate use of Turkish or vapour baths, coupled with gentle, prolonged shampooing, graduated to the strength of the patient, so as not to cause fatigue. But the best therapeutical agency, no doubt, is out-of-door life and very moderate exercise. VICTOR HORSLEY.

FATTY TUMOURS. *See* LIPOMA.

FAVUS (Tinea Favosa).—*Definition.* A contagious chronic disease of the skin caused by the growth of a fungus.

Symptoms.—Among the several skin-diseases produced by a fungus, favus is the most severe, by reason of the length of time it lasts and the great amount of permanent damage done to the skin. All regions of the body are subject to attack, but especially the scalp. Like ringworm, favus shows itself first as a small erythematous spot, which gradually spreads in the form of a ring, and in a few days becomes covered with crusts which almost immediately assume the characteristic cup-shaped form. In these early stages there is some itching, but this gradually subsides. When the disease attacks the head, the few hairs that pierce the cup will become dull in appearance and easily fall out. The cups themselves are yellow or sulphur-coloured, and, if the eruption is at all extensive or of long duration, emit a mouse-like odour which is one of the distinctive features of the disease. They are more or less firmly attached to the skin, and are difficult to remove, and leave pits. In long-standing cases the pressure of the cups causes atrophy of the skin, so that it is not uncommon for favus of the head to produce complete baldness, and the hair, once destroyed in this way, does not usually grow again. The cups vary in size from that of a pin's head to that of a split bean. On removal they will be found to be very brittle and dry, breaking up into powder, which, when placed under the microscope, is seen to be largely made up of fungus. Sometimes there is suppuration round the crusts, the dried pus mixing with the cups and altering their appearance. The disease, which usually attacks the poorer classes, is rare in England and the United States, common on the Continent, and also in Scotland, though not so common as it was formerly. It is contagious, but not so much so as ringworm, and has been known to be communicated by mice, dogs, and cats.

Diagnosis.—In the early stage favus may be mistaken for either simple erythema or ringworm; but when the crusts form the diagnosis is easy. It may also be distinguished from eczema and psoriasis by the cup-shape and yellowness of the crusts, and by the fungus found on microscopical examination. Favus of the scalp may also be erroneously taken for eczema, psoriasis, seborrhœa, contagious impetigo, pustular syphilide, or tinea tonsurans; but there are many points of difference. In eczema the surface is often moist; the redness shades off into healthy skin; the scabs are not cup-shaped or yellow; the hair often falls out, but it does not lose its lustre and permanent baldness is never produced; and, lastly, eczema is not contagious. Psoriasis, again, is distinguishable by the silvery whiteness of the scales, by the fact that the disease usually attacks other parts of the body, such as the tips of the elbows and fronts of the knees, and when the head is the part assailed the hairs are but slightly affected. In seborrhœa oleosa the crusts are more or less oily; the hairs fall out, but there is no fungus. In seborrhœa sicca the light yellow crusts do not form cups, and have not the peculiar odour of favus, and there is no fungus. Contagious impetigo has many characteristics in common with favus; but the scabs are not cup-shaped, nor do they contain fungus. Pustular syphilide, occurring early, may be diagnosed by the presence of other symptoms —sore-throat, &c.—and the mixed character of the eruption; rupia by the ulceration seen on removal of the crusts and by their conical shape. In ringworm of the scalp the different appearance of the fungus and the short, broken condition of the hairs, form a sufficiently clear distinction. In the later stages, when the hair has been destroyed, favus may be mistaken for alopecia areata and lupus erythematosus; in the former of these, however, the hair falls out, leaving smooth, bald patches, without scar; while the latter is usually seen on the face as well as on the head, and there is moreover on the margin of the scar the characteristic red appearance, and the seba-

ceous plugs can be extracted from the follicles.

Pathology.—When examined under the microscope the cups are seen to be composed almost entirely of fungus, called after the discoverer, Achorion Schoenleinii. The mycelium or threads are made up of ovoidal segments containing granules; the spores are large as compared with ringworm.

Treatment.—Most authorities in the countries in which favus is common lay great stress on constitutional treatment, particularly change of air to dry localities, good food, and tonics, such as iodide of iron and cod-liver oil. But, however much good may be gained from such means, a cure cannot be effected without local treatment, which must be most thoroughly carried out. The first point is to remove, by oiling, all cups and scabs, and the hairs that are diseased must be carefully epilated. Poultices should never be used, as the heat and moisture encourage the growth of the fungus. After all the crusts on the surface have been removed, the deep-seated fungus must be destroyed in one of two ways—that is to say, either by setting up inflammation by means of irritants, such as strong ointments containing carbolic acid or mercurial preparations, or by blistering; or else by applying certain drugs, not necessarily strong, that have the power of killing the fungus without inflaming or injuring the skin. Such drugs are known as parasiticides. If the former plan be adopted, care must be taken not to produce too great an inflammation, and soothing remedies must be used as soon as the fungus is destroyed. Oleate of mercury 5 or 10 per cent. is a useful remedy. As parasiticides may be mentioned: perchloride of mercury, 2 gr. to f℥j. of equal parts of sp. vini rect. and water; sulphurous acid; hyposulphite of soda, ℥j. to f℥j.; salicylic acid; boracic acid; thymol; menthol; and many others of a similar nature. When a strictly parasiticide action is required, it is important not to use fatty applications, as they tend to block the hair-follicles and so prevent the destroying drug from reaching the fungus. Ether, chloroform, and spirit are all good penetrating vehicles. The nails should be softened with liq. potassæ, scraped, and kept covered with lint soaked in one of the above-mentioned lotions. The head should be washed from time to time with a disinfecting wash, but plain soap and water should only be used with extreme caution. As favus is a very chronic disease, it must be understood that patience is required, as well as drugs, to effect a cure.

MALCOLM MORRIS.

FEMALE CATHETER. — Several varieties of this instrument are usually sold, but the simplest form is the best, as admitting of being most effectually cleansed. This consists of a slightly curved silver tube, six or seven inches in length, and of the diameter of a No. 8 English male catheter, perforated with five or six small openings on either side near its extremity, and fitted with a fine wire stilette mounted on a movable metal plug.

When in constant use after operation, the catheter should always be thoroughly cleansed by a stream of warm water immediately after being passed, and then be placed in a vessel containing 1–20 carbolic solution until it is again required.

Method of Introduction.—This should always be effected by touch alone, without any exposure of the patient. From the right side of the bed the forefinger of the right hand is passed from behind forward between the nymphæ until the projection of the meatus urinarius—continuous with the cord-like urethra—is detected immediately in front of the entrance to the vagina beneath the pubic arch. The point of the catheter, held in the left hand, is then carried along the palmar surface of the right index finger until it enters the orifice. Unless the above plan be followed, the instrument is liable to pass into the vagina, and thus become coated with mucus or other secretions, which, if subsequently conveyed into the bladder, may readily excite catarrh of that organ. It is better, therefore, should this accident occur, to at once wash and re-carbolise the catheter before again attempting its introduction.

For *retention in the bladder*, the best form of instrument is a short, slightly-curved vulcanite tube terminating in a perforated olive-shaped bulb, to prevent its escape after introduction. A suitable length of rubber tubing, attached to its outer extremity, will convey the urine into a vessel beneath the bed containing some disinfectant solution.

W. A. MEREDITH.

FEMORAL ANEURISM.—A pulsating blood-sac in direct connection with the femoral artery, more common in Scarpa's triangle than in Hunter's canal, probably because the artery in the former place is more exposed to injury, and is less supported by surrounding muscles, than in the latter.

Femoral aneurisms spring either from the common femoral, from the deep femoral, or from the superficial femoral artery. Deep femoral aneurism is very much rarer than

the other two. Both it and superficial femoral aneurism present very similar physical signs, and the diagnosis between the two cannot always be made. Aneurism of the profunda presents an apparent want of definition from its greater depth, while aneurism of the superficial femoral occasionally interferes with the pulse in the tibial arteries. Neither of these tests, however, can be regarded as very satisfactory, and it will be best to consider these two forms together, remembering that aneurism of the superficial femoral is so much more common than aneurism of the deep artery, that the probability is all in favour of the superficial artery being the one affected.

A regional classification of femoral aneurisms, different from the above, is made use of by some writers. In this classification, if the swelling occurs in Scarpa's triangle it is called an inguinal aneurism, and the term 'femoral aneurism' is restricted to the affection of that part of the artery which corresponds with Hunter's canal.

Aneurism of the femoral below its bifurcation usually presents the form of an ovoid, pulsating, rapidly-growing swelling, the pulsation of which may be readily controlled by pressure on the artery as it crosses the pelvic brim. While this pressure is kept up, the swelling gradually diminishes in size from partial emptying of the sac, but directly the pressure is taken off the sac fills again, with a strong expansive force. If the sac be of large size, there may be signs of venous pressure in the parts below. Thus there may be more or less œdema of the foot, or a gorged and varicose condition of the superficial veins below the knee. Aneurism of the common femoral presents somewhat similar signs, but it occurs higher up in Scarpa's triangle, and very often runs on into the external iliac artery, the swelling being felt as much above Poupart's ligament as below.

Femoral aneurism may be either sacculated, fusiform, or diffused. The first is the most common; but the long, straight course of the artery sometimes favours the formation of a fusiform aneurism. A diffused aneurism may either result from traumatic causes, or from the rapid spread of the disease and bursting of the sac in either of the other forms.

Treatment.—If the pulsation in either a sacculated or fusiform femoral aneurism can be easily controlled by pressure on the artery as it passes over the pelvic brim, an attempt should be made to cure it by compression. This may be done, if the aneurism is sufficiently low down, by two tourniquets, placed the one on the pelvic brim, the other about two inches below this point, so that the one may be relaxed while the other is tightened. In this way alternate pressure is obtained on different points, and the risk of bruising and injury to the soft parts is very much lessened. Or a combination of instrumental and digital compression may be applied. The lower of the two tourniquets spoken of above may be retained, and in place of the upper, the finger compressing the artery may be substituted. If the aneurismal swelling extend up near to Poupart's ligament, digital compression will, probably, be the only method effectually applied. This will require a staff of three assistants, so that due relief may be given as each one compressing the artery becomes tired. It has been found that ten minutes is about the average time for one person to maintain effectual compression of the femoral artery. The arrangement of the three assistants, therefore, is best made thus: one man compressing the artery; the second sitting with his hand on the aneurismal sac, to give warning directly a pulsation is felt; the third assistant resting. If the patient be very quiet, the action of the second assistant can sometimes be replaced by the use of a long, light lever, such as a bit of whalebone bougie, one end of which is fixed by a joint to some immovable substance placed close to the limb, the bougie itself resting on the aneurismal swelling, and the long arm projecting beyond it. A pulsation is then indicated by the long arm rising in the air.

Whichever method be adopted, considerable patience and endurance will be needed on the part of the patient, if a successful result is to be attained. Digital compression is usually more speedy than instrumental, because generally more perfectly applied, and twenty-four to forty-eight hours should, in most cases, decide the question whether it is possible to cure the patient in this way. It is often necessary to keep the patient very much under the influence of morphia during its application, in order to avoid the distressing and harassing pain which it often entails. Compression is generally a less successful mode of treatment with femoral aneurism than with popliteal, and if the patient prove refractory, or if the aneurism be manifestly increasing in size, it will be best to adopt operative proceedings.

The particular operation selected will depend upon the part of the artery affected. If it be the superficial femoral in Hunter's

canal, ligature of the same artery near the apex of Scarpa's triangle will be advisable. If the aneurism affect the deep femoral artery, ligature of the common femoral or of the external iliac must be had recourse to. The same is true if the superficial femoral in Scarpa's triangle is the part affected, and if the common femoral be the seat of disease, ligature of the external iliac becomes compulsory. In those cases where there is a choice between ligature of the external iliac and common femoral, it is, probably, best to choose the former. The unfavourable statistics respecting ligature of the common femoral have been very much modified of late by the successful results of the Dublin surgeons in this operation. Independently, however, of these statistics, it is probable, for many reasons, that the external iliac will be a better and safer artery to tie than the common femoral; not the least of these reasons being the uncertainty which always exists as to where the common femoral divides.

Should a femoral aneurism have become diffused, an attempt may still be made to cure it, by compression or ligature, if it be seen sufficiently early. If the swelling be extensive, it may be necessary to amputate. The only operation which may then possibly save the limb is that in which the sac is boldly laid open, and the artery ligatured above and below.

H. G. Howse.

FEMORAL ARTERY.—The Common Femoral runs from the level of Poupart's ligament, in a line drawn from a spot midway between the anterior superior spinous process of the ilium and the symphysis pubis to the adductor tubercle; its average length is two inches, but it varies from half-an-inch to four inches.

The coverings are:—(1) Skin, thin and freely movable. (2) Superficial fascia, here consisting of a superficial and deep layer; the latter is called the cribriform. (3) Between the layers are the femoral glands, the crural branch of the genito-crural, and cutaneous branches of the common femoral artery with the accompanying veins. (4) Fascia lata, called at this part the iliac portion, being on the outer side of the saphenous opening. (5) The femoral sheath, embracing the femoral vessels. This sheath is formed by the transversalis and iliac fasciæ of the abdomen escaping from beneath Poupart's ligament—the former in front of, and the latter behind, the femoral vessels. There are in it three compartments, separated by two septa; the inner, for a gland, is called the crural canal; the middle is for the vein; and the outer for the artery. The sheath is but loosely applied to the artery, it being common to both artery and vein; but within the common there is the immediate sheath, characterised by its vasa vasorum.

The relations are:—In front, the coverings just mentioned. Behind, the psoas, resting on the horizontal ramus of the pubes, the anterior part of the hip-joint, and the head of the femur; when pressure is applied, the vessel slips from off the psoas, to rest internally on the origin of the pectineus. Internally, the vein. Externally, one-third of an inch from the sheath, are the branches of the anterior crural nerve lying in a groove between the iliacus and psoas.

Ligation is required for wounds, for aneurism, and varicose aneurism. Place the patient in the recumbent position, with the knee semi-flexed, the thigh slightly flexed on the abdomen, and the limb abducted; make an incision 2½ inches long over the artery in the line of the vessel, cutting downwards on the right side and upwards on the left, the incision beginning or ending just below Poupart's ligament. The structures cut through are the coverings (*see* above); the recognisable tissues are the skin, fascia with fat, fascia lata, common and immediate sheaths. When the immediate sheath is opened, the needle is passed from within outwards—i.e. from between the vein and artery. Another method of ligation is to make an incision parallel to Poupart's ligament and half an inch below it. There is then no difficulty in finding the artery and in opening the sheath directly over it.

The Superficial Femoral.—Course: From half an inch to four inches below Poupart's ligament in the guiding line given for the common, to the opening in the adductor magnus, which is, in the adult male limb, four inches, in a vertical line, above the adductor tubercle.

The coverings:—(1) The skin, movable and thin. (2) The superficial fascia, containing fat in its superficial layer; but the deep layer at the upper part is distinct, and called cribriform. The middle cutaneous nerve runs superficially to the artery. The internal saphenous vein runs upwards just internally to the line of the femoral artery. (3) The fascia lata looks thick and white above, but over the sartorius it is thinner, and allows the colour of the muscle to show through it. (4) Beneath the fascia lata, at the upper part—i.e. in Scarpa's triangle—there is a quantity of fatty tissue; beneath the fascia, below Scarpa's triangle, the sar-

torius muscle covers it. (5) The sartorius muscle, four inches below Poupart's ligament, touches the adductor longus, and then pursues a course downwards and inwards over the superficial femoral artery, and onwards across the knee to the tibia. The part above where it touches the adductor is Scarpa's triangle; the part below, Hunter's canal. As the artery lies in the triangle, the muscle is to the outer side; as the vessel lies in Hunter's canal, it is best exposed at the upper part by pulling the sartorius outwards, but at the lower part inwards. (6) Beneath the sartorius, and over Hunter's canal, is a special fascia—thick below, thin above—which passes from the vastus internus to the adductor longus muscle, the two boundary muscles of the canal.

Relations of the artery. A. *In Scarpa's triangle.*—This triangle is formed by the adductor longus internally; the sartorius externally; the base by Poupart's ligament; the apex four inches below the groin, where the sartorius crosses the adductor. In front, the structures given as coverings are the skin, superficial and deep fascia, and some fat. Behind, the superficial and deep femoral veins unite to form the common; a small quantity of fatty tissue separates the femoral vessels here in addition to the veins. Internally, the vein can be seen only at the upper part. Externally, the internal saphenous nerve and the nerve to the vastus internus gradually approach the artery from the anterior crural.

Ligation.—Select a point five inches below Poupart's ligament; keep this as the focal point in the operation. Place the limb as for the common; cut in the guiding line of the artery from two inches above to two inches below the focal point. Cut through skin, fat, cutaneous branches of vessel and nerves, cribriform fascia, fascia lata. Recognise the inner edge of the sartorius, clear away a small quantity of fatty areolar tissue, open the sheath, and pass the needle from within outwards to avoid the vein, especially if it is passed high on the artery.

B. *In Hunter's Canal.*— Hunter's canal extends from where the sartorius covers the superficial femoral above, to the opening in the adductor magnus. It is bounded externally by the vastus internus, internally by the adductor longus, and the roof of the canal is formed by the special aponeurosis above-mentioned. In front the coverings of the artery are skin, superficial fascia, fascia lata, sartorius muscle, and the special aponeurosis; the internal saphenous nerve lies on the artery at the lower part only. Behind, the superficial femoral vein and adductor longus muscle. Internally, the adductor longus and a bit of the magnus below. Externally, the vastus internus with the internal saphenous nerve, and the nerve to the vastus internus.

Ligation of the superficial femoral artery in the middle of the thigh—that is, at the lower third of the vessel. Place the limb as for the common femoral. The surgeon stands on the outer side of whichever limb is to be operated on, cutting upwards upon the left side, downwards upon the right. The incision is to be taken one finger's breadth internal to the guiding line. With the limb held in the position as for ligature of the common femoral, make an incision four inches long, with its central point midway between the groin and the knee. Cut through skin, superficial fascia, and branches of the middle cutaneous nerve. Recognise the sartorius, and divide the fascia lata along its outer border; draw the muscle inwards and backwards by a spatula; open the special aponeurosis forming the roof of the canal on a director. The vessel is now seen with the internal saphenous nerve lying on it; pull the nerve outwards; open the sheath, and pass the needle from without inwards. JAMES CANTLIE.

FEMORAL ARTERY, Wound of the.—INCISED WOUND.—It rarely occurs that opportunity is afforded for surgical interference involving the main vessels, for so severe an injury usually proves rapidly fatal before assistance can be obtained. If the bleeding has been temporarily arrested by firm bandaging by the bystanders, and an immediately fatal issue thus prevented, the surgeon, before attempting to remove the bandages, should have a tourniquet, or the fingers of an assistant, placed in position over the vessel in the groin, so as instantly to exert compression should bleeding occur on removal of the bandages. It is also of great value to have a second assistant to exert compression, if necessary, below the wound.

The clot being rapidly sponged out, it may happen that the stream of blood may at once point to the wounded vessel, which can be readily secured by ligature. If, owing to the retraction of a vessel, instead of a distinctly bleeding point, blood appears to well up from the tissues, the finger should be placed over the spot, and the tissues cautiously dissected up in the longitudinal direction, and if more space is required to accomplish this, the superficial wound must be enlarged. The vessels

having been securely tied with catgut, and the wound cleansed, the soft parts may be brought together. If it has been the femoral artery that is wounded, it is very probable that the vein has been at the same time damaged. In such a wound the probability of gangrene must be remembered, so that, while searching for the wounded vessel, the limb should not be unnecessarily exposed, for all the warmth possible should be retained as helping the anastomosing circulation.

When the operation is completed, the entire limb should be wrapped in cotton wool kept in position by a loose flannel bandage. The limb being slightly flexed at the knee and thigh, should be a little raised on a soft pillow.

Punctured Wound.—In a punctured wound it is impossible to say with absolute certainty that it is actually the femoral itself furnishing the blood, but if the wound be in the line of this vessel, and the bleeding of great volume, it is a fair inference to draw that the blood flows from the main artery. If the wound be in the upper half of the thigh—that is to say, in a position where the femoral artery is comparatively superficial—and situated over the course of the vessel, the surgeon may enlarge the opening with a good prospect of finding the wounded vessel without an extensive or prolonged operation. If the wound be in the lower half of the thigh, owing to the greater depth of the artery, and the possibility of its being the popliteal that is wounded, the search is rendered a far more severe and hazardous operation, and it should not be undertaken until a thorough trial of pressure has proved ineffectual. The method of applying pressure is explained under the heading of secondary hæmorrhage from this artery.

Wound of the Femoral or Popliteal, complicated with Fracture.—This is an accident which may occasionally occur in fracture of the lower end of the femur, and the popliteal has been wounded immediately behind the adductor magnus by a spiculum of bone after Macewen's operation for genu valgum. When hæmorrhage occurs after a compound fracture or osteotomy, it is of course impossible to know with certainty whether it is the main vessel or only a branch that is wounded. Pressure should be tried in the first instance, and if this fail the wound may be laid open, and the bleeding point searched for. Should this prove to be but a branch of the main vessel, it should be secured; but supposing, after laying open the wound, that it be found to be the main artery itself (the femoral or the popliteal) which is wounded, the safest course is to amputate the limb. It cannot be denied that it may occasionally happen that, by tying the wounded artery, both the life and limb of the sufferer may be saved; but looking at the terrible complication of such an accident, involving as it does an extensive incised wound, a fracture of the bone, and ligature of the main vessel, the chance of saving the limb is too remote to be weighed against the risk to life incurred, and amputation should be performed.

Secondary Hæmorrhage from the Femoral.—This must be considered, first, with reference to secondary hæmorrhage from the vessel after its ligature in continuity; secondly, when occurring from a thigh-stump.

Secondary Hæmorrhage from the Artery tied in continuity.—Four plans have been advocated for treating this serious accident, viz. (1) ligature of the external iliac; (2) pressure and bandaging; (3) an attempt to apply a ligature within the wound; (4) amputation.

Ligature of the external iliac has been mentioned merely for the purpose of condemning it, since in the vast majority of cases in which this procedure has been adopted, it has either failed to arrest the hæmorrhage, or, if it has done so, it has been only at the expense of gangrene of the limb. The ligature of the iliac, therefore, is a dangerous and perfectly useless operation, and should be abolished as a method of treatment in hæmorrhage from the femoral.

Treatment by Pressure.—This undoubtedly is the method by which secondary hæmorrhage should be treated in the first instance, and, if properly carried out, will in many instances effectually and permanently control the bleeding. Few studies in surgery are more instructive and interesting than that of the literature of secondary hæmorrhage from the femoral artery; for, not only is it shown that many cases have been successfully treated by pressure from the first, but that both life and limb have been saved by this means after the surgeon has failed to find the artery in the wound, or where the iliac has been tied in vain.

Method of applying Pressure.—Great care and attention to detail are necessary for its successful application, for, on the one hand, if an undue amount of force be used, gangrene results; on the other, if it be but timidly applied the treatment will prove ineffectual. It should further be remem-

bered how frequently, in secondary hæmorrhage from an artery tied in its continuity, it is the lower end of the vessel that furnishes the blood, so that it becomes a matter of great importance to exert well-directed pressure not only above but below the wound. The main vessel being effectually compressed in the groin, the limb, gently raised, is carefully bandaged from the foot upwards to within a short distance of the wound, which is not covered. The tips of the toes should be left exposed, in order to allow the surgeon to judge of the condition of the circulation. The bandage is then continued as a spica above the wound and over the groin. Rollers the thickness of the index finger, prepared as previously described, are then placed along the course of the main vessel, the one above, the other below the wound. These rollers are placed outside the flannel bandage enveloping the limb, and are kept in position each by a few turns of a separate bandage. A conical pad of eighty pieces of lint, the smallest the size of a shilling, the largest two inches in diameter, is laid directly over the orifice from which the blood has been issuing. This pad being liable to slip, must be kept in position by a couple of cross-pieces of narrow strapping, after which compression can be exerted on it by a few turns from a roller. *See* Arteries, Wounds of.

On the opposite or outer side of the thigh may be placed a well-padded broad splint, over which the three bandages compressing the two rollers and the conical pad are carried. The value of the splint consists in firm pressure and counter-pressure being obtained without the thigh being circularly compressed. The compressing pads, being independent of each other, allow of the pressure being diminished or increased as any one of them may require. The whole limb should be slightly raised on a pillow, and partially bent at the knee and thigh.

Search for the Bleeding Vessel in situ *and Amputation.*—If hæmorrhage recur, and cannot be controlled by tightening one or other of the pads, the whole apparatus should be removed, and once more carefully applied. Should this fail, or the limb be in such a condition as to forbid the further trial of pressure, an attempt may be made to tie the artery in the wound, and in a good light with a little dissection upwards and downwards this may sometimes be successfully accomplished; but it has occurred to surgeons of experience, that, owing to the disorganised state of the part, they have failed to pick up the vessel. If this be the case, desperate as the measure may seem, there remains no alternative other than that of amputating the limb through or just above the seat of ligature.

The greatest care should be observed in such an amputation that as little blood as possible be lost, and a Davy's lever, or other effectual means of preventing hæmorrhage during the operation, must be resorted to.

Secondary Hæmorrhage from the Femoral Artery in a Stump.—The following are the three methods by which the bleeding may be treated:—(1) pressure; (2) reopening the flaps; (3) ligature of the main vessel at a higher point.

Pressure.—A tourniquet being placed on the artery in the groin, the stump is raised and, as far as practicable, the clot, if it has distended the flaps, syringed away with cold, carbolised water. The stump is then very firmly and evenly bandaged from its extremity to the groin. Two pieces of pencil, each about three inches in length, and thickly wrapped round with lint, may be laid along the course of the femoral artery. Compression is exercised upon these by two separate bandages, passing round the limb and over an outside splint on the opposite side to avoid complete circular pressure. The advantage of having the roller compress over the main artery in two portions, is that more equable pressure is maintained by tightening or relaxing one or the other as occasion may demand. The bandage used for exerting pressure on these compresses should be of domette, which has much more elasticity than cotton. Whilst the stump is being bandaged and compression applied, firm digital or instrumental pressure must be exercised in the groin. If pressure should fail to stop the bleeding, the surgeon may fall back upon one of the remaining alternatives, that is, either opening the flaps or ligaturing the main vessel higher up. Which of these proceedings is best to adopt depends upon the amount of union between the flaps.

If the bleeding should occur early in the case, before firm union is established, say within the first fifteen or twenty days, the flaps may be separated by the finger, and the vessel sought for. It is not, however, always easily found, owing to its retraction, and its being covered by granulations. With a little perseverance, however, and by using a director rather than a knife, it may be discovered and isolated

from the surrounding tissue. It is well to remember how very soft the end of the vessel becomes in these cases of secondary hæmorrhage, so that the ligature of thick soft silk must be tied with much gentleness. It has occasionally happened when the surgeon has been unable to isolate the artery, that it has answered to pass a large curved needle threaded with the ligature deeply beneath the bleeding part, thus including the artery with a considerable portion of the neighbouring structures.

If the hæmorrhage has come on late in the case, the flaps being united, and the blood issuing from a sinus at the angle of the flaps, it is a less formidable procedure than breaking open so large a wound, to put a thread round the main vessel by cutting down upon it as near above the flaps as it can be conveniently found. Thus, if the amputation be through the knee-joint, the artery may be secured in Hunter's canal. If the amputation be through the middle of the thigh, the vessel should be tied in Scarpa's triangle. HARRISON CRIPPS.

FEMORAL HERNIA.—In this form of rupture the gut leaves the abdomen through the femoral ring, and descends along the crural canal. This canal is funnel-shaped, is about half an inch in length, and ends opposite the saphenous opening. Femoral herniæ are always acquired, and possess a sac. The hernia in its descent first of all takes a vertical course. At the lower end of the crural canal it bends forwards, and then tends to mount upwards over Poupart's ligament. In the upward movement it inclines also outwards in the direction of the anterior superior spine. The neck of the hernia will be at the femoral ring. The rupture, as it lies within the canal, must always be small. As soon, however, as it passes the saphenous opening and reaches the loose subcutaneous tissue, it enlarges, and may attain considerable dimensions in this latter position. The coverings of the rupture from without inwards are the skin, superficial fascia, cribriform fascia, the crural sheath, septum crurale, subserous tissue, and peritoneum. The stricture is usually at the neck, and is mainly caused by the sharp edge of Gimbernat's ligament. The femoral vein lies just to its outer side. The spermatic cord lies above the anterior border of the ring, and the epigastric artery skirts its upper and outer part. The little pubic branch of this artery passes round the ring, to ramify over Gimbernat's ligament. In 1 case in 3½ the obturator artery arises from the epigastric. Out of 101 cases where the vessel so arose, it reached its destination in 54 instances by passing along the outer side of the crural ring, a position quite free from danger in herniotomy. In 37 cases it passed backwards across the ring, and in 10 instances around its inner border. When in the last-named situation it could hardly avoid being wounded in herniotomy. A pubic vein—passing between the obturator and external iliac vein—skirts the ring, and may have the same relations to it as the artery just alluded to.

It is estimated that in 100 cases of hernia 84 will be inguinal, 10 femoral, and 5 umbilical. Femoral hernia is more common in females than in males. In males ruptures occur in the proportion of 1 femoral to 32 inguinal; but in females these two forms of hernia occur with almost equal frequency. Inguinal hernia is, excluding the umbilical, practically the only form of rupture that occurs in the female before the adult age.

Femoral herniæ are rare before the age of twenty, and very rare indeed before puberty. They seldom attain great size. When large their coverings are often very thin, and the sac of lobulated and irregular outline.

Femoral ruptures are more often strangulated than inguinal, are more often strangulated on their first descent, and are, in any case, much more difficult to reduce. Irreducible femoral enterocele is rare, but irreducible femoral epiplocele is common. Femoral ruptures are frequently inflamed, but very rarely obstructed. When strangulation has occurred, it is found that gangrene of the gut and artificial anus follow more commonly in femoral than they do in inguinal herniæ.

In applying the taxis the thigh should be flexed, adducted, and rotated inwards. If the tumour has mounted up over Poupart's ligament the pressure must be applied first in a downward direction, then backwards and upwards. In herniæ of smaller size, which have not projected far beyond the saphenous opening, the pressure is applied in a direction backwards and upwards.

In herniotomy an incision from 1½ to 2 inches in length is made along the inner side of the tumour. This incision should be parallel to the long axis of the tumour, provided that this does not involve too great a deviation from the vertical line, and should be so planned that the centre of the incision corresponds to the top of the saphenous opening. The stricture is divided by cutting inwards.

Femoral herniæ have been mistaken for psoas abscess, enlarged glands, varicose veins, and cysts. For the diagnosis *see* Groin, Affections of the. When a femoral rupture has mounted up over Poupart's ligament, it may present some of the appearances of an inguinal hernia. If, however, the finger be placed upon the spine of the pubes, the inguinal hernia will be always to the inner side of it, the femoral to the outer. The bulk of a femoral hernia is also below the line of Poupart's ligament, and the tumour can without difficulty be traced down to the saphenous opening.

Frederick Treves.

FEMUR, Fractures of the. — The numerous fractures to which the femur is liable are divided into those of (1) the upper end, (2) the shaft, (3) the lower end. Those of the upper end include fractures of the neck, fractures through the trochanter and base of the neck, and fracture detaching the great trochanter. To these must be added, in young subjects, separation of the epiphysis of the head, and that of the great trochanter.

Fracture of the neck may occur in any situation—either transversely, just below the head; in the middle; or at the base, at its junction with the shaft. The first-named injury, though it has been met with under the age of fifty, or even under twenty, after heavy falls on the trochanter, is almost confined to persons of sixty-five and upwards, and is more frequent in women than in men. In the old it occurs as the result either of a fall on the hip, or of some slight force indirectly applied, by a trip of the toe in the carpet or even a turn in bed, during which the femur is suddenly twisted on its long axis; in a few instances it has been produced by muscular action. The frequency of the accident in advanced life is due in part to atrophy of the bone, the cortical layer of which is thinned, while the plates of the cancellous tissue are absorbed; and in part to the fact that the neck often joins the shaft at a right angle instead of at an angle of 125°, as is the case earlier in life; so that not only is the trochanter more prominent and therefore more likely to be struck in falls on the hip, but the leverage with which any force acts through the shaft on the neck is much increased. Should the fracture be the result of a fall on the trochanter, impaction may occur, the lower fragment being driven into the cancellous tissue of the head; but, owing to the trivial character of the force by which the injury is generally produced, impaction is seldom present. In rare instances the head is said to be driven downwards and backwards, but as a rule it remains in the acetabulum, where, however, it is liable to more or less rotation, so that its broken surface is turned away from the lower fragment. Fracture through the middle portion of the neck may be either transverse, or oblique from above downwards and inwards, extending from the outer margin of the head to the neighbourhood of the lesser trochanter.

Fracture through the base of the neck, in a line with the anterior trochanteric ridge, though it is, like fracture close to the head, most common in elderly persons, may be met with at any age, as the result of falls on the trochanter. By the continuance of the force under which the bone gives way, the upper fragment is usually driven into the cancellous tissue of the trochanter and shaft. Should the force be only moderate, the fragments remain securely impacted, and displacement is slight; but when it is more considerable the trochanter is split in a longitudinal direction, and, perhaps, also detached from the shaft, so that the fragments are no longer mutually grasped. When this is the case the surrounding muscles draw up the limb and produce considerable shortening. This fracture was termed extra-capsular by Sir A. Cooper, in contrast to fracture higher in the neck, which he termed intra-capsular. Later writers, however, have justly pointed out that since the capsule entirely invests the neck in front, any fracture that is extra-capsular in this situation must involve, not the neck, but the shaft. Indeed, the division of fractures of the neck into the intra- and the extra-capsular groups has been by many authorities discarded, on the ground that, though there are highly important differences between fractures of the upper part and fractures of the base of the neck in respect to the prospect of union and the future condition of the limb, these are dependent, not so much on the relation of the fracture to the capsule, as on the different ages at which these injuries are chiefly met with, and the fact that in the former impaction is rare, while in the latter it is of almost constant occurrence.

Symptoms.—In a typical instance, after a fall on the hip or knee, a false step, or even a turn in bed, or some such trivial source of injury, the patient complains of sharp pain on any attempt at movement, and of a powerless condition of the limb. On examination the limb is seen to be shortened

to the extent of half an inch to an inch and a half, or even more, and everted; the patient is unable to lift the heel from the bed; the trochanter is displaced upwards, and also inwards towards the middle line, so as to be less prominent than natural. There is swelling in front of the joint, due to projection of the fragments against the front of the capsule, or sometimes to extravasated blood: pressure over either the front or back of the joint is painful. Crepitus may perhaps be felt when the limb, after it has been drawn down to its proper length, is gently rotated inwards and outwards; and during these movements the trochanter is found to move through an abnormally small arc. It must be pointed out, however, that cases are often met with in which many of these symptoms are modified, or even entirely absent. Thus, owing to the presence of impaction, or more rarely because the periosteum is untorn, or more rarely still because the fracture is incomplete, the patient may be able to move the limb freely, or even walk upon it. Shortening of the limb, and displacement of the trochanter, though they are usually distinct, may be so slight, or so masked, the one by the difficulty of placing the two limbs in the same position while the measurements are taken, the other by the stoutness of the patient, that they cannot be clearly made out; in some cases eversion is very slight, and is detected only by the fact that during manipulation the surgeon experiences a difficulty in turning the foot inwards. Sometimes the foot is in its natural position, while very rarely it is markedly inverted. Crepitus is absent when, as is so commonly the case, the fracture is impacted, and also when the fragments are displaced in relation to each other; and although it may be sometimes produced by drawing the limb down and then rotating it, manipulation for the purpose of eliciting this symptom must always be employed with great caution, in view of the danger that so favourable a condition as impaction may be sacrificed, and the fracture converted into one in which the fragments may become widely displaced.

Shortening, in a previously healthy limb, is important evidence when fracture is suspected; but its absence must not always, as already indicated, be taken as any proof that fracture has not occurred. In taking measurements great care must be used. The pelvis must be placed so that the anterior superior iliac spines are on the same horizontal level, and the two limbs must be parallel to each other and in a straight line with the trunk. Above, the superior iliac spines are the most salient points, and below, either the upper edges of the patellæ or the tips of the external malleoli; but it is a useful precaution to measure to both these lower points, and to see whether the results agree. Very valuable information is afforded by the position of the great trochanter. If fracture is present, the trochanter is higher and at the same time less prominent—that is, nearer to the middle line than that of the opposite side.

The position of the trochanter may be ascertained either by Nélaton's or Bryant's line. Nélaton's line is drawn from the anterior superior iliac spine to the most prominent part of the tuberosity of the ischium. In the normal state, in no position of the limb does the trochanter extend above this line, while in fracture it lies above it by as much as the limb is shortened. It must, however, be borne in mind that when the neck of the femur forms a right angle with the shaft, as it may in persons in whom the bone has yielded during the atrophy of advancing life, and also in many of those who were rickety during infancy, the trochanter is placed above Nélaton's line. Moreover, the exact point of the tuber ischii to which the line should be drawn is difficult to select when the patient is stout, or when swelling is present. This test should therefore be checked by other measurements, and the suspected should always be compared with the sound side. Bryant draws a horizontal line backwards from the anterior iliac spines (that is, a line which, if continued, would form a circle round the pelvis at this level), and takes the vertical distance between it and the top of the trochanter, comparing the length of this vertical line with a similar measurement on the opposite side.

Eversion, which is generally present, and which in many instances forms so marked a symptom, is due chiefly to the weight of the limb, which as its line of gravity passes through its outer part, has a natural tendency, as is seen in sleep, to turn outwards; but it depends in part on the action of the external rotator muscles, and in part, also, on the circumstance that the neck of the bone is thinner and more brittle in its posterior aspect than it is in front, and is therefore prone to be more extensively broken down in the former than in the latter situation.

Diagnosis.—The accidents with which fractures of the neck of the femur are most likely to be confounded are—fracture

of the upper border of the acetabulum and displacement of the femur upwards; fracture of the bottom of the acetabulum, the head of the bone being driven through its floor; dislocation of the femur upwards and backwards, or on the pubes; severe bruising about the hip. In elderly persons, however, in whom fractures of the upper end of the femur are so common, fractures of the acetabulum, whether involving its rim or its floor, are almost unknown; and though in early or adult life they are occasionally met with as the result of great violence, they are still of very rare occurrence. In fracture of the edge of the acetabulum, if a large piece is detached, the limb will be shortened to the extent of an inch or much more, but can be easily drawn down when the patient is under an anæsthetic, and when traction ceases, shortening recurs; while when the femur has been drawn down it is found to present its natural outline of neck and trochanter, and to rotate naturally in the acetabulum. In fracture of the floor the trochanter is carried towards the middle line, so that its prominence is altogether lost, the bone is fixed, and any attempt at movement causes great pain. Possibly this fracture might be detected by the finger introduced into the rectum. In dislocation on the pubes, a very rare accident, the head of the bone can be felt on the pubic ramus, the normal outline of the upper end of the bone can be traced, and, moreover, the limb is generally, in this dislocation, markedly abducted.

When severe bruising has occurred, it may be difficult to exclude the existence of fracture, and a guarded opinion must be given till further examination shall have cleared up the doubt. In the article on Injuries to the Hip those cases are mentioned in which after severe contusion, without fracture, shortening, eversion, and other signs of old fracture of the neck, come on as the result of chronic inflammation and absorption. These examples have sometimes led to unjust charges of malpractice. Fracture through the great trochanter and base of the neck, so that the upper fragment is composed of the head, neck, and a portion of the trochanter, while the remainder of the trochanter forms part of the lower fragment, is an accident of which a few instances are recorded—amongst them one by Sir A. Cooper, and one very clearly described by Stanley (*Med.-Chir. Trans.*, vol. xiii.), and verified by post-mortem examination. The main interest in respect to this injury lies in the fact that it is very likely to be mistaken for dislocation. In Stanley's case the upper fragment of the trochanter had been drawn upwards and backwards towards the sciatic notch, where it was supposed to be the head of the femur. Diagnosis turns on the fixed position of the trochanter when the shaft of the femur is rotated, and the presence of crepitus. Shortening will be slight if the separation of the fragments is incomplete. When, however, the fragments are widely separated, considerable shortening is produced by the muscles acting on the femur below the fracture, and eversion is very marked.

Prognosis in these fractures must often be very grave, and should always be guarded, for while many cases recover very favourably, in many others, occurring in old persons, in spite of all the care that can be used, the injury is followed by exhaustion, congestion of the lungs, large pressure-sores, or by cystitis following enlarged prostate, and unavoidably aggravated by the use of catheters, and the patient sinks; while, even if a fatal result is averted, the limb often remains crippled, and a source of much suffering and distress.

Treatment.—This must vary somewhat with the circumstances of each case; but as it is now a well-established fact that fractures within the capsule may be repaired by bone, or by close and firm ligamentous substance; and as, in fractures of the base of the neck, bony union is of common occurrence, all cases of fracture of the upper end of the femur should, with the exceptions mentioned below, be treated with a view to obtain this result. In order to keep the fragments in apposition and at rest, the appliance most commonly in use, and on the whole the best, is the ordinary long splint carefully padded, interrupted opposite the fracture, and reaching from the armpit to the foot. Some surgeons employ Thomas's splint. With this the patient can be more easily moved and turned over, so far as this is necessary for cleanliness; but unless the bar of which it is constructed is flat, wide, well-padded, and accurately moulded to the shape of the trunk and limb, and unless the patient is placed on a soft mattress, pressure-sores are very apt to form. The double inclined plane was at one time much in favour. It is now, however, but seldom used, for it exercises no reliable influence on the length of the limb, and its tends to concentrate pressure on the sacrum. Moreover, the position of flexion which it entails is, in

the long run, more irksome than that of extension in the horizontal posture.

In cases where there is impaction, the only indication is to keep the fragments at rest and prevent their separation. No extension, therefore, either at the time the fracture is put up, or subsequently, should be employed; but where impaction is absent, extension must be used to bring the fragments into apposition, and be continued to maintain them so. The weight and pulley answer well for this purpose, and enable us to discard so useless and objectionable a contrivance as the perineal band. The weight should be applied by means of the strapping stirrup used in hip-disease, and it is easily combined with either the long splint or with Thomas's splint. Counter-extension may be obtained by raising the foot of the bed on bricks or wood blocks. Treatment must be continued for from six to eight weeks. In impacted fracture the splints may generally be removed at the end of six weeks, the limb being kept for another fortnight at rest between sandbags, and steadied by a weight of five or six pounds.

The exceptional cases referred to above are those occurring in very old and feeble persons, in whom confinement in one position would exhaust their strength, and lead to pressure-sores, or passive congestion of the lungs, or trouble in the urinary bladder. In these instances the limb should be placed in an easy position upon a pillow, and be steadied between sandbags, and by a weight of three to six pounds attached to the foot. As soon as bruising has subsided the patient should be raised in bed with pillows for some hours a day, so as to profit by a change of posture, and, later on, may be upon crutches, with the limb supported by a loop passing round the neck and under the sole. It is often difficult in certain cases to determine whether in non-impacted intra-capsular fracture an attempt should be made by the use of rigid apparatus to obtain bony union, for in many instances this will necessarily fail, either from the feeble nutrition of the upper fragment, or because the fragments cannot be maintained in apposition; and there may be a doubt whether the health will not give way. The decision must turn on the patient's age and general strength, and on the presence of any other injuries that may have been sustained, and which would render a constrained position more than usually difficult to bear.

Shaft.—Fractures of the shaft of the femur are much more common in the middle than at either end, and in the lower than the upper third, the proportion, stated approximately, being six in the middle, three in the lower, and two in the upper third. Fracture occurs at all ages and in both sexes, but it is most frequent in adult males, who are more exposed to the injuries by which it is produced. It is caused by violence, either direct, or indirect as in falls on the feet; or by muscular action, of which some remarkable instances have been recorded. In infants the accident has sometimes been produced during birth, and it is often met with in children under three or four. At this age it is apt to be overlooked, since it is often of the green-stick variety, transverse in direction, and attended with little or no displacement of the fragments. The writer has seen three instances in which the bone was broken, under the influence of very slight force, in attempts to straighten the limb in cases of old hip-disease. Spontaneous fracture is not rarely met with as the result of necrosis, or of new-growths which have destroyed part of the shaft.

In direction the line of fracture presents considerable variety. It is, however, generally oblique, and often runs from above downwards and forwards. In some instances the bone is split for a considerable distance in a longitudinal direction. Some cases of spiral or screw-like fracture, chiefly in the upper or the lower third, have been recorded. Occasionally there is double fracture, and as many as three fractures have been met with in different parts of the shaft. Sometimes the fragments are driven the one into the other—usually the lower enters the upper—so as to produce either impaction, or splitting of the base. Displacement is very usually present. In fractures of the superior third the upper fragment tends to be carried forwards and outwards, in part by the action of the surrounding muscles, especially of the psoas and iliacus, and in part by the lower fragment, which is drawn upwards behind it and to its inner side, so as to impart a lifting movement to it. Often, however, the upper fragment projects directly forwards, and it may even be carried inwards or backwards. The lower fragment may not only overlap, or form an angle with, the upper, but be rotated on its own long axis, either outwards, or, more rarely, inwards, so as to produce inversion of the foot.

Symptoms.—These are shortening and deformity of the thigh, which is generally curved forwards and outwards, mobility at the seat of fracture, crepitus on rotation,

often to be obtained only after extension, loss of power in the limb, pain on movement. The nature of the accident is usually at once apparent; but in young children, in whom there may be very little displacement, and in adults, when the fracture is transverse, the deformity slight, and the thigh very large, muscular, and difficult to manipulate, or when the injury has led to considerable swelling, fracture may easily be overlooked.

Prognosis.—In the old and feeble, if the accident has been attended with much violence, and in cases in which the fracture is compound, and there is great injury of the soft parts or of the large blood-vessels, prognosis must be grave; but in simple fractures, carefully treated, a good result may almost always be obtained. The question of shortening has been much discussed, some surgeons holding that some degree is inevitable, others maintaining that it may be entirely avoided. The facts, however, briefly stated, are, that in many instances in which much displacement has once occurred, shortening cannot be altogether prevented; and in actual practice the amount varies, in carefully-treated cases, from half an inch to two inches and a half. When, however, the fracture is transverse, or nearly so, and there is little displacement, repair without shortening may be secured. In children, as the fracture is usually transverse, the periosteum incompletely torn, displacement slight, and muscular contraction feeble, no shortening will generally remain. The subsequent length of the limb, however, will always depend largely on the treatment that is adopted, and on the care and watchfulness with which it is carried out.

Treatment.— This subject has been much discussed from very early times, and much difference of opinion still exists respecting it; but in the present article all historical discussion must be omitted, and reference be made only to the chief methods that are now in common use.

The objects to be aimed at are: (1) adjustment and fixation of the fragments; (2) extension to maintain length; (3) support and gentle compression of the limb. The appliance most in favour in the London hospitals is a Liston's or Desault's long splint, reaching from the axilla to the foot, and combined with extension maintained either by the perineal band, by the weight and pulley, or by an india-rubber accumulator. When the perineal band is used, the splint, which should be very carefully padded, is bandaged to the outer side of the limb from the foot to the knee, the roller being passed several times round the foot and lower end of the splint, so that the two are securely connected. The perineal band is now placed in position, extension is made upon the splint and foot together, and, as soon as the limb has been brought down to its full length, the perineal band is drawn tight and securely tied; a bandage is then carried round the thigh and corresponding part of the splint, and a wide band is applied to keep the upper part of the splint in contact with the chest. Many surgeons apply a short back splint, padded, with its convex surface directed forward to the back of the thigh, so as to maintain the normal curvature of the femur forwards. Others place short splints also on the front and inner aspect of the thigh. The perineal band is, however, not in general favour; it is uncleanly, especially in female patients, and it is apt to be either so tight as to excoriate the groin, or so loose as to be useless. These objections are by no means entirely removed even when the band is made of stout india-rubber tubing. To supersede it, some have advised an axillary crutch fixed to the upper end of the long splint; but neither does this answer.

Efficient extension may be obtained by the use of the weight and pulley. A piece of strong plaster, four or five inches wide, and long enough to extend from a little above the knee to eight inches below the foot, and to return to the opposite point of the limb, is applied as a stirrup, and is secured to the limb by wide transverse pieces of strapping and a bandage; a thin piece of wood, of the same width as the strapping and about four inches long, is placed transversely in the base of the loop below the foot, so as to defend the malleoli from pressure; and through a hole in the centre of this, and a corresponding hole in the stirrup, a strong cord is passed and knotted on the proximal side; this cord runs over a pulley fixed to the bottom of the bed, and supports the weight. Care must be taken that the lower end of the splint is not entangled in the sheets, so that the action of the weight is neutralised, and a weight of from seven to twelve pounds or more will be required.

De Morgan's and Bryant's splints have each met with considerable approval. So also has Thomas's splint. Indeed the results obtained depend less on the particular splint that is used than on the care with which the treatment is carried out. In Dr. Gurdon Buck's method the thigh is surrounded by four short splints, fastened with

webbing and buckles; extension is secured by the weight and pulley, and counter-extension by the perineal band fixed to the head-end of the bed. As in fracture of the neck of the femur, so in fractures of the shaft of the bone, treatment on the principle of flexing the limb on the trunk by means of the double inclined plane has been generally discarded, the extended straight position being, when long-continued, less irksome than that of flexion. The inclined plane, however, is useful in cases in which either the hip or the knee-joint is ankylosed in a fixed position; and in such instances adequate extension may be secured by using the weight and pulley, the stirrup being fixed to the thigh.

Another plan is to enclose the limb in some immovable apparatus, such as a case of starch, plaster of Paris, gum and chalk, &c. The former material has been strongly advocated by Mr. Erichsen and Mr. Gamgee. The method, however, is open to the objections:—(1) that to enclose a limb soon after a severe injury in a rigid case, which does not accommodate itself to the swelling that may follow, involves serious danger to the circulation; (2) that, once applied, the bandage allows of no examination of the fracture in order to ascertain whether the fragments are remaining in place; (3) that the bandage soon becomes loose, from shrinking of the soft parts. These dangers are not imaginary. Instances have occurred in which the limb has become gangrenous, and others in which when the bandage was removed, great deformity has been found to have occurred. This plan cannot therefore be recommended for fractures of the thigh, although plaster splints are very useful in fractures elsewhere.

Union is generally complete in about six weeks, so that at the end of this time the apparatus may be removed, and the fracture carefully examined. If the bone feels firm the limb should be left at rest between sand-bags for another fortnight, when the patient may get about upon crutches; or a plaster of Paris or other rigid bandage having been applied, he may be allowed to be on crutches at once, though for the next two months he should bear but little weight upon the limb. Before the case is finally dismissed, the surgeon should see that the knee is freely movable. If stiff it should be subjected to manipulation-movements, and, if necessary, an anæsthetic should be employed, though this is seldom required.

In children, fractured shaft of the femur is best treated by the application of four short splints to the thigh, and extension by a four or five-pound weight suspended by the stirrup, as above described. A long splint should be applied on the opposite side, to keep the child at rest on his back, while sand-bags are placed along the inner and outer side of the injured limb; or Thomas's splint, which answers very well, may be employed. To the use of plaster of Paris or other rigid splints, the same objections which were mentioned in the case of adults apply in the case of children; while the leather splint, buckling round the thigh like a wide collar, which some have recommended, is a very imperfect appliance, seeing that the thigh is short and fat, and that the femur is deeply surrounded by soft parts. Hamilton uses two long splints, one for each limb, fastened together by means of a cross-bar connecting their lower ends; with this he considers that no extension is generally required. Bryant's splint is a convenient modification of this contrivance. Union is complete in four or five weeks, and after this period has elapsed the limb should be kept for a fortnight in a plaster of Paris or some other rigid case.

Lower End.— Fractures of the lower end of the femur, which are situated entirely above the condyles, may be either transverse—but this is rare—or oblique in any direction, their most usual course being from above downwards, and from behind forwards. Another group includes those which involve the knee-joint. In some of these cases, as the result of kicks, blows, or other direct violence, a part or the whole of the condyles is detached from the shaft; while in others, produced generally by falls on the knee, the two condyles are not only separated from the shaft, but are also split asunder by the wedge-like action of the patella. This injury closely resembles the T fracture of the lower end of the humerus, where in falls on the elbow the olecranon acts so as to split the lesser fragment into two lateral pieces. In transverse fracture the shaft is sometimes driven into the cancellous tissue of the lower fragment. Diagnosis is usually readily made. When the joint is involved there is generally distension of the synovial cavity by effused serum and blood. The condyles, one or both, are found to be movable on the shaft, and an increase in the width of the lower end of the bone, or some irregularity in its outline, is detected. Crepitus may be felt by moving the condyles in an antero-posterior direction, or by rotation of the leg.

Prognosis.—As fractures of the lower end of the shaft are generally oblique, and attended with considerable displacement,

it is difficult to avoid shortening. This, even after very careful treatment, will sometimes amount to an inch and a half or even two inches. When fracture passes through the condyles and involves the joint, the normal outline of the articular surfaces is lost. Sometimes, after the acute inflammation of the joint which follows the injury, fibrous or even bony anklyosis occurs. Any of these conditions, coupled with shortening, greatly impairs the function of the limb, and produces permanent lameness.

Treatment.—Fractures above the condyles are, like fractures higher in the shaft, best treated either by the long splint, with the addition of short splints if these seem to be required, and extension by means of a weight of from ten to twenty pounds; or one of the other methods already mentioned may be employed. In fractures involving the joint, the fragments must be as far as possible restored to place by manipulation, the patient if necessary being placed under an anæsthetic. When reduction has been effected, the limb should be placed on a back splint and swung by the method described under Leg, Fractures of the. The back splint, however, must extend for some distance up the thigh. Or the limb may be placed in a raised position in Gant's apparatus for excision of the knee, which consists of a simple straight back splint, and a long outside splint extending from the trochanter to the foot and interrupted at the knee; or the long splint and extension may be used. In some examples the fragments remain in position best when the limb is placed on the double inclined plane. When the joint is much injured, an icebag should be applied, and care must be taken to avoid all constriction of the limb above. Should the joint be tensely distended, it may sometimes be advisable to aspirate it; but as this is a proceeding which may be followed by serious results, the cases in which it should be performed must be very carefully selected, and every care, during the operation, must be used. Passive movement should be commenced at the end of five weeks, and be carefully followed up; but no undue force must be used. The operator will find it most convenient to use his own knee, placed behind the patient's joint as a fulcrum, and then to flex the leg, slightly at first, and by degrees to carry it through its full normal range.

Should the patella be adherent to the condyles, forcible flexion would lead to rupture of the ligamentum patellæ.

Separation of Lower Epiphysis.—An injury closely resembling fracture through the condyles consists in separation of the lower epiphysis from the shaft. This accident is very rare, and can occur only in those who are under the age of twenty, for after this period consolidation of the bone is complete. Very few, if any, cases, however, have been recorded in subjects above sixteen. The injury may result from the passage of a wheel or other direct violence; but it is generally produced indirectly, by a wrench or twist; in one case it was caused by a rope in which the limb was entangled. Although the epiphysial line is above the level of the synovial membrane, the articulation is often involved through laceration of the intervening soft parts. Sometimes a vertical fracture between the condyles—of course entering the joint—is present. The amount of displacement varies. Sometimes it is so slight that the injury may easily escape notice, or be mistaken for a mere traumatic synovitis. In other instances the epiphysis is thrown completely in front of the lower end of the shaft, which projects backwards into the popliteal space. The other symptoms are pain, swelling of the joint, and crepitus; the latter, however, is often very indistinct. In some cases the popliteal vessels have been compressed by the backward projection of the bone, and the limb has become gangrenous, so that amputation has been necessary. When displacement is complete, it may be impossible to effect reduction, and amputation may be called for, though it ought not to be resorted to until it is clearly proved that the limb is useless. If displacement can be corrected a satisfactory recovery will generally take place, though, in some cases, the joint becomes stiff, or shortening results from arrested growth. The treatment, after reduction, is the same as that for fracture close to the condyles. When consolidation has taken place, should stiffness remain, an attempt may be cautiously made to restore movement, when the patient is under chloroform, by manipulation; but no violence must be used.

Howard Marsh.

FERGUSSON'S EXTENDING ARM-SPLINT consists of a rectangular iron splint for the inner side of the arm and forearm. The upper end of the arm portion is provided with a crutch for the axilla, against which extension may be made by means of a screw apparatus which elevates the crutch. The forearm and lower part of the arm are first fixed to the splint, and

then the crutch is raised into the axilla, care being, of course, taken not to make too much pressure there. BILTON POLLARD.

FIBROUS TUMOURS. — The non-malignant tumours which are classed under this heading, and the basis of whose structure is fibrous tissue, include—first, the softer fibro-cellular tumours, which may be either (*a*) diffused growths of the subcutaneous tissue, as molluscum fibrosum and the more pendulous forms of elephantiasis arabum; or (*b*) single encapsuled tumours, usually pedunculated, and found most commonly connected with the labia and external generative organs, but also seen in the neck and sometimes deeply placed between muscles. Secondly, the firm, hard fibromata, in whose composition other tissues have a share, which occur either as single or multiple growths, and are either superficial, as in the 'painful subcutaneous tumours,' or deeper, as in 'uterine fibroids,' or firmly connected with periosteum and bone, notably of both upper and lower jaws and adjacent bones.

Cause.—Beyond the circumstance that, in the case of fibrous tumours of the uterus, evidence of inheritance may be often made out, no explanation for the occurrence of fibrous tumours can be given. Elephantiasis being an overgrowth, and due to obstruction in the lymphatic circulation, cannot be adduced as a cause of fibrous tumours in general.

Pathology.—In the more pure types of fibrous and fibro-cellular tumours, interlacing bands of white fibrous tissue with scattered cells, oat-shaped or rounded, are seen under the microscope; but in the majority of fibromata these elements of fibrous tissue are mingled with oil-globules or fibres of unstriped muscular and other tissues. On section, fibrous tumours cut firmly, are white and glistening, and rather friable.

The tendency of fibrous tumours is steadily to increase, and they may reach to many pounds in weight. Some are painful, but this symptom appears to depend upon nerve-tissue entering into their composition, or upon their being subjected to compression by neighbouring fibrous structures, in which case it may even be doubted if the pain is not due to the tension upon those parts by the enlarging tumour.

These tumours seem peculiarly liable to degenerate, the production of cysts, or the occurrence of gelatiniform and calcareous deposits, being the most frequent changes; moreover, uterine fibromata are wont to atrophy when the menopause occurs.

In large pendulous tumours the skin often inflames and ulcerates, whilst the tumour itself may mortify and slough away.

Diagnosis. — Fibromata and cellulo-fibromata, when single, are usually firm to the touch, and may be even very hard; are ovoid in shape, and very imperfectly lobed, and they have a distinct tendency to be pedunculated. Even when soft, they have not that sense of fluidity which is so deceptive in lipomata, and for this reason they are unlikely to be mistaken for chronic abscess; but the hard fibromata are often supposed to be either cartilaginous or osseous growths. They occur usually in adult life, and hence a difficulty in diagnosing them from sarcomata presents itself.

Some forms of these growths are so characteristic as to be unmistakable—as, for instance, the outgrowths of molluscum fibrosum, and the pendulous overgrowths about the genital organs of elephantiasis, or uterine polypi.

Treatment.—Such tumours and growths as may be regarded as within the scope of direct surgical interference should be, of course, removed. Where this is impossible, either from the number of tumours or from position, various internal remedies, as arsenic and liquor potassæ, may be given, with fair prospect of success in certain instances; and, these failing, the author would advise electrolysis as offering a reasonable expectation of arresting the increase of the tumours. A. WILLETT.

FIBULA, Fracture of the. *See* LEG, Fractures of the.

FILARIA or DRACUNCULUS MEDINENSIS (Guinea-worm).—*Definition.* — A nematode worm of the genus Dracunculus, which attains to maturity in the human body, and produces the disease called Dracontiasis, the main feature of which is the formation of a subcutaneous tumour just before the exit of the worm.

Etiology.—The disease is due to swallowing the water containing the larvæ, and not, as formerly supposed, to the young worm penetrating the skin of the foot, &c., while bathing. The disease is endemic in Arabia, Hindostan, Upper Egypt, Nubia, Abyssinia, the Gold Coast and coast of Guinea, and a few other places.

Symptoms.—The worm gives rise to no symptoms until it is nearly mature, when it may be felt under the skin like a coil of string. When about to escape, in a mild case, a circumscribed pea-sized tumour is

formed, not always at the place where the worm was first observed, with itching and a feeling of tension; the tumour ruptures, either from scratching or poulticing; a serous fluid escapes, and the white head of the worm can then be seen at the bottom of the cavity; it is usually soon protruded, and, if properly managed, the whole worm is removed in from three to ten days. In more severe cases violent inflammation may occur along the whole worm-track, and a painful abscess is then formed, with smart febrile symptoms, and the worm may die and be so softened that it breaks during extraction—a very serious accident, whether it is alive or dead, which may lead to crippling gangrene, or even death, due it is supposed, to the escape of the embryos into the tissues, and the setting up thereby of violent inflammation. In more fortunate cases the worm is discharged at a later period by the formation of a fresh tumour. The point of exit is, in over 90 per cent., in the lower extremities, usually from some part of the foot, especially the heel, but in exceptional cases has occurred from almost every part of the body. As a rule there is only one worm, but two are not uncommon, and as many as fifty have been recorded.

Pathology.—The female worm, which is alone concerned in the production of the symptoms, is one-tenth of an inch thick, and from 1 to 6 feet long, the usual size being from 25 to 30 inches, with a curved pointed tail, and a slightly convex head. It is viviparous, enclosing an enormous number of embryos which, after their escape from man, if they get into water, penetrate a minute crustacean of the genus Cyclops and undergo their full larval development; the Cyclops host is swallowed, the larvæ develop, conjugate, and then the female sets out on her migrations into the muscles, &c., while the male, it is supposed (it has never been seen) dies, and is cast out with the fæces. The female undergoes further development in the deep tissues, but it is nine or ten months from the time of her entrance into the body before she appears at the surface.

Diagnosis.—This can only be made when the worm can be felt under the skin, and is confirmed if it migrates while under observation.

Prognosis is favourable as a rule, if the worm is not broken in abstraction, or unless unusually violent inflammation occurs along the worm-track.

Treatment. — The tumour or abscess should be poulticed to facilitate its opening, and the worm should then be seized and very gently drawn out, as far as it will readily come; the end is then wound round a piece of stick, and a turn or two carefully given every day, until the whole worm is extracted, the greatest care being exercised not to rupture it. Horton recommended large doses of assafœtida, to kill the worm before the cavity was opened, and then poulticing, a plan which answers very well. When the worm is broken, and violent inflammation ensues, this must be treated on ordinary surgical principles, amputation of the limb being sometimes necessary when gangrene has occurred.

H. Radcliffe Crocker.

FILARIA SANGUINIS HOMINIS.

Historical Résumé.—In 1866, Wucherer, at Bahia, discovered, in the urine of a patient suffering from hæmato-chyluria, living microscopic nematode worms (embryo filariæ). In 1868, Salisbury described, under the title of Trichina Cystica, nematode worms he had found in the milky urine of an insane patient. In 1870, Dr. Spencer Cobbold found, in the hæmaturic urine of a young girl from Natal, besides the ova of Bilharzia, not only embryos but ova of a næmatode worm, but was doubtful of their significance. In 1870, Dr. Timothy Lewis found in the chylous urine of a patient at Calcutta microscopic nematode worms in a living state, which, on being sent to England, were classified by Dr. Parkes and Mr. Busk as belonging to the Filaridæ. In 1872, Dr. T. Lewis discovered minute nematode worms, in a state of great activity, on a slide containing a drop of blood obtained from the finger of a Hindoo. These he recognised as identical with those he had previously found in the chylous urine. The man whose blood contained the worms could not be subsequently found, so that nothing could be ascertained as to his past history, nor of the pathological conditions which may have been associated with their presence. This hæmatozoon Lewis named *Filaria Sanguinis Hominis.* He subsequently found filariæ in the blood of many patients, and in the various tissues and secretions of a number of others, all of whom were known to suffer, or to have suffered, from chyluria, or some closely-allied pathological condition. They have since been found by different observers within tolerably well-defined geographical limits.

The surmise of Dr. Cobbold, from the discovery of ova in blood sent from Australia, that the hæmatozoa were the embryos

of a larger worm probably inhabiting the lymphatic system, was confirmed by the discovery of the parent worm, in 1876, by Dr. Bancroft, at Brisbane, and a few months later (1877) by Lewis in India. Parent worms have also been found, in all cases in lymphatics, by Manson in China, and by Aranjo and Los Santos in Brazil. From Bancroft being the discoverer of the parent worm, Dr. Cobbold named it *Filaria Bancrofti*, but, by general consent, the name given by Lewis (who, moreover, was the first to supply a proper diagnosis and anatomical description of the mature worm), to the hæmatozoal embryo—*Filaria Sanguinis Hominis*—has been adopted. It was further ascertained by Manson, in 1878, that the mosquito acts as an 'intermediary host,' the embryos sucked up, with the blood containing them, by the female mosquito undergoing developmental changes in its body. In 1880, Manson made a further important discovery, viz. that the embryo filariæ are not present in the circulation during the whole twenty-four hours, but that they disappear in the daytime and reappear each evening. These observations have been confirmed by Dr. Wykeham Myers, at Formosa, and by the writer, and the latter has further shown that this 'periodicity of filarial migration' is in some way connected with the moving and resting condition of the host. Lastly, Manson, from observations of his own and others, that ova sometimes escape prematurely from the female parent, has advanced a theory of the pathological changes induced by filarial infection, which unites the various maladies associated with the presence of filariæ in the human subject, and at the same time explains how the parasite may exist in the lymphatics and the embryos in the blood without any marked manifestations of its presence. The pathology of these diseases has also been elucidated by Dr. Vandyke Carter, Lewis, Sir Joseph Fayrer, and others.

The Mature Filaria Sanguinis Hominis.—The female is a fine, thread-like worm of white colour, about 3 to 3½ inches long and about $\frac{1}{100}$ of an inch wide. The body is of uniform thickness, and the cuticle smooth and devoid of transverse markings. The head is club-shaped, with simple circular mouth, destitute of papillæ. The vagina opens about $\frac{1}{25}$ of an inch from the head; it is very short, and bifurcates into two uterine horns, which run backwards nearly to the tail, and in the fecundated condition are stuffed with embryos at all stages of development. The following careful measurements by Lewis will serve for identification:—

	of an inch		mm.
Oral aperture to end of œsophagus	$\frac{1}{55}$	or	·45
Diameter of oral aperture	$\frac{1}{3000}$	„	·008
Width of neck	$\frac{1}{545}$	„	·045
„ about ¼-inch from anterior end	$\frac{1}{153}$	„	·162
Width where packed with ova and embryos	$\frac{1}{100}$	„	·25

The entire male has not yet been obtained, but a portion ½-inch in length, examined by Lewis, measured $\frac{1}{180}$ of an inch transversely; it was thinner than the female, but of firmer texture, and manifested greater tendency to coil. The intestinal canal measured $\frac{1}{633}$ of an inch across, and the spermatic tube $\frac{1}{1500}$ of an inch.

The female is viviparous, the embryos, having stretched their chorional envelopes, emerging from the vagina and manifesting active movements. Parturition appears, from observations by Manson, to be a continuous and not an intermittent process.

The *ova*, fully formed, measure about $\frac{1}{500}$ by $\frac{1}{750}$ of an inch.

The *embryos*, measuring from $\frac{1}{75}$ to $\frac{1}{90}$ by $\frac{1}{3200}$ to $\frac{1}{3500}$ of an inch, are fine thread-like worms of a uniform thickness, with rounded head and tapering tail. They are translucent and apparently structureless, but Manson describes a kind of pouting movement noticeable at the anterior extremity. The embryo is enclosed in a delicate sheath, which is often difficult to detect. When, however, the embryo has been kept for some time on a microscope slide, the body shrinks, and the sheath becomes very manifest; the animal, shortening its body, retracts itself from the superfluous envelope at one or other extremity, and again on stretching itself occupies the previously empty sac. The sac is sometimes seen folded on itself ribbon-like. The sheath is easily demonstrated by staining reagents.

The embryo, when freshly removed from the body in a drop of blood, exhibits lively eel-like movements, coiling and uncoiling its body, and lashing the blood-corpuscles by which it is surrounded. It may be kept alive for many days in a drop of blood on a slide, simply mounted with a cover-glass, especially if the edges of the preparation are prevented from dessication by a film of oil or paraffin. Under these conditions, after a time, its movements become less and less active; from being coiled its body becomes gradually extended and straightened; then only feeble move-

ments of the extremities occur from time to time, and finally these cease. When dead, the body is nearly always more or less extended, assumes a granular appearance, and is often partly retracted from the sheath. When a slide containing a number of embryos is watched day after day, some of them disappear by a process of solution. The embryos are best searched for by a one-inch or half-inch objective, and when present, usually, if the examination is made at night, from 10 to 100 may be counted on a slide. The number circulating in the blood in most cases must be enormous. From the number counted in a cubic millimetre of blood, in a case under the care of the writer, it was computed that the patient's blood contained from 36,000,000 to 40,000,000 at the maximum at night.

Habitat of the parent and embryo filariæ.—It has been established by the observations of Bancroft, Lewis, Manson, and others, that the parent worms are located in the lymphatics, the two sexes living together. Apparently any part of the lymphatic system may be occupied, but the abdominal, iliac, scrotal, spermatic, and femoral regions seem to be involved more frequently than other regions. When the lymphatic channel is free and unobstructed, the embryos emitted from the parturient female into the lymph-stream pass with it along the thoracic duct to its termination, where they finally reach the blood. Should, however, the lymphatic channel be occluded at any point proximal to that inhabited by the parent worms, the embryos will be confined to the distal side of the obstruction, and will not reach the blood.

Filarial Periodicity.—In ordinary circumstances when the blood of a filariated patient is examined between 6 a.m. and 6 p.m., the embryo filariæ are either entirely absent, or only one or two are found in a drop of blood. At about 6 p.m. they begin to make their appearance; at 9 p.m. they are numerous, and at midnight they reach their maximum. From this hour they again diminish, so that by 3 a.m. they are less numerous, and by about 6 a.m. they have disappeared, or a few stragglers only are found. This periodicity, which was first observed by Manson, and confirmed by Dr. Wykeham Myers, is not a habit of the filariæ confined to the tropics, but has been observed by the writer in a case in this country imported from India, and in a case observed by Dr. Lloyd Jones. The knowledge of this periodicity of filarial migration is of the highest practical importance, for, unless the blood is examined *at night*, filariæ may not be discovered, even when a patient is infested with them. The full explanation of filarial periodicity has not been arrived at; but the writer has shown that, whilst it is uninfluenced by the hours at which regular meals are taken, it is in some way connected with the moving and resting (or sleeping) condition of the host. For, in a case under his observation, he was able, by turning the patient's day into night and night into day, to invert the periodicity, so that the filariæ swarmed into the blood in the daytime when the patient was at rest, and almost or entirely disappeared from the blood at night when the patient remained up and moving about. This observation has been confirmed by Dr. Manson, who has further shown that prolonged sleep probably disturbs periodicity and diminishes the number of embryos circulating at the time of maximum, and that when the usual allowance of eight hours' sleep is taken in spells of four hours at a time, at intervals of eight hours, periodicity is disturbed, and the numbers circulating at the time of maximum are sensibly diminished. The periodicity is further influenced by the febrile state. When pyrexia is present the periodicity is disturbed—not immediately, but after it has lasted for some days; in a similar manner, the regular rhythm of filarial migration is not re-established immediately on the cessation of the increased temperature of the body, but only after the fever has ceased for some days.

What becomes of embryo filariæ when they disappear from the general blood-stream, is not known. Dr. Manson suggests that they repose in the blood-vessels of the lungs, or some other blood-reservoir, during the day. Dr. Wykeham Myers has advanced the view that the embryos found in the blood each night are a separate brood, which perishes in the morning, to be replaced by a new brood the next night. This view is mainly founded on his observations as to the activity and viability of the embryos on removal from the body, at the hours when they enter and leave the general circulation. Dr. Myers asserts that, whereas those found in the blood in the evening are invariably strong, active, and long survive their removal from the body, those found in the blood in the morning are feeble, lethargic, and survive their removal from the body for a shorter time than the evening embryos. Dr. Manson has not been able to confirm Myers' observations. This theory of a diurnal brood necessitates intermittent parturition, and the issuing of a fresh swarm from the parent every twenty-

four hours. In opposition to this, Manson has shown that the parturition of the adult female is a continuous and not an intermittent act. It is further thought by Cobbold, and others competent to judge, that the enormous number of embryos in the blood precludes the possibility that they could be a single brood, even assuming that several fertile females are present.

The rôle of the mosquito.—The discovery that the mosquito acts as an 'intermediary host' to the filaria sanguinis hominis—that is, that whilst in the body of the mosquito certain developmental changes take place in the embryo which fit it for its ulterior destiny—made by Manson, has been confirmed by others. It has not been clearly ascertained whether this office is confined to a single species of the culex, or whether several species are capable of performing it; but it is certain that some species of mosquito are impotent to assist the embryo, digesting them but not nurturing them. The fact that all mosquitoes are not efficient in this respect may be an explanation of the limitation of filarial infection and its results in regions quite near together. The mosquito feeds by night—the female only sucks blood—and the periodicity of filarial migration appears an adaptation of nature to allow for the removal of the embryos to complete their cycle of development. Further, there seems to be a mutual adaptation between the perforating instrument of the mosquito (the proboscis) and the shape and character of the movements of the embryos, so that when the proboscis penetrates a blood-vessel the embryos become entangled around it, or attracted to it; and thus a drop of blood from the freshly-gorged mosquito is found to contain a larger number of embryos than a drop of the blood obtained from the bitten subject. Received into the stomach of the mosquito, some of the embryos are digested even by the friendly mosquito, but others perforate the thorax of the mosquito and commence a series of changes. These have been studied with great care and detail by Manson. That certain developmental changes of the embryos take place in the body of the mosquito, has been established by Lewis, Bancroft, and Sonsino, but the later shades of development described by Manson have not yet been confirmed.

Most mosquitoes lay their eggs and die during the fifth or sixth day after feeding, so that the final stage is difficult to trace. What becomes of the filariæ after this stage can as yet be only conjectured. The mosquito lays its eggs upon the water and soon after dies, its body probably falling into the water. The embryo probably perforates the body of the dead or dying mosquito, or is liberated by its decomposition, and escapes into the water, for which medium it is admirably adapted. It is, further, in the highest degree probable that the metamorphosed and free embryo gains access to a fresh human host through the medium of drinking water, and on arriving in the alimentary canal perforates its way, by that kind of elective affinity which leads the trichina to the muscles, the liver-fluke to the bile-ducts, the strongylus-gigas to the pelvis of the kidney, &c., to some lymphatic, where it grows to adult size, is impregnated by the male, and sends forth a fresh progeny to perpetuate the species.

The geographical distribution of Filaria Sanguinis Hominis, and prevalence in infected regions.—The exact distribution of the parasite has not been absolutely determined, but judging from the diseases attributed to its influence, this is probably well-defined. It is an inhabitant of tropical and sub-tropical climates, and its limits are probably co-extensive with chyluria, so often due to it, and which Lewis states occurs, with rare exceptions, between 30° south and 30° north latitude. With regard to its prevalence, Manson has shown that at Amoy and the surrounding districts, amongst patients applying for treatment for miscellaneous diseases, and in their relatives and friends not themselves diseased, filariæ are found in the blood in about one in ten persons examined, and that, allowing for their occasional absence, one in eight persons are probably so affected. At Bahia, Drs. Paterson and Hall found filariæ in one in twelve, but from the insufficiency of the examinations, they calculate that this is an under-estimate. This, in both the above instances, is almost certainly the case, for the examinations were mostly made by day, before the nocturnal periodicity of the filaria had been discovered. Exact information on this point does not appear to have been collected in India, Australia, and other affected regions.

Both sexes are liable to be infected by the filaria sanguinis hominis, and Manson's observations tend to show that the prevalence of filarial infection increases with age.

The conditions associated with, or dependent on, filarial infection.—The above statements by Manson, Paterson, and Hall, as well as the experience of many observers in India, show not only that filariæ may be present in the blood in persons not suffering

from any of the diseases attributed to the parasite, but that they may exist in the blood without any other evidence of disease. This does not militate against filarial infection being the true cause of the various morbid conditions commonly associated with their presence, for—(1), this association is too frequent to be merely the result of coincidence; and (2), an explanation can be afforded which at once accounts for the presence of filariæ in the blood without these diseases resulting, and for the production of disease in the cases in which they occur.

The diseases that have been found associated with the presence of filariæ in the blood or lymph, and have been attributed to this cause, are the following: chyluria, hæmaturia (certain forms), varicose groin-gland with lymphangitis, lymph-scrotum (nævoid elephantiasis) elephantiasis (arabum) of scrotum or legs, hydrocele and affections of the spermatic cord and testis, and 'craw-craw,' a form of skin-disease. Less certainly connected with filarial infection are—diarrhœa, cachexia, debility, deafness, and eye-disease. It is not claimed that the most typical of these are always so caused (Fayrer), but filarial infection gives an efficient explanation of the first group. With or without local disease filariated persons are liable to irregular pyrexia (elephantoid, lymphatic or filarial fever) which is often mistaken for ague. It differs from true malarial (intermittent) fever, in the irregularity of the attacks, and in the greater length of both the febrile paroxysm and interval.

Whilst many—especially Sir J. Fayrer, Lewis, Bancroft—have connected filariæ and several of the previously named diseases as cause and effect, the most complete explanation of the pathology of filarial diseases has been advanced by Dr. Manson, whose theory is as follows. The parent filariæ occupy the lymphatics, and, if the lymph-channel is free, the embryos will be carried with the lymph-stream until this commingles with the blood, whence the embryo will be carried to all parts of the body, and no disease necessarily result. If the *glands* or lymphatics traversed by the lymphatic paths are obstructed, the lymph will be dammed up, and the embryo will be confined to the distal branches of the occluded lymphatic, and not reach the blood at all.

Up to this point probably all who have had opportunities of practically studying the subject are agreed. But Manson further believes that—and this view is entirely his own – the obstruction of lymphatics and glands is induced by abortion of the pregnant female filaria. He and one or two other observers have noticed that occasionally ova escape from the female filaria. These ova, the contained embryo not having stretched the chorional envelope, equal from five to seven times the smallest diameter of the embryos, and are not capable of the propulsive movements of the latter. When the ova reach the narrow channels of the lymphatic glands, being too large to pass, they act as emboli, plug the vessels, and obstruct the lymph. 'There will then be complete stasis of lymph in this particular vessel as far back as the first anastomosing lymphatic. Along this the current will now pass, carrying with it other ova; these, in their turn, will be arrested at the first gland they reach. And this process of embolism, stasis of lymph, diversion of current into anastomosis, will go on until the whole of the lymphatic glands, directly or indirectly connected with the vessel into which the parent parasite ejects her ova, are rendered impervious, provided the supply of embolic ova is sufficient, kept up long enough, or renewed from time to time. The particular form of lymphatic disease, and the place affected, will depend on the position occupied by the parent worm, on the number of ova she ejects, on the frequency with which these miscarriages are repeated, and on the nature of the tissues involved, and individual peculiarities and accidents.'

The writer ventures to suggest that in some cases the lymphatic obstruction that gives rise to the various diseases associated with filarial infection may be caused by inflammation excited by the presence of the parent worms, without filarial abortion being a necessary step in the process. It may be further inferred that any condition which brings about mechanical obstruction of the lymphatics, of a lasting kind, will be followed by similar results, and thus may be explained what is known to occur, that the various diseases ascribed to the influence of filaria sanguinis hominis may happen without the presence of this parasite. Plugging of the upper group of the superficial inguinal glands, if anastomosis is not established, will give rise to 'lymph scrotum,' or to elephantiasis of the scrotum. If the lower group of these glands is obstructed, elephantiasis of the lower extremity may result, the two affections, from the intimate connections of these two groups of glands, being frequently associated. Where the lumbar glands are affected the lymphatics of the spermatic cord may be involved, and hydrocele, simple or milky, be caused. Chyluria or lymphuria will re-

sult when the lymphatics of the bladder, ureters, or kidneys are occluded (*see* CHYLURIA). In many of these conditions, besides chyluria, the over-distended lymphatics rupture and a discharge takes place, lymphous if no regurgitation from the lacteals occurs, chylous if such regurgitation takes place.

Prevention of the diseases attributable to filarial infection.—Whilst the exact mode of entrance of the filaria has not been established, it will be seen that in all probability it is through the medium of drinking-water. Preventive medicine may therefore be of signal service in lessening or stamping out the diseases due to this cause, by insisting that all water used for drinking purposes be filtered, or, better still, boiled.

Filariæ are not confined to the blood of man. *Filaria immitis* is very common in dogs in China, Japan, and India, and other carnivora are known to be similarly affected. Many birds also have filariæ in their blood. The common ringed crow and magpie of China are frequently infested, the parent worms being found in the pulmonary artery or valves of the heart.

STEPHEN MACKENZIE.

FINGER-CHANCRE.—Chancres may occur on any part of the body, and they are unfortunately of not infrequent occurrence on the fingers of those engaged in midwifery practice. A chancre on the finger, whatever may have been its source of origin, often presents throughout its course very deceptive appearances. As a matter of fact the true nature of these sores is but seldom recognised until the constitutional symptoms appear. In some cases this is due to the very slight amount of inflammation which attends them, but in a majority to its excess. It is probable that the finger is seldom inoculated unless there has existed previously some sore or abrasion. Their most common seat is the nail-bed, producing there what may be termed the 'whitlow-chancre.' There is nothing in their early stages to distinguish them from the sores due to common inflammation. They are attended by much dusky swelling of the end of the finger, considerable suppuration, and great pain and soreness. At no stage is there any characteristic induration. The nail often becomes loose, and may be shed or removed by the surgeon. If treatment be adopted early, however, the nail will usually be in part at least preserved, but it often remains ever afterwards rugged and thickened.

In making the diagnosis of finger-chancres the examination of the lymphatic glands is of great importance, but of course does not afford conclusive evidence, since indolent enlargements of them may occur in connection with other sores than those of syphilis. The stages of chancres on the fingers are the same as those of chancres on other parts, and the conditions are just as variable in individual cases. It is not uncommon for the period of incubation (four to five weeks) to pass over without any sore being noticed, but in other cases inflammation in varying degree may be present from the first. Now and then a finger-chancre when not implicating the nail-bed may present, even when at its height, nothing more than a dry dusky and scaly patch, and in these cases the axillary bubo may be omitted or be but very slightly marked. It is in such cases almost impossible to make the diagnosis before the appearance of the secondary rash.

Chancres may of course occur on other parts of the hand besides the fingers, but they are very infrequent. The writer has seen them more than once in the middle of the palm; and here, as on the face and some other parts, they occasionally assume extraordinary dimensions. Thus in one instance almost the whole of the palm of the hand of a policeman, who had been injured in a scuffle, was occupied by a chancre.

Although in a very large majority of cases a finger-chancre is also a 'midwifery chancre,' yet it is of course to be understood that this is not always so. A surgeon's finger may be inoculated in the performance of an operation, or in making a dressing or examination. We also now and then see professional chancres on the fingers of dentists and policemen; whilst in a yet smaller proportion they are met with, either from improper practices or as mere matters of accident, on the fingers of those whose occupations are not attended by any special risk.

For further information concerning erratic chancres in general, the reader is referred to SYPHILIS.

JONATHAN HUTCHINSON.

FINGERS, Amputations of the.—The soundness of what has been designated 'conservative' surgery receives ample illustration in connection with this group of amputations, the principle being the removal of as little of the limb as is compatible with the patient's safety and convenience. The preservation of even one or two fingers is of the last importance to the patient,

from his being able to accomplish more with them than with the most elaborately constructed artificial hand. The wounds, too, owing to the great vascularity and inherent vitality of the parts, usually heal with exceptional rapidity.

The amputations of the fingers may be divided into three groups :—(*a*) The phalangeal ; (*b*) the metacarpo-phalangeal ; and (*c*) the carpo-metacarpal amputations.

The PHALANGEAL amputations may be done either between or through the articulations, or in the 'continuity' or 'contiguity' of the phalanges. The amputations performed through the articulations or in the contiguity, are those more frequently selected, and are done by a short posterior, and a long anterior or palmar, flap. The operation is performed in one of two ways. In the first, the hand is pronated, and the neighbouring fingers being separated and held asunder, the surgeon seizes the portion of the finger to be removed, and forcibly flexes it on the proximal phalanx. The articulation is then easily opened by directing a narrow-bladed scalpel or bistoury across the front of the joint. The operator can facilitate the procedure by pressing the tissues forward with his left index-finger, kept behind the part to be removed. Having divided the ligaments in front and at each side of the joint, and freely opened into it, the scalpel is brought well behind the phalanx and close to the bone, and an anterior or palmar flap of sufficient length is made by cutting from behind forwards. The articular surface of the proximal phalanx should then be removed with either a fine saw or, better still, by a bone-pliers. All bleeding vessels should be secured, and the palmar flap brought up and secured to the edge of the dorsal incision by two or more points of interrupted suture.

Another method consists in making the palmar flap in the first instance by transfixion, the hand being supinated. The articulation is opened into in front, and a short dorsal flap is then formed. The first-mentioned method is decidedly to be preferred. These operations are equally applicable to the amputation of the terminal and second phalanx; the great merit of the procedure being its facility, the ample covering for the bone that is obtained, and that the cicatrix, situated on the dorsal aspect of the finger, is not liable to be injuriously affected by pressure. When possible, amputation in the continuity of the second phalanx is to be preferred, with the object of preserving muscular attachments, and a consequent power of motion in the first phalanx.

Amputations in the continuity are applicable both to the first and second phalanges. They may be done either by antero-posterior flaps of equal length, or by lateral or circular flaps. The first-mentioned is the one most usually selected. The hand being prone, the operator grasps the finger to be removed, and with a narrow-bladed scalpel or bistoury makes a lunated incision over the dorsal aspect of the finger, and a flap from a quarter to half an inch in length. A palmar flap, somewhat longer than the dorsal, should be made by transfixion. The bone is then cleared and divided, either with a fine narrow-bladed saw or preferably with a cutting pliers. The method by lateral flaps is mainly applicable to amputations of the first phalanx, and may be made either by transfixion or dissection. In this operation the surgeon must exercise his own judgment as to the removal or not of the head of the metacarpal bone. As a rule the writer prefers removing it.

The operation best adapted for the next group of digital amputations, METACARPO-PHALANGEAL, is the 'oval' method, so called in consequence of the wound made being somewhat of an oval shape. It consists in making an incision on the centre of the dorsal aspect of the metacarpal bone, commencing a few lines behind the point where the bone is to be divided. The knife, on approaching the head of the metacarpal bone, should make an oval sweep round the finger, following in so doing the natural somewhat transverse crease or groove on the palmar surface, great care being taken to avoid wounding the web of the fingers, the formation of any palmar cicatrix being most undesirable. The tissues on, and at each side of, the bone, are then divided, care being taken not to open into the articulation with the first phalanx. Another point of importance connected with amputations of the fingers with portions of their corresponding metacarpal bones, is in reference to the way these latter are divided. If the 'ring' or the middle finger be operated on, the bone should, as a rule, be divided horizontally in a line at right angles to its axis. If, on the other hand, the fifth or little finger, or, again, the 'index' finger be operated on, the division of the bone should be made obliquely, in order to prevent deformity and the pressure of any sharp edge of bone on the integuments covering them. In dividing the metacarpal bone of the little finger,

therefore, the division should be obliquely from behind forwards and inwards, and the direction should be reversed in operating on the index fingers.

Carpo-Metacarpal Amputations. — With the exception of the amputation of the thumb, these amputations are seldom performed, for the sufficient reason that the operations involve opening the synovial membrane of the wrist, an occurrence which—no matter how careful the antiseptic precautions taken may be—is fraught with considerable peril to the joint.

Amputation of the *thumb* is, of all the amputations on the fingers, the one which the surgeon should be the least disposed to perform. It is only in cases of the most urgent necessity that it should ever be undertaken. The reason for this is that of all the digits it is the one the preservation of which is most important for the patient. By some of the older French authors, it has been well termed *le petit main*. The complete removal of it, therefore, with its metacarpal bone, should be regarded in the light of a *dernier ressort*.

It may be performed in one of three ways:—(1) the oval method; (2) the method of transfixion; and (3) the method of 'direct incision,' i.e. separating the thumb from the other fingers, thus making the web tense, and then dividing this by cutting directly down through it, keeping close to the metacarpal bone until the articulation with the trapezium is reached. This joint is then opened, and the bone disarticulated. A lateral flap is then made by getting the knife behind the bone, and cutting a flap from behind forwards. The great disadvantage of this operation is that a long and often painful palmar cicatrix is left. In fact, the operation has little to recommend it, with the exception of the rapidity with which it can be performed.

The oval method is performed in a manner similar to that already described in connection with the metacarpo-phalangeal amputations. The procedure is one which, though it necessarily takes a much longer time for its performance than the other methods, still is one which, as a rule, is attended with very satisfactory results. The wound made in this operation is not so extensive as in the method by direct incision, and it has the additional merit of there being only one cicatricial line, and that far removed from the palmar surface.

The third and last method deserving of mention is that known as the one by transfixion. It is performed with a small catlin. An oblique incision is made along the posterior aspect of the thumb, dividing integument, long extensor, and a portion of the first interosseous muscle. The incision commences at the centre of the commissure, and extends to a point terminating in front of the styloid process of the radius. Here transfixion of the tissues forming the 'ball' of the thumb occurs, the point of the instrument being made to enter at the termination, and emerge at the commencement of the oblique dorsal incision. The flap is then made by dividing the tissues from within outwards, keeping close to the metacarpal bone.

The capsule of the joint is opened, the bone dislocated and removed. This operation is also performed by reversing the steps of it as already indicated, making the transfixion flap in the first instance, and the oblique dorsal incision afterwards. The procedure is a slight modification of the procedure described by Velpeau.

The oval method is, in M. Guérin's opinion, from every point of view the one to be preferred, and in this the writer is disposed to coincide. The same opinion may also, he thinks, be given as regards amputation of the little finger with its metacarpal bone. This operation is performed in two ways:—(1) the flap method (Lisfranc), and (2) the oval. The former of these is performed by making a flap by transfixion by means of a full-sized triangular bistoury, which is the instrument usually employed. It should be inserted, Malgaigne observes, opposite the ulnar side of the joint perpendicularly from the dorsal to the palmar surface, and a semi-elliptical flap formed by cutting from behind forwards. The knife, keeping close to the bone, should divide the interosseous tissues, cutting from behind forwards to the digital commissure. The joint should then be opened, and the bone dislocated. On making traction of the finger, the ligamentous and muscular tissues, as yet undivided, are made apparent and incised by a few touches of the point of the bistoury. A simpler and better method—that by direct incision through the web of the finger and interosseous space – has been thus described by Mr. Heath: 'The finger being drawn away from the hand, the knife, held at right angles to the finger and with its point upwards, is made to cut through the web of the finger and interosseous space until it reaches the base of the metacarpal bone. This is somewhat expanded, and the knife must be turned outwards slightly to open the joint, when forcible traction of the finger will dislocate it. The knife is

then passed round the base of the metacarpal bone, and brought out with the edge forwards, cutting a flap from the ulnar side of the finger, rather longer than the exposed surface, in order to allow for shrinking.'

In the writer's opinion, for amputations in the contiguity of the phalanges, the method by a short posterior and long anterior flap is to be preferred; in amputations in the continuity, antero-posterior flaps of equal length; and in metacarpo-phalangeal and carpo-metacarpal amputations, the oval method should be the operation selected. WILLIAM STOKES.

FINGERS, Congenital Deformities of the.—The more common among the congenital deformities of this region range themselves naturally into two classes—namely, those of excess and those of deficiency. In a very large proportion of instances there is some history of inheritance, and the story, when accurately to be obtained, is often of considerable interest, and may show the existence of similar, though not always identical, deformities in many generations. Extra digits are among the most frequent of all aberrations of type occurring congenitally. Every variety is to be met with, from a small piece of flesh resembling the last phalanx and provided with a rudimentary nail, which is attached by a minute thread of skin to some portion of the outer side of the thumb or the inner side of the little finger, to the perfectly developed digit or digits provided with an additional metacarpal, and even in some cases an extra carpal bone. Sometimes such fingers have special tendons and are accommodated with an efficient vascular system. More commonly, however, their usefulness is very slight and their nourishment but imperfect. The condition may be unilateral or symmetrical, and additional toes may co-exist in the same individual. These are the two extremes of the deformity, but intermediate conditions are frequent, as when an extra phalanx articulates with the distal end of the second phalanx, or where an additional finger articulates by a common joint with the metacarpal, which is then expanded at its extremity, or, in some cases, bifurcated, Where a separate articulation exists it is usually placed below the normal articular surface of the metacarpal or phalangeal bone. Sometimes—and this is especially frequent in the case of the thumb—the extra digit is intimately united along its whole length with the normal finger, and the two move and act freely together.

On the side of deficiency there is met with again every gradation of variety. A finger may be represented by a single phalanx, or all the fingers of the hand, and even the hand itself, may be absent. The thumb, although less often deficient, may be only partially represented, and the little finger, though less frequently absent than others, is often only rudimentary. Not uncommonly all the parts on the ulnar side of the hand may be unrepresented, together with the corresponding metacarpal, and even carpal, bones, and in such cases more or less deficiency of the ulna itself will be detected. The same condition is found, though not so frequently, on the radial side. These cases must be distinguished from those of so-called intra-uterine amputation, which may occur at any part of the hand or arm, though even in these some representative of a digit is very commonly discovered.

Treatment.—The only remedy which may be called for in cases of extra digits is to amputate the part which is excessive and useless. In doing so, it should be remembered that there is usually a common articulation to both the normal and abnormal portion, and, therefore, that it may be impossible to avoid opening the synovial membrane of the former. Even the smallest skin attachment transmits an artery which will require careful ligation. No portion of bone should be left behind, as this will inevitably grow and cause an unsightly and inconvenient prominence. *See* WEBBED-FINGERS. JOHN H. MORGAN.

FINGERS, Dislocations of the. *See* HAND, Dislocations of Bones of the.

FINGERS, Fractures of the. *See* HAND, Fractures of Bones of the.

FISSURE OF THE ANUS.—The affection of the anus usually known by this name is really an ulcer of the mucous membrane, at or immediately above the margin of the anus. The ulcer is somewhat oval, with the vertical diameter greater than the transverse. When the sphincter muscles are contracted, the ulcer is bounded on each side by a projecting fold of swollen and, in chronic cases, indurated mucous membrane, and so resembles a fissure. When the orifice is dilated, the true nature of the case is evident. The lower end of the ulcer is, in many cases, overlapped by a protuberance of mucous membrane, which resembles, and is sometimes mistaken for, a muco-cutaneous pile. The ulcer is generally situated on the posterior wall of the anus, and occurs more

frequently in females than in males. It is comparatively rare in children.

A sedentary life, congestion of the rectum, and constipation are predisposing causes. It sometimes results from parturition. During the passage of the child's head through the vulva, the margin of the anus may be slightly lacerated, and the subsequent irritation of the lochial discharge may cause ulceration. Catarrh of the rectum—whether simple or caused by a polypus, internal piles, or a fistula, or, in women, vaginal discharges—may cause excoriation and subsequent ulceration of the margin of the anus.

The symptoms vary in different cases. Some patients feel merely some irritation or uneasiness during the passage of a motion. In others, defecation is attended with excruciating pain, which may last for several hours. Not infrequently there is intense spasm of the sphincter and levatores ani muscles. The muscles at the neck of the bladder may be similarly affected, and so produce retention of urine. In patients of irritable nervous temperament, this apparently trifling ulcer may cause unceasing torment, and the sufferers complain, not only of local distress, but also of pains in the lumbar and sacral regions, and down the thighs. The anatomy of the part explains these symptoms. The submucous tissue of the rectum is abundantly supplied with a nervous plexus, the terminal branches of which end in the papillæ and epithelium of the mucous membrane. When the surface is ulcerated, these nerve-terminations are exposed, and, when irritated by the passage of fæces, or by mucous or purulent discharges, or even by the tension produced by the contraction of the muscles of the part, may induce reflex spasms and local or referred sensations of pain. As some of these symptoms occur in so-called neuralgia of the rectum, the diagnosis can only be assured by inspection of the part. For this purpose, if there be much spasm, or if the patient be very sensitive, anæsthesia must be induced. The orifice being then dilated by the fingers of the surgeon, or by a Fergusson's speculum, the ulcer, if present, will be seen. The rectum should be carefully examined, to ascertain whether there are any complications, such as catarrh, polypus, piles, or fistula. If there be any of these, or if, in women, there be a vaginal discharge, the complication must be appropriately treated as well as the ulcer.

For the ulcer itself, if it be recent and the symptoms not severe, cauterisation with solid nitrate of silver, and the subsequent application of iodoform in powder, or as an ointment, will usually suffice. If this treatment fail, or if the ulcer be chronic or the symptoms severe, operative treatment will be required. The bowel having been previously emptied, the patient should, if necessary, be anæsthetised, and placed in a suitable position, the lithotomy position being usually the most convenient. The orifice having been dilated by the fingers of an assistant, or by a Fergusson's speculum, a vertical incision should be made along the centre of the ulcer, extending into the healthy tissues above and below it. Any overlapping protuberance of mucous membrane, at the lower end, should be excised. By this incision the mucous membrane and the superficial fibres of the sphincter muscles should be divided. The ulcer may then be dressed with cotton wool steeped in carbolised oil, and subsequently with iodoform. The patient should maintain the recumbent posture, and the bowels be kept at rest for some days. About the fifth day some castor-oil should be administered, to produce an easy action of the bowels. The ulcer usually heals rapidly by granulation, but may require some stimulating application, such as dilute nitrate of silver lotion.

It was at one time considered necessary to completely divide the sphincter muscles. In order to avoid this needlessly formidable operation, the practice of forcible dilatation was adopted. The surgeon having introduced both thumbs into the bowel, resting his fingers on the nates, then separated his thumbs until they came in contact with the ischial tuberosities. By this means the base of the ulcer was torn across. This practice was given up when it was ascertained that superficial division of the sphincters sufficed. It has been recently revived by some surgeons, but does not appear to have anything to recommend it in preference to the limited incision above described. JEREMIAH MCCARTHY.

FISTULA IN ANO.—This is a sinus in the neighbourhood of the anal part of the rectum, of which three varieties have been distinguished:—The Complete, opening into the bowel internally, and on the perineum externally; the Incomplete External, opening on the perineum but not into the bowel; and, the Incomplete Internal, opening into the bowel but not on the perineum. The second and third varieties are very rarely met with, and the diagnosis of the second should only be made after careful examination, as the in-

ternal opening may be small, and concealed by a fold of mucous membrane; or the sinus may travel round the rectum, in the so-called 'horse-shoe' form, and open on the wall of the bowel remote from the perineal aperture. If an internal opening cannot be detected in the ordinary way, by the passage of a probe into the sinus with one hand, and of the opposite forefinger into the bowel, the patient should be placed in the lithotomy position, and a Fergusson's speculum introduced into the rectum, with the slit directed towards the wall of the bowel adjacent to the perineal opening of the sinus. Some milk should be injected, under moderate pressure, into the sinus; and if none pass into the bowel, while the injection is still continued, the speculum should be slowly rotated so as to bring the slit successively opposite to all parts of the circumference of the bowel. Then, if milk pass into the bowel, an internal opening will be discovered, which might otherwise have been unnoticed, or, on the contrary, the absence of any opening can be satisfactorily ascertained.

Cause.—Anal fistulæ result from suppuration of the peri-anal connective tissue. This may be due to perforation of the mucous membrane by some foreign body, such as a fish-bone, or by ulceration. It may also occur without any lesion of the mucous surface, possibly in connection with the lymphatics, or blood-vessels, or glands of the part. If a free opening be made in the perineum as soon as fluctuation can be detected, the wound will probably heal without further trouble; but if the abscess be neglected, as is often the case, since it causes little pain, it will ultimately point and open in the perineum, generally on one side of the anal orifice, but sometimes in front of or behind it. The abscess-cavity then contracts, but cannot close completely from the constant traction of the anal muscles. The internal opening, if not already existing, will form subsequently, and if the contents of the bowel can pass into the fistula, healing will be still further prevented. The inner opening is usually at some point within the limits of the internal sphincter, which extends upwards to about one inch from the orifice. The inner opening is very rarely higher than this, and in the majority of cases will be found close to the margin of the anus. The channel connecting the openings may be straight or tortuous. It sometimes passes round the bowel, as the so-called 'horse-shoe' fistula. In chronic cases secondary sinuses often form, which may ramify in any direction, so that there may be more than one perineal or internal opening.

Symptoms.—Anal fistulæ are painless, so long as the discharge can escape freely. If the external opening become occluded, the part will inflame; but the patient is chiefly inconvenienced by the surrounding parts being kept always moist and soiled by the discharge. The discharge itself may vary in quantity and character, being scanty or abundant, serous or purulent, according to the patient's general condition and the irritability of the part. Sometimes flatus, or even fæces, pass by the fistula, especially if the inner opening be large.

Diagnosis.—All perineal fistulæ in the neighbourhood of the anus are not necessarily connected with the anus. They may be due to stricture of the rectum, or to necrosis of the sacrum or coccyx, or to stricture of the urethra, or to disease of the prostate gland. The history of the case, the direction of the sinus, and examination of the surrounding parts, will sufficiently distinguish these from an anal fistula. In chronic cases the perineal opening is usually marked by projecting granulations, but in recent cases this indication does not exist, and the surgeon may have to search closely for the orifice, if it be small and concealed by folds of skin round the anus. The direction and extent of the fistula may be ascertained by the cautious use of a probe, and injection, as above described, may, if requisite, be used to discover the internal opening.

Treatment.—The only curative treatment that can be recommended is complete division of the structures between the fistula and the anus. This may be performed as follows:—An aperient should be administered the evening prior to the operation, and if the patient be a male adult, the perineum should be shaved. The patient should be placed on the side corresponding to the fistula, with the thighs flexed or in the lithotomy position. If the fistula be recent and simple, and the patient not very sensitive, an anæsthetic will not be requisite. But in chronic cases, where secondary sinuses may be present, the operation can be performed more satisfactorily if the patient has been anæsthetised. The direction of the fistula having been previously ascertained, a suitably curved director should be introduced through the perineal orifice, and brought out at the anus. A sharp-pointed bistoury, passed along this, should then be made to cut through all the intervening structures.

The angles of the wound, and any undermined skin or mucous membrane, should be excised, and an incision made with a scalpel along the upper wall of the fistula, to divide the callous cicatricial tissue which forms the boundary of it. Secondary sinuses, if superficial, should also be laid open. Sometimes a sinus will be found to extend upward by the side of the rectum. If this be in the submucous tissue, the undermined mucous membrane should be divided. This can be conveniently done with blunt-pointed scissors, one blade being passed up the sinus, and the other up the bowel. But this division must not be carried out of sight and reach of the operator for fear of hæmorrhage. If the sinus extend farther than this, and division be considered requisite, it may be effected by a galvanic or elastic loop.

If the sinus be in the peri-rectal connective tissue, division is unnecessary, as it will close when a free outlet for the discharge has been made. It may, with advantage, be injected with tincture of iodine, diluted with an equal quantity of water. The wound should be carefully packed with cotton-wool, and any oozing of blood can be controlled by the pressure of a pad of lint and a T-bandage. The bowels must be kept inactive for some days. About the fifth or sixth day some castor-oil, or similar laxative, may be administered, and afterwards a daily, easy action of the bowels insured. After each motion the wound should be thoroughly syringed. The wound may be daily filled with cotton-wool, and the compound tincture of benzoin, or nitrate of silver, five grains to the ounce, may be applied with advantage; but many surgeons are content to have the wound syringed out only with a stimulating lotion, thus obviating a daily painful proceeding. The patient must maintain the recumbent position until healing is completed, which usually occurs in about six weeks. Sometimes, however, the process is very tedious, and change of air and sea-bathing may prove of service. As a rule, however, a surgeon will act more wisely in insisting on complete rest, and keeping the patient under his personal supervision until the cure is completed.

Phthisical patients are very subject to anal fistulæ. If the pulmonary disease be far advanced, any operation would be useless. Otherwise the tubercular diathesis need not be any bar to the operation, as the patient's general health will probably be benefited if the fistula can be healed. But in such cases healing is especially tedious, and, in order to prevent disappointment, the patient should be warned of this beforehand.

The Hippocratic treatment of anal fistula by ligature has been recently revived by some surgeons. It has the great advantage of not interfering with the patient's ordinary avocation, but is only applicable in recent and uncomplicated cases. It is unsuitable if there be secondary sinuses, and as these are usually only discoverable when the primary fistula has been divided, the number of cases in which the ligature can be employed with advantage is very limited. The ligature may be inelastic or elastic. If the former, the ligature—whether of silk, whipcord, or silkworm gut—should be passed through the fistula by means of an eyed probe, and then, the probe having been withdrawn, the ligature should be tied so as to constrict the tissues, but not so tightly as to excite inflammation. It should then be drawn tighter daily, or every second day, until it shall have cut through the tissues, and the resulting wound should be dressed with cotton-wool in the ordinary manner. This was essentially the method employed by Hippocrates, who used a five-fold ply of undressed flax corded with horsehair, as a ligature. If the flax became corroded before its task was accomplished, more flax could be attached to the horsehair, and so drawn through. In order to avoid the repeated tightening of the ligature, an india-rubber band of suitable strength may be passed through the fistula, and the tissues at once adequately constricted, the ends of the ligature being either knotted or clamped.

The ligature, whether elastic or inelastic, takes from six to fourteen days to cut through the tissues, and sometimes causes severe inflammation, so that even in the simplest cases, if the patient can afford the requisite time, division by the knife is the preferable procedure.

Sometimes, but very rarely, anal fistulæ heal spontaneously. In cases of incomplete external fistulæ, examination of the mucous membrane of the bowel with a speculum will sometimes disclose a punctured cicatrix, corresponding to what had been the internal opening of a complete fistula. If there be a free outlet for the discharge, the rest of the channel may also close. This result may be aided by dilatation of the perineal opening with laminaria. But the process is tedious, and the benefit often illusory, since the fistula, even if it should close, is prone to recur. This mode of treatment should therefore only be adopted

when, from the general condition of the patient, operative treatment is impossible.

Incomplete Anal Fistulæ.—In the external variety, a director should be thrust through the thinnest part of the undermined mucous membrane of the bowel, and the case treated as one of complete fistula. In the internal variety, a curved director should be passed into the sinus, which should then be laid open down to the perineum, and the resulting wound dressed in the ordinary manner.

JEREMIAH MCCARTHY.

FLAT-FOOT.—*Definition.*—A falling down or giving way of the normal arch of the foot, which may be so slight as to be scarcely noticeable except from the discomfort it causes, or so severe that the inner malleolus touches the ground, with the outer border of the sole raised.

Causes.— Flat-foot is directly due to weakness of the leg-muscles, which pass in front of and behind the inner malleolus into the sole of the foot. Infants on commencing to walk are normally flat-footed and without any arch to the feet; after running about for a few months, a perfect arch is formed when the muscles of the leg have become sufficiently developed. Anything that weakens the patient generally tends to produce flat-foot, as too rapid growth, the occurrence of acute fevers, &c. Infantile paralysis of the leg produces flat-foot as soon as the patient begins to walk. The writer finds that two out of every three patients with lateral curvature of the spine have flat-foot of varying degrees of severity. Flat-foot is intimately associated with knock-knee, and the one may induce the other, or both may commence simultaneously. Injury or chronic disease of one leg, throwing extra work on the sound limb, will frequently induce flat-foot in the latter.

Pathology.—When flat-foot is due to general muscular weakness, there is at first a simple relaxation of the tarsus with slight displacement downwards of the scaphoid, which can be easily replaced when the feet are taken off the ground, or by standing with the heels raised. In time, the scaphoid becomes more and more thrust inwards and downwards till it is partially dislocated; this sub-luxation is accompanied by more or less displacement of the inner cuneiform bone and the astragalus. The articular surfaces of the scaphoid and adjacent bones become so altered that complete replacement is no longer possible. When the tarsus has become so distorted, the muscles of the leg and sole may in time recover their strength, but are unable to restore the depressed arch of the foot. While the muscles are weak and unable to support the plantar arch, undue pressure and tension are thrown upon the ligaments and tendons in the foot, which become irritated and painful. In some cases, so much irritation is produced that the articulations between the scaphoid and the inner cuneiform in front and the astragalus behind become inflamed, and ankylosis results.

Symptoms.—As already mentioned, flat-foot is a very general term and includes everything from a slight relaxation of the plantar arch to extreme cases where the internal malleolus touches the ground, as in some cases of infantile paralysis. In severe cases there may be scarcely any pain or discomfort, except that of wearing down the inside of the boot in an unusual way, which may be accompanied by a sort of waddling gait in walking; while a patient with but very slight flat-foot may suffer constant severe aching or acute pain over the whole inner aspect of the plantar arch, extending upwards over the dorsum of the foot and frequently even up the legs to the knee or beyond.

Treatment.—With a view to treatment cases of flat-feet may be divided into three groups:—

(1) Cases in which it is possible to restore the foot completely to the normal shape by passive manipulation, without any decided force being employed.

(2) Cases in which the tarsal bones have become more or less fixed in their displacement by fibrous ankylosis, shortened ligaments or osseous deformity, and which require operative interference under anæsthetics.

(3) Intermediate cases, in which *partial* restoration of the normal plantar arch is possible by passive manipulation. Groups (1) and (3) require (*a*) the restoration and maintenance of the previously depressed plantar arch, and (*b*) the strengthening and approximation of the parts that support the normal instep.

(*a*) Boots really shaped to the form of the feet should be worn, made from an outline drawn round the foot while the patient is standing with the toes, especially the great one, well spread out inside the stocking, so that the inner margin of the foot is nearly straight and parallel with that of its fellow. It is essential that the outer portion of the sole should also touch the ground through the boot, which in all severe cases should be made without a heel, and with the 'waist' stiff, since the chief

motion of the foot during walking takes place at the metatarso-phalangeal articulations, and not in the arch of the foot. A wedge-shaped pad, with the straight side forming the base, and corresponding in size to the normal hollow of the plantar arch, is fixed inside the boot. The best materials for the pad are superimposed layers of felt or horsehair, firmly packed in a suitably shaped leather case. Steel springs or solid india-rubber pads cause too much discomfort, if they be fairly brought against the depressed plantar arch. In no case is the pad to extend right across the 'waist' of the boot, as this at once interferes with the normal transverse plantar arch. The boot being made without heel, the pad has the same effect in it as on the ground. The boot must be laced, as the pad, to be efficient, should be well braced up against the plantar arch. In more severe cases, if the foot still treads over, it is necessary to have, in addition to these properly made boots, an outside leg-iron to below the knee, fixed to the boot, with a triangular leather band on the inside, attached to the sole and fastened round the iron. Where possible, these irons should be avoided, as they interfere so much with the use of the feet.

(*b*) To strengthen and approximate the parts that support the plantar arch, systematic exercise is most useful. Walking forwards and backwards bare-footed on the toes, with the heels moderately raised, for 100 steps, several times daily, is easily carried out and is very efficient; so also is walking on the outside edge of the feet, with the soles directed inwards and slightly forwards.

Anything causing cold feet must be removed, such as tight garters worn above or below the knee, which should be replaced by suspenders attached to a band round the pelvis. The circulation of the lower extremities, if languid, must be promoted by extra clothing if necessary, and by warm baths, followed by rapid cold sponging and good friction in drying. If the leg muscles are very weak, massage for half an hour twice daily should be employed. *See* Massage.

If any knock-knee is present, this should be corrected at the same time.

In group (2), where the displacement of the plantar arch is immovable, forcible breaking down of the adhesions under anæsthetics should be done, and the patient kept in bed for a few days, when the treatment advised for groups (1) and (3) should be applied. Severer operative measures, such as the removal of a wedge-shaped piece of bone from the tarsal arch under antiseptic precautions, do not appear justifiable to the writer, who has not yet seen a case which offered any reasonable probability of this treatment being of permanent benefit to the mutilated patient. *See* Club-Foot (Talipes Valgus).

Bernard Roth.

FLOATING TUMOURS. *See* Abdominal Tumours, Diagnosis of.

FOMENTATIONS.—A combination of heat and moisture, in the form of a fomentation, is one of the most soothing and at the same time one of the most efficient therapeutic agents which can be applied to inflamed parts. The tensive pain of inflamed parts is relieved, possibly by relaxing tissues and so reducing tension, whilst the severity and extent of the inflammation may be diminished and the formation of pus prevented. The beneficial effects of fomentations on cutaneous and subcutaneous inflammations are striking and apparent, but deeper parts, the internal organs, are not beyond the reach of their influence; they cause relaxation of spasm, as in renal and hepatic colic, and they influence inflammations, as in acute cystitis, orchitis, &c. When suppuration has taken place, fomentations are sometimes recommended, on the ground that they will hasten the advance of pus towards the surface; this is undoubtedly correct, but it is equally certain that the knife, rather than a fomentation, is to be recommended, for by its means the pus may be evacuated at once and further destruction of tissue arrested, whilst the natural process, accelerated as it is by fomentations, involves the breaking down of all the tissues lying between the abscess and the surface. But when the abscess has been opened, and the tension of accumulated matter removed, the inflammation will tend to subside, and then fomentations are very useful, as they hasten the resolution of the inflammatory products.

When the skin of the inflamed part is not broken, soft flannel, wrung out of boiling water, or spongiopiline, similarly treated, makes good fomentations, but if the inflamed area be also wounded, antiseptic fomentations are preferable; two or three folds of boracic lint or a thick piece of salicylic wool, steeped in boiling water, and thoroughly wrung out, make admirable antiseptic fomentations. Whatever material be used it must be covered over with a piece of oil-silk or macintosh cloth of larger size than itself, in order to retain the moisture, and this,

again, must be covered with a thick layer of cotton wool, in order to retain the heat; the whole application should be fixed in position by some form of bandage, which is easily applied and easily removed without causing the patient much disturbance. For the limbs the many-tailed bandage is the best. The external covering of cotton wool is most important, for without it the heat of the fomentation would be quickly lost, and even with it the loss is so rapid that it is desirable that fomentations should be changed every hour or two hours.

Fomentations should be wrung as dry as possible, for they can then be borne by the skin at a higher temperature than when the moisture has not been so thoroughly expelled.

To make a fomentation the cloth should be placed in a 'wringer,' consisting of a piece of stout towelling with a rod at each end, and boiling water poured over it into a basin; the fomentation should then be squeezed dry by twisting the rods in opposite directions; in the absence of the wringer an ordinary towel answers very well. The fomentation should be carried to the patient in the wringer and at once applied.

Fomentations are often used as vehicles for applying other therapeutic agents; thus, if a strong counter-irritant effect is desired, 20 or 30 minims of turpentine may be sprinkled on the fomentation; if an anodyne effect be required, one or two drachms of the tincture of opium or belladonna may be sprinkled on the fomentation, or equal parts of the extract of belladonna and glycerine may be first smeared over the inflamed part, and then the fomentation be applied. In some cases the effect of heat without the relaxation of tissue produced by an ordinary fomentation is desired, and then bran, chamomile heads, or sand heated in a pan over the fire and poured into suitable bags, may be applied over the affected parts. These applications are especially effective in relaxing muscular spasm and relieving its attendant pain.

BILTON POLLARD.

FOOT, Amputations in the.—Much of what has been already said in reference to the methods of amputating the fingers, applies equally to the corresponding operations on the toes. Partial amputations, excepting that of the great toe, are seldom, if ever, performed, the stumps resulting being short, useless, and inconvenient, from their tendency to upward projection. The distal phalanx of the great toe is, however, occasionally removed; but it is important to preserve as much as possible of the great toe, so much of the weight of the body being thrown upon it. Previously to the operation, it is desirable to render the part anæmic by the application of an Esmarch bandage. An assistant then draws aside the adjacent toes by means of a loop of bandage over them; and the surgeon, forcibly flexing the distal on the proximal phalanx, makes a transverse incision with a narrow-bladed straight bistoury or scalpel, exposing the joint. Continuing the forcible flexion, the knife is inserted behind the distal phalanx and a plantar flap is cut from behind forwards. Amputation in the continuity of the first phalanx can be done either by the circular, or by antero-posterior or lateral flaps made by transfixion. The latter plan is the one the writer prefers, as there is less risk of a plantar cicatrix. The bone should be divided with a pair of cutting pliers. For the metatarso-phalangeal amputations, the oval method, as already described, is the one most suitable. In the amputation of the great toe, it must be borne in mind that owing to the size of the head of the metatarsal bone, care should be taken to make ample provision for covering it, and that this can best be done by bringing the oval incision well on to the first phalanx.

In cases where the removal of the metatarsal bone of the great toe is indicated, it is well, in order to preserve the insertion of the peroneus longus, if possible, not to disarticulate, but to divide with cutting-pliers or saw, which should be done obliquely, to prevent any angular projection of the edge of the bone. In operations on the toes the surgeon must remember that the joints are more deeply situated than the corresponding articulations in the fingers. The following points should be observed in complete or partial amputation of the toes:—(1) All methods of amputation should be rejected from which a plantar cicatrix may result; (2) the most suitable method in the amputation of all the phalanges is by two curved incisions—a dorsal and a plantar—by which means the largest available amount of integument can be obtained to cover the heads of the metatarsal bones; (3) in the metatarso-phalangeal amputations the oval method should be adopted, and the dorsal incision should be commenced well behind the point where the bone is to be either divided with a cutting-pliers or disarticulated; (4) in this particular group of amputations, disarticulation should be, if possible, avoided, and this is especially important in dealing with the great toe; (5) in dividing the metatarsal

bones, let those of the great and little toe be cut obliquely, to avoid any sharp projection of the edge of the bone against the skin; and (6) let the comparatively greater depth of the joints of the toes than of those of the fingers be borne in mind.

Amputations through the Tarso-metatarsal Articulation.—The method now preferred is that of Lisfranc, which is an improvement on the somewhat complicated procedure of Mr. Hey, of Leeds. Lisfranc, having determined the line of the incision, which is taken from a point immediately behind the spur of the fifth metatarsal bone, on the outside, to a point behind the projection at the base of the metatarsal bone of the great toe, on the inside, makes a curved incision with a strong scalpel, which should reach to a point three-quarters of an inch below the centre of the line corresponding to the articulation, its convexity directed forwards from one point to the other. The incision should not be brought lower down than the point indicated, otherwise the cicatrix would be drawn too far back on the face of the stump, owing to the retraction of the plantar flap. In this incision the integument alone is divided. A second incision made a little behind the first, and on a level with the retracted skin, divides the extensor tendons and dorsal ligaments over the articulations of the 5th, 4th, and 3rd metatarsal bones, assuming the operation to be on the right foot. In continuing this incision to divide the interosseous ligaments, since the 2nd metatarsal is wedged in between the internal and external cuneiform bones, its position must be borne in mind in disarticulating. The joint between the 1st metatarsal and internal cuneiform bone is then opened, thus completing the disarticulation. The interosseous ligaments being freely divided, two lateral incisions are made from behind forwards, their length corresponding as nearly as possible to half the circumference of the foot at the tarso-metatarsal articulation. Grasping the condemned portion of the foot, the surgeon forcibly extends it and cuts the plantar flap from behind forward, keeping as close as possible to the bone. In forming the flap, its edges should be sloped in order to facilitate subsequent adaptation. The vessels requiring ligature are the dorsalis pedis and the plantar arteries. Hæmorrhage having been arrested, the edges of the wound are brought together by means of numerous points of interrupted suture.

Of the foregoing operation an account of a modification practised by the late Prof. R. Wm. Smith was published by the writer some time ago, in which he claimed as an advantage the preservation of the two anterior points of support—namely, the ball of the great toe, and the base of the 5th metatarsal bone. The importance of this is obvious. The operation is performed by making an oblique incision across the four lesser metatarsal bones, commencing about three-quarters of an inch in front of the base of the 5th metatarsal bone, and in a direction towards the metatarso-phalangeal articulation of the great toe. The incision should be made down to the bones and another incision should then be made at the centre of the first one, but at right angles to it, upwards and inwards, for about an inch or an inch and a quarter. The tissues at each side of the second incision should then be dissected off the bones, and these, thus freely exposed, should be obliquely divided close to their proximal articulations with a small saw or fine forceps. The flap should be taken altogether from the sole of the foot.

In the case of a crushed foot, it would be best to dissect up such dorsal and plantar flaps as might be possible, and then to apply a saw at any convenient spot, either in the metatarsus or tarsus.

Chopart's Medio-tarsal Amputation. This operation is a disarticulation through the tarsus between the os calcis and cuboid on the one side, and the astragalus and scaphoid on the other. As guides to the articulation there are two landmarks—one, on the inside, a point immediately behind the tubercle of the scaphoid; and the other, on the outside, a point midway between the spur at the base of the 5th metatarsal bone and the external malleolus. These two points determined, the surgeon grasps and extends the foot, and making a lunated incision between them, carries it arched forwards three quarters of an inch below the articulation. The flap then is dissected back and the articulation opened. Two lateral incisions are next made, as in Lisfranc's operation, to guide the operator in forming the plantar flap, which is made by cutting from behind forwards and keeping quite close to the bones. It has been recommended to make the plantar flap first, which is done by cutting from without inwards, the flap extending to the heads of the metatarsal bones. Care should be taken to avoid a mistake sometimes made of confounding the articulation between the scaphoid and cuneiform bones with the astragalo-scaphoid joint. This is done by remembering that the

articulation lies behind the tubercle of the scaphoid, and not in front of it. Professor von Langenbeck recommends preliminary tenotomy of the tendo Achillis, to prevent the retraction of the plantar flap bringing the cicatrix on the front of the stump; but if the plantar flap be made sufficiently long, as already described, there is no necessity for such a procedure. The arteries requiring ligature are the plantar vessels and the dorsalis pedis, as in Lisfranc's operation, and the same method is adopted of bringing the edges of the wound together by points of interrupted suture.

Other defects in Chopart's amputation have, it is stated, been observed; these are a tendency to eversion or valgus of the remains of the foot, to displacement of the heel upwards and backwards, liability to ulceration on the cicatrix, from its being drawn downwards on the face of the stump, and to the subsequent supervention of caries in the os calcis. These alleged defects of Chopart's operation the writer has not observed; though he can easily understand the probability of their occurrence if the plantar flap be not made of sufficient length. It is necessary to make allowance for the retraction of the plantar tissues which takes place to a greater or less extent after Chopart's operation.

WILLIAM STOKES.

FOOT, Dislocation of the. *See* ANKLE, Dislocations at the.

FOOT, Dislocations of Bones of the. CUBOID, DISLOCATION OF.—From the strong plantar ligaments connected with this bone, and the powerful tendon grooving it, one might infer that dislocation would be a most exceptional injury. There is no recorded case of uncomplicated dislocation; but there are two specimens in the Musée Dupuytren of partial displacement downwards associated with dislocation of the astragalus.

CUNEIFORM BONES.—Dislocation of these bones is rare, and, when it does occur, is determined by their shape in an upward direction. The *internal cuneiform* is the most frequently dislocated in an upward and inward direction, a position due in part, no doubt, to the action of the tibialis anticus muscle. Astley Cooper records two cases, and Smith another, which were left unreduced. Nélaton, for a compound dislocation, removed the bone. All these patients recovered with useful feet. To effect reduction the great toe should be drawn forcibly outwards, and the bone then pressed into its place; but any difficulty in reduction or any tendency to reluxation should suggest to the surgeon the propriety of dividing the tibialis anticus tendon.

SCAPHOID BONE OF THE FOOT.—A simple dislocation *upwards* has been recorded by Walker. A bricklayer, jumping from one wall to another, alighted on his toes and fell forward. The scaphoid formed a prominence on the dorsum, and a depression existed where its tuberosity should, normally, have projected. By drawing the foot forcibly downwards and pressing with his thumbs, the surgeon reduced the bone with a click. Bryant mentions a similar case from Birkett's practice, which was also reduced; and Smith an unreduced case which he saw some years after the accident. Piédagnel has recorded a compound dislocation *downwards*, complicated with fracture, for which amputation of the foot was performed.

SCAPHOID AND ASTRAGALUS. — These bones are occasionally dislocated together upwards and outwards. Burnett has related a case caused by a gentleman, when hunting, taking a fence with his foot pressed strongly against the outer edge of the stirrup. The dislocation was compound, and the bones were reduced by pressure. B. Anger has recorded a somewhat similar case. For dislocations of the astragalus *see* ASTRAGALUS, Dislocations of the.

SMITH'S DISLOCATION OF THE FOOT.—R. W. Smith first described a dislocation of all the metatarsal bones, together with the internal cuneiform, and explained the adhesion of this tarsal bone to its metatarsal as due to the tibialis anticus and peroneus longus tendons being partly attached on either side of the articulation. The foot was shortened an inch; a ridge due to the displaced bones occupied the dorsum of the foot; the plantar surface of the foot was convex transversely and from before backwards, and looked inwards. Dissection showed the bones to be displaced upwards and backwards. Smith describes two unreduced cases of long standing; Dupuytren one which he reduced; and Bryant two cases, one of which was displaced inwards.

The writer proposes to term this peculiar displacement *Robert Smith's dislocation*, in remembrance of that distinguished Dublin surgeon.

TARSO-METATARSAL DISLOCATIONS.—The metatarsal bones may be dislocated together *upwards*, *downwards*, *inwards*, or *outwards*. They may be also dislocated singly, or in groups of two, three, or four; and, rarely, some may be dislocated in one direction, whilst others are dislocated in another

These injuries are caused by falls from a height on the toes (the way in which Smith's dislocation is usually caused), or more frequently by crushing accidents. Many have been for a time overlooked, on account of swelling. The shortening of the foot in front of the ankle and loss of the arch, prominence of the bones, and deflection of the toes, are the principal signs of dislocation of all the bones. In single dislocation the projecting bone is generally evident, and the toe is shortened. In many cases extension has failed to produce reduction, but useful feet have remained. Hitzig has analysed 29 cases; 13 were of single bones, and 16 of the entire metatarsus; 11 of the latter were displaced upwards.

Toes, Dislocations of.—Metatarso-phalangeal dislocations are the most frequent; but inter-phalangeal displacements occasionally take place. Malgaigne records three instances of dislocation of all the toes—two upwards, and one compound and outwards. The latter necessitated excision of the end of the first metatarsal bone before reduction could be effected. The same author has collected 19 cases of dislocation of the great toe, all of which occurred in males. It may take place upwards and backwards, upwards and inwards, or upwards and outwards. The first form is the most common, and is often as difficult to reduce as dislocation of the thumb, for similar reasons. The treatment is the same as for metacarpo-phalangeal dislocation of the thumb.

Subastragaloid Dislocation of the Foot.—A displacement which leaves the astragalus in its normal relation to the tibia and fibula, but carries away all the other bones of the foot in a definite direction, is a not infrequent accident. Much confusion has existed concerning these subastragaloid dislocations, which, till somewhat recently, were altogether overlooked and confounded with dislocations proper of the astragalus, luxations of the os calcis, and midtarsal dislocations. The head of the astragalus is not firmly bound to the scaphoid, there being no inferior ligament uniting them, and but a comparatively weak superior one; hence, except for the support of other bones, this joint offers little resistance to dislocation. With the os calcis the astragalus is united by a strong interosseous ligament; but above there is a kind of mortise-like locking between it and the tibia and fibula, which, it is not difficult to understand, might often bear the strain of injury better than its ligamentous connections with the calcaneum. In this accident the foot separates from the astragalus at the calcaneo-astragaloid and astragalo-scaphoid joints.

Subastragaloid dislocation of the foot may take place in four directions—*inwards*, *outwards*, *backwards*, and *forwards*, of which the first-named is the most common. These dislocations are very rarely complete—that is to say, the articulating facets of the os calcis are not entirely removed from contact with those of the astragalus.

Subastragaloid dislocations may be distinguished from enucleations of the astragalus by the head of the bone being felt at its normal distance from the tibia and malleoli; by the fact that none of its upper articular surface is to be detected projecting beneath the skin; and by the existence of movements of flexion and extension at the ankle-joint. From dislocations of the calcaneum they are to be diagnosed by observing that the whole foot is turned in the same direction as that bone, and that the head of the astragalus has escaped from its socket. Dislocations of the ankle-joint are unaccompanied by the prominence caused by the displaced head of the astragalus, and the movements of the joint are lost.

R. Clement Lucas.

FOOT, Fractures of Bones of the.—Astragalus.—Though not very rarely dislocated, the astragalus is but seldom fractured; some clear examples, however, of this injury have been recorded. Doubtless fracture is sometimes present, though it is masked by the enclosed situation of the bone, or by injury of the surrounding parts. It is usually caused by falls from a height on the feet, and may involve any part of the bone—its neck, general mass, or posterior portion. It is often accompanied by dislocation. The writer lately met with a case in which, together with a partial dislocation, so that the bone was rotated on its antero-posterior axis in such a way that its inferior surface presented directly inwards, there existed a fracture of its internal border. This injury may be combined with fracture of the malleoli.

Symptoms.—Pain on pressure, or on any attempt to bear weight on the foot, the presence of crepitus on movement, combined with an absence of injury to other parts, and diminished height of the malleoli from the ground, would be the most marked signs of this injury. Sometimes the detached fragment has been found protruding under the skin. But when other tarsal bones are injured, and when swelling is considerable, an exact diagnosis cannot be made.

The only *treatment* generally required is to subdue inflammation by position, rest, and cold applications, and subsequently to maintain rest by a well-adjusted splint, or a light case of plaster of Paris. If any portion of the bone is protruded and cannot be replaced, it may be necessary to remove it. This operation should be performed with very careful antiseptic precautions. It is best, however, to postpone interference till the swelling and inflammation following the accident have subsided. As some stiffness is very likely to remain, a guarded prognosis should be given; and the foot should be placed at a right angle with the leg, so that the heel, when the patient is allowed to walk, may be easily brought to the ground.

Calcaneum.—This bone may be fractured either by direct violence, as the passage of a wheel over, or the fall of a heavy weight upon, the foot, by a fall on the feet, or by muscular action. The fracture may take any direction, or involve any part of the bone. When due to direct violence it is often extensively comminuted, and accompanied by great injury to the soft parts of the foot. Sometimes, though rarely, it is compound. When the result of muscular action, it involves the part of the bone lying behind the astragalus, and the fragment, variable in size, is drawn upwards—sometimes slightly, but sometimes to the extent of two, three, or even five inches, by the muscles of the calf. In fracture of other parts of the bone displacement is usually very slight, the fragments being held together by their connection with the surrounding fibrous structures of the foot. Cases in which both calcanea were fractured have been recorded.

The *symptoms* consist of pain, swelling, extravasation of blood, and crepitus, produced by grasping the heel and moving the anterior part of the foot upon it; by fixing the heel and flexing the anterior part of the foot; or by grasping the heel while the patient moves his toes. In cases of extensive comminution there is marked increase in the width of the bone below the malleoli, and flattening of the arch of the foot. When the bone has been severely crushed, especially if the fracture has involved the sustentaculum tali, so that the tendons have been displaced, the strength and movements of the foot are considerably diminished, and there may be a troublesome tendency to valgus. Generally, however, in fracture uncomplicated with much displacement, satisfactory recovery takes place, although repair is very tedious.

Treatment, when displacement is slight, consists in reducing inflammation by position and cold applications, and the subsequent employment of a plaster of Paris or leather splint; and allowing the patient to be about on crutches for two months or more before any weight is thrown upon the foot. At a later period much may be done by careful passive movements, after any adhesions that may be present have been broken down. When the fragment is displaced by the muscles of the calf, the leg must be flexed upon the thigh and the foot extended on the leg, as in rupture of the tendo-Achillis, and retained in that position either by a loop passing from the heel of the slipper and fastened above the knee, or by the apparatus recommended in rupture of the Achilles tendon.

Tarsus and Metatarsus.—Fractures of the remaining parts of the tarsus, and of the metatarsus call for no detailed notice. They are always the result of direct violence, and are frequently compound, and attended with considerable laceration of the soft parts. When the fracture is simple, all that is required after adjustment has been effected is a splint to control the fragments and keep them at rest. For this purpose plaster of Paris is often useful. When the soft structures are lacerated, or when the bones are comminuted, care should be taken to remove parts as sparingly as possible. Yet it must be remembered that when the foot has been crushed the soft parts are often more widely injured than is at first sight apparent, and extensive sloughing of the flaps will sometimes take place.

Howard Marsh.

FOOT and ANKLE, Diagnosis of Injuries and Diseases of.—In diagnosing an injury about the foot and ankle the surgeon must remember—(I) certain bony landmarks; (II) what are the common injuries; (III) the chief points which will help in diagnosis.

I. Bony Landmarks.—*Malleoli.*—The outer descends lower than the inner, and locks the joint in more completely, a point which makes opening the joint in Syme's amputation more easy on the inner side. The tip of the outer is about half an inch below and behind that of the inner malleolus. Their posterior borders are in the same plane, owing to the greater antero-posterior diameter of the internal.

Foot.—Inner side.—(1) Internal tuberosity of os calcis. (2) Tip of internal malleolus. (3) Sustentaculum tali, one full inch below internal malleolus. (4) Tubercle

of scaphoid, one full inch below internal malleolus and a little lower down, the gap between (3) and (4) being filled by the calcaneo-scaphoid ligament. (5) Tuberosity of the internal cuneiform bone. (6) Base of first metatarsal bone. (7) Head of metatarsal bone and sesamoid bones.

Outer side.—(1) Outer tuberosity of os calcis. (2) External malleolus. (3) Nearly one inch below the malleolus, and a little in front of it the peroneal tubercle, with the short tendon above and the long below. (4) Base of fifth metatarsal bone.

II. Injuries Common in this Region. These may, for practical purposes, be divided into two groups.

A. *Those without fracture or dislocation.*—(1) Sprains. (2) Rupture of tendo Achillis. (3) Slipping of tendons.

1. *Sprains.*—Sprains of the ankle are fully described under that heading; it remains only to point out the chief points which distinguish them from fracture or dislocation. Amongst these are the absence of crepitus or bony deformity, the comparatively slight injury, such as a slip or twist on uneven ground, the fact that the patient has very likely been able to use the foot between the time of the accident and the visit of the medical man, the correspondence of measurements between bony points in the two limbs.

2. *Rupture of the tendo Achillis.*—It may be diagnosed by the comparatively trivial violence, as the mere strain of walking, dancing, &c., the feeling of a snap or as if a blow had been struck on the part, the depression between the ruptured ends, increased by action of the muscles, &c. Much more rarely the rupture of a tendon near the ankle takes place in the case of the peronei or tibialis posticus.

3. *Slipping of Tendons.*—This usually takes place with the peronei, which most frequently of all tendons in the body get out of their grooves. The condition may be diagnosed by the history of a twist or slip, followed immediately by pain, swelling, and ecchymosis along the sheath, and the feeling of the tendon as it slips backwards and forwards over the posterior edge of the external malleolus.

B. *Injuries accompanied with Fracture or Dislocation.* — Those most frequently met with are—(1) Fracture of the lower ends of the fibula and tibia, with partial dislocation of the foot. (2) Dislocation of the astragalus. (3) Subastragaloid dislocation. (4) Dislocation at the ankle, which may take place laterally or antero-posteriorly, the dislocation outwards being most common, and all of these dislocations being very liable to be accompanied by fracture of one or other of the bones of the leg. (5) Fracture of astragalus. (6) Fracture of os calcis. (7) Injury to epiphyses, e.g. that of the tibia.

III. The following are the chief points to which paying attention will aid the practitioner in making out the nature of an injury about the ankle, accompanied with fracture or dislocation :—

1. *The kind and severity of the violence*—thus, a sudden exertion, as in lawn-tennis, dancing, running, &c., may produce rupture of the tendo Achillis, slipping of the peronei, or sprain of the ankle. A slip on uneven ground, down a bank, &c., may produce a sprain or one of the slighter forms of fracture of the malleoli, with displacement of the foot outwards or inwards, far more frequently the former. More violent twists, a direct blow upon the ankle, coming down with the foot sideways after leaping, the foot being caught and fixed while the body is free to move, jumping from a carriage in motion, and similar accidents, are much more likely to cause the severer forms of Pott's fracture, and dislocation of the astragalus, or subastragaloid dislocation of the foot.

2. *Comparison of the two ankles and feet.* If a depression is found one or two inches above the external malleolus, with prominence of the malleolus on the inner side, the practitioner will know that he is dealing with Pott's fracture. If, in addition to the above, there is widening between the malleoli, there is probably a split running through the lower extremity of the tibia into its inferior articular surface, as well as a fracture of the fibula. If the malleoli seem to have settled down on to the dorsum, and under the skin of this region is a projection lying obliquely inwards or outwards, resembling the anterior and rounded, or superior and trochlear surface of the astragalus, this bone has probably been dislocated. If the malleoli have not sunk down on to the dorsum, if some movement of the ankle-joint remain, and just in front of the tibia the head of the astragalus can be felt rounded and prominent, one malleolus projecting while the other is buried in a deep fossa, the foot being inverted or everted, and no crepitus obtainable, a subastragaloid dislocation of the foot laterally has probably taken place.

3. *Crepitus.*—This is often difficult of detection in fractures of this region, owing to the rapidity with which the natural fixity of the parts is increased by swelling,

the great pain, and by the fact that occasionally, as in Pott's fracture, reduction may have taken place. The following may aid in detecting crepitus:—Pressure with two fingers on either side of the suspected fracture, e.g. a malleolus; rotation of the foot from side to side; keeping one finger over the suspected site of fracture, and making pressure at a distance so as to 'spring' the bone of the fibula at the spot where this is broken.

In the absence of other symptoms of fracture—e.g. displacement—where, after severe injury, there is much pain, inability to use the foot, and deep-seated crepitus, fracture of the astragalus or os calcis may be present. Where in an apparent fracture of the end of the tibia, the crepitus is modified, when the patient is about sixteen or seventeen, and when the lower end of the upper fragment is smooth and rounded instead of sharp and rough or angular, the injury is separation of the lower epiphysis of the tibia.

4. *Measurements.*—These are of less value here than in fractures of the long bones, owing to the injury not being so localised, and the amount of swelling which so often obscures the bony landmarks. Finding, in examining a suspected case, injury to the ankle or foot, the practitioner will remember that the majority of patients will make no allowance for the difficulty and obscurity which often accompany the examination of these cases, or for the tedious and troublesome sequelæ which sometimes follow on most careful treatment, and, remembering this, he will do well to fortify himself with the advice and opinion of a friend or neighbour.

The most common forms of disease which present themselves for diagnosis in the foot are the various forms of synovitis and caries. Synovitis in its acutest form will be often met with in a sprain of the ankle. Forms much more insidious, and tending gradually, if untreated, to serious disorganisation, are met with in the ankle, the calcaneo-astragaloid, and the medio-tarsal joints. Stiffness and tenderness, preceded by some injury or over-use (both, perhaps, of little apparent moment), are followed by increasing swelling and actual pain. In the case of the ankle-joint the swelling will show itself chiefly in front and around the malleoli. In the case of the astragalo-calcanean joint the swelling is much less distinct, owing to the depth and surroundings of the joint. No certain diagnosis can be made without watching the case, allowing for its insidiousness, its crippling nature, and the exclusion of any evidence of disease of the ankle-joint. In synovitis of the medio-tarsal joints, which should always, if possible, be recognised early, owing to the extent of the synovial membrane and the number of bones with which it is in contact, it will be found, on comparing the two feet, that the natural instep is lost, being gradually replaced by a swelling which gradually becomes more and more clubbed.

Where pulpy disease and caries have followed on synovitis, their presence will be known by the preceding history, the longer duration, the formation of abscesses here and there, owing to the implication of the skin and soft parts, leading to sinuses, with their characteristic bluish, undermined edges and prominent granulations. The chief seats of caries are the os calcis, the ankle-joint, and astragalus (for these may practically be taken together, the latter being only occasionally by itself the site of disease), the medio-tarsal joint, occasionally only the cuboid, and, more often, the metatarsal bones, these being, especially in 'strumous' children, liable to be the sites of multiple caries. From the devious burrowing of pus, sinuses over a bone do not necessarily mean caries of that bone, but must be taken with other points, such as the site of the chief thickening; whether behind and below the malleoli and obliterating the natural hollows there, as in caries of the os calcis, or in front of the malleoli and even a little up the leg over the ankle-joint, combined with impaired movement of the joint, when that is involved, and so in other cases. Sinuses on the plantar aspect of the foot almost always point to that form of caries which is associated with, or secondary to, PERFORATING ULCER.

W. H. A. JACOBSON.

FOREARM, Amputation of the.—Amputation of the forearm may be performed at either its lower, middle, or upper third. Owing to early prejudice against the operation in the lower third on the part of some eminent French operators—notably Larrey—on account of the large number of tendons, the middle and upper thirds were the situations preferred. The opinion generally accepted now, however, is that unless there be some special contra-indication, the lower third is the most desirable situation. The particular operation to be selected depends largely on the situation in which it is to be performed. The circular or rectangular methods are best in the lower third; in the middle of the forearm, the

antero-posterior flap method or the rectangular amputation; and in the upper third, Syme's modified circular, or the antero-posterior flap method. When practicable, amputations of the forearm, whatever method be adopted, should, as maintained by Skey, be performed below the supinator brevis and pronator radii teres, with a view to the preservation of pronation and supination of the limb.

The *circular* operation may be performed as follows:—Pressure on the brachial artery should be made either by digital pressure, by an Esmarch bandage, or a Petit's or Signoroni's tourniquet. The elastic Esmarch bandage is, in the writer's opinion, to be preferred. Supposing the right forearm to be the one to be operated on, the surgeon, standing on that side of the patient, grasps the forearm with his left hand and retracts the skin, the portion of the limb to be removed being held steadily and somewhat elevated by an assistant. A circular incision is then made with a medium-sized amputation knife down to the fascia, and the skin dissected back for the distance of an inch or an inch and a half. The second stage of the operation consists in the division of the muscular tissues at the upper angle of the wound down to the bones. There the interosseous membrane and periosteum round each of the bones are carefully divided, and the bones are then simultaneously sawn across. The radial, ulnar, and interosseous arteries should then be secured, and the wound dressed. This method may also be employed in the upper third of the forearm, but is not so applicable to the centre or middle third of the forearm, where the flap operation is, as a rule, performed.

In this situation the antero-posterior *flap* method, for the reasons already stated, is the operation usually indicated. It may be carried out by long anterior and short posterior flaps, or by antero-posterior flaps of equal length. They may be made either by transfixion, or, if the arm be large and muscular, by cutting from without. Short musculo-cutaneous flaps, with oblique division of the deeper structures, are recommended by Sédillot (Alanson's operation somewhat modified). The simplest and best method, when the middle third of the forearm is the situation to be operated on, is that by antero-posterior flaps made by transfixion. The limb should be held in the prone position by an assistant. The operator then, grasping the dorsal tissues with his left hand, draws them up, determining accurately at the same time the edges of the ulna and radius. With a medium-sized catlin the dorsal tissues are transfixed, care being taken not to fall into the error, occasionally made by unskilful operators, of getting *between* the bones. A flap two or three inches in length is then made, and in doing so the operator should avoid having an irregular, jagged edge to it. This he can best do by avoiding too short and sawing an action of the knife in the division of the tissues. The flap having been made, it is held back by an assistant, and the catlin is then reintroduced in front of the bones, and a flap somewhat longer than the posterior one is made, ending somewhat differently, for the tissues should not be divided so obliquely as in the posterior flap, but cut more abruptly or squarely. The interosseous structures should then be divided, the periosteum carefully incised at the points where the bones are to be sawn, and the latter then simultaneously divided. The radial, ulnar, and interosseous vessels will require ligature, the first two of which will be found in the anterior flap, the radial being most superficial.

Teale's rectangular flap method is, in cases where the tissues are abundant, applicable to amputations of the lower and middle thirds of the forearm. In the upper third, where the bones occupy a more central position, and the muscles are thick, lateral flaps have also been recommended. The writer, however, fails to recognise any advantage to be obtained by substituting this latter method for either the modified circular or the antero-posterior flap operations.

In performing Teale's rectangular amputation, the radial vessels should be in the short flap. 'The operator,' Mr. Teale observes, 'in forming the long flap, makes the two longitudinal incisions merely through the integuments, but the transverse one is carried directly down to the bones. In dissecting the long flap from below upwards, the tissues of which it is composed must be separated close to the periosteum and interosseous membrane. The short flap is made by a transverse incision through all the structures down to the bones, care being taken to separate the parts upwards close to the periosteum and membrane. The prone position is recommended, to allow the dorsal flap to be superior when the patient is recumbent, and thus fall over the ends of the bones.'

In reference to the statistics of amputations of the forearm when performed on account of serious injuries, it is interesting

to note a fact recorded by Dr. Otis, and mentioned by Agnew in reference to the superiority of primary over intermediary and secondary amputations, the mortality of primary being 9·6 per cent., intermediary 23·5 per cent., and secondary 15·7 per cent. The special points to be borne in mind in amputation of the forearm, are:—

I. Division, when possible, of the bones below the insertion of the pronator radii teres and supinator brevis.

II. Selection in the lower third of the circular or rectangular operations, and in the middle and upper thirds of the antero-posterior flap method.

III. In the latter group of amputations the division of the bones at least half an inch above the angles of incision of the soft parts, in order to prevent projection of them at the sides of the wound.

WILLIAM STOKES.

FOREARM, Diagnosis of Injuries and Diseases of the. *See* ARM and FOREARM.

FOREIGN BODIES IN THE AIR-PASSAGES.—Foreign matter of the most diverse kind, gaseous, liquid, or solid, not infrequently enters the air-passages, and gives rise to symptoms, varying in severity and urgency according to the nature, size, shape, and position of the offending substance.

Irritating vapours or minute solid particles suspended in the air, as they touch the upper part of the larynx generally excite such a violent fit of coughing that they are swept away at once, and, beyond the immediate distress and discomfort, give rise to no further consequences. Only exceptionally, when, as in the case of steam from a tea-kettle, they are drawn well in by a sudden inspiration, and inflict serious injury on the mucous membrane, does inflammation follow and affect the larynx, or the trachea and bronchi, or even the lungs themselves. So also with liquids; only, from the peculiar circumstances under which they enter, the consequences are more lasting and more serious. It is rare for them to penetrate further than the larynx, from which they are ejected at once, unless it has undergone some change which has either impaired its sensibility or rendered it less capable of rapid and co-ordinate action. For example, after wounds involving the floor of the mouth or the air-passages (such as cut-throat), and also after tracheotomy, the larynx sometimes loses its delicate sensitiveness, probably from swelling and œdema of the mucous membrane, and does not close with sufficient rapidity to prevent liquid portions of food passing down the trachea into the lungs. Pneumonia set up by this is the cause of the fatal issue in many cases of tracheotomy which have survived both the primary mischief and the immediate effects of the operation. The same thing may happen as a consequence of diphtheritic paralysis, or when a patient is insensible, either from anæsthetics or from alcohol. During operations about the mouth, blood and fluids from the stomach vomited up may be drawn down the trachea, and, according to the amount, either cause an immediately fatal asphyxia or broncho-pneumonia some days later.

Solid substances may enter under similar conditions; sets of false teeth (which ought always to be removed prior to the administration of an anæsthetic), a tooth dropped from the forceps immediately after extraction in the haste to grasp a second, wedges to keep the mouth open, improperly secured, are all recorded as having dropped into the larynx. The same thing has been known to occur during sleep, or in the vomiting following anæsthesia. A case of death after the administration of ether was found to be due to the skin of a ripe plum, rolled up; it had been vomited during the stage of recovery, drawn into the larynx, and was firmly wedged into the right bronchus, so that its upper extremity fell over and occluded the orifice of the left. In the vast majority of instances, however, this very serious accident arises from a careless habit of holding things in the mouth or between the teeth, especially in the case of children. Something or other, such as a laugh or a blow on the back, causes a sudden inspiration, and the substance, whatever it may be, is drawn down through the widely open glottis and lodged in the air-passages before it is known that the hold on it is lost. Blow-tubes carrying a dart, pea-shooters, and other hollow instruments, act in the same way. A child, in trying to fill its chest with air previously to a vigorous expiratory effort, often inspires with all its force through the tube, and draws the projectile into the larynx.

It is rare for solid bodies to enter in any other fashion, but exceptional cases are on record in which they have penetrated through wounds, or, more often, through openings produced by ulceration, especially of a malignant character, where the trachea or the left bronchus lies in contact with the wall of the œsophagus

Cases of epithelioma of the œsophagus are not infrequently brought to an unexpectedly rapid termination by an attack of pneumonia set up in this way.

The symptoms that follow the entry of a foreign body are either immediate and due to obstruction, whether this is caused by the substance itself or the spasm it excites; or else remote and secondary, set up by the inflammation that follows; and they depend mainly on two conditions—the position of the body, as determined by its size, weight, and shape, and the changes which it undergoes itself or induces in the tissues with which it is in contact. For convenience of description the air-passages may be divided off roughly into three portions—that lying above the rima glottidis, including the upper aperture and the ventricles of the larynx; the lower part of the larynx and the trachea, including its bifurcation; and, lastly, the bronchi of the second order and the lungs. Of course this division is artificial, and it does not by any means follow that when a foreign body is fixed in one part the symptoms will be confined to that part; but there is sufficient difference both in the consequences and in the treatment to justify its adoption.

When lodged in the *larynx*, the symptoms caused by a foreign body are most severe and very characteristic. From the spasm, distress, and violent cough produced when anything touches the interior of the larynx, it is easy to infer the course of events when either a large rounded mass blocks the opening by its size, or a smaller but sharp and angular one is impacted in the mucous membrane and sets up spasmodic contraction. The patient starts up wildly, gasping for breath, and clutching at his collar; the face is livid, rapidly becoming cyanosed; the veins in the neck and in the forehead stand out like cords; he may be quite unable to speak, or, more often, if the orifice is not quite closed, utters the most distressing inarticulate cries, attempting at the same time to put his finger down his throat; violent coughing, often leading to vomiting, is rarely absent; the body becomes more and more convulsed, a cold sweat breaks out all over, commencing on the face, and within a minute he may fall down unconscious, fæces and urine escaping without control.

The symptoms, however, are not always so urgent as this; after some time—it may be a few minutes or it may be some hours—they gradually diminish in intensity, leaving the patient in a state of complete exhaustion. But they are liable to return with all their former severity at any moment, and this tendency to recurrence with intervals of almost complete repose is one of the most important points in the question of diagnosis. Their degree of severity depends mainly on the size and shape of the body and its exact position; if it is smooth and rounded, of some material that does not swell up or undergo other change, and lodged in one of the ventricles, they may be exceedingly slight, or be postponed for an almost indefinite period, although the patient is never free from the danger of asphyxia, due to dislodgment and impaction elsewhere, or from the risk of inflammation and ulceration. Pain, or a sensation of tickling in the region of the larynx, often felt in the ear, and a sense of anxiety or of impending suffocation, are nearly always present; so are frequent and violent fits of coughing, characteristic from the sudden way in which they come on, their sharp, spasmodic character, and uncontrollable violence; a change of posture is often sufficient to induce them. At first they are unattended by expectoration, but afterwards, when inflammation has set in, this may be copious, thick, and stained with blood. The respiration, especially in children, is often distinctly croupy, so as sometimes to render the diagnosis difficult; but it is to be noted, conversely to what happens in croup, that expiration is generally more difficult than inspiration. The voice may be quite lost, or may at first be hardly altered in its tone, according to the position of the foreign body; but nearly always it becomes changed and hoarse after the first few hours, from swelling and œdema of the mucous membrane.

If the foreign body is allowed to remain, the symptoms that arise vary greatly in different cases. When it is sharp and pointed, or of such nature as to be a continual source of irritation to the structures among which it is lying, inflammation sets in rapidly; and although confined at first to the larynx and the immediate neighbourhood of the offending substance, soon spreads thence to adjacent parts, and finally to the trachea and lungs. Ulceration of the mucous membrane, involving the cartilages at last, and causing necrosis and destruction of the articulations; spasm and œdema of the glottis, with constant danger to life at any moment; emphysema of the lungs; congestion, followed by bronchitis and broncho-pneumonia; rupture of blood-vessels from the violence of the cough may

ensue. Great impairment of the general health, ending in fatal exhaustion, from the combined effect of inflammation, continued anxiety, and want of rest, will follow inevitably sooner or later, sometimes commencing within a few days, or, in exceptional instances, not sufficiently severe to attract serious attention till years have elapsed and the exciting cause has almost been forgotten.

In those cases in which the foreign body slips between the vocal cords and enters the *trachea*, but is too large to be admitted into the bronchi of the second order, the immediate symptoms are, as a rule, of less intensity, the secondary ones more severe. They seem to depend mainly on whether it is fixed in the mucous membrane of the trachea or remains free in the interior, so that it can move up and down, and depend consequently more upon the shape and weight of the substance than anything else. A smooth, round, heavy body, such as a coin, falls down to the bifurcation, and, owing to the position of the septum, is generally directed to the right side, where it either becomes impacted in the bronchus or remains free, and with every cough shifts its position. This makes the diagnosis more easy, for in addition to the distress, dyspnœa, and pain that are always present after the entry of a foreign body, every time it comes in contact with the larynx or moves in the trachea it excites such violent paroxysms of coughing, often preceded by a deep whooping inspiration, as are seldom met with under other conditions, especially as aphonia under these circumstances is not a common symptom. Sometimes the patient is himself conscious that the body shifts its position; or it may be heard, and even has been felt from the outside, moving about in the trachea. It occasionally happens that during one of these attacks the foreign substance escapes through the orifice of the glottis with instant relief; but it must not be forgotten that it may be caught and held in the same situation, and give rise to a spasm that will prove rapidly fatal.

If the shape is more irregular, particularly if it is pointed at one end like a bearded ear of corn or a puff-dart, both of which are more than usually dangerous from the way in which they lie with their points uppermost so that each cough drives them further and further in, it generally becomes fixed, and soon excites inflammation, attended by copious expectoration and ulceration. The rapidity with which this sets in depends on the irritating nature of the body and on the changes it undergoes. Some organic substances, particularly when they are retained in a bronchus in contact with the mucous membrane all round, and exposed to a moist and even temperature, swell up to double their former size, and, in the case of seeds, have even been known to show signs of germination. Others remain unchanged themselves and become less irritating, though their size is increased from the deposition of layers of mucus on their surface. When fixed in this way the pain is felt most acutely over the actual spot, although a sensation of soreness behind the sternal notch is rarely absent. Aphonia is not met with, at any rate at first, and the fits of coughing, being due rather to the irritation and inflammation, are less violent and spasmodic, but more continuous, than when the foreign body is always shifting its position and coming in contact with the larynx.

The same train of symptoms is apparent when the foreign body is small enough to pass beyond the bifurcation of the trachea and enter the *bronchi* or the substance of the lung, only now those caused by the obstruction are less marked in proportion to the smaller area shut off, and those due to the consecutive inflammation become more prominent. Important evidence in addition may be obtained from an examination of the chest. If one of the bronchi, and it is usually the right one, is partially obstructed, that side of the chest moves less in inspiration, the percussion note is unaltered at first, and the respiratory murmur is diminished; while occasionally an unusual whistling sound may be heard, owing to the passage of the air past the obstruction, and nearly always coarse râles, due to the greatly increased secretion thrown out by the irritated mucous membrane. On the other hand, should the whole of one lung or of one lobe be shut off, vocal fremitus and the normal vesicular murmur are completely absent over the corresponding area, and the respiration over the rest is puerile and exaggerated. The percussion note varies; at first it is normal, or may even be hyper-resonant for a time, but in a few hours, as the lung becomes congested and the air absorbed, this diminishes to such an extent that it may be almost dull.

The later symptoms, consequent on lodgment in the lungs, depend on the intensity and progress of the inflammation that follows. It may be slight, and even postponed for years; more often it is rapid and acute, broncho-pneumonia setting in with great severity and running on to the

formation of abscesses, with destruction of the lung, and even gangrene or fatal hæmoptysis, this depending in all probability on the ease with which the intruding substance undergoes septic changes. Pulmonary tubercle, hyperæmia and swelling of the bronchial glands, ending in caseation and suppuration, and occasionally empyema, with even the escape of the foreign body through the walls of the thorax, have also been described as resulting from this injury, though they are much more rare.

Numerous instances are on record in which the accident has been overlooked and the symptoms assigned to some other cause, and nearly as many in which the opposite mistake has been made. Nor is this surprising when we take into consideration the fact that there is no single symptom peculiar to it alone, and that the history, which is of the utmost importance, is often altogether wanting, because the patient was either insensible at the time or too young to be able to give an account of himself. Foreign bodies in the pharynx, by pressing on the back of the larynx, or by the spasmodic contraction they set up, may cause immediate death with all the symptoms of obstruction to the larynx; but this is not of so much importance, as the same treatment would apply to either if it could only be carried out in time. When the symptoms are less urgent the diagnosis is easily made by making the patient swallow, or, if necessary, by examination with the finger or an œsophageal probang.

Inflammatory affections of the air-passages set up by other causes are much more hard to diagnose. Croup, especially in children, and laryngitis setting in suddenly, may be very difficult to distinguish in the absence of any history. Most reliance is to be placed on the sudden character of the onset, and the absence, at the commencement, of feverish symptoms as judged by the state of the pulse and the skin. It is very rare for either croup or laryngitis to commence with such rapidity or attain such severity in the first few moments, and the remissions that occur in the course of these diseases are not nearly so complete. Moreover, in spasmodic croup, the chief difficulty is during inspiration—the reverse of what obtains when a foreign body is lodged anywhere in the respiratory tract.

Hysteria, reflex irritation arising from disorders of the alimentary canal, especially in children, spasm of the glottis consequent on ulceration of the larynx or trachea, œdema due to the same cause, even such affections as aneurism of the aorta, pressing on the laryngeal nerves, and whooping cough, may occasionally present such symptoms as to make the diagnosis doubtful at first, particularly if the history is misleading—if, for example, the patient was known to be holding something in his mouth when the attack first commenced and the substance cannot be accounted for. Sometimes, too, the feeling of irritation left after the foreign body has been removed is so distinct that the patient firmly believes it to be still there; and it must not be forgotten in connection with this that on several occasions more than one foreign body has been known to enter the larynx at the same time, and that it is quite possible for some of the substances which find their way in to break into separate pieces during a violent attack of coughing.

Treatment.—Unless the case is so urgent that the larynx must be opened on the spot, it is most important to obtain as accurate an account as possible, not only of the previous condition of the patient, and of the fact that he was holding in his mouth or playing with some substance which cannot be found, but also of the nature, size, and shape of that substance, so that some idea may be formed of the situation in which it will lodge and of the changes it will undergo. Then, if the symptoms permit, a thorough and careful examination of the mouth, epiglottis, and upper part of the larynx, must be made with the finger and the laryngoscope, an anæsthetic being administered if it is required. If nothing can be ascertained by this, if the acute symptoms have passed off, and only recur at intervals with less intensity; and particularly if there is no aphonia or pain in the region of the larynx or ear, it is probable that the substance has passed through the rima glottidis and is lodged in the trachea or bronchi, where its presence may be ascertained by careful inspection, auscultation, and percussion. Very severe symptoms at the first, subsiding without extrusion, point to the substance having passed the larynx and entered into the trachea; their repeated recurrences suggest its still being present in the larynx, or loose in the trachea and coughed up against it.

'It may be definitely and decidedly asserted that life is in peril so long as a foreign body of any appreciable size is retained in the respiratory tract. At the same time it is very uncertain at what period danger may become imminent, and in what way it may arise' (Durham). Suffocation, laryngitis, hæmorrhage from ulceration, inflammation and œdema, pneumonia,

pleurisy, phthisis, or gangrene, may make their appearance at any time so long as the foreign body is retained; and even after it has been expelled the morbid process originated by it may still go on to a fatal issue. The first thing, if time permit, is to make as sure as circumstances allow that a foreign body is really there; and then, unless the symptoms are very urgent, to endeavour to ascertain in what part it may be lodged. Sometimes laryngotomy must be performed without an instant's delay if it is to be of any service. The operation is easy, the crico-thyroid membrane superficial, the extra risk to the patient quite trivial, and the danger of hæmorrhage slight; while the relief is perfect in proportion to the severity of the symptoms, and valuable time is gained for more deliberate action.

When the case is not so urgent, when, as is usually the case, the patient is seen after the first violent paroxysm has passed off, during the deceptive calm that follows, an attempt must be made to ascertain the exact position of the substance; but under no circumstances should the patient be left without assistance. Many cases, especially in childhood, have suddenly proved fatal from œdema, spasm or impaction, owing to the deceptive calm that so often follows the first outbreak.

By means of the laryngoscope and laryngeal forceps of various shapes a large number of foreign bodies of all kinds have been extracted from the larynx. Even in children this method succeeds sometimes, while with adults the results are very encouraging, pins, bones, rings and other substances having been removed even after long periods of impaction, without external wound or any after-trouble. The extreme sensibility of the mucous membrane in many patients, rendering even examination difficult, and any operation impossible, may in general be overcome by the prolonged application of ice or the inhalation of chloroform vapour. Small subcutaneous injections of morphia over the superior laryngeal nerve in the region of the greater cornu of the hyoid bone are sometimes very successful as a temporary measure; and provided the time can be afforded, large doses of bromide of potassium for several days help materially; but the most useful application of all for this purpose is a 20 per cent. solution of hydrochlorate of cocaine. If the fauces and the upper aperture of the larynx are painted with this three times at five minutes' interval, the mucous membrane becomes quite insensitive without the least danger or inconvenience, and remains so for a quarter of an hour, so that operations may easily be performed while the patient is free from pain, quite quiet, sensible, and able to assist.

Should the laryngeal forceps fail, owing to the situation of the foreign body preventing firm hold being obtained or from any other cause, the choice of the surgeon lies between laryngotomy and exploration of the interior of the larynx from below with a probe or gum-elastic catheter (using the end covered with an ivory cap and taking care that it is well secured), or thyrotomy—i.e. a vertical section in the middle line between the two alæ of the thyroid cartilage, so that when they are separated the whole cavity is exposed to view. The latter is the better of the two unless laryngotomy has already been performed to relieve symptoms of obstruction. The whole interior of the larynx, including the ventricles, can be thoroughly explored by this operation, and if care be taken to keep the section exactly in the middle line, and to unite the perichondrium or the fibrous layer covering the cartilages accurately by catgut sutures, union takes place readily and the voice rarely suffers.

Supposing it has been ascertained that the foreign body is not in the larynx, and the symptoms point to its being in the trachea or bronchi, tracheotomy, or if the neck is very short laryngo-tracheotomy, should be performed without more delay than the time to administer an anæsthetic. Emetics, sternutatories, inversion, and other so-called remedies only waste time and distress the patient. It is true they have all of them occasionally been successful, but the same thing might be said with equal truth of the plan of leaving the patient alone. The only possible exception is in the case of small, round, and heavy bodies loose in the trachea without urgent symptoms; but even then inversion should never be attempted without all preparations being made for instant tracheotomy, and it is as well to avoid having to perform this operation against time.

It often happens that the foreign body is ejected either through the glottis or the tracheal opening, immediately after this has been made, a large volume of air being taken in, the spasm completely relaxed, and violent coughing excited. When this does not occur, and very often it is some time before the intruding substance is dislodged, the patient is almost safe from the danger of asphyxia, and valuable time has been gained for other measures. No

canula should be inserted unless extraction fails; retractors, easily made with a piece of bent wire, should be fixed in the tracheal opening and fastened round the neck with an elastic band, so as to maintain a certain amount of tension on the orifice. The patient may then be turned over on to his abdomen with the edges of the wound held as wide apart as they may be, gradually inverted and sharply struck across the back opposite the spines of the scapulæ. Or the body may be secured on a narrow table in the supine position, which has the advantage of presenting the widest part of the glottis to the foreign body when it comes in contact with it, quickly inverted, and compressed with a broad circular bandage, so as to secure vigorous expiration in that position.

If this procedure fails and the foreign substance is too firmly fixed to move, the trachea, and bronchi, as far as they can, must be very gently explored with probes, hooked at the end, tracheal forceps (either Gross's, which are made of German silver so that they can be bent to any shape, or Mackenzie's, or Durham's, which are so contrived as to open only at the extremities), and even with the finger. All these attempts bring on violent expiratory efforts, no matter how gently they may be performed, and sometimes in this way, sometimes by being actually hooked up, large firmly-wedged bodies have been extracted, even from the right bronchus. A great deal depends on a knowledge of the nature of the substance: tubular bodies, such as a broken-off tracheotomy canula, from their allowing one blade of the forceps to enter the interior and grasp the margin, or both blades to pass inside and raise it by the pressure they bring to bear when opened, are particularly easy of extraction. The worst of all are such things as puff-darts, which lie with the point uppermost and fixed in the mucous membrane, so that every effort of expiration only serves to drive it further in; if this can be felt to have perforated the trachea it should be cut down upon and removed with pliers.

It by no means always follows that the operation of tracheotomy is successful at once: there are many instances in which a canula has been inserted and worn for some time, and then quite unexpectedly, perhaps from changes it undergoes itself, or from ulceration round it, the foreign body has suddenly become detached and been expelled.

The main object in the after-treatment is to check any tendency to inflammation. The patient must be confined to his room, and even to bed, for the first few days; the air must be kept of even temperature, and sufficiently warm and moist, by means of steam; there is no need to retain the canula after extraction unless œdema of the larynx is feared; the wound need not be closed by sutures, but covered over with a layer of moistened gauze to prevent the entry of cold or dusty air, and allowed to granulate; the edges will generally be found in apposition and the tracheal opening almost closed, from the elasticity of the cartilages, in twenty-four hours. The diet should be mild and unstimulating; morphia may be given (provided there is no severe bronchitis) to relieve the feeling of irritation, and expectorants if there is much secretion. If the foreign body has been impacted for any length of time there is nearly always some thickening and induration of the mucous membrane resulting from ulceration, but this usually subsides of itself after removal; the exuberant granulations that are sometimes found blocking up the passage must be removed by scissors or caustic.

In the later stages Gross considers an operation not only to be justifiable but highly proper so long as the respiratory passages are healthy or even comparatively healthy, no matter what length of time may have elapsed since the entrance of the extraneous substance. 'If, on the other hand, the respiratory apparatus is seriously diseased, the knife should be studiously withheld, certainly temporarily, if not altogether, on the ground that the artificial opening would be very likely to complicate the morbid action and thereby greatly enhance the patient's danger.'

C. Mansell Moullin.

FOREIGN BODIES IN THE BLADDER.—The urinary bladder is often the receptacle of a foreign body. The most common one is a broken surgical instrument. In the treatment of various urinary diseases catheters and bougies may break, and a portion be left in the bladder; or if such instruments be handled carelessly or left unsecured, they may slip into the urethra beyond reach, and ultimately into the bladder. Portions of stricture-cutting or dilating instruments, and instruments used in making caustic or other applications, have not infrequently broken off and passed into the bladder. The beak of the male blade of a lithotrite has broken off when crushing a stone; but the most serious foreign body of this kind is a lithotrite with

its jaws so impacted in a stone, or bent, or jammed with calculous débris, that they cannot be approximated, making removal by the natural passages impossible. As a surgical curiosity, it may be mentioned that a small steel artery-clip was once found in the bladder of a lady long after she had made a good recovery from ovariotomy; the instrument doubtless had made its way from the peritoneal cavity by a process of ulceration. Next in order of frequency come foreign bodies introduced into the bladder by design, and left there accidentally by patients themselves. This may be done legitimately by persons anxious to relieve themselves of retention of urine or of stricture of the urethra, and who, lacking proper instruments, resort to stalks of grass or pieces of straw; but usually the motives which have prompted such self-manipulation have been most improper, or it has resulted from mere wantonness. Most extraordinary articles are sometimes introduced. The following have all been met with—hairpins, needles, pins, bodkins, straws, stalks of grass, penholders, pencils, tobacco-pipe stems, sealing-wax, glass rods, leathern thongs, string, nuts, marbles, wire, feathers, matches, pebbles, and beads.

Foreign bodies may enter by the ordinary accidents of military and civil life—as for example, bullets, fragments of shells, portions of clothing and arrow-heads, in war; pieces of wood and reeds, from falls upon such objects, and splinters of the pelvic bones from severe crushes. Then, as the result of disease (not necessarily malignant), an opening may exist between a portion of the intestine or rectum and the bladder, and fæcal matter find its way into that organ; fruit-stones and other bodies so conveyed, and too large to be expelled by the urethra, may give rise to trouble. Also, as the result of disease of the pelvic bones and of the hip-joint, portions of bone have found their way into the bladder. The bladder is sometimes the seat of a dermoid cyst, and hairs and sebaceous matter, with or without phosphatic coating, may be passed naturally or be discovered by exploration. Fœtal débris, bones, hair, teeth, have been known to find their way into the bladder. Finally, the various intestinal worms may enter the bladder by fistulous openings, and other parasites may be developed in the kidney and pass down the ureters. Hydatids occasionally find their way also into the bladder.

Consequences.—In rare cases life is immediately threatened. Death has been known to result from peritonitis, caused by perforation of the bladder by a sharp stalk of grass or other foreign body. As a rule, however, the first symptoms are those of cystitis, consisting of pain and frequency in passing water, with mucus and perhaps blood in the urine. If the offending body is not removed, it usually soon becomes encrusted with urinary salts; these are generally the phosphates, but more rarely the urates are deposited. The writer is not aware of an instance of the deposition of oxalates. The patient shortly becomes to all intents and purposes the subject of stone in the bladder, and there are specimens in many of our museums of urinary calculi having bullets, nuts, pieces of bone, &c., as nuclei.

Diagnosis.—The diagnosis is often sufficiently easy, and can only be difficult when the patient is reticent, or the foreign body is very soft, or when, as in the case of a catheter suddenly found to be without its end, the owner cannot be absolutely sure that it has not been lost since its last withdrawal from the bladder. The diagnosis can never be complete without careful sounding, and in rare cases even the digital examination of the bladder by dilatation of the urethra in the female, or by means of external urethrotomy in the male, may be absolutely necessary to clear up the case.

Treatment.—In cases of foreign bodies introduced by the urethra, unless the symptoms are very urgent, operative interference should not at once be resorted to, but every opportunity allowed for the natural expulsion of the body through the urethra. The patient should be kept at rest; if necessary an opiate may be cautiously administered; and he should be directed to hold his urine until a considerable quantity has accumulated in the bladder. He should then stand up, and with his legs slightly apart, make a free stream of urine. Such a proceeding will often cause the expulsion of a small foreign body, or it may thus become engaged in the urethra.

When, however, it is evident that the body cannot be naturally expelled, or if the case is urgent, an operation should be undertaken without delay.

Several instruments have been devised for the extraction of foreign bodies from the bladder, but as few of them are really practical, or are likely to be at hand when wanted, they need not be described here; there is one, however, for the removal of hairpins, which deserves mention, although the female urethra admits so readily and safely of dilatation that, with the finger and simple instruments, pins of all descriptions can usually be easily re-

moved. It consists of a stout tube with a central rod ending in a hook; the hook seizes the pin, and the central rod is then screwed back into the stout tube, until the pin is bent and dragged into the tube and extracted. In addition to the usual lithotomy and lithotrity instruments (including evacuating tubes and aspirator), all of which may be found useful, the operator should be provided with a pair of nasal polypus forceps, a blunt hook on a long handle (an ordinary button-hook will do), a long urethral scoop and forceps, and if possible Sir Astley Cooper's forceps. This is an instrument like a curved metal sound; the curved end is split, and by pulling a trigger in the handle it separates laterally into two blades, which come together again directly the trigger is liberated, grasping any foreign body which may be present.

The most useful instrument for men and boys is a lithotrite; this instrument, however, requires care in its use, and special attention must be paid to three points. (1) It is not safe to crush glass in the bladder, but sealing-wax, clay-pipe stems, and other brittle materials may be safely attacked, crushed, and washed out through tubes, just as an ordinary calculus is removed by lithotrity. (2) In attempting to remove a soft or gummy body, such as the end of a vulcanised india-rubber catheter, the male blade must not be screwed home unless the body is known to be small or is felt to be seized in its long axis; for the jaws of the instrument may become jammed and the operator may be unable to remove it. (3) In seizing an oblong body it is almost sure at first to be seized transversely, and resistance will be encountered as the lithotrite and its load approach the prostatic urethra; if this is so, the lithotrite must be disengaged at once; generally after several seizures the body will be caught 'end on,' and extraction will be possible.

Women and Girls.—A careful attempt should be made to withdraw the body with a lithotrite, or with a pair of long urethral forceps, or with Cooper's forceps just described, or with a simple button-hook, if the foreign body be a hairpin. Should simple means fail, then under the influence of an anæsthetic the urethra should be dilated with a Weiss's dilator or a pair of polypus-forceps, and the surgeon's left *little* finger introduced. The nature and position of the foreign body will now be ascertained, and usually no difficulty will be met with in removing it, for the urethra admits safely of great distension, and forceps or hook may be passed along the finger and guided by it into position. If the foreign body after all should prove too large to be removed by the urethra, it may be extracted through an incision made into the vesico-vaginal septum, after which the edges of the wound should be carefully approximated and stitched up. The method of removal by incision of the urethra has few advocates. The supra-pubic method is not recommended in women. Should the foreign body owe its great size to deposits of calculous matter, lithrotrity may be practised, and the foreign nucleus afterwards extracted through the urethra; this remark is equally applicable to the male subject.

Men and Boys. — The lithotrite or Cooper's forceps should be used. If the foreign body be small, an attempt may be made to wash it out through an evacuating lithrotrity tube (No. 16 or 17 Eng.); a pebble, bead, or small pin may in this way be removed. Should the lithotrite part company with the foreign body in the deep urethra, the finger should at once be passed into the rectum and the body pressed upon from behind to prevent its return into the bladder. The finger in the rectum is often a useful adjunct in all manipulations now described, and the writer has succeeded with the finger alone in compelling the exit of a piece of catheter engaged in the neck of the bladder; and in another's practice, a shawl-pin, with a large round head, was ingeniously extracted with the finger in the rectum; the point of the pin was forced through the perineum, the pin's point was then brought well down to the coccyx, and the head thus pushed up the urethra to the meatus, whence the whole pin was withdrawn.

If all attempts at extraction by the urethra fail, the knife must be resorted to. If the patient is a boy, the ordinary lateral operation is, as a rule, to be preferred. If, however, the patient is an adult, the operation should not be more than an external urethrotomy (*la boutonnière*). This consists of a median perineal incision into the membranous urethra upon a grooved staff; a small gorget is next passed into the bladder and the staff withdrawn; the surgeon's forefinger is then passed through the dilated prostatic urethra into the bladder. After the surgeon has ascertained the exact position of the foreign body he may introduce a pair of small straight forceps and extract it. Should more space be required, the prostate may be divided downwards, and the operation converted into a median cystotomy.

G. Buckston Browne.

FOUR-TAILED BANDAGE. *See* BANDAGES.

FRACTURE-BOARDS may be made either as one piece, of sufficient size to extend over the whole bedstead; or in a number of separate pieces, long enough to reach across the bed, but only about a foot or a foot and a half wide. The latter have the advantage that they can be placed side by side over the whole bedstead, or only in the required situations. When the fracture-board is made in one piece, it is necessary to prepare the bed before the patient is placed on it; but with a number of separate pieces it is easy to slip them in or remove them without in any way disturbing the patient. The boards should be placed between the matiress and the bed.

BILTON POLLARD.

FRACTURES are divided into *simple*, where the skin is entire, so that no air enters, and *compound*, where there is a wound through which air gains admission to the broken ends of the bone—a distinction of well-known importance, both as to the danger involved and the method by which repair is accomplished. They are further classed as *incomplete* (greenstick), when, as often happens in children, the bone is only partially broken; *impacted*, when one fragment is driven into the other and there locked; *oblique*, *transverse*, *longitudinal*, and *splintered*, terms which explain themselves; *multiple*, when the same bone is broken in two or more places, or when two or more bones are broken; and *complicated*, when the fracture is combined with other serious lesions—e.g. a dislocation, the laceration of a large artery or nerve, or the rupture of some internal organ, such as the liver or bladder. In early life the epiphyses may be separated, as will be described under the fractures of the various bones.

Causes.—The immediate causes of fracture are external violence and muscular action. External violence may be direct, as in gunshot injuries, and when a heavy weight falls on the limb; or indirect, when force is applied in the long axis of the bone, as when the clavicle is broken in falls on the hand. Or a sudden twist of a bone may produce fracture. Though the patella is the bone most often broken by muscular action, the same accident may occur to the clavicle, humerus, sternum, femur, and other bones. The various conditions which, by weakening the bones, act as predisposing causes of fracture, are chiefly mollities ossium, rickets, atrophy, whether senile or from disuse—as in old joint-affections—and inflammation, with extensive necrosis or caries, especially when syphilitic or strumous, and cancer.

Symptoms.—These are divided into the *circumstantial*—as when, after an injury to the head, blood and watery fluid continue to drain from the ear, or when emphysema and hæmoptysis occur after injury to the chest—and the *direct*, which are, altered outline or length of the limb, movement of one part of the bone on the other, and crepitus. Sometimes the patient feels, or even hears, the snap at the moment of fracture. The circumstantial, though they may be strongly suggestive, generally admit of some alternative construction, and are therefore inconclusive—e.g. the flow of blood and watery fluid may be from the ear itself; emphysema and hæmoptysis may depend on ruptured lung. As to the direct; although movement is easily felt when a superficial bone is broken in the middle of its shaft, it is not so when the bone—e.g. the body of the scapula—is deeply placed, or when a small block, difficult to grasp, is detached, as in fracture through the anatomical neck of the humerus. Both these difficulties are met with in fracture of the neck of the femur. Movement is often absent, as in impacted, or very slight, as in incomplete fractures. Sometimes it is impossible, as in fracture of the base of the skull, or wrong, as in fracture of the spine, even to attempt to produce it. Alteration of outline may result, either directly from the force which broke the bone, as when the skull is driven in; or from the weight of the limb, as when the shoulder drops inwards and forwards in fracture of the clavicle; or from contraction of the surrounding muscles, the strongest preponderating, and some acting on one fragment, some on the other, as when in fracture of the femur just below the trochanters the ilio-psoas and glutei flex and abduct the upper fragment, while the hamstrings draw the lower fragment upwards behind the other. Crepitus is often unmistakable, but it is very often absent. It is so in impacted and in incomplete or greenstick fractures. In some fractures, as those through the neck of the femur. it is felt only when, by drawing down the limb, the fragments are brought into contact. Even in fractures through the shafts of the long bones, it is sometimes impossible to bring the surfaces into such close contact as to produce crepitus.

Much care is required to distinguish between true crepitus and the grating often

present in rheumatoid joints, and even the creaking in the sheaths of tendons. It is often difficult to be sure at exactly what point crepitus is produced. Mobility, and crepitus, as a faint and momentary click, are sometimes to be detected only in one particular movement of the bone. They are thus easily overlooked. It is therefore necessary, when the upper part of the bone has been fixed, not only to perform rotation, but to move the part below gently in every direction. In impacted fracture, in which there is neither mobility nor crepitus, the only reliable direct symptom is altered outline. The bone may be shortened, its axis may deviate, or some irregularity of surface may, as the fingers are carefully passed over it, be detected. In doubtful cases the question whether the injury is at some point where impacted fracture is common (e.g. the lower end of the radius, or neck of the femur), the cause of the accident, and the amount of pain, must all be taken into account. Care must be taken against concluding that there is no fracture, on the ground that the patient can move, or even bear weight upon, the limb. Not rarely in fractures of the clavicle the hand can be raised above the shoulder, or even placed on the head; and patients with fracture through the neck of the femur, the patella, the fibula, or in other parts of the lower extremity — especially when there is impaction—have been known to walk long distances on the limb.

From what has been said it will be seen that it is often impossible to secure positive proof that fracture has occurred. This is especially the case when the bone concerned is one of a series closely knit together, as in the carpus or metacarpus, or, even when, of two bones lying side by side, only one is broken—e.g. the ulna or fibula. And it may be as difficult to deny as to affirm that fracture is present. Yet it is highly inadvisable to endeavour, by forcible and prolonged examination, to obtain conclusive evidence. Our duty is, if doubt remains after all reliable means have been critically used, to adopt such precautions as may provide for safety, should fracture after all exist; to watch carefully the progress of the case; and to act on such further knowledge as may be obtained at any later stage. What reasonable patient would ask for more than this? In many cases an anæsthetic should be used. When the muscles by this means are relaxed, gentle manipulation will often elicit evidence which, without it, even forcible and painful movement of the limb would fail to disclose. An anæsthetic, however, it must always be remembered, is not given that rough manipulations may be practised—these are as dangerous when the patient is insensible as when he is conscious, and have often done irreparable harm.

Another point is that the limb is to be thoroughly exposed, and minutely compared with the opposite side. A complete examination should be made as soon after the accident as possible and before great swelling is present, so that accurate diagnosis has become out of the question. The diagnosis between fracture and dislocation may sometimes be difficult; nor must we forget that these two conditions may exist together. In fracture there is preternatural mobility; deformity is easily removed, but it returns when external support is withdrawn, and there is generally crepitus. In dislocation the limb is fixed in an abnormal position; there is no true crepitus; when its upper end is grasped and the shaft is rotated, it is felt to move in one piece, and the bone when once replaced, remains in position. Moreover, its various salient points can be felt in their normal relations to the rest of the bone, but the relation of the bone to its socket is changed. As rheumatoid joints often present grating, we must be careful not to conclude that what we feel is true crepitus without taking other symptoms into account.

Summoned to a fracture, the surgeon's first care must be to provide against further injury. The patient must be induced to remain as still as possible while preliminaries are arranged. The clothes covering the limb must be removed by cutting along the seams, and the limb must be securely supported by extempore inside and outside splints formed of pieces of board (thickly doubled newspapers will suffice for the upper extremity), a strong walking-stick, &c.; a shawl or thin pillow being used to protect the skin and distribute pressure. The patient must now be placed on a stretcher, or a door covered with spare clothes or straw, the surgeon himself taking charge of the limb, while he directs the bystanders how, acting steadily together, to lift the sufferer. The patient should be hand-carried if this is practicable, as the jarring of any conveyance may do serious injury. He must be lifted to bed with as little disturbance as possible, and placed on a narrow bedstead with a firm mattress, with a board beneath the latter to keep it flat. A feather bed is quite unsuitable. Some surgeons have advised that the fracture should not be 'set' before the third or

fourth day. This, however, is an exploded view; adjustment should be effected with the least possible delay.

In the treatment of fractures three objects present themselves: (1) the replacement of the fragments; (2) their maintenance in position during repair; (3) the prevention or removal of complications. The difficulties which arise vary with the case. In the clavicle the displacement depends mainly on the weight of the limb, which falls inwards and forwards—little on spasmodic muscular action. Hence adjustment is easily effected by lifting the limb into its normal position. The difficulty here is to maintain reduction. In oblique fracture of the femur or tibia it is the powerful muscles of the limb that oppose reduction. In fractures of the surgical neck of the humerus the muscles inserted into its tuberosities rotate the upper fragment; and this is so deeply situated that we can sometimes neither learn its exact position nor turn it back into its place. Sometimes the mere irregularity of the fragments, or the presence of soft parts between them, hinders adjustment. To effect reduction the limb above must be fixed by an assistant, while extension is made below, as far as possible in the long axis of the upper fragment, the surgeon himself guiding the ends into place. In some instances of fracture of the tibia reduction cannot be effected till the tendo Achillis has been divided; but tenotomy, either here or in other fractures, is very seldom called for. Sometimes, in fractures of the femur, shortening cannot at the time be entirely removed; but it may gradually be subsequently overcome by weight-extension. Position sometimes assists—e.g. flexion of the leg on the thigh during the reduction of fractures of the tibia. An anæsthetic is often called for, not, of course, as before stated, that violence may be used, but because it obviates resistance which must otherwise be forcibly overcome.

If practicable the fragments should be at once exactly adjusted; but rather than make violent or over-long attempts, we must secure the best attainable position at the time, and improve this, so far as may be possible, by subsequent modification. If such swelling has occurred that neither a complete diagnosis nor satisfactory adjustment is possible at the time, the limb must be brought as far as may be into its normal position, such apparatus as can be used without restricting the circulation must be employed, ice-cold lotions must be applied, and the limb be placed in the best position for the subsidence of the swelling. The surgeon must wait for the earliest opportunity of completing reduction, whether by using more extension, the insertion here and there of pads, or even an entire re-setting, though this is generally both unnecessary and unadvisable. In using retention-apparatus we must provide efficient support, so as to guard against displacement due either to (*a*) the weight of the limb, (*b*) muscular action, (*c*) the movements of the patient; avoid all constriction, especially above the fracture; distribute pressure, and prevent its occurrence over prominences or tender areas; and place the limb in the most comfortable position, remembering that in a very few hours after a fracture is properly adjusted the patient ought generally to be free from pain in the limb, remembering also that considerable swelling is in prospect. This latter must be taken into account while the fracture is being put up, and very carefully watched subsequently. Tight bandaging not only causes pain, but may lead to gangrene or other serious consequences. It is dangerous to place strapping in a circular direction round the limb, and cover it with a bandage; should swelling occur below, we are apt, while loosening the bandage, to forget the strapping, and so fail to remove the constriction. Such an oversight has sometimes led to gangrene of the limb. For the first few hours the condition of the circulation in the fingers or toes should be carefully watched.

Complications.—(*a*) The soft parts may have been so extensively crushed that sloughing ensues, and the fracture becomes compound—no rare event in the case of the tibia and other superficial bones. Should this be threatened, the area involved should be protected by antiseptic dressings, and the subsequent treatment will be that for compound fracture. *See below.*

(*b*) Extravasation of blood may cause tense swelling and so lead to gangrene, especially if the bandages are tight. To avert such a result all circular constriction must be at once removed, the limb, supported in loosely adapted splints, must be raised (the same end may to some extent be attained by raising the foot of the bed), and if the surface be hot, evaporating lotions must be used. If however, the limb is cold, it should be wrapped in cotton wool. Bullæ should be pricked and emptied, but the cuticle must be carefully preserved.

(*c*) Rupture of the main artery, a grave accident, is happily rare. It is chiefly met with in fractures of the upper end of the humerus, the lower end of the femur, and the upper end of the tibia. The symptoms

are: the rapid formation of a tense elastic swelling, in which a distinct thrill or even a faint diffused pulsation may often be felt; loss of sensation and coldness of the limb, and loss of pulsation in the vessels below. The choice of treatment is embarrassing. Three courses present themselves. To trust to compression or ligature of the artery higher in the limb; to endeavour to find and tie the two ends of the vessel; to perform amputation. This last step should not be taken till gangrene has absolutely set in, for the symptoms mentioned are not proof positive that the artery is torn, and recovery has sometimes occurred although they were all present. To search for the ends of the vessel is a proceeding surrounded with such difficulty, and involving such free dissection of the soft parts, that, although it may occasionally be justifiable, it cannot be recommended. The safest plan, generally, will be to try the effect of pressure on the artery above, applied if possible by the digital method, so that the return of venous blood is as little as possible interfered with. Ligature of the vessel above is, as a rule, unadvisable. Compression secures the same end, and can be remitted should swelling cease to increase, while ligature, by suddenly arresting the circulation, may precipitate gangrene. Where gangrene has supervened, amputation should as a rule be at once performed; though it may be right to postpone it when the patient is very old or very weak. The point selected must vary with the case. When the artery has been wounded by one of the fragments in a fracture produced without much violence, amputation may be performed just above; but when the fracture has been accompanied by extensive injury of the soft parts, amputation must be done at some distance higher in the limb, where the soft structures are uninjured. If this rule is not followed gangrene will probably reappear in the stump. The inference to be drawn from the appearance of bullæ varies in different cases. They result from extravasation around the fracture, and indicate extensive laceration. When the limb is cold and numb, bullæ are but another sign that gangrene is at hand. But when the surface is warm, and there is pulsation in the vessels below, bullæ may be regarded as evidence that serum is reaching the surface, and that tension is being relieved. *See* Arteries, Wounds of; Femoral Artery, Wound of the.

(*d*) Dislocation is sometimes produced by the same force which caused the fracture. This is a complication which may prove very difficult to manage, especially when one fragment is short and deeply placed, as in dislocation of the head of the humerus accompanying fracture high in the shaft. The possible existence of this condition must not be overlooked, nor can such a complication well escape notice during a careful examination, unless considerable swelling has already taken place. In any doubtful case examination must be repeated as soon as swelling has subsided. Reduction should be, when practicable, at once effected, but the attempt has often failed. It may sometimes be accomplished by enclosing the limb securely in splints, so that a firm hold is gained on the displaced end of the bone; and then, when the muscles are relaxed by an anæsthetic, employing the method by manipulation. *See* Dislocations. Failing reduction, the fracture must be adjusted in the best available position. When union has occurred —that is, in six or eight weeks—manipulation may be again tried; but at this period reduction generally cannot be effected, and the case must be treated as one of unreduced dislocation: adhesions must be broken down by careful manipulation, under an anæsthetic, when union of the fracture is firm, and passive movements must be employed with perseverance, to secure such motion as can be obtained. *See* Humerus, Fractures of the.

(*e*) When fracture extends into a joint, mobility may be permanently and considerably impaired by sharp synovitis, followed by adhesions; by the displacement of fragments which cannot be adjusted; or by the formation of callus, altering the shape of the articular ends. This is especially apt to be the case in comminuted Colles's fracture extending into the wrist-joint, and in fracture of the humerus just above the condyles, extending into the elbow-joint, particularly in children. In such cases the utmost care must be taken in the adjustment of the fracture, though the swelling which so quickly results may defeat this object. The surgeon in such instances should do himself the justice of at once explaining the state of the case to the patient.

(*f*) Œdema of the limb is often a troublesome complication. Following immediately on the fracture, it depends on copious serous effusion from bruising of the soft parts; it may depend entirely on tight bandaging; or, slowly ensuing some days after the accident, it arises from plugging of the veins in the neighbourhood of the fracture—a condition especially apt to occur in gouty or rheumatic

subjects. In these cases fatal embolism may result from the detachment of thrombi and their passage into the lungs, or hemiplegia may occur from their transit into the arteries of the brain. Acute œdema, from phlebitis, must be treated by raising the limb and relieving circular pressure; the more chronic forms, often very obstinate, by frictions, shampooing, and by the application—when union of the fracture is firm—of Martin's elastic bandage, which is very efficient for the purpose. The treatment, however, must be gently conducted, or the phlebitis, always very prone to relapse, will be renewed.

Compound Fracture.—The gravity of compound, as compared with simple, fractures depends, to some extent, on the admission of air. But the danger accruing from this source has of late years largely diminished. Formerly, when sanitary conditions were neglected, the air which entered a wound was almost invariably charged with some septic material, so that a true inoculation of the tissues occurred. But now, when ventilation is amply provided, when all infectious cases are removed from the general wards, and when wounds are treated, whatever the details of dressing may be, on antiseptic principles, the mere admission of air is much less deleterious than it was twenty years ago. This is constantly demonstrated by the safe repair of that form of compound fracture which is artificially produced in the operation of osteotomy, in some instances of which, when a wedge of bone is removed, an opening larger than that of many compound fractures is made, and air is most freely admitted into every part of the wound. Compound fractures, however, are generally the result of much greater violence, and are attended with proportionately greater injury to the soft parts than is the case with simple fractures. Often the skin is widely stripped off, the muscular structures are reduced to a pulp, the main vessels or nerves are lacerated, and the bone is extensively comminuted. These injuries are the main sources, at the present day, of the dangers attending compound fracture.

Treatment.—Should either of the fragments—it is usually the upper—protrude through the skin, reduction must, if necessary, be assisted by enlargement of the wound at the point of greatest resistance. Should the fragment protrude far, and be completely bare of periosteum, or should reduction be otherwise impossible, a portion of the bone must be sawn off. The danger of this latter proceeding, as increasing the liability to pyæmia, osteomyelitis, or necrosis, has been exaggerated. Of course no part of a bone should be lightly sacrificed, but the removal of an end which is found to materially hinder reduction after the wound has been enlarged, is less objectionable than forcible and prolonged manipulation. In comminuted fracture, fragments which are completely loose should be removed; those which, though broken away from the rest of the bone are still covered in their whole length with periosteum, should be carefully replaced; while those which are partially bared must be dealt with according to circumstances. In young subjects they may be left, as also when on account of their depth from the surface they are difficult to reach. The condition of the soft parts may have some influence on our decision. When the surrounding injury is comparatively slight, so that nutrition will probably soon resume its ordinary course, they may remain; but when, especially in middle-aged or elderly persons, there is extensive crushing of the soft parts, with a prospect of long suppuration, in the course of which they would almost certainly perish, it is safer to extract any that are easily reached. Hæmorrhage must be arrested by ligature (with carbolised catgut), or by torsion. In order to do this, when bleeding is deeply seated, it is necessary freely to enlarge the wound (an Esmarch's bandage having been applied, or the artery being compressed above), to turn out all clots, and tie both ends of the vessel. *See below* on Amputation.

If large nerves are torn, their ends must be brought together by two or three fine catgut sutures passed through their sheath. The wound must then be thoroughly cleansed, and washed out in all its recesses with a 1 in 20 solution of carbolic acid in water, introduced by means of a gum-elastic catheter fitted to a syringe or to an irrigator. The surface of the limb must be well washed with the lotion; coagula, as far as possible, should be removed; a counter-opening for drainage, maintained by a tube or by a strip of guttapercha tissue soaked in the lotion, will often be advisable. The opening in the skin, if extensive or branched, may be partially closed; but an ample outlet for free drainage must be left. A strip of 'oil-silk protective,' or guttapercha tissue soaked in a 1 in 40 solution of carbolic acid, is placed over the wound itself, and the limb is widely enveloped in the neighbourhood of the fracture with gauze wrung out in the carbolic solution, and more superficially with eight or ten layers

of antiseptic gauze, having a sheet of thin mackintosh between the outermost and the next layer. The quantity and the covering extent of the gauze must depend upon the probable amount of discharge. The dressings must be so applied as to admit of easy removal, without disturbing the fracture; and they must be changed often enough to prevent the discharge from escaping beyond them. They should be renewed, usually, on the second or third day, and then according to circumstances. If the wound has been long exposed to the air, it should not only be syringed out with carbolic lotion as directed, but iodoform powder should be dusted into the wound and between the fragments. A convenient dressing, when the wound is small, consists of oil-silk protective covered with folds of lint soaked in a saturated solution of boracic acid. *See* ANTISEPTIC SURGERY.

Mr. Sampson Gamgee's method of dry dressing is also excellent; or absorbent cotton-wool impregnated with iodoform, and covered with mackintosh, may be used; or the wound may be thoroughly washed out with a solution of one part of tincture of iodine to five hundred or a thousand parts of water. The condition of the limb, as the neighbourhood of the fracture is thus covered in, must be closely watched by observing the temperature, sensation, and circulation in the parts below. Great care must be used that the dressings are not applied tightly, but that some allowance is made for swelling, which will in all likelihood ensue. These dressings may be discontinued as soon as the wound has healed.

Amputation.—The treatment of wounds has undergone so complete a revolution during the last twenty years, that the rules for amputation in compound fracture have had to be recast. Conservative surgery has been carried to a point which it would formerly have seemed impossible to reach, and highly dangerous even to attempt. The change is shown in the greater rarity, not only of primary amputations, but of secondary also. The effort to save the limb is commonly justified by the result. Amputation, however, must still be performed in cases in which, without reckoning such complications as in former days threatened all large wounds—secondary hæmorrhage, cellulitis, prolonged suppuration, and the like—the fate of the limb is already sealed. As when all the soft parts are completely torn through, or when some considerable portion has been torn away in a machinery accident; when the whole thickness of the limb is completely crushed; when large areas of skin have been stripped off; when, with other formidable injuries, a large joint is torn open and its ligaments ruptured; when the main vessels and nerves of the limb are severed; when deep hæmorrhage is profuse, and the vessel cannot be reached without a wide, and therefore destructive, dissection of the limb, as when the popliteal, or the upper part of the posterior tibial artery, is lacerated. Conditions other than local must also have due weight—the patient's age, habits, and the presence or absence of visceral disease, especially of the kidneys. In the old, and in persons of unsound health, amputation is a formidable measure, and the choice between the risks of leaving the limb and of amputation are so evenly balanced that the case is one of great difficulty, and every point must be critically considered.

In young and healthy subjects, if the main artery is wounded, its two ends must be tied; if the main nerves are torn, their cut ends must be brought together by two or three carbolised catgut sutures, passed through their sheaths; if a joint is opened it must be thoroughly washed out with carbolic lotion (1 in 40) and provided with free drainage, and an attempt must be made to save the limb; for amputation, should it become necessary, can be performed later. But in deciding what our course should be, we must always bear in mind that our first charge is the safety of the patient's life; to save this we must not hesitate to sacrifice the limb. Should gangrene ensue, amputation must, unless contraindicated by the general condition of the patient, be immediately performed. In the later stages of the case, should secondary hæmorrhage of formidable amount occur (happily this is very rare), and be repeated in spite of compression of the trunk above; if suppuration is so copious that the patient is becoming dangerously weak; or if the fracture involved injuries which have disorganised the limb so that repair seems hopeless, secondary amputation must be resorted to.

In fractures which are attended with only moderate displacement and laceration of the soft parts, and are subsequently kept at rest, the callus is limited to the interval between the fragments, whether between their ends, or where they overlap. But when the soft parts have been widely injured, so that inflammation is considerable, or when the fragments cannot be kept at rest, as in fractured rib, so that inflammation is prolonged, callus is

formed both in the medullary canal (interior callus), and in the parts around (ensheathing). These varieties are termed provisional. They exist during the process of repair, but are subsequently entirely removed; so that when normal repair is complete no callus remains but that which lies directly between the fragments. In compound fracture union takes place—after any sloughs that may have formed have been either extruded or absorbed—by the development of granulation-tissue between and around the fragments, and its subsequent ossification. The period occupied by repair varies widely with the degree of injury, and is extended by the tedious separation of sloughs and sequestra, and by the difficulties which attend healing where soft parts have been extensively destroyed. But it is generally twice or three times as long as that required in simple fractures. After union is complete, a process of modelling occurs, by which projections are rounded off, all superfluous callus removed, and the medullary canal re-formed, so that the bone is restored, in respect alike to its size and outline, density and strength, as far as possible to its original state. This is so perfectly effected that in many instances, even on section, no trace of the fracture remains. Union takes place very rapidly in children, and may be complete in ten to twenty days; in older persons it extends over—speaking approximately—six or eight weeks, and is more slowly effected the larger the bone concerned. The bones of the lower, perhaps because they are larger, unite somewhat more slowly than those of the upper extremity.

In fractures of the upper extremity splints may, as a general rule, be removed, and the patient be allowed gradually to resume the use of the limb, at the end of a month or five weeks. For the lower extremity, as it has to sustain the weight of the body, this time must be extended to seven or nine, or even twelve weeks, according to the age and the circumstances of the patient. But in each case the patient must be guided by the advice of his surgeon, given after a careful examination has been made, for sometimes union is found to have been unexpectedly delayed. Should any yielding be observed, he must be forthwith directed to abstain for a time from bearing weight on the limb. Great and unmanageable deformity will otherwise supervene; witness the distortion of the leg which sometimes gradually ensues after Pott's fracture. Various, some of them fanciful, causes of delayed union have been assigned, Those calling for mention here are (*a*) local, (*b*) general. The first include defective apposition of the fragments, want of rest, the intervention of some of the soft structures between the fragments, necrosis, and in compound fracture considerable loss of substance, as when fragments have been extracted, or bone has, to facilitate reduction, been cut away; the ligature of the main artery for hæmorrhage; and, probably, injury of the large nerves of the limb. The second comprise atrophy, as in the very old, or that which occurs from long disuse, scurvy, the advanced cachexia of syphilis, or that attending the later stages of cancer, and, according to some observers, pregnancy. The influence of these causes has, doubtless, been exaggerated. *See* Ununited Fracture.

Consequences of Fracture. — Fat-embolism may occur after fracture involving the medullary canal. *See* Fat-Embolism. Necrosis is extremely rare, if, indeed, it ever occurs, after simple fractures. In compound fractures it is not rarely met with. It may be suspected in cases in which, though the surrounding structures have become sound, openings leading down to the bone remain long unclosed. Under these circumstances an examination involving as little disturbance as possible should be made, and any dead bone that is discovered should be removed. Sequestra generally consist of fragments of compact tissue. They may sometimes be extracted more easily when divided by a fine chisel. The rapid development of new-growths in the site of recent fracture is to be noted. Atrophy, sometimes very marked, may follow the interruption of the blood-supply to the bone, resulting from rupture of its medullary artery. For individual fractures, *see* separate bones. Howard Marsh.

FRAGILITAS OSSIUM.—This is an old term, which has gradually fallen out of use as the more exact pathology of the various conditions under which the bone is more than usually brittle has become better known.

The chief morbid process with which it was most frequently confounded—osteomalacia—will be considered in another article. Fragility was scarcely a proper term to apply to cases of osteomalacia, for the bones more frequently bend into all sorts of odd shapes in the latter disease than break with a clean fracture. Simple atrophy of bone from various causes will here alone be considered as the condition giving rise to fragilitas ossium. Cancer

and tumour of bone, in which spontaneous fracture occurs, will be considered under their proper heading of Tumours of Bone.

Causes.—In old age the bones, like other tissues, undergo fatty degeneration, and, becoming more brittle, are liable to fracture from insignificant injuries. Long confinement to bed during a lingering illness in the adult, will sometimes produce the same effect; that is to say, the bone may atrophy from want of use, and become so brittle as to break. It is also well known to surgeons how light and porous the bones of a limb become in which one or more joints have been diseased and kept at rest for any length of time.

This atrophy from disuse may in some degree explain the ease with which a patient who has been kept in bed for six weeks or two months for fracture of the femur breaks the other thigh-bone, when he gets up and begins to move about. The bone may even break in the neighbourhood of the original fracture from the same cause. And Curling has shown very clearly that another factor plays an important part in such atrophy. He maintains that when the line of fracture crosses the nutrient artery, the osseous tissue supplied by that vessel undergoes atrophic changes.

In insane patients, and especially in cases of general paralysis, the bones sometimes break from very slight injuries. And although there is frequently some little difficulty in proving the absence of any undue violence on the part of the attendant, yet it is an established fact that the bones may be very fragile. This is generally due to atrophy and fatty degeneration, arising probably from the low and depressed vital condition of such patients. It has been asserted that the bones may be found in the condition described as osteomalacia; but, in the writer's opinion, there is insufficient evidence that this is by any means common in the fragilitas ossium of the insane.

A somewhat similar condition of atrophy and thinning of the bones has also been observed in the advanced stages of carcinoma, especially in that of the breast, without any deposit of new-growth in their substance. The cachexia induced by the carcinoma would seem here to be the cause of the atrophy and consequent fragility. In some cases rheumatism or syphilis has been present before the occurrence of such evidence of a feeble condition of the bones. But in others no history of these constitutional affections has been obtainable. Some of the cases referred to by Stanley are remarkable for the extraordinary number of fractures, and the early age at which they occurred. In one, a girl of fourteen, there were no less than thirty-one fractures in different bones, the first occurring at the age of three years. 'In a sister of this patient, six years of age, there was the same condition of the bones favouring the occurrence of fractures. She had suffered nine fractures since the age of eight months.' In another, to which he alludes, a boy aged ten years had been the victim of eight fractures—six in one tibia, and two in the femur. There was no difficulty in obtaining their union, a fact which is quite unlike the history of cases of osteomalacia. A decided hereditary tendency to this condition of the bones has been proved to exist in a small proportion of the cases recorded. In infantile paralysis the affected limb may exhibit the same symptoms from a feeble condition of the bones, but this is due to a want of development from disease of the spinal cord.

Pathology.—In the atrophy of old age the bones become light, spongy, and more porous. The spaces in the cancellous tissue coalesce by absorption of the osseous trabeculæ, whilst the cortical tissue becomes more and more cancellous, till finally the bone may be reduced to a mere shell filled with yellow fat. In this senile atrophy the lime-salts are not absorbed, leaving the organic matrix to represent the bony outline, as occurs in the early stage of most, if not all, the cases of osteomalacia; but, on the contrary, the part which has not yet entirely disappeared, and been replaced by fat, contains more than the usual proportion of lime-salts, and is consequently more brittle. In osteomalacia, on the other hand, the texture of the bone is at first softened by the absorption of its lime-salts, and bends rather than breaks. So much for the contrast between senile atrophy and osteomalacia. The question then appears to be whether atrophy of bone, arising from other causes than simple old age, is similar in its pathology to senile atrophy or to osteomalacia; and secondly whether there is a fragility of bone besides that due to osteomalacia, occurring in young or middle-aged people, to which no definite cause can be assigned other than simple atrophy of bone. To the first of these questions the answer would seem to be fairly definite, that the atrophy and consequent fragility arising from some definite cause, such as long-continued disuse, resembles most completely the changes occurring in senile atrophy. To the second question

a less definite answer must be given, as the cases are so excessively rare that few can have been observed by any one man.

The cases recorded by Stanley would seem to indicate that there is an atrophic condition of bone, occurring at almost any age, resembling, in its morbid anatomy, the changes naturally arising in old age, and to which no definite cause, such as disuse, can be ascribed. Stanley thus concludes: 'Still, however, it is not clear that this condition of the bones, disposing them to fracture from the slightest causes, is a different disease from that which was previously described (osteomalacia), wherein the thinning of the walls was accompanied by softening of the texture of the bones, disposing them to bend rather than to break, since between these two states of the osseous system there is really no other observable difference than in the relative proportions of the animal and earthy constituents of the affected bones; their chemical constitution is the same.' But, in the writer's opinion, this is quite a sufficient difference to separate the two conditions of atrophy of bone and osteomalacia, especially when the clinical symptoms and history of the latter are taken into consideration. *See* Osteomalacia.

Symptoms.—Beyond the lightness of the affected bone, and the tendency to fracture from trivial causes, there is nothing to point out as indicative of atrophy of bone. The surgeon will, however, know from the history of the case—for example, in continued disuse of a limb from any cause—that the bones so treated are liable to atrophy, and consequently may be easily broken. In the other class of cases, in which the atrophy seems to arise spontaneously from no ascertainable cause, the first indication of the presence of the disease will be the occurrence of fracture from some trivial accident.

Treatment.—In senile atrophy, and in atrophy from other causes, the bones very readily unite. Professor Humphry has lately (*Brit. Med. Jour.*, Feb. 1884, p. 55) proved that in old people fractures unite as readily as in the young and middle-aged; and in the atrophy from other causes than age, the histories of the cases which have been recorded tend to prove that there is no delay in their union. It is therefore necessary to treat these fractures exactly on the same grounds as ordinary fractures, except that the surgeon should most carefully search for any clue in the patient's history pointing to a constitutional cause, and attempt, as far as possible, to rectify the defect if such be found. There cannot be said to be any special treatment even when the atrophy giving rise to the fragility of bone is discovered. H. H. Clutton

FRECKLES. *See* Lentigo.

FRICTION. *See* Massage.

FRONTAL SINUS, Diseases of the.—Distension of the frontal sinus from pent-up secretion, or pus, sometimes called abscess of the frontal sinus, may so closely resemble an orbital tumour as to render a diagnosis difficult without making an exploratory incision.

Causes.—Distension of the frontal sinus is usually due to an injury, in many cases very remote from the symptoms which first attracted attention to the eye. The extent, however, to which the sinus is often found dilated, and the time which must be required to produce such distension of a bony cavity, together with the oft-told tale of a blow or fall years before, can only lead to the conclusion that an injury is the most frequent exciting cause of these accumulations. The explanation is probably that at the time of the accident some of the anterior ethmoidal cells were fractured, and that the infundibulum, the canal by which the secretion from the frontal cells escapes into the nose, had been blocked. This channel being thus closed, there is retention of all mucous secretion, which slowly accumulates and gradually expands the sinus. In one case of extreme distension of the frontal sinus in a man æt. 58, under the writer's care, the disease was clearly traced to a kick received on the left eyebrow from a horse when four years old, fifty-four years previously. The left eye was considerably displaced by the tumour; it was half an inch further from the nose, and nearly an inch lower down in the face than its fellow on the opposite side. The eye was projected outwards, and the patient was unable by any effort to draw it inwards. This case was greatly benefited by treatment, and the eye regained to a large extent its proper position within the orbit.

A case has also been recorded by Mr. Hulke of a girl æt. 17 with great expansion of the right frontal sinus, which was evidently caused by an accident when she was four years old. 'She fell from a window and received a cut over the right eyebrow. Her forehead was much bruised and swollen, and she had concussion of the brain.'

There are, however, cases of distended frontal sinus in which no history of an injury can be traced. It is probable that

in these cases an inflammation of the lining mucous membrane, or some other cause which we cannot detect, has closed the communication between the frontal cells and the nose, and thus allowed the secretions of the frontal sinuses to accumulate and distend them. This hypothesis is the probable explanation of a case of great distension of the frontal sinus in a girl æt. 21, who was attending at the Royal London Ophthalmic Hospital, and who had never received an injury. Her mother dated the disease from an attack of erysipelas of the head and face when she was six years old.

Symptoms.—In most cases the distension of the frontal sinus is *chronic*, the collection of fluid within its walls being the pent-up secretion of many years. Sealed up in a bony cavity no decomposition of the fluid ensues, and, increasing year by year in quantity, it distends the sinus and displaces the eye. There is frequently no pain, not even a sense of weight over the brow. The only symptoms which are manifest to the patient are the gradual formation of a tumour at the upper and inner portion of the orbit, and a slow but steadily increasing protrusion of the eye downwards, outwards, and forwards. The disease is usually confined to one frontal sinus, but cases have been met with in which both frontal sinuses were affected. Occasionally a chronic distension of the frontal sinus will become acutely or sub-acutely inflamed, and there will be a feeling of constant heaviness and aching across the forehead, with tenderness on the inner side of the orbit, which will compel the patient to seek for advice.

Acute inflammation and distension of the frontal sinus is rare, but still it does occur and should be recognised. There is a dull aching pain over the brow and root of the nose, accompanied by considerable constitutional disturbance. The pus gradually accumulates in the frontal sinus, and ultimately discharges itself either by bursting into the nose, or by making an exit for itself through the upper and inner part of the orbit. When the latter site is selected there is usually some bulging of the distended sinus into the orbit, and a slight displacement of the eye downwards and outwards. The upper lid becomes red and swollen, and the tumour, examined with the finger, is tender, and will, if sufficient thinning of the bone has taken place, impart a sense of fluctuation.

Treatment.—The objects to be attained are, first to evacuate the pent-up fluid, and then to establish a free communication between the frontal sinus and the nose, through which the secretion may continue to drain as fast as it is secreted. By these means the cavity of the sinus will gradually collapse, and the eye will be restored in a great measure to its normal position. The ends to be desired will be accomplished by the following operation:—

A single curved incision parallel with the fold above the lid is to be made over the most prominent part of the tumour, and having by a little dissection exposed its surface, the scalpel should be plunged into it, and an opening made to the extent of the incision. The index finger of the right hand is now to be pushed into the sinus through the wound, to ascertain the size of the cavity and if there is any necrosed or carious bone. Whilst thus exploring the sinus, the little finger of the left hand should be passed up the corresponding nostril, and an endeavour made to find out the spot at which the tip of the finger in the sinus will approximate most closely the end of the one in the nose. After a little search it will be found that at one part the fingers will almost meet, there being only a thin plate of bone between them. Having gained this information, the finger in the frontal sinus is to be withdrawn, but that in the nostril is to be retained *in situ* to act as a guide to the gouge or elevator, which is to be passed into the sinus and made to force a passage into the nose through the lamina of bone on which the tip of the little finger is resting. A communication between the frontal sinus and the nose having been thus established, an india-rubber drainage-tube, with holes cut at short distances, is to be introduced, one extremity of which is to be afterwards fastened on the forehead, whilst the other end protrudes slightly from the nostril.

The easiest way of introducing the drainage-tube is to pass a probe with an eye up the nostril and out of the wound, and having fastened the tube to it by means of a piece of string, to draw it back again through the nose.

The object of the drainage-tube is to keep the channel between the two cavities from closing, and to enable the attendant to wash out the frontal sinus at least twice a day with some astringent and disinfectant solution. For the latter purpose a lotion of alum gr. iij., sulphate of zinc gr. j., to the ounce of water; or a lotion of carbolic acid ℥iij. to the ounce of water, may be injected with a glass syringe through one of the openings at the upper extremity of the tube. The drainage-tube should be worn for five or six months, or until all discharge from the nose has ceased. The results of

these cases when thus treated are usually most satisfactory.

Tumours of the Frontal Sinus.—The tumours which are met with in the frontal sinus are—

1. Those which originate in the frontal or ethmoidal cells; or, in some cases, in the sphenoidal cells at the base of the skull. These are usually bony or ivory exostoses.

2. Those growths which originate in the nose, antrum, or adjacent locality, and afterwards extend into the frontal sinus.

1. Ivory exostosis is the tumour most frequently met with in the frontal sinus. It grows in two ways:—

(*a*) As a sessile tumour, which is connected with the portion of bone from which it sprang by a very small pedicle; it then occasionally becomes detached, and remains as a loose bony tumour within the cavity of the distended sinus.

(*β*) As a tumour with a broad base, which increases with the growth of the tumour.

Ivory exostoses in their growth extend forwards and downwards into the nose and orbit, and frequently also backwards into the cavity of the skull.

A case of large ivory exostosis was reported by the late Sir William Fergusson. The weight of the bony growth removed was 10½ ounces, or 5,040 grains. Another case has been related by Dr. Duka. The weight of the bony growth removed was 1,060 grains.

Mr. Bryant, in his *Practice of Surgery*, has also recorded a case of ivory exostosis which he enucleated from the frontal sinus of a man æt. 24, which had been growing for four years.

Treatment.—In all cases of bony growth within the frontal sinus it is necessary to proceed with extreme caution. When the tumour is connected by a very small pedicle with the adjacent bone, it may generally be easily detached and turned out; but if it is found to be connected by a broad base to the cranial bones, it is better to make no further attempt to remove it.

2. Of the tumours which originate in the nose, antrum, or adjacent locality, and extend into the frontal sinus, we have:—

(*a*) The polypoid growths. These may start from the nose and extend upwards into the frontal sinus, and completely distend it so as to form a tumour, bulging the inner wall of the orbit and displacing the eye.

(*β*) The fibroid polypi, which grow from the base of the skull and make their way into the nose. These also sometimes extend themselves into the frontal sinuses.

A very remarkable case of a large tumour which occupied the nose, both frontal sinuses and upper maxillary bones, was reported by the late Mr. Moore, of the Middlesex Hospital, in the *Pathological Transactions*, vol. xix. p. 332, under the heading of Cranio-facial Enchondroma. The deformity in this patient was excessive. Both eyes were displaced outwards, and the width between the inner angles of the two eyes was four and a half inches. There was a huge protuberance of the upper part of the face, caused by the distension of the cavities which were filled with the tumour.

The tumour was examined by the Morbid Growths Committee of the Pathological Society, who described it as a compound growth of myxoma and enchondroma. The preparation is in the Middlesex Hospital Museum, No. 539.

Fracture of the frontal and ethmoidal cells is occasionally produced by blows on the face. The injury is recognised by an escape of air into the cellular tissue of the face on the patient forcibly blowing his nose.

Treatment.—The patient should not blow his nose, and in a short time the emphysema will entirely disappear, and in a few days the fissure in the bones through which the air escaped will be completely closed.

George Lawson.

FROST-BITE.—Any uncovered part of the body when exposed to the continuous action of intense cold becomes at first red and tender, next hard, white, and insensitive, and at last passes into a state of dry gangrene. In frost-bite which is caused by the action of cold air on peripheral and exposed organs, such as the nose, external ear, and fingers, the lesions are not so rapidly produced, and each of the above stages is well-marked and more or less prolonged. In a division analogous to that of burns the lesions produced by the action of cold were arranged by Callisen in three degrees: the first, of erythema; the second, of vesication and superficial ulceration; and the third, of gangrene.

In the erythematous state the well-known condition is met with, in which the skin is rendered deep red or livid on temporary exposure to a frosty air, and subsequently, when warm, becomes very painful and slightly swollen. In the second degree, caused by more prolonged or frequently renewed application of cold, the epidermis is raised in small blisters and the

skin becomes raw. In the extreme forms of this degree the whole thickness of the cutis becomes inflamed, large blisters containing blood-stained serum are formed, and the affected surface is threatened with complete disorganisation.

Gangrene from frost-bite presents a variety of forms, and is influenced by the intensity of cold, the duration of its action, and the condition of the affected part. In the very rare instances in which it is caused solely by the action of very intense cold, the frozen skin first becomes white and firm, like a surface acted upon by the ether spray, and then passes into a state of dry gangrene, the integument becoming black and inodorous and hopelessly disorganised. In the more frequent form of frost-bite the gangrene is moist, and due either to too rapid application of warmth to a livid and incompletely frozen surface, or to the prolonged action of moderate cold combined with wet. In some few instances the gangrenous part becomes 'mummified,' being quite dry, though soft and pliable, and separating very slowly from the adjacent sound parts.

In most cases of gangrenous frost-bite the causation is complex, as the action of cold is assisted by that of other conditions. Debility from insufficiency of nourishment and from fatigue has undeniable influence, as is proved by the records of military surgery, and by the fact that frost-bite, once so prevalent amongst Lascars, is now very seldom observed in the crews of the well-manned and well-provided steamers which make short voyages between the East Indies and English ports. In enfeebled and aged subjects of arterial degeneration, as also in the younger subjects of *gangrène symétrique*, the application of but a moderate degree of cold may cause destructive changes in toes or fingers. Occasionally with the action of cold is associated that of compression of the chilled extremity, as in the not infrequent occurrence of gangrene of the toes in a patient who, after prolonged exposure to cold and wet, had fallen asleep without removing his boots. A dry and still air, however cold, is less likely to cause frost-bite than cold associated with wind and moisture.

In *treating* frost-bite of that grade in which the skin is of a deep red or a livid tint and has not yet become black and gangrenous, the medical attendant should apply warmth very gradually, and trust at first to prolonged friction with snow or sponges dipped in iced water. As the skin becomes warmer and less congested, the frozen part should be enclosed in dry flannel or cotton wool. Often, after a frost-bitten part has been found quite cold and livid and apparently dead, the whole or much of this threatened organ has been saved through great care having been taken in restoring warmth and in controlling the inflammatory reaction.

When a portion of a finger or toe has been destroyed by frost-bite, it is advisable to allow the gangrenous part to come away by itself, or, at the most, to interfere only when it is retained by ligament or bone In gangrene of a larger portion of an extremity, as of more or less of the foot for instance, it becomes necessary in order to prevent any septic poisoning, to remove the destroyed parts as soon as this can be done without much danger to the adjacent tissues. In most cases it will be found advisable to wait for a time and to perform a secondary amputation. The structures above the seat of gangrene remain affected for some time after the application of cold, and from the direct action of any stimulus may themselves become gangrenous. By the time that a distinct line of demarcation has formed, the sound parts beyond have very probably returned to their normal condition, and may now form sound and useful flaps. In a case of decided gangrene, from intense cold, of a considerable portion of either the lower or the upper extremity, primary amputation is indicated.

W. Johnson Smith.

FUMIGATION. *See* Calomel Vapour-bath.

FUNGOUS DISEASE OF INDIA

(*Synon.*: Madura foot; Mycetoma).—*Definition.*—An endemic disease affecting the extremities, producing disorganisation of all the tissues.

Etiology.—The disease is endemic in certain parts of India, but is not limited to any particular soil or geological formation. Hitherto it has been limited to natives, especially those who go barefoot and work in the fields; it is much more frequent in men than women, and is rare below puberty, but may occur at any age after that. In many instances the patient dates the onset from an abrasion, prick, or other slight injury, but it is often impossible to trace it to any cause, either predisposing or exciting. A previous attack of guinea-worm disease, though not infrequent, can scarcely have any etiological bearing.

Varieties.—Two varieties are recognised, the pale and the black, the black

being the most common; but the only difference is in the colour of the granules and the presence or absence of fungus-elements.

Pathology.—The pathology is still obscure. Vandyke Carter considers the disease to be due to a fungus, named after him Chionyphe Carteri; but since his discovery has only been confirmed in the black variety, it leaves the pale form unexplained, and the presumption therefore is that the disease is not due to the presence of the fungus; at the same time, no other theory offers any semblance of plausibility. When a section is made of a diseased foot it is often difficult to make out the various tissues, on account of the fatty and fibrous degeneration they have undergone, many even of the bones having disappeared and been replaced by fibrous tissue; the muscles are the least affected, and the fat is often much increased, but may contain black or coloured granules. The foot is perforated by sinuses in all directions, which pierce even the bones as if they had been drilled, often with no surrounding degeneration of the bone-substance; the sinuses lead into small spherical cavities, single or multiple, containing an abundance of granules, which stud the walls of the sinuses and lie free in their lumen.

The granules consist of altered fat, with a central caseous mass, surrounded by fatty crystals, while the black granules are made up chiefly of the mineral constituents of the tissues, with black pigment derived from the blood-colouring matter, and an abundance of the fungus alluded to.

Symptoms.—The tumour is single, and in the vast majority of cases affects the foot or leg, sometimes the hand or arm, and in rare instances the shoulder or scrotum. In a well-marked case the foot is enormously swollen and distorted, from the bones of the foot giving way, so that the arch is destroyed and the toes are over-extended. On various parts of the surface are pea-sized projections, and the centre of each is the orifice of a sinus leading into a cavity, which may be either superficial or deep. From these sinuses issues a sero-purulent discharge, containing the granules compared to fish-roe, which are white, yellow, or black, according to whether the case is one of the pale or black form, and in rare instances the granules are pink or red; they also stud the surface of the eminence round the orifice.

The mode of commencement varies. Only a finger or toe may be attacked first; or, affecting the body of the foot, there may be very little swelling or redness and circumscribed induration; or a papule, pustule, or tubercle appears, which may be superficial or deep, firmer, larger, and less tender than a boil, which, when opened, discharges ordinary pus at first, and later on the characteristic granules above described. Or there may be mottled discoloration under the skin like tattoo-marks, before any wound appears. The disease progresses slowly, as a rule, and it may be six or seven years, or more, before the foot becomes thoroughly disorganised, though it may have been useless for progression for a long time.

Diagnosis.—The fully developed disease, with its enormous swelling, its limitation to an extremity, and the numerous sinuses, with the characteristic discharge of 'fish roe' granules, offers no difficulty. The cases beginning with 'gunpowder grains' under the skin are also distinctive, but those with a pustule or tubercle are very like the guinea-worm disease; and probably it might be difficult to decide until the pustule was opened, when the absence of the worm and the character of the discharge would clear up the diagnosis.

Prognosis.—The disease is slowly but steadily progressive if untreated, and the whole foot or hand becomes completely disorganised and a useless and painful encumbrance.

Treatment. — When the disease is limited, removing the toe or finger may be sufficient; or, in the early stage, when the process is superficial, scraping all the affected tissue away with a sharp spoon has effectually arrested its progress in several instances; but in more advanced cases the limb must be amputated above the disease. The operator, however, is sometimes disappointed to find the bones of the leg softened beyond the apparent limit of the morbid changes, and has, therefore, to remove more than he anticipated.

H. Radcliffe Crocker.

FUNGUS OF THE BRAIN. *See* Brain, Hernia of the.

FUNGUS OF TESTIS. *See* Hernia Testis.

FURUNCULUS. *See* Boils.

FUSIBLE CALCULUS. *See* Calculus, Urinary.

G

GALACTOCELE or MILK CYST.—The term galactocele has been applied to three pathological conditions, of the existence of two of which grave doubts must be entertained. The true galactocele is caused by the obstruction of a duct during lactation. The obstructed duct becomes dilated by the secretion, and a cyst is thus formed, giving rise to a fluctuating swelling which is most superficial near the nipple. The tumour appears during the first few weeks of lactation without any of the signs of inflammation. It has been known to reach an enormous size, as in the celebrated case recorded by Scarpa, in which it rested on the patient's knees when she was in a sitting position, and contained ten pints of pure milk. Galactocele is undoubtedly very rare.

Velpeau describes a form of 'galactocele,' in which the milk was distending the meshes of the connective tissue of the breast, but the evidence he gives in support of the existence of such a condition is not sufficient.

The third form of galactocele which has been described, is that in which the contents have become converted into a material like cheese. Most, if not all of these cases, have probably been chronic abscesses.

Treatment.—A true galactocele is best treated by repeated aspiration, if the cyst be large, to diminish its bulk, after which it may be punctured, and a drainage-tube inserted. It may be necessary to wean the child and arrest the secretion of milk, to effect a cure. MARCUS BECK.

GALACTORRHŒA. *See* BREAST, Diseases of the.

GALL-BLADDER, Obstruction of the. *See* CHOLECYSTOTOMY.

GALL-STONE, Extraction of. *See* CHOLECYSTOTOMY.

GALVANIC CAUTERY. *See* CAUTERY.

GALVANO-PUNCTURE. *See* ELECTROLYSIS.

GANGLION is the name given to a limited collection of fluid which is found in connection with the sheaths of tendons, and is most commonly situated on the back of the wrist, and therefore in relation to one of the extensors of the thumb or of the fingers. It is as common in youth as in adult age, and its causation is not very definite. In some cases it may be ascribed to excessive use of the fingers, as in wringing or in piano-playing, but as often as not its origin is spontaneous. When situated on the dorsal surface it forms an even, globular swelling, fluctuating, not painful, but causing some weakness in the muscles with which it is connected. But when placed on the anterior aspect, the shape is not so distinct, and care must be taken to distinguish it from one of those protrusions of the synovial membrane of the wrist-joint which are sometimes found, and are situated usually beneath the radial artery. Another origin to which the existence of ganglia has been traced is the protrusion, through a rupture of the sheath, of some portion of the synovial sac, which, if healing of the rupture take place, is shut off, and its connection with the parent sac becomes obliterated. In most instances the contents are a clear transparent white or yellow homogeneous jelly; but when the effusion is large, there are frequently found numerous small round or oval bodies, resembling melon-seeds, which consist of a collection of fibrine, and have no organisation. Their presence before evacuation can be ascertained by a crepitation on movement of the part, which is almost unmistakable. They originate from small depositions of fibrine on the inner surface of the sac, which become rolled off by the constant movements of the tendon.

The compound palmar ganglion is a much larger collection of the same materials, which forms in the sheath of the flexor tendons, and passes beneath the annular ligament, above and below which the contents can be made to fluctuate. This sometimes attains a very large size, and may arise gradually from over-work, or from a sudden exertion, as in the case of an attendant struggling with a violent lunatic.

Diagnosis. — These chronic swellings need to be distinguished from the acute inflammation of the synovial sheaths—tenosynovitis—which occurs after such violent exertion as rowing, &c., and are evidenced by their acuteness and by the ordinary symptoms of inflammation. From disease of the wrist they must be distinguished by their situation, shape, and by the absence of other symptoms of disease of the joint.

When small and on the back of the wrist, a ganglion can often be ruptured by pressure

of the surgeon's thumb, or by a smart blow from a broad instrument, and the contents are then poured out into the surrounding tissue. But if it resist this, the fluid should be evacuated by a fine trocar or grooved needle, or a sharp-pointed tenotome, and the puncture sealed with collodion. In case any return of the collection is threatened, a blister may be applied, or an absorbent ointment, containing Ung. hyd. ʒj., Ung. pot. iod. ʒj. to Ung. simpl. ʒj., may be frequently rubbed over the part until the skin is reddened. When, however, the collection is large, or when the existence of melon-seed bodies can be ascertained, an incision should be made under antiseptic precautions, and the contents evacuated completely, after which pressure by strapping must be applied and rest of the part maintained. Sometimes after the sac has been incised it may be necessary to scrape off any collections adhering to the walls, and to keep the opening patent by a drainage-tube or a wisp of horsehair.

JOHN H. MORGAN.

GANGRENE is a term employed to denote the death of a part of the living body. It implies the destruction of a considerable portion of tissue *en masse*, in contradistinction to ulceration, where, although there may be as great a destruction of tissue, the part is destroyed slowly by molecular disintegration, and there is no palpable mass of dead material, the portion destroyed being thrown off in minute particles in the form of discharge. The mass of dead matter which is the result of the process of gangrene is termed a *slough*.

Causes.—The immediate cause of gangrene, in almost every instance, is the arrest of the flow of blood in the part, but the causes which may give rise to this arrest are very numerous. It may be due to injury, or arise from constitutional causes, or from the two in combination, or it may be occasioned by specific influences. These various causes may be tabulated in the following order:—

Local Causes.—1. Mechanical injuries. 2. Chemical injuries. 3. Heat and cold. 4. Local poisons. 5. Arrest of circulation. 6. Intense inflammation. 7. Pressure or tension.

Constitutional.—1. Deficient blood-supply. 2. Impaired nutrition. 3. Loss of nervous power. 4. Spontaneous. 5. In diabetes. 6. From ergot.

Specific.—1. Carbuncle and boil. 2. Noma and cancrum oris. 3. Malignant pustule. 4. Glanders. 5. Spreading traumatic gangrene. 6. Hospital gangrene.

LOCAL CAUSES OF GANGRENE.

1. *Mechanical injuries* are frequent causes of gangrene, the injury being of such a nature as to destroy the vitality of the tissue, so that its functions can no longer be carried on; hence the part dies and separates as a slough. This process may be seen daily, in a minor degree, in contused and lacerated wounds. The blow which produced the wound kills a thin layer of tissue, which must separate as a slough before the wound can heal. Occasionally the violence done to the part is so great that it kills its whole substance, as, for instance, in the case of the wheel of a heavy waggon passing over a limb; here the tissues are so destroyed that all circulation immediately ceases, and the part speedily falls into a condition of gangrene. At other times the injury may not be so great as to kill the tissue outright, but the vitality is so impaired that the inflammation necessary for recovery terminates in gangrene. But whether the gangrene occurs in the one way or the other, the immediate cause of it is the arrest of the circulation in the part.

When a part has been severely contused and is about to fall into gangrene, it is generally of a dark purplish colour, cold to the touch, and devoid of sensibility. The symptoms, in a great measure, will depend upon the amount of blood which has been extravasated into the tissues. When this has been poured out in large quantities the part is swollen, black or purplish-black, and soft and boggy to the feel. The temperature falls, the limb becoming cold and insensible. Bullæ, filled with blood-stained serum, form on the surface, and the part rapidly falls into a condition of decomposition. Emphysematous crackling may be felt, from the evolution of gases, and a fetid, stinking odour is perceptible.

2. *Chemical agencies* also cause gangrene in the same way, by destroying the tissue so that the blood can no longer circulate through it. This they do either by combining with the animal matter, so as to form a new compound; or else by causing the elements of the animal tissue to enter into new combinations, and thus destroying the life of the part. A familiar example of this is the common issue, where the desiccating action of the potassa fusa destroys the tissues with which it is brought into contact.

Where the gangrene is produced by the application of a caustic, the process par-

takes more of the dry form. In fact, the gangrene produced in forming an issue forms a typical example of 'dry gangrene,' in which the process can be well studied; the desiccating action of the potassa fusa drying up the fluids in the part, and thus destroying the tissues with which it is brought in contact. If an issue be examined a day or two after its formation, the dead tissue will be found to be quite black and somewhat shrunken, so that the cavity in which it is contained appears to be somewhat cup-shaped, and there is no discharge and no fetor. Shortly after, a halo of redness appears in the natural skin around, and the slough begins to separate.

3. *Heat and cold* produce gangrene, the amount varying with the intensity and the duration of the application. It may merely involve the cuticle, or it may destroy the whole limb; but the principle is the same—gangrene is produced in the one case as much as the other. Gangrene from frostbite may occur either from the direct effect of the suspended circulation, or from inflammation which subsequently ensues after the circulation has been re-established. *See* Burns; Frost-Bite.

4. *Local poisons*, as the extravasation of urine or fæces, may lead to gangrene. A familiar example of this is seen in cases of ruptured urethra from stricture, where the concentrated and putrefying fluid is effused into the cellular tissue in the neighbourhood, producing death of this tissue and, secondarily, of the skin from deficient supply of blood, owing to the circulation through the cellular tissue being arrested.

The skin, at first of a dusky-red hue, speedily becomes purple, and gangrenous spots appear. These give way and large masses of pultaceous, sloughing material are separated, accompanied by quantities of foul-smelling discharge. In these cases there is always great general depression; the patient is delirious, with exceedingly feeble pulse and dry, brown tongue, and often sinks from exhaustion.

5. *Arrest of circulation.*—As has been already stated the immediate cause of gangrene, in almost all cases, is the arrest of the flow of blood in a part and the stoppage of the supply of nutritious fluids, and this is due to the suspended circulation in the capillaries, as in the causes already, and still to be, enumerated. Under the heading 'arrest of circulation' are included those cases in which this suspension of circulation in the capillaries is produced by an arrest of supply of arterial blood to a part, or the obstruction of the circulation through, or retardation of the flow of venous blood from, a part. For obstruction of a main artery can only be the cause of gangrene when the collateral circulation is impossible, and therefore the capillary circulation is suspended; and in order that gangrene may result from venous obstruction it is necessary that complete stasis in the capillaries should exist as the result of complete plugging of the veins returning blood from a limb. Thus ligature or obliteration of an artery is not necessarily followed by gangrene, nor will it occur so long as the capillary circulation can be maintained. Nor will obstruction of a single vein cause gangrene, because there is in almost all parts of the body a double channel of superficial and deep veins, which freely intercommunicate, so that if one channel become closed, the other will probably be, at all events partially, open. Under certain circumstances, however, arrest of the circulation through the arteries or veins will produce arrest of the capillary circulation in a part, and then nutrition will cease, and gangrene be the result. Complete arrest of the circulation both from and to a part would of necessity cause capillary stasis, and would result in gangrene. A ligature tied tightly around a limb would produce gangrene in this way; the mortification of a strangulated hernia would depend upon the same cause. The arrest in the supply of arterial blood to a part may be produced by obliteration of the artery by accident, by ligature, by embolism, or by calcification. The return of the venous blood may be retarded or obstructed by inflammation, by thrombosis, or by pressure on the venous tract.

In the cases in which the primary cause of the gangrene is venous obstruction, the limb swells and becomes œdematous, and vesications form on its surface. The skin, at first deeply congested, speedily becomes purplish and then black. The discoloration, commencing at the point furthest from the centre of circulation, extends up the limb. The discoloured parts become cold and insensible, and gas is evolved from the decomposing tissues, which eventually become converted into a deliquescent putrid mass.

When the gangrene occurs from a thrombus or embolus, it is of the dry kind. This condition not infrequently occurs in cases where vegetations on the cardiac valves, the result of endocarditis, are washed into the arteries, and become arrested when the calibre of the vessel is no longer sufficiently large to permit their onward progress. Its advent is generally sudden and it affects one limb. The patient is suddenly seized

with severe pain in the course of an artery, where it diminishes in calibre either by bifurcating or by giving off a large branch. This is followed by numbness and weight in the limb. The part 'feels dead.' It is sensibly colder than the rest of the body, and has a shrunken and white, waxy appearance. No pulsation can be felt in the arteries below the seat of obstruction. At first the boundary line between the dead and living tissues is not clearly defined, but in the course of a day or two becomes more marked, and can be exactly differentiated. The changes take place slowly, the white and waxy skin gradually assumes an olive-green tint, and then becomes black, the blackness, for the most part, appearing in patches which gradually spread. The discoloured tissues shrivel and contract, and the skin becomes hard and horny. There is little or no fetor. At the line of junction of the dead and living parts a halo of redness may now be observed, and the gradual formation of an ulcerating furrow. Later on the soft dead parts may be seen falling away from the living, the tendons resisting the disintegrating process the longest. In this form of gangrene the process is essentially chronic, and is attended by much less constitutional disturbance than in the acuter forms of the disease. In fact, the temperature may remain normal and the pulse good in these cases during the earlier stages of the disease. The formation of the line of demarcation is, however, generally attended with a slight rise of temperature and access of febrile symptoms.

6. *The intensity of the inflammation* of a part may lead to gangrene—that is to say, the inflammatory disturbance of the nutrition of a tissue is sometimes so great as to lead directly to the arrest of tissue-change, and this in its turn leads to cessation of the capillary circulation, and thus gangrene is established. In these cases it is therefore not correct to say that the gangrene is the result of capillary stasis, since, in all probability, death is established before the circulation in the part is arrested, the stoppage of the circulation being the result, and not the cause, of the death of the tissue.

7. *Pressure and tension* will produce gangrene. A practical example of the former is to be seen in a bedsore, brought on by continued pressure in a sick person. Not that all bedsores are produced by pressure; they may be produced partly by loss of nervous influence, or from a maceration of the skin from long-continued lying in a bed wetted with urine or other fluids. The true gangrenous bedsore produced by pressure occurs in debilitated and emaciated patients, who are prevented by weakness from shifting their position, and thus continuous obstruction to the capillary circulation is maintained, and the passage of blood through the parts where the pressure is great becomes mechanically difficult or impossible. Stagnation occurs, and death of the tissues takes place. The blood-vessels in the neighbouring parts become engorged, and the slough, acting as a foreign body, sets up inflammation in them, a gradual process of separation taking place, and the dead tissue is thrown off, leaving an ulcerating surface which only very tardily cicatrises, should the patient survive.

Too great tension of the tissues, leading to a deficient blood-supply, is not an uncommon cause of gangrene. Thus, in cases of phlegmonous erysipelas and diffuse cellulitis, the tension of the cellular tissue leads to deficient blood-supply to the skin, with loss of nutrition, followed by coagulation in the capillaries and consequent gangrene.

There is in these cases great swelling from the effusion into the subcutaneous tissue, and the skin becomes so hard and tense that no pitting on pressure can be produced. The redness is of a dusky hue, and is not uniform, being darker at the centre than towards the circumference. Pain is great and of a burning character. The general symptoms are severe, and often marked by paroxysms and remissions. The pulse is quickened and oftentimes irregular and intermittent; the tongue thickly coated, with a yellow, creamy fur; the urine high-coloured and loaded, and its quantity much diminished.

Constitutional Causes.— One of the most frequent constitutional or general causes of gangrene is (1) *deficient blood-supply* to a part, arising either from disease of the arteries or of the heart, or probably more frequently from the two combined. It is met with usually in the lower extremities of persons of advanced life, and the disease is the result usually of systemic decay. When it arises from this cause it is distinguished by the generic term 'senile gangrene.' In advanced life the arteries become rigid and calcified, and lose their power of adapting themselves to suit the various exigencies necessary for nutrition; this in itself is not sufficient probably to produce the gangrene, but when combined with diminished propulsive power of the heart, so that the circula-

tion, especially in the lower extremities, is weakened, arrest of the flow of blood takes place, and gangrene inevitably follows. It appears, however, that the immediate cause of the arrest is sometimes a slight injury, such as an abrasion or some such trivial lesion, which is the starting-point of the disease. It seems as if the tissues were just sufficiently nourished to maintain their vitality, and that the slight injury destroys the balance of the circulation, and, as a result, gangrene ensues.

The disease is usually ushered in by the appearance of a dark red or purplish spot at the seat of the injury, or on one of the toes, generally the inner side of the great toe. This is surrounded by an areola of dusky red tissue, and is accompanied by a smarting and burning pain of a paroxysmal character. The gangrene advances by involving the inflamed areola, and as the whole toe becomes involved, it shrinks and becomes smaller. In this way the disease extends, gradually invading one toe after another, until it implicates the foot, and unless arrest takes place and a line of demarcation is set up, it may extend up the ankle and leg. Frequently, however, if the patient should survive, the gangrene becomes arrested in the neighbourhood of the ankle-joint, at about the situation of the division of the posterior tibial vessels, and a tolerably clearly defined line is formed between the living and dead tissues. Here a process of ulceration may be set up, and the parts which have perished gradually separate from the living tissues. Or it may happen that after an apparent line of demarcation has been established, a fresh impulse appears to be given to the mortification, and it again rapidly extends and involves the whole limb. There is generally considerable constitutional disturbance: fever of a low asthenic or irritative type, with depression of the vital powers, and low, muttering delirium; and the disease frequently terminates fatally in a month or six weeks.

2. *From impaired nutrition.*—Under this head is included gangrene occurring in the course of certain severe diseases, especially the exanthemata, which have long been known to produce this result. There seems to be good ground for believing that in some of these cases, at all events, the gangrene is the result of a debilitated condition of the system, consequent on a long illness. The heart in these cases being especially enfeebled is unable to drive the blood, which itself is impoverished and deficient in nutrition to the distant parts of the body, and gangrene is the result, from coagulation of the blood in the capillary vessels. It may be that, in some of these cases of gangrene following the exanthemata, embolism is the immediate cause of the complication. According to Estlander, this is the cause in cases of gangrene after typhus fever, miasmatic thrombi forming in the left side of the heart, and being carried thence into the vessels of the extremities.

3. *Loss of nerve-power.*—There can be little doubt that loss of nerve-power is a cause of gangrene, and that parts deprived of their proper nerve-stimulus may fall into a condition of mortification. A familiar example is presented in sloughing of the cornea, resulting from injury of the fifth pair of nerves, which destroys the nervous sensibility of the part and impairs its nutrition. Two explanations of this phenomena are usually given. One is that this impairment of nutrition depends on some altered state of the vaso-motor nerves, producing, probably, a paralysis of the muscular coat of the blood-vessels and a permanent dilatation; the other, that the change is brought about by irritation of certain special or 'trophic' nerves. It must be borne in mind that even the existence of these trophic nerves is purely hypothetical, and that, if they exist, nothing certain, as to the course they run or the centres they own, is known about them; whereas it is an acknowledged fact that elevation of temperature, the result of hyperæmia from vaso-motor paralysis, is a common sequel of loss of nerve-power, and, according to Professor Schiff, changes in nutrition occur in parts which are the subjects of vaso-motor paralysis.

Mr. Hutchinson has advanced a third theory as to the cause of gangrene as a result of nerve-lesion. He believes that it is due to a condition of spasm of the muscular coat of the blood-vessels, brought about by reflex irritation of a sensory nerve. He quotes, as an example, a case related by Mr. Hilton, where an exostosis on the first rib, pressing on the ulnar nerve, produced gangrene of the little and adjacent side of the ring finger, and states his opinion that the pressure on the ulnar (sensory) nerve was conveyed to the spinal cord, and reflected along the vaso-motor nerves which run in the ulnar nerve itself to the blood-vessels of these two fingers. Mr. Hutchinson also suspects that ordinary senile gangrene begins from defective nerve-supply.

4. *Spontaneous gangrene* is a peculiar form of gangrene affecting the extremities,

which Raynaud first described under the name of 'La gangrène symétrique des extrémités.' As the name implies, the gangrene comes on symmetrically in the two extremities. In a case recorded by Dr. Begg, of Dundee, it attacked both upper and lower limbs. The exact cause of this form of gangrene is unknown, for pathological examination has revealed neither embolism nor blocking of the vessels, nor degeneration of their coats. It occurs for the most part in weakly and anæmic individuals, with extremely feeble circulation, who habitually suffer from cold extremities, and appears to arise from a contracted condition of the capillaries, so that little blood circulates in them, conjoined with a weak action of the heart, so that its propulsive power is reduced to a minimum. *See* Arteries, Diseases of.

5. *Gangrene in diabetes.*—Patients suffering from the presence of sugar in their urine appear to be especially liable to be attacked by gangrene, which may come on either spontaneously or follow some slight operation. It appears to commence as an inflammatory process, to which patients suffering from diabetes are peculiarly liable, and which would seem to arise from the diseased condition of the blood, and passes on into gangrene, accompanied by considerable inflammatory action.

Like senile gangrene, it may commence apparently as the result of a slight injury, or may occur spontaneously, appearing as a black spot, generally on the side of the toe, which spreads rapidly, and is accompanied by a considerable amount of inflammation in the tissues around, and often by acute pain.

6. *From ergot of rye.*—The gangrene due to ergotism is supposed to be due to a continuous spasmodic contraction of the muscular coats of the smaller arteries, thus narrowing the calibre of the vessels and diminishing the supply of blood to the part. The disease is almost unknown in modern times, and appears to have been more common in France than in this country.

The disease appears to have presented itself under various forms and types, partaking more of the character of dry gangrene, and rarely presenting the moist variety. It usually commences with itching and tingling of the hands or feet, and cramp coming on from time to time in the muscles of the limbs affected. After a time these abnormal sensations are succeeded by numbness, passing into complete loss of sensation. The fingers or toes, as the case may be, become shrivelled, dry, black, and mummified, and the gangrene gradually extends, and may involve the whole extremity. When the disease is chronic the result is generally favourable, though several fingers or toes, or even a whole limb, may be lost; but in the more acute cases death generally results within the course of a week or ten days.

Specific Gangrene.—Under this heading are classed together those cases of gangrene where the disease is believed to arise from some special condition of the blood, or to be due to some miasmatic influence. Such are cases of *noma pudendi* and *cancrum oris*, which are probably due to some specific poison, occurring in the children of the poor, who have been exposed to faulty hygienic and dietetic conditions, and particularly if the child has been previously ill; but occasionally occurring in perfectly healthy children, who have had no previous illness. Such, also, are cases of *boils* and *carbuncles*, where there is gangrene of the subcutaneous cellular tissue following inflammation, set up by some abnormal constituent in the blood. *Malignant pustule* or *charbon*, and *glanders* are also forms of gangrene where the disease is caused by the introduction of a specific morbid poison.

The true *spreading traumatic* gangrene is believed also to be due to the presence of septic organisms, causing a diffuse inflammation extending along the cellular planes or up the course of the veins or absorbents, and rapidly running into gangrene. This unhealthy spreading inflammation is predisposed to by certain diseased conditions or impure states of the blood, arising more especially from disease of the eliminatory organs, particularly the kidneys, or from chronic alcoholism. It seems that in these vitiated constitutions the tissues furnish a soil peculiarly favourable to the growth of organisms which give rise to inflammatory processes.

It occurs only in recent wounds, before suppuration is established, and for the most part manifests itself within three or, at the most, four days after the receipt of the injury. The edges of the wound become swollen and everted, and present a waxy appearance, with vesications along their margins. There is a slight discharge of fetid, brownish-coloured serum, but no suppuration. At this time there is but very little constitutional disturbance, but within twenty-four hours, swelling, tension, and redness appear around the wound, and rapidly spread upwards, especially along the inner side of the limb. The discoloration,

at first red, soon becomes of a dusky, purplish hue, and speedily passes into black. The swelling, primarily firm and resisting, becomes soft and doughy, and presents to the fingers the sensation of emphysematous crackling, due to the evolution of gases which are produced by the decomposition of the affected part—the putrefactive process immediately following the death of the tissues. The disease spreads with fearful rapidity, being preceded by swelling and dusky redness of the skin, which speedily becomes purplish-black, and passes on into a condition of hopeless gangrene in the course of a few hours. The disease extends along the cellular planes until it reaches the trunk, when it terminates in death. It differs from other forms of gangrene in presenting no tendency to arrest, or the formation of a line of demarcation.

The constitutional symptoms which rapidly supervene after the commencement of the disease are of the lowest ataxic type. The pulse, at first full and strong, soon becomes rapid and feeble, and after a time irregular and intermittent. The temperature is raised considerably above normal. The skin becomes yellowish and the countenance contracted and sunken, the face presenting a peculiar leaden hue. There is often constant vomiting, accompanied by hiccough, and the tongue is dry and brown. The abdomen becomes tympanitic, and there is a sensation of constriction around the præcordium. A deep-seated, tensive, burning pain is complained of in the limb. Soon muttering delirium, with jactitation of the limbs, comes on, followed by coma, and death almost invariably ensues in three or four days after the invasion of the disease.

Hospital Gangrene is due to a specific cause, the introduction by inoculation into the system of a contagious material, which by its presence is the cause of the progressive destruction of the tissue.

All these forms of gangrene due to a specific septic cause will be considered under separate headings, to which the reader is referred.

Pathology.—In considering the causes of gangrene, it has been stated that almost all forms commence by a stasis or arrest of circulation in the capillaries. The only instance in which this is not the case is, when the inflammation is so intense that it leads to the arrest of tissue-change even before the circulation in the capillaries has completely ceased. This, however, soon follows, as the result of the alteration in the nutrition of the coats of the vessel from cellular infiltration; so that, sooner or later, in a part which is becoming, or has become, gangrenous, there is complete stagnation in the capillary vessels, and arrest of the supply of nutritious fluids. The part therefore, of necessity, dies, is no longer capable of taking part in the functions of the living body, and becomes a foreign substance to which two things must happen. First, being no longer living, it must undergo a series of chemical changes, which result in decomposition; and secondly, being a foreign body and no longer capable of ministering to the necessities of the individual, it must be cast off and separated from the living tissues, thus forming what is termed 'a slough.' The death of a part is not always followed by the same series of changes. These will depend upon the presence of oxygen, and the amount of water in the tissues. For in the first place if oxygen be absent from the part, as in splenic infarction (which is a form of gangrene), no putrefaction can take place; and secondly, when the tissues are much engorged, at the time of death, with blood and serum—when, in other words, there is the presence of water in large quantities—the moist form of gangrene will be the result, with rapid decomposition. When, on the other hand, the quantity of fluid, that is, water, in the tissues is small, the dry form of gangrene occurs, and the part undergoes a process of mummification, the difference existing rather in the clinical characters than in the anatomical changes. The putrefactive change consists in a solution of all the solids of the body, with the exception of the bones, in the fluids, because, in consequence of their death, they are no longer able to withstand the solvent power of such fluids. It is therefore a solution of the constituent elements of the body in water, and consists chemically in the decomposition of the various constituents of the body, and the recomposition of new products formed out of the elements with the addition of the oxygen of the atmosphere.

The gangrenous part, being dead and undergoing decomposition, becomes injurious to the living tissues, and must be cast off and separated from them. This is done by a process of ulceration, or molecular disintegration, in the living tissues which are in contact with the dead. The process of ulceration is a vital process, and can only be carried on in living tissues. Accordingly we find the vessels in the tissue forming the extreme boundary of the living part becoming enlarged and gorged with blood; migration of cells with proliferation takes place, so that the part is crowded with a dense

layer of leucocytes. From these is formed a layer of granulation-tissue, by the growth of new vessels. The surface of these granulations—that is to say, the surface in contact with the dead tissue—softens and breaks down, the cells becoming converted into pus-cells, and thus the dead portion naturally falls off, because its adhesion to the living tissues has ceased to exist. This border line between the living and dead tissues, in which the process of separation of the one from the other takes place, is called 'the line of demarcation.'

After the dead parts are separated from the living, the surface of the latter is seen to be covered over with a layer of granulations, which eventually cicatrise and become converted into fibrous tissue.

Symptoms.—The symptoms of gangrene naturally form two great divisions, the one where the parts are swollen and moist—the so-called *moist gangrene*; and the other where they are dry and shrivelled—the *dry gangrene*. This division is a classical and, in extreme cases, a well-marked one, but, under ordinary circumstances, it is not easy to refer a case to one or the other class; the form of gangrene being often midway between the two extremes. Or, in a given case, we may have a gangrene partaking of the dry form in one part and the moist form in another. Thus in a case of mortification of the leg, it is not uncommon to find the toes and dorsum of the foot presenting the characteristic appearances of the dry or mummified form, while the calf of the leg, where the tissues are thicker, presents the typical characters of the moist variety of the disease.

Moist Gangrene may be best studied in a part which has been sufficiently strangulated to arrest the return of blood from the tissues. If the strangulation is more severe than this, so as to stop the flow of blood both from and to a part, as in the ligature of a pile or nævus, it kills the tissues outright. But if it is less severe, it prevents the flow of blood from the part, at the same time that it permits the entrance of blood to the part, the veins being more affected by the constricting force than the arteries. In consequence of this we get, first, a condition of intense congestion; blood continues to be propelled into the capillaries, from which it cannot escape. Hence, as the vessels become more and more loaded, the inflowing stream becomes slower and slower, until it eventually stops, the part being so overcharged with blood that no more can enter. This constitutes the second stage, for when complete stasis takes place gangrene is established. The third stage consists in decomposition, for after the gangrene has set in, decomposition commences, as has already been stated.

A line of demarcation is then established, and the mortified parts begin to separate at this point.

In considering the *symptoms* it is useful to divide them into three stages. *First stage*, congestion. The part becomes swollen, the swelling being at first hard and brawny, but after a short time pulpy and œdematous, as transudation through the coats of the vessels takes place. The colour, at first red, speedily becomes dusky and purplish and then almost black. There is a dull heavy burning pain in the part, with exalted sensibility, and the temperature is raised above its normal standard. Phlyctenulæ or vesicles arise on the surface, and become filled with a dark bloody fluid. *Second stage.* So soon as complete stasis takes place, the temperature begins to fall, and the thermometer soon registers a degree considerably below that of the rest of the body, and on a level with that of the surrounding media. Pain in the part ceases and it loses all its sensibility, so that the prick of a needle can no longer be felt. It changes its colour, becoming of a mottled greenish-black or purplish hue. *Third stage.* Decomposition now sets in, the part becomes very soft and boggy, and gives to the finger a sensation of emphysematous crackling, due to the evolution of gases in the tissues; a peculiar odour is also evolved from the formation of certain volatile compounds, such as sulphuretted hydrogen, ammonia, and hydro-sulphate of ammonia. At the same time a line of demarcation is established. At the point where the living join the dead tissues, a bright red band may be seen, gradually losing itself in the natural skin. This halo of redness is very different, and easily to be distinguished, by its brightness, from the dark and purplish hue of the gangrenous tissue. There is also generally some swelling. Shortly after a careful examination will reveal a slight furrow at the extreme margin of this inflamed tissue. The furrow deepens day by day, and increases somewhat in width, gradually undermining and separating the dead from the living tissues, the process being accompanied by a copious secretion of pus. The line of demarcation does not present a regular circular appearance, but a zigzag irregular outline, in consequence of the unequal distribution of the vessels. If a whole limb be mortified and cast off, the

superficial tissues are separated at a much higher level than the deeper ones, and therefore the stump after this natural amputation presents a very conical form, from the centre of which the bone, which is only separated by an exceedingly slow process, protrudes.

Dry Gangrene occurs when the whole supply of blood is entirely cut off and the part perishes from want of nutrition. It is best studied in those forms of gangrene in which the supply of blood to a limb is suddenly cut off by the blocking of the main artery by an embolus. In these cases there is a rapid cutting off of the arterial supply. The blood in the limb finds its way out by the veins which are unaffected, and hence there is less blood than natural in the part. Accordingly the part presents a shrunken or shrivelled appearance, and assumes a dull, tallowy-white colour, mottled here and there with brownish or greyish streaks. No pulsation in the vessels can be detected. The part feels dead and heavy, and at once entirely loses its sensibility. It feels cold to the touch and its temperature speedily falls, until it reaches that of the surrounding media. Very shortly the pale colour becomes lost, and the part becomes first brown and then black; it presents a more and more shrivelled appearance, and gradually dries up, as it were, so as to present the appearance of a mummy, and hence the name 'mummification,' which has been applied to this condition. The line of demarcation is set up and the process of separation continued as in the other variety.

The *constitutional symptoms* vary according to circumstances. When the constitution is sound and the gangrene is the result of some injury, the fever is of the ordinary inflammatory type, being characterised by a hot and dry skin, with a rise in the temperature of from 2° to 4° F., a full and quickened pulse, and a white and creamy fur on the tongue. But even in these cases there is a great tendency to asthenia, with depression of the powers of the system. If, on the other hand, the constitution is unsound, the symptoms are of an asthenic type from the first; a hot and burning skin, a considerable rise in the temperature, a feeble, very quick, and easily compressible pulse; a dry, furred tongue, with sordes; great depression of the nervous system, with anxiety of countenance and low, muttering delirium. The amount of constitutional disturbance in gangrene varies also with the situation and extent of the disease. If it affects a part which is of no great importance, as a finger or toe, and is limited in extent, and perhaps due to a local cause, the accompanying fever is very slight. When, on the other hand, it implicates an important organ or structure, as, for instance, a knuckle of intestine, the symptoms assume a grave and rapidly adynamic type.

Treatment.—As gangrene arises from numerous causes, it is clear that no one plan of treatment can be universally adopted. It will be convenient, nevertheless, to consider first the broad indications for treatment, and then pass in review the various modifications in our therapeutical and operative measures which will have to be resorted to, in reference, not only to the cause of the disease, but also to the constitutional condition of the patient.

The first point in the treatment of gangrene, and one of the highest importance, is, if possible, to remove the cause, and so arrest the gangrene. In some cases this, of course, cannot be done; but in others, where it is caused by the mechanical obstruction to the circulation of the blood in the part, the first thing the surgeon has to do is to get rid of this obstruction. Thus, gangrene, when threatening as a result of inflammatory processes producing tension, may often be averted by timely and free incisions into the inflamed and swollen tissues. So again, in hernia, by division of the stricture; in parts which have been too tightly bandaged, by the removal of the bandages; in paraphimosis, by freeing the prepuce; and in other cases, the surgeon may prevent a gangrene from supervening, and recovery may take place by restoring the circulation of the part, if the disease has not progressed so far as to have irreparably destroyed the tissues. In all cases where gangrene is imminent, an endeavour should be made, by maintaining the vital warmth of the part and encouraging and relieving the embarrassed circulation, to prevent its occurrence. This is best done by swathing the whole limb in a thick layer of medicated cotton-wool and applying loosely a flannel bandage. Hot water bottles may be placed in the bed, but not in contact with the part. The limb should be raised and the joints flexed; thus, in the lower extremity, the thigh should be bent slightly on the abdomen and the leg on the thigh, a position which will best facilitate the flow of blood through the larger vessels. If there is any appearance of venous congestion, the return of blood through the superficial veins may be accelerated by continuous and methodical friction in the course of the circulation, which will tend

to keep these veins empty. Poultices, which are often employed in these cases, should be avoided. The endeavour of the surgeon should be to maintain an equable temperature; whereas the tendency of a poultice would be to produce a directly opposite effect, when first applied raising the part above the normal temperature, and subsequently, on cooling, depressing it below the ordinary heat of the body. After the gangrene is fully established and a line of demarcation set up, poultices—and especially charcoal poultices—are often extremely useful in hastening the separation of the dead parts.

After the gangrene has become fully established, our aim must be to control, as far as possible, the spread of the disease; to encourage the rapid separation of the sloughs; to support the powers of the patient, and to keep the parts as clean and free from odour as possible. At this time the question of amputation will present itself to the surgeon, and is one of vital importance. As a rule, in most cases it is safer to await the formation of a line of demarcation before undertaking the removal of a limb, but nevertheless there are exceptions to this general rule. In some forms of local gangrene, where, for instance, it is the result of some severe injury, and the whole limb has fallen into a condition of gangrene, either as the direct result of the injury or indirectly as the result of the subsequent inflammation, and the gangrene is clearly defined, it cannot be doubted that it is expedient to remove the part at once in order to relieve the patient of a great source of irritation, and of the depression of the vital powers which will of necessity ensue from the efforts made to rid the system of a spoiled part. So again, in gangrene from a ruptured artery or aneurism, amputation should at once be performed, inasmuch as the tissues are so infiltrated with blood poured out from the ruptured vessel or sac that there is no chance of the collateral circulation being carried on, or of the gangrene being arrested short of the seat of the injury. But in cases of mortification arising from ligature of an artery, or from an embolus plugging a large vessel, the proper course to pursue is to wait until a line of demarcation is set up, for it is impossible to say how much of the limb is dead or how far the gangrene may extend. Many forms of local gangrene do not require amputation at all; when it arises from a mechanical injury, and is *strictly limited* in its nature, no operative proceedings are required. So again, in the gangrene arising from the application of heat or cold, or from chemical agencies, it is better not to remove the destroyed parts, but to wait for the formation of a line of demarcation, unless, indeed, a hand or foot is completely dead, when immediate amputation may be necessary.

In gangrene arising from constitutional causes, there can be no question as to the propriety of delaying the amputation until not only a line of demarcation has been set up, but until it is well established and the ulceration has extended deeply into the tissues. In these cases it is impossible to say where the mortification may stop, and if amputation is performed it may not be done high enough, and the disease will recur in the stump; and, on the other hand, it may be done too high, and an unnecessary amount of limb be sacrificed. In these cases of constitutional gangrene, it must be borne in mind also that the tissues immediately above those which have fallen into gangrene are in a condition of greatly-diminished vitality, and therefore, if an operation be too hastily carried out, the disturbance set up by the amputation may occasion a recurrence of the mortification.

With regard to amputation after a line of demarcation is set up, there is some divergence of opinion, some surgeons preferring to allow the limb to separate of itself, others considering that its removal through, or just above, the line of separation is the preferable course. As a general rule, it would seem better to get rid of a large mass of decomposing tissue, which must create a very deleterious atmosphere, and expose the patient to the risk of purulent absorption; but to this rule there are exceptions.

If the surgeon has decided to save the limb, or if the gangrene is in some part inaccessible to operation, his endeavour must be to hasten the separation of the sloughs and diminish their fetor. This may be done by maintaining the heat of the part by wrapping the limb in cotton-wool well sprinkled with carbolate of lime, or animal charcoal powder. Poultices should not be applied if the amount of sloughing is great, since the moisture tends to promote decomposition; but if the sloughs are small, charcoal or yeast poultices may be used. The separation of the sloughs may be hastened also by the application of some of the balsams, of which the compound tincture of benzoin is the best. A most useful application for the same purpose is the 'green ointment' of the St. George's Hospital pharmacopœia:—℞. Unguenti elemi, lb. j.; Unguenti sambuci ʒij.; Copaibæ ʒiij.

The ointments to be melted together, and, when cooling, the copaiba to be added. Ung. sambuci is made with the *fresh* leaves of the elder (lb. ij.), prepared lard (lb. ij.), and as much water as required.

The constitutional treatment consists in supporting the powers of the patient and lessening the irritability of the nervous system. It must be borne in mind that the disease in itself indicates a depressed condition of the system, and therefore the endeavour of the surgeon should be to maintain the patient's strength by easily-digested nutritious food, stimulants, and tonics, and to improve, if possible, the digestion, by clearing out the alimentary canal, so as to enable him to take the requisite amount of nourishment. The food and stimulant must, however, be given with a discriminating hand, great care being taken not to overload the patient's stomach; just so much of bland, nutritious food and stimulant as he can easily digest should be given in small quantities and frequently. In most cases the issue of a case of gangrene depends upon the digestive organs effectively and efficiently performing their duties. Should they become overworked, sickness and vomiting, with loathing and refusal of food, will come on and the patient will rapidly sink. At the same time pain should be allayed and the general system soothed by the administration of opium, or some other narcotic. There are few cases of gangrene in which a narcotic is not required, and of these opium is decidedly the best. Should it, however, cause excitement, or loathing of food, some other must be substituted, as morphia injected under the skin, or cannabis indica, which is often tolerated when opium cannot be borne.

It remains now only to say a word or two upon the treatment of some special forms of gangrene. And, first, as to the treatment of senile gangrene. Here the plan to be adopted, as far as regards the constitutional treatment, is much the same as in other forms, opium being especially indicated and usually well borne. At the same time stimulants must be given with care. A small quantity is no doubt usually necessary; but, given in large quantities, so as unduly to excite the patient and increase the action of the heart in its endeavours to drive the blood through the calcified and narrowed vessels, they do more harm than good. The main point for consideration is the question of removal of the dead parts after a line of demarcation has been set up, and this may be done either by amputation just above the line of separation, or by removing the limb high up in the thigh, a plan formerly advocated by James, of Exeter, and more recently adopted in several cases by Hutchinson. As a rule, the former operation is to be deprecated, gangrene often recurring in the stump, and secondary hæmorrhage, from the diseased condition of the vessels being of frequent occurrence. The latter operation is also a very serious alternative, and unless the general health is otherwise good and the constitution tolerably sound, appears to be scarcely justifiable. The better plan in these cases seems to be to allow the soft parts to separate by nature, and then carefully to cut through the hard parts along the line of demarcation.

The question of amputation in another form of gangrene demands attention, and that is in the spreading traumatic gangrene of inflammatory origin. In these cases there is, as has been pointed out, no tendency to the arrest of the gangrene and the formation of a line of demarcation. The morbid process rapidly extends to the trunk and speedily kills the patient. In these cases, feeble as is the chance, amputation is the only hope of saving the life of the patient, and should be adopted at once. There is no time for delay; so soon as traumatic gangrene begins to spread, amputation should at once be performed through healthy parts, and a certain proportion of cases will recover. T. Pickering Pick.

GASTRIC FISTULA.—A communication between the stomach and the external air. It necessarily implies adhesion between the peritoneal surfaces of the stomach and the anterior abdominal parietes. The object of the operation of gastrostomy is the safe production of such a fistula. But it is occasionally produced by accidental causes; for example, by gunshot wounds, where a portion of the anterior abdominal parietes and wall of the stomach have been carried away, as in the well-known case of Alexis St. Martin. Another class of cases in which these fistulæ may be produced is where the patient has swallowed hard, irritating material which cannot pass through the pylorus. Thus knives, and other iron instruments, have occasionally given rise to the formation of such a fistula. The way in which they do so is this: first such a body becomes impacted in a certain position, usually from before backwards, in the stomach. The constant pressure gives rise to some severe local peritonitis between the front wall of

the stomach and the anterior abdominal wall, and the two adhere. Ulceration then supervenes from the same cause, and gradually affects the opposing thickness of stomach-wall and wall of abdomen, so that finally the foreign body presents at an abdominal wound, and may be removed at that point. The aperture so left is the gastric fistula in question.

No particular treatment is required for such a case, except to prevent leakage of the gastric juice from it. A gastric fistula may nearly always be recognised by the acid, irritating quality of the secretion flowing from it, by the absence of bile-staining, and by the kind of food escaping from it. If it should be desired to cure it, this can nearly always be done by a plastic operation—paring the edges and bringing them closely together by sutures. The same is true of a gastric fistula produced by a gastrostomy. H. G. Howse.

GASTROSTOMY.—The operation of making a fistulous opening into the stomach from the anterior abdominal parietes, for the sake of feeding a patient, when, from any cause, the natural passage down the œsophagus is obstructed. The word is derived from γαστὴρ, belly, στόμα, mouth, —the 'belly-mouth,' hence not to be confounded with gastrotomy, which is simply cutting into the abdomen for tumour or any other affection.

The operation is most frequently performed for cancerous or syphilitic strictures of the gullet, but it has been also done for simple inflammatory stricture or ulceration, as when the gullet has been nearly destroyed by the patient swallowing caustics by accident or for suicidal purposes. Up to quite recently the operation had been nearly always attended with fatal results; but, by a modification introduced by the writer of the present article a few years ago, the operation is now only attended with a very small mortality, and even this is mostly attributable to the late period at which the operation is done, and the consequent exhaustion (from starvation) of the patient. The modification alluded to consists in securing adhesion of the stomach to the abdominal walls before opening the viscus itself, this part of the operation being delayed for periods varying from three to five days.

The steps of the operation are:—(1) making an oblique incision about two and a half inches long, parallel with, and about one inch below, the lower margin of the costal cartilages forming the lower boundary of the thorax on the left side. This incision should start about one and a half inches from the median line, and its length must depend upon the varying development of the rectus muscle. It is not wise to go higher than this, as it will not leave enough free integument and muscle between the cartilages and the incision to fasten the sutures to. This first incision is only to be carried through the integuments and fascia. When made, the sheath of the rectus will be seen at its inner end, and at its outer end a portion of the linea semilunaris and of the obliquus externus muscle. The usual plan of continuing the operation is to have the muscle and fascia of the abdomen incised in the same way as the superficial parts. The writer has, however, found it more advantageous to continue the operation in the following way:—(2) The lips of the wound being separated towards the inner part as widely as possible by retractors, a *vertical* incision is made in the sheath of the rectus a little way from its outer margin. The vertical fibres of the rectus will then be seen, and these should be separated (not cut) with the handle of the scalpel, and the posterior part of the sheath exposed. This may then be incised vertically, together with the sub-peritoneal fat and peritoneum. (3) The search for the stomach will now commence. Very possibly it may protrude into the wound, but it may be altogether hidden under the ribs, or the liver may be enlarged, and be the only viscus at first visible when the peritoneal cavity is opened. If the liver presents it may be easily pushed aside, though the position of this viscus may afterwards interfere inconveniently with the adjustment of the sutures. The principal difficulty is with the great omentum and transverse colon, which may be easily confounded with the stomach. If one of these presents in the wound, it is best to catch hold of it and draw it down. In this way the stomach may be brought into view. It is recognised by its pink-red, smooth, thick coat, quite unlike that of the transverse colon.

(4) The stomach has now to be fixed to the abdominal parietes. This is usually done with a double row of sutures. For this the writer commonly uses moderately thick, smooth carbolised silk. Drawing the stomach well over to one side, a needle (in handle) carrying the silk should be passed through the serous and muscular coats of the stomach only, and should then transfix the abdominal parietes about one inch from the wound. The needle is now withdrawn, leaving one end of the silk on the surface,

and without unthreading the other end the abdominal parietes are again punctured alone. The silk is now unthreaded from the eye of the needle and the latter withdrawn. The two ends of silk will thus be left projecting from two distinct wounds on the skin close by one another, and holding up a bit of the serous and muscular coats of the stomach. These ends may ultimately be tied over a bit of bougie, the aim being to secure isolated points of attachment between the two layers of peritoneum by interrupted sutures. Before tying any one suture, it is best to introduce the others, drawing the stomach well over from the side towards which it is wished to introduce the suture. Six or eight sutures introduced in this fashion are usually used. The result is to fix the gastric peritoneum in a circle about one inch round the wound. The part of the stomach exposed in the wound should then be fixed to the lips of the incision by small wire sutures, introduced by a small curved needle held in a needle-holder, these again only taking up the serous and muscular coats of the stomach. Finally it is best to *mark* the point at which it is desired to puncture the stomach ultimately, by fixing to it a moderately long, loose suture, which may easily be recognised from the others. The operation should be conducted with Listerian precautions, and, of course, under an anæsthetic.

Five days is the usual time the writer has left the stomach in this way for complete adhesion to form. The opening of the stomach is a very minor affair, and does not require any anæsthetic. The patient never complains of pain and, in the writer's experience, generally does not even know when the puncture is actually made. A long narrow-bladed pointed knife is usually employed, such as is used for paring the edges of a vesico-vaginal fistula. The knife should be very sharp, and be driven straight into the stomach in the position of the mark left at the first operation. The cavity of the stomach often apparently lies much deeper than would be expected, and makes the operator sometimes fear he has punctured the lesser bag of the peritoneum. A small catheter (No. 7 or 8 English) should then be slid along the blade of the knife, which may be withdrawn. For ascertaining whether this is in the stomach-cavity, sucking at the tube is often a useful though not a pleasant mode of testing; but in these cases of starvation there is usually very little to draw out through the tube. Small quantities of milk and brandy may immediately be injected along the catheter, but the quantity should be very moderate at first, beginning only by teaspoonfuls, and increasing afterwards. A bit of elastic tube being adjusted over the catheter and plugged, the wound should again be dressed antiseptically, leaving the end of the tube projecting through a mass of surrounding gauze.

At subsequent dressings larger sizes of catheter may be substituted for the No. 8, and, finally, soft red rubber tubes introduced up to any convenient size. The patient should first be fed with fluid food, such as milk and beef-tea, &c. But when the larger sizes of tube have been introduced, solid food may be poured into the stomach by the aid of a large wide-mouthed syringe, This food should be minced meat with a certain proportion of vegetables, all finely ground in the mincing-machine.

Many other details must of necessity be omitted in a short article like the present; but it may be remarked, in conclusion, that the object of the vertical incision through the rectus muscle, and of the small incision, and subsequent gradual dilatation, of the stomach, is to obtain a kind of sphincter action around the tube, so as to prevent the leaking of the gastric juice, which is so unpleasant a feature in some of these cases. The vertical separation, without cutting, of the fibres of the rectus muscle, and the puncture and subsequent dilatation of the muscular coat of the stomach, conduce to this end more effectually than any other method. H. G. Howse.

GASTROTOMY. *See* Laparotomy.

GAUZE DRESSING. *See* Antiseptic Surgery.

GENU EXTRORSUM is something more than Bow-Leg (q. v.), which is simply an outward bending of the leg-bones; in genu extrorsum the thigh-bone is bowed outwards as well as the leg-bones, so that the knees are widely separated. As opposed to the inward deviation of knock-knee, genu extrorsum is sometimes spoken of as 'out-knee.' The condition is met with in heavy, weakly, or rachitic children, in whom the bones are less able to support the weight than are the ligaments. When the ligaments are the first to yield, genu valgum appears, but when the bones are feeble, genu extrorsum is induced. With the strong support of the ilio-tibial band, the external lateral ligaments of the knee-joint are competent to resist any strain that may be brought to bear upon them, whilst from

the natural obliquity of the femur, the chief strain falls upon the inner side of the joint. The bending of the bones of the thigh and leg is not associated with notable alteration in the shape of the femoral condyles, as is the case in genu valgum.

Many of the remarks made in connection with the subject of Bow-Leg will apply in the treatment of genu extrorsum; but as the knee-joint is displaced to the outer side of the normal line, it would be incorrect to bandage the limb to the outer side of a long splint; the effect of this treatment would be to throw a useless strain upon the internal lateral ligament, which is in no way at fault. Indeed, in all attempts at the forcible straightening of the limb, this ligament must be respected. Though forcible straightening is of value in the treatment of these limbs in early childhood, it is as a rule unnecessary; for if the child be kept entirely off his feet, and well looked after, he will most probably outgrow his deformity. A strict and prolonged supervision gives excellent and surprising results. The expensive mechanical supports of the makers of surgical apparatus are of little service; whilst to allow a weak-boned child to walk about in 'irons' is a violation of all sound principles of practice. What is required is absolute rest in childhood; but when the bones are fully developed, as in young adults, nothing short of osteotomy can remedy the deformity. *See* Osteotomy. Edmund Owen.

GENU VALGUM or KNOCK-KNEE is a common deformity of childhood, and, unless corrected, is apt to persist in even a more marked form in adult life. To leave this disfigurement unattended to, and to promise the parents that the child will certainly 'grow out of it,' is to court disappointment. It is generally associated with, if not determined by, a relaxation of the ligaments of the ankle and sole of the foot, the knock-kneed subject being generally flat-footed. The tibia having lost much of its support at the inner ankle, the upper surface of its head receives the weight unevenly from the two femoral condyles, the outer tuberosity getting more than its due share. This extra pressure causes some arrest of growth of the external condyle of the femur, whilst under the diminished pressure the internal condyle grows inordinately; in some instances it is at the internal tuberosity of the tibia that the growth of bone takes place, in which case there will be considerable bony thickening at the inner side of the epiphysial cartilage. When growing lads are called upon to do an excessive amount of walking or standing, or when they follow employments which involve much weight-carrying, the deformity is apt to supervene. Thus bakers are particularly apt to become in-kneed. In young children the most common cause is malnutrition; it is especially apt to be found in those who have been brought up by hand, and who have been surrounded generally by a defective hygiene. In the writer's experience, children who have been reared on condensed milk and a farinaceous diet are likely subjects of knock-knee. These rickety children have generally a heavy trunk and a large head, which the ill-developed legs and feet are unable properly to support, and if the ligaments yield rather than the bones, flat feet and knock-knees are the result. When once started, the deformity increases rapidly.

Probably heredity has but little direct influence on the condition, though parents of feeble constitution, themselves valgous, are likely to have weak-kneed offspring. In estimating the amount of the deformity, the leg should be fully extended, so that the lateral ligaments of the joint (which are behind its vertical axis) may be rendered tense, and the tibia rigidly locked upon the femur. If the least amount of flexion be permitted, the valgous condition may be completely effaced. When the patient is lying supine, the patellæ should be made to look directly upwards; these bones are displaced considerably outwards on account of the deflected course which the rectus femoris has been made to take in the valgous knee. At times one limb is found valgous whilst the other is bandy, as is explained under Bow-Leg.

Treatment.—In the early days of genu valgum, the treatment will involve care in the matter of clothing and diet. The child should be taken completely off his feet, and the mother or nurse should rub the legs and feet well, in front of the fire, and should see that the circulation in them is always active. She must be instructed also in trying to straighten the extended limb by judicious, firm, and repeated efforts, five or six times a day. From time to time also the surgeon should manipulate the limb. If only one limb be affected, a well-padded outside splint may be applied to the limb, firmly strapped or bandaged to it. If both knees be valgous, a firm, flat pillow may be fixed between the knees and the ankles tied together. On no account should the child be allowed to stand or walk. If the treatment prove slow or unpromising, the surgeon may attempt the straightening of the limb, under chloroform, by forcible manipulation.

In many cases this treatment answers well. After the straightening, the limb may be fixed in lateral splints of plaster of Paris, or the straightening may be effected more gradually by a hinged splint, working with a rack and pinion. But in those cases in which, from one cause or another, this treatment cannot be employed, or in which, being tried, it proves ineffectual, osteotomy may be resorted to with advantage. *See* Osteotomy. Edmund Owen.

GIBSON'S SPLINT FOR FRACTURED THIGH consists of two long splints, with a crutch for the axilla at the upper end of each; the lower end of each splint is perforated by a series of holes for pegs, and fits into a slot in a footboard. Counter-extension is maintained by the pressure of the crutches against the axillæ, and extension is made by pulling on the footboard, to which the feet have been fixed; when sufficient extension has been made, the footboard is prevented from slipping back by pegs placed in the proper holes in the splint. Bilton Pollard.

GINGIVITIS. *See* Gums, Affections of.

GLANDERS (*Synon.* Equinia; Farcy) is an inflammatory affection of the nasal mucous membrane, to which horses, mules, and asses are liable; and it is occasionally communicated to those who tend them by accidental inoculation, or by absorption of the specific contagion through the unbroken skin or mucous membrane. Farcy is the name given to a peculiar inflammation of the subcutaneous lymphatic vessels and glands, accompanied by the formation of hard swellings which break down into foul ulcers. Both these affections are manifestations of the same specific disease, and it is probable that their differences are determined by the mode in which the contagion is received. In man, as in animals, the disease may run an acute or chronic course.

Course and Symptoms.—After an incubation of three to eight days in the more acute forms, but extending to several weeks in more chronic cases, the onset of the disease is marked by languor and feverishness, pains in the joints and muscles, and chilliness or even rigors. The wound by which the virus has entered, although it may have healed, becomes inflamed, and a chancroid ulcer forms, with red, swollen, and very tender margins. In other cases, however, there is no such evidence of the seat of inoculation. The characteristic features of the disease soon appear in the form of (1) hard swellings under the skin and in the muscles; (2) a cutaneous eruption; and (3) an ulcerative inflammation of the mucous membrane of the nose.

1. To the pains in various parts of the body succeed diffused or circumscribed elevations in the subcutaneous or muscular tissues. They are hard, tender, and very painful, and they soon break down into foul, deeply excavated ulcers. Some, however, after a time, undergo resolution and disappear. At the same time a corded state of the lymphatics may be observed, not only near the seat of inoculation but in other regions, and this is accompanied by glandular swellings similar to the 'farcy-buds' which occur in the horse.

2. A peculiar skin-eruption appears somewhat later. At first papular or even tubercular, it soon develops into pustules or blebs containing sero-purulent material. These are scattered in irregular groups over the surface, and especially over the face, chest, and abdomen. Sometimes they are very hard, and slowly soften, resembling small boils; at other times they form flattened, irregularly-shaped vesicles or bullæ of various sizes, surrounded by a livid erythematous swelling of the integuments, and they are succeeded by foul, superficial ulcers.

3. Usually the latest, but occasionally the first, symptom is an inflammation of the nasal mucous membrane. A thin, clear discharge like that from an ordinary coryza is noticed. Soon this becomes viscid, sanious, and offensive. The mucous membrane swells, and patches of ulceration form, with foul crusts upon them. The skin of the nose and of the adjacent parts of the cheeks and forehead becomes red, tense, and swollen, and glandular enlargements appear in the parotid and submaxillary regions. The inflammation may also extend to the frontal sinuses, the tonsils, and the air-passages, and the eyelids may be glued together by a similar discharge from the inflamed conjunctivæ.

The constitutional symptoms, meanwhile, tend to assume a typhoid character. Muscular tremors, muttering delirium, sour sweats, and diarrhœa supervene. In the most acute forms the patient may die exhausted in three or four days, even before the third stage has been reached. Few survive for more than three or four weeks, and in the more chronic cases it is usually many months before the abscesses heal and the patient recovers.

Pathology.—According to Virchow, the nasal affection and the cutaneous eruption

are both due to the formation, in the substance of the corium, of tubercular masses, which caseate and then soften down into suppurating foci. The larger nodules in the subcutaneous and deeper tissues are due to similar deposits of caseous material which degenerate into hæmorrhagic abscesses. After death the blood is usually found to be fluid, the muscles soft and rotten, and there are changes in the viscera which bear a close resemblance to those found in pyæmia.

The *diagnosis* is at first obscure. The fever and vague pains may be confounded with rheumatism, and when the swellings have appeared it may be difficult to distinguish the acute form from pyæmia, and the more chronic form from tertiary syphilis or scrofula. The patient's antecedents will probably give some clue, and the diagnosis will soon be confirmed by the appearance of the eruption. This has been mistaken for varicella and smallpox, and, later on, for ecthyma and pemphigus; but the fact that it is associated with hard or suppurating subcutaneous swellings ought to suffice for its recognition. The acute character of the nasal affection, together with its concomitants, will distinguish it from the various forms of ozæna.

Treatment.—It will be necessary to support the patient by a liberal diet with alcoholic stimulants. Quinine in five to ten-grain doses should be given three times a day. Other aseptic remedies, such as sulphite of sodium, deserve a trial. Mineral acids, perchloride of iron, and other tonics, will be useful in the more chronic cases, and opium will be required to alleviate the severe muscular pains, as well as to induce a more healthy action in the local inflammations.

The original seat of inoculation, as soon as there is reason to suspect its dangerous character, should be cauterised with nitric acid or potassa fusa. The abscesses should be freely incised, and their cavities well washed out with carbolic acid, and dusted over with iodoform powder. Similar applications must be used for dressing the superficial ulcers. The nose must be repeatedly syringed with antiseptic solutions, and the patient should be directed to inhale frequently vapour charged with iodine, creasote, or carbolic acid.

Equinia Mitis is a milder disease, consisting of an eruption of pustules and bullæ, which sometimes attacks the hands of those who have to dress the heels of horses affected with 'the grease.' It appears to have no relation to glanders, and its treatment will be cleanliness, with the application of liquor plumbi subacetatis dilutus, or a weak solution of carbolic acid.

N. Davies-Colley.

GLANDS, LYMPHATIC, Affections of. *See* Lymphadenoma, &c.

GLAUCOMA, in its most general acceptance, signifies all those conditions in which the eyeball is unduly hard. But it is necessary, for the proper study of its pathology and treatment, to separate the cases of primary glaucoma from those in which the hardness is merely secondary to some other recent morbid condition—e.g. iritis, intra-ocular tumour, &c. The subject of secondary glaucoma will be separately discussed later.

The hardness of primary glaucoma may be permanent or but temporary, recurring from time to time. Such temporary cases pass ultimately, if unchecked, into the permanent condition. They are known by the name of intermittent glaucoma.

Though numerous and most ingenious instruments called 'tonometers' have been constructed, yet the tension of the globe is now universally estimated by the finger of the surgeon. The eye, while open, and directed gently downward, is felt through the upper lid by the two index fingers. The estimation is made by the amount of dimpling effected by slight alternate pressure of the fingers, or by the feeling of resistance imparted to the touch. In any case the standard is a purely arbitrary one, and consequently varies with different observers, and even with the same observer at different periods. The other eye of the patient, if sound, will afford some guide. Three degrees of increased or diminished tension are usually recognised, the first being represented by T_1, T_2, and T_3, and the last by $-T_1$, $-T_2$, and $-T_3$. Between the two series stands normal tension, Tn. T ? expresses a doubt whether there is any deviation from the normal; but T_1 ? or $-T_1$? accepts the increased or diminished tension, but is uncertain as to its degree.

Glaucoma is comparatively a rare disease, being met with in one out of about two hundred and fifty cases of eye-disease. Four-fifths of the sufferers are over forty years of age. It affects the sexes in not very unequal proportion, though the statistics of various authors make it a little more common among males.

Briefly speaking, the diagnostic symptoms of a primary glaucoma are, *in the premonitory stage*, unduly failing accommoda-

tion, frequently repeated attacks of foggy vision, and halos; *later*, hardness of the eye, with, in all probability, cupping of the optic papilla or disc and contraction of the field of vision. *See* PERIMETRY.

Primary glaucoma is usually divided, for clinical purposes, into two groups—the non-inflammatory and the inflammatory.

The *non-inflammatory* is the one more commonly encountered, especially among men, where, according to Nettleship, it constitutes 75 per cent. of all the cases; whereas in women it forms but 52 per cent.

A typical case of non-inflammatory glaucoma would be as follows:—The patient, who may well be a man of from fifty to sixty years of age, makes complaint of long-standing occasional aching in the eyes and difficulty in reading. He has changed his reading spectacles several times recently without much benefit. It is found that he is more presbyopic than usual at his time of life, even when allowance is made for the hypermetropia which he usually exhibits. For some time he has had occasional attacks of foggy vision, with coloured rings or halos round an artificial light. The pupil is sluggish; the anterior chamber rather inclined to be shallow, but the cornea fairly bright. Light thrown into the eye by the mirror alone shows the lens and other media to be perfectly transparent. While there is some general impairment of sight, the defect is far greater at the peripheral portions of the field of vision, especially at the inner or nasal part, so that fingers, or, better, a white spot, cannot be perceived till nearer the point of central vision than normal. The ophthalmoscope shows the optic disc to be excavated so as to form a cup narrowed at its mouth. Its base—white, with a bluish tinge—shows greyish mottlings corresponding to the pores of the lamina cribrosa. Its vessels, only slightly diminished in size, are visible where they emerge at the bottom of the cup and as they wind round its overhanging edge; but between these two points they lie along its hollowed-out sides, and so are hid from view. The disc may be fringed by a pale ring of atrophied choroid. Closer examination by the erect image shows a pulsation not only of the veins, but also of the arteries; or this latter sign, if wanting, may be produced by slight pressure of the finger on the globe. The eye is distinctly harder than normal, though not excessively so. No outward signs of inflammation or vascular congestion are present.

An *inflammatory* glaucoma in its more acute form (glaucoma acutum) presents changes for the most part similar. But its onset has been more sudden, unless, indeed, it has supervened upon a glaucoma simplex, and is frequently marked by neuralgic pain in the eye or round the orbit, or possibly by vomiting. There is lacrymation, with great vascular congestion, both ciliary and conjunctival, and possibly even swelling of the upper lid. The anterior ciliary arteries are decidedly larger and more tortuous than normal, and their very superficially placed communicating vessels are also large. The iris is dull and discoloured, and the dilated inactive pupil not infrequently oval in a vertical direction. The anterior chamber is markedly shallow, and the cornea steamy. The lens, though transparent, has a smoky appearance. Ophthalmoscopic examination is difficult, and sometimes impracticable, from corneal and vitreous haze. Cupping of the disc is not so constant or so well-developed as in glaucoma simplex on account of the less average duration of the disease; indeed, it may be entirely wanting, and the disc be simply red, with large and apparently numerous pulsating vessels; or it may be indistinguishable on account of opacities in the media, as above mentioned. Limitations of the visual field are not so striking or so easily detected as in glaucoma simplex, a condition dependent to some extent on the more marked general impairment of sight. The eye is decidedly hard (T_2 or T_3).

Inflammatory glaucoma is usually subdivided, for clinical purposes, into two forms—glaucoma acutum and glaucoma chronicum.

Very rarely it happens that an inflammatory glaucoma is so rapid and severe as to reduce the vision to perception of light, or even destroy it altogether within a very short time—perhaps only twenty-four hours. To this variety of acute inflammatory glaucoma the name of *glaucoma fulminans* is applied.

Sometimes the glaucomatous outbreak is preceded by the appearance of numerous small retinal hæmorrhages. To such cases the name of *glaucoma hæmorrhagicum* is given. This group is important in a clinical sense, as this form of the disease is little amenable to ordinary operative treatment. Still more rarely glaucoma is preceded by swelling of the optic disc. It is questionable, however, whether the disease can then be ranked as a primary glaucoma at all. The same remark applies to hæmorrhagic glaucoma. Glaucoma, in whatever form, has its later stages characterised by still diminishing sight, both central and peripheral, by increasing whiteness of the floor of the cup,

and by diminishing size of the retinal vessels. The widely dilated pupil may be reduced to a mere rim. The cornea becomes quite anæsthesic, but there may be occasional attacks of severe neuralgic pain both in and around the orbit. Minute retinal hæmorrhages are not uncommon, but they may be obscured by the development of the cataractous condition. In cases of long standing there may be corneal opacities of inflammatory origin, which are apt to take the form of a superficial, horizontally-running, transverse band.

Any case of primary glaucoma which has so far progressed as to be hopeless, passes by the name of *glaucoma absolutum.*

Cases are also not infrequently observed where, though all the other usual symptoms of glaucoma simplex are present, inclusive of the cupped disc, no increase of tension is perceptible to the finger. In such we may accept the arterial pulsation and the usually well-marked cup as indicative of some long-continued increase of pressure, too slight for appreciation by our ordinary methods, or we may find a definite history of occasional outbursts of tension (glaucoma intermittens).

Glaucoma, though rare, is not wanting in children and young adults. In such cases the sclerotic yields gradually to the pressure, the change being more noticeable in the anterior half of the eye, especially in the cornea. The disease has consequently passed under the name of 'buphthalmos' or 'hydrophthalmos.' But the more numerous cases where this condition is secondary to iritis in infancy, or, more commonly, in intra-uterine life, should be carefully distinguished from those in which the buphthalmos indicates primary glaucoma occurring in young subjects.

It is clear that opportunities of examining early and slight cases of glaucoma must be, of necessity, rare in the extreme. But the pathological changes of advanced glaucoma are well-determined, though authorities are by no means agreed as to the precise significance of each and their relative order. Taking, therefore, a chronic inflammatory glaucoma which has attained the absolute stage, the globe is of about normal size and the conjunctiva extremely thin. Small bluish-black areas often mark the existence of local thinnings of the sclerotic. Two such—at the outer and inner equators respectively—are of common occurrence. They correspond to the terminal part of the course of the long ciliary arteries and nerves within the substance of the sclerotic, and are correspondingly elongated in form from before backwards. The nerves themselves are usually of large size, as are also the accompanying arteries. The optic nerve is smaller in section as well as more firm and unyielding than normal, though its mouth is somewhat widened from a yielding of the fibres of the lamina cribrosa. The globe, when divided across its equator, stands up well against the knife, on account of the firmness and full size which the vitreous body usually presents. The iris is advanced, so that its widely-dilated pupillary margin no longer rests upon the lens, and its excessively atrophied peripheral part firmly adheres to the corresponding anterior, or rather outer wall, of the anterior aqueous chamber. The rest of it is also much atrophied, apparently from long-standing inflammation, of moderate severity though of low type. Its anterior surface is shortened, so that the uveal pigment, rolled forward into view, lines the pupillary margin with black. The ciliary body and the iris have their afferent arteries enlarged and patent. The shrinking of the ciliary body may be such as ultimately to reduce it to half its original thickness. This change is associated with the formation of more or less connective tissue between its much-atrophied muscular fibres, the product of a low form of inflammation, as in the iris. The pigment epithelium of both iris and ciliary body remains unaltered. The ciliary folds are commonly much shrunken. The optic disc may be encircled by a narrow zone of atrophy, but otherwise the choroid is normal. The retina is also normal in structure, except for some atrophy of its nerve-cell and nerve-fibre layers, and a diminution in the size of its arteries and veins. The walls of both arteries and capillaries are hyaline and rigid, and aneurismal dilatations of the latter are not uncommon. The retina is commonly cystic where it borders upon the ora serrata.

The connective-tissue framework of the optic nerve is much thickened and very irregular. It supports many large blood-vessels, and encroaches very much upon the nerve-bundles, which, like the trabeculæ, show a very marked hypernucleation. The cupped and atrophied disc may be lined by imperfectly formed non-vascular fibrous tissue. The vitreous is usually slightly yellowish in tinge; it is comparatively easy to find cell-elements in it. The canal which traverses it—the canal of Cloquet—may be found enlarged, especially at its posterior part. The lens is usually of average size, except when it is cataractous, in which case it is for the most part somewhat diminished.

Some few cases, however, occur where it is large, soft, and globular—the result, in all probability, of an early stage in the formation of cataract, similar to that sometimes also encountered in eyes with normal tension.

The exact condition of things in the earlier stage of glaucoma may be inferred from the comparatively few examinations that have been made, and from the ophthalmoscopical and clinical appearances. It is certain that the lens and iris-base are at first free from the cornea, but that they afterwards become advanced by pressure from behind in the course of development of the disease. The writer is also satisfied that the inflammation and atrophy of both iris and ciliary body are also consequences of the increased pressure. Both are, in all probability, the direct result of the application and resulting inflammatory adhesion of the iris-periphery to the cornea. The changes affecting the optic disc, as well as those within the optic nerve itself, are also secondary to the increased pressure within the vitreous chamber. Some uncertainty exists as to the state of the ciliary folds. It is maintained by some that they are congested and consequently enlarged in the earlier stages of glaucoma. Such a condition is not improbable in view of the supposition of an increased flow of fluid into the eye, though the evidence at present before us is not sufficient to establish it.

The pathological differences in the various forms of glaucoma relate to the period and degree of development of inflammatory symptoms, these being entirely wanting, so far as external appearances are concerned, in glaucoma simplex (at all events, in all but its later stages), whereas they are observable in inflammatory glaucoma from its very outbreak.

The original development of a primary glaucoma is due to a disturbance in the balance of the intra-ocular fluid, to the origin and course of which it is consequently necessary to devote a short space. According to common acceptance it is secreted mainly by the pigment-epithelium of the ciliary folds, and to a less degree by that of the ciliary body generally and posterior iris-surface. From the ciliary body it passes centripetally—some into the posterior aqueous chamber, some into the adjacent lens-margin, but most into the vitreous chamber, where it tends to accumulate in the canal of Cloquet. From these various parts it passes forwards by way of the pupil to the extreme peripheral part of the anterior aqueous chamber, where it filters through the epithelioid cells of the meshwork of the ligamentum pectinatum into the canal of Schlemm, whence it gains the episcleral veins. That portion coming from the vitreous chamber has passed round the lens margin, either between it and the ciliary folds, or along the grooves between the latter, into the posterior aqueous chamber, and so on through the pupil as above described. An obstruction to this flow at any point of its forward course, or a secretion of the fluid in larger quantity than can traverse the normal outlets, will constitute a glaucoma.

There is strong evidence that the fifth nerve determines the amount of secretion into the eyeball. Experimental irritation of this nerve has caused the tension to rise, and glaucomatous attacks are often ushered in by neuralgia of one or more of its branches, though we must not forget, on the other hand, that trigeminal neuralgia is far more commonly unaccompanied by any change in the tension. Paralysis of the fifth is sometimes associated with distinct slackness of the eyeball, and the same result is favoured by stretching the supra-trochlear branch of this nerve. It is likely that, as the tension of the eyeball has been found to bear a distinct relation to the blood-pressure, the influence of the fifth may be exerted through its connection with the sympathetic.

The phenomena of intermittent glaucoma, of sudden outbreaks of tension, especially when preceded or accompanied by neuralgia of the fifth nerve or much lacrymation, of increased or diminished tension following a blow without apparent structural change, are all totally irreconcilable with the production of glaucoma by obstruction. Moreover the action of eserine, which by contracting the sphincter muscle of the iris and thereby opening more widely the meshwork of the ligamentum pectinatum, does in certain cases reduce the tension to normal, shows that the fault lies neither in closure of the outlets, which are really capable under the influence of this drug of transmitting a far larger quantity of fluid than normal, nor in the nature of the fluid itself.

Therefore the writer adheres most unreservedly to the view first enunciated by Donders, that the original cause of a primary glaucoma is an undue secretion into the eyeball. But, at a more advanced stage of the disease, obstruction to the normal outflow at the ligamentum pectinatum is superadded, this being a direct mechanical result of the previously existing hypersecretion.

The various pathological changes of glaucoma are perfectly explicable on the hypothesis of an increased secretion followed by a secondarily produced obstruction. The accumulation of fluid within the substance of the vitreous itself and in its central canal thrusts forwards the lens and ciliary folds, and with them the adjacent iris-base. If the quantity be large, as in the inflammatory forms of glaucoma, the iris-base becomes actually applied to the meshwork of the ligamentum pectinatum, thereby effectually blocking it. The same result is favoured, both here and in the later stages of glaucoma simplex, by paralysis of the muscular fibres of the iris from pressure in the course of their afferent nerves. The iris-base becomes inflamed, and subsequently atrophied, in consequence of its compression. The same changes extend to the rest of the iris and to the adjacent muscular fibres of the ciliary body.

There has been much discussion as to the exact means by which the iris-base is advanced. Though it is now certain that the anterior extremities of the ciliary folds are the immediate propelling agents, yet the difficulty is thus merely removed one stage backwards. Some have said that the folds are so much swollen in glaucoma as to press upon the iris. But swelling of the ciliary folds is at least as well established in many diseases, with normal tension and no advance of the iris, as in the early stage of glaucoma. Nor would this supposition account for the advance of the lens, unless indeed it were maintained (as has been done) that the swollen folds and the lens together form a diaphragm impermeable to the proper passage of fluid from the vitreous chamber. But the iris-periphery is as readily advanced after the extraction or dislocation of the lens as when this body is intact. Consequently we are driven to the conclusion that it is the vitreous body itself which presses upon the ciliary folds, and through them upon the iris-base. In the rare cases where the vitreous does not occupy its entire chamber, the pressure must come from the fluid accumulated behind it.

The inflammation of the trunk of the optic nerve has attracted less attention. It is developed just as strikingly in glaucoma distinctly due to blockage of the ligamentum pectinatum—for example, in cases of perforated corneal ulcer with prolapse of iris—as in primary glaucoma. The writer attributes it to infiltration of the ocular end of the optic nerve by fluid from the vitreous cavity. It is a question whether this infiltration, its existence being granted, is an entirely new development under the influence of the increased intra-ocular pressure, or whether it is simply an exaggeration of a normally existing flow. In favour of the latter view is the fact that the lymph-spaces of the optic nerve communicate with the canal of Cloquet, as well as with the sub-hyaloid space; and, more decidedly still, that swelling of the disc, narrowing of the peripheral part of the anterior aqueous chamber, and even, in rare cases, glaucoma itself, can be produced by compression of the optic nerve. Mooren states that the intra-ocular fluid of glaucoma is less albuminous, and consequently less coagulable, than normal. If so, the change in quality may have some deleterious influence on the tissues of the optic nerve. If we accept a normally existing outflow along the nerve, we must suppose this to be extremely slight compared with that by way of the ligamentum pectinatum; since experimental injections into the vitreous chamber have given no indication of their penetration in the nerve, and since all sorts of affections of the optic nerve may exist without a change in the tension of the eye. The widening of the nerve-entrance from stretching of the fibres of the lamina cribrosa would favour a flow of fluid into the nerve. We must, however, remember that to the ophthalmoscope the optic disc usually appears altered, prior to the establishment of any tension appreciable by the touch. But, on the other hand, we must bear in mind that even then pulsation of the retinal arteries is either present or very easily producible. Probably a long-continued slight hypersecretion may be got rid of through the normal outlets without producing any obvious rise of tension, and nevertheless may excite slow inflammatory changes within the ocular end of the optic nerve.

The advanced lens will naturally recede to its former position so soon as the pressure in front and behind it becomes equalised. This will be the case so soon as the ligamentum pectinatum becomes completely obstructed, and the secretion of the ciliary folds diminishes as the result of their shrinking. But the adherent iris must necessarily maintain its advanced position.

The various symptoms of glaucoma can also be explained by its pathology.

The dull and steamy appearance of the cornea, in inflammatory glaucoma, is due to distension of its lymph-spaces and an alteration in its anterior epithelial layer. The dull fundus reflex is due partly to this and partly to haze of vitreous, a result of its

increased fluid and cell contents, which will also account for the halos and attacks of foggy vision. The failing accommodation is attributable to tension of the suspensory ligament of the lens and inelasticity of the sclerotic, both direct results of the distension of the eyeball and its approach to a spherical shape. The redness and subsequent atrophy of the disc are accounted for by the changes within the nerve. The limitation of the visual field, when temporary, is due to ischæmia of the retina. When permanent—i.e. when not remediable by the re-establishment of normal tension—it is due to the destruction of the nerve-fibres at the place where they are compressed along the sides and round the edge of the excavation. The inner part of the field is the first to go, since the arteries supplying the corresponding outer part of the retina have the longest course. The field for colour shrinks *pari passu* with that for form. But we must remember that the condition of the optic nerve itself must soon be sufficient to damage, and ultimately to destroy, both peripheral and central vision.

The pulsation of the vessels is a direct result of the diminished elasticity of the tunics of the globe from the pressure. The entry of the blood at each beat of the artery is no longer provided for by the slight dilatation of the globe which should normally occur. Consequently it is compensated by an immediate collapse of the vein to the same extent, and we have venous pulsation. Later, the increasing hardness of the globe allows an admittance of blood to the arteries at the moment of the systole only, and we have a visible arterial pulsation also. The pressure of the finger on the globe will diminish the elasticity of its coats, and thus give rise to pulsation of the arteries, the ease with which this is produced being a measure of the tendency to glaucoma. The paralysis of the iris and anæsthesia of the cornea are probably direct results of the pressure on the ciliary nerves, where they course between choroid and sclerotic. The dilatation of the pupil to a mere rim, as so commonly occurs in glaucoma absolutum, is due both to paralysis of the iris in association with the rolling forwards of its pupillary edge, and to the adhesion of its base to the peripheral part of the front wall of the anterior aqueous chamber. The cupping of the optic disc is in the main a direct result of the pressure. It is due to the atrophy of the nerve-fibres, both directly from the pressure and from the changes within the nerve. It takes time—probably at least a month in inflammatory glaucoma—for its complete development. It commences as a funnel-shaped central pit, which gradually extends till it reaches nearly or quite up to the margin of the disc, where a narrow, well-defined, white ring—the scleral ring—is often conspicuous. Gradually the nerve-fibres are pressed against its sides and atrophied here, as well as at its overhanging edge, so that the cup becomes flask-shaped in antero-posterior section—that is to say, its mouth is narrower than its cavity.

This overhanging, which need not involve its entire circuit, is due to the tapering of the normal optic nerve just before and at its entrance to the eye. This is a result of an anatomical change in the nerve-fibres, which normally lose their white matter of Schwann about the level of the lamina cribrosa, and are, consequently, for the rest of their forward course, represented by the axis-cylinders alone. The peculiar shape of the cup explains the apparent interruption of the vessels, as previously described. The most typical cupping is seen in glaucoma simplex. It is not well exhibited in the glaucoma of myopic eyes, probably from the distensibility of the thinned tunics of the globe. It used to be taught that a cup must occupy the whole of the disc, and, moreover, have an overhanging mouth in order to indicate a glaucoma. The idea is certainly incorrect as regards the first-mentioned condition, and apparently also as regards the last, since such a cup is not infrequently seen without any appreciable increase of tension. But it is certain that an extensive cup with undermined edges is typical of glaucoma, as compared with certain other conditions. For an atrophic cup, though extensive, is saucer-like, and a physiological cup, though its edge may be undermined, does not involve the whole of the disc.

Glaucoma probably depends upon some constitutional tendency or disturbance. It has been attributed to gout, but, though many patients with glaucoma undoubtedly have a gouty history, no such evidence has been hitherto collected as would warrant an absolute statement. The tendency to the disease is distinctly hereditary. Hypermetropia, excessive use of the eyes in near vision, uncorrected presbyopia, great anxiety, mental emotion or exhaustion, doubtless predispose to an attack.

Glaucoma is far more common as a disease secondary to other affections than in its primary form. Secondary glaucoma is encountered in the progress of most intra-ocular tumours, whether such be sarcomata

of the uveal tract, retinal gliomata, or tuberculous. The effect of an intra-ocular growth upon the tension appears to be twofold. Its first and direct effect is to render the eye very slightly slack, possibly by the absorption of vitreous which it induces; an absorption which proceeds even more rapidly than the tumour grows. But the later outbreak of an inflammatory glaucoma is due to some cause not yet determined with precision. It probably varies in each case, being sometimes due to the blockage of the anterior outlets by the iris-periphery under the direct pressure of the now rapidly increasing tumour mass in the vitreous chamber. But more often the growth seems to prevent the flow from the vitreous chamber itself round the lens-margin. It is also a clinical fact that some tumours lead to shrinking of the eye without any manifestation of tension at any time, while others, large enough to reach nearly or quite up to the posterior lens-capsule, may exist for long with slightly diminished or normal tension.

Secondary glaucoma also occurs very commonly after perforated corneal ulcers. If the destruction affect a considerable area of cornea, the whole pupillary part of the iris prolapses into the gap thus made, and the pressure from behind applies the remaining part to the undestroyed cornea, thereby excluding most effectually all drainage by the canal of Schlemm. Similarly, after more extensive slough of the cornea, the exposed iris unites together, so that the pupil no longer exists. Thus a diaphragm is formed which becomes rapidly covered by a layer of lymph. Till this is slowly organised into dense fibrous tissue, it is incapable of resisting the intra-ocular pressure, and we have a prominent corneal staphyloma gradually formed. So soon, however, as a certain amount of firmness is gained, a secondary glaucoma is established. Prevention, by freeing the iris, is difficult, and relief of the glaucomatous condition, when once established, either by iridectomy or by any other procedure, still more difficult and uncertain. Indeed, little remains to us in the later stages but to mitigate the deformity, as far as possible, by tattooing the cornea, by abscission of the globe posterior to the ciliary body, or by enucleation.

Secondary glaucoma may also be produced in the course of iritis by adhesion of the iris to the anterior lens-capsule. In such cases the pupillary margin alone may be adherent (exclusion of the pupil), or the adhesion may involve a great part, or even the whole, of the posterior iris surface (universal posterior synechia). Thus, fluid is prevented from escaping by the anterior outlets of the eye, and we have a rise of tension with a diminution in the size of the anterior chamber.

It is remarkable that the pupil may be excluded and still the tension may remain perfectly normal, or even may be diminished, whether the iris be bulged or remain flat. Under the same circumstances increased tension may suddenly arise, or a hard eye become normal. The explanation resides in a varying amount of secretion of the ciliary body, according to its condition, whether normal, or inflamed, or inclined to atrophy after inflammation. The appearances in glaucoma from excluded pupil are characteristic, and the remedy simple. The central part of the anterior chamber is funnel-shaped, the apex of the funnel being formed by the pupillary area of the lens, and its base by the cornea. All the rest of the anterior chamber is extremely shallow, being encroached upon from behind by the bulged iris. An iridectomy will re-establish communication between the chambers, and effect very commonly the cure of the glaucoma. More extensive or universal posterior synechiæ are naturally less remediable by iridectomy. Indeed the indication for it is not so certain, since so extensive an iritis usually brings with it cyclitis and a subsequent softening of the eye.

Glaucoma also occurs commonly in the course of an iritis serosa. Since the secretion of the iris itself, especially its anterior surface, is here augmented, being, indeed, the cause of the increased tension, we have the anterior chamber markedly deep, and the iris-periphery pushed far back from the cornea. Numerous loosely arranged cells are found in the meshwork of the ligamentum pectinatum, and it has consequently been maintained that these produce the tension, by causing a direct obstruction at this, the point of outflow. This is probably not the case, since a similar accumulation of cells occurs commonly in suppurative iritis in association with normal tension. The most advantageous treatment of the tension of iritis serosa is not determined with certainty. If the disease has persisted for very long, the iris-periphery will usually be found applied, and the iris atrophied, as in an ordinary glaucoma absolutum.

Dislocation of the lens, whether into the vitreous or aqueous chamber, is very commonly followed by rise of tension. Indeed, slight lateral displacements appear just as liable to produce a glaucoma as the most extensive and violent changes of place. A

displaced lens may block the meshwork of the ligamentum pectinatum by its presence in the anterior chamber, or by its direct pressure from behind upon a portion of the iris-periphery. Where such pressure cannot be proved to exist, it has been supposed that the displaced lens produces an irritative hypersecretion from the ciliary body by traction on the zonula. The question is not yet cleared up satisfactorily; but it is certain that the vitreous, after removal of the lens, or after its displacement with rupture of the hyaloid, is just as competent to thrust forward the ciliary folds and iris-periphery, as the lens would be with its normal attachments still unbroken. This result can scarcely be due to any other cause than swelling of the vitreous or an alteration in its shape. It is also to be noted that the tension due to lenticular dislocations may vary very much, a sudden outbreak of glaucoma being perhaps followed by a temporary period of diminished pressure. Secondary glaucoma, immediate or after the lapse of some months, was a common cause of entire loss of sight after the old cataract operation of couching or depression. Extraction of the displaced lens is the clearly indicated remedy, but it is not done without considerable difficulty, and there will almost certainly be loss of vitreous.

Wounds of the lens, accidental or operative, may be followed by glaucoma. In many such cases the lens is demonstrably swollen, and must encroach directly upon the cavity of the globe. To what extent it may have an indirect effect in closing the periphery of the anterior chamber or exciting an irritative hypersecretion from the ciliary folds, is less certain. The tension may be relieved by a speedy evacuation of the soft lens-matter by a curette through a small corneal incision, or by extraction of the lens *en masse* by the ordinary methods.

Glaucoma may supervene after a blow, without obvious structural change, or after a small perforating corneal wound with prolapse of iris.

Increased tension is also common in the course of suppurative panophthalmitis, and is doubtless directly due to swelling of the vitreous from abundant infiltration with cell-elements. It is not uncommon in uveitis of sympathetic origin. In both these cases the eye manifests a subsequent tendency to shrink; in the first, certainly, and in the last, probably. Scleral puncture or enucleation may be resorted to in suppurative panophthalmitis. In sympathetic disease we must be cautious about undertaking any operation, but, if the tension absolutely necessitates some interference, it will probably be found best to do sclerotomy.

High tension may also occur in the course of inherited syphilitic kerato-iritis, or indeed in the course of any serious affection of the uveal tract. In the former case it will often fall spontaneously to normal or even be followed by an abnormal softness of the globe. The need of an operation—best, probably, an iridectomy—will be determined by the probable effect of the tension on the nervous tissues of the eye.

Hæmorrhages between the choroid and retina are not infrequently the cause of a secondary glaucoma, especially in defective eyes. They are not uncommon in children, where they constitute one form of what has been described as pseudo-glioma.

It has already been stated that glaucoma may occur second in point of time to retinal hæmorrhage, in which case it is called hæmorrhagic glaucoma. This and the glaucoma which not infrequently follows plugging of the central vessels of the optic nerve may be, in reality, forms of secondary glaucoma; being perhaps related to an interference with the flow of lymph from the retina itself and vitreous cavity into the lymph-spaces of the nerve, either alone or, more probably, in association with some extensive vascular disease leading to an increased secretion from the ciliary body.

W. A. Brailey.

GLAUCOMA, Treatment of. — All authorities have agreed to make tension the diagnostic symptom of glaucoma, and with some practical reason, since it is the cause of a far more rapid deterioration of vision than would otherwise occur, and since it is the one condition we have some power of remedying. The effects of tension may be experienced by anyone making pressure with the finger on his own eye. The sight fails progressively from the circumference to the centre of the field of vision, and is re-established progressively on removing the pressure. The effects of removing morbid pressure are occasionally brilliantly demonstrable after operations for the acute inflammatory, and especially the fulminating variety of glaucoma. But, on the whole, the treatment of glaucoma can hardly be pronounced satisfactory. Except for combating any gouty, or possibly any general rheumatic, symptoms, and giving suitable glasses and instructions for the use of the eyes, we can do nothing in the premonitory stage. The question of proper spectacles, especially for near work, is, however, far

more important than is often supposed. It is very probable that an iridectomy or, better, a sclerotomy, might check the further development of the pressure, but few surgeons would propose, or few patients would risk, an operation while still vision was good and an increase of tension but doubtful.

With regard to drugs, the subcutaneous injection of morphia (gr. $\frac{1}{6}$ of the hydrochlorate) under the skin of the temple will relieve the pain and, very occasionally, even reduce the tension to normal. A violent purgative has also a distinct reducing effect on the tension, but we may lay down generally that the known action of all drugs is at present simply temporary. Undoubtedly the most valuable is the Calabar bean, which in the form of a solution of the sulphate of its alkaloid, eserine (gr. ij. ad fʒj.), will sometimes restore normal tension. It is well established by observation that the tension is only reduced when the drug is able to exert to the full its myotic action. Doubtless eserine diminishes tension by gathering the iris more towards the centre of the pupil, so that its peripheral part is thinner and the fibres of the ligamentum pectinatum well stretched apart. Consequently, fluid can transude freely through the periphery of the anterior chamber. On the same principle, atropine, by dilating the pupil, has a tendency to precipitate a threatened glaucoma, the widely dilated iris being much thickened, and the periphery of the anterior chamber, towards which it is gathered, correspondingly narrowed. There has been much misapprehension as to the relative actions of atropine and eserine. For, while the one raises and the other lowers tension by the above-described mechanical action, each drug has an influence of its own on the secretion of the intra-ocular fluids, in an entirely opposite direction. Thus, atropine, by diminishing the secretion according to its well-known action in other regions of the body, tends to lower the tension, and would do so were not this influence more than counterbalanced by the results of its mechanical action on the iris. In the same way, eserine would make the eye harder, were it not that its mechanical action more than counterbalances its influence on the secretion of fluids. It therefore follows that eserine is useful when it contracts the pupil, but that it is actually deleterious in all other cases; also, that atropine may be usefully employed where a rise of tension is associated with a pupil immovable from iritic adhesions, but that it should be sedulously avoided in all cases of threatening glaucoma with unadherent pupil. The weakest solution of eserine that will produce extreme myosis is consequently the best adapted for glaucoma.

Operative treatment is of more avail in glaucoma. Statistics show improvement of sight after operation in about 25 per cent. of the cases of glaucoma simplex, and an actual deterioration of vision in another 20 per cent. The remainder stand in much the same position as regards vision as previous to the operation, though the future course of the disease must be modified beneficially from the reduction of tension which usually occurs. In inflammatory glaucoma, about half the cases are improved in vision, the bulk of the others remaining stationary in this respect. We know, however, that they would all steadily get worse if they remained unoperated upon. The most useful operations are iridectomy and sclerotomy. Others are scleral incision, trephining the sclerotic, hyposcleral cyclotomy, and paracentesis corneæ.

The last has its principal use in reducing tension pending the adoption of some more radical measure. Cases are on record in which such a simple puncture has cured a glaucoma, but anyone expecting to meet with even one such result in his lifetime will probably be doomed to disappointment. It can be performed from below—the best position—with a special broad-pointed stop needle (paracentesis-needle), with the point of a keratome, or with an ordinary broad needle. No anæsthetic is required, provided the operator is moderately skilful. It is surprising how quickly the increased tension and the anterior chamber may become re-established after paracentesis.

Iridectomy was introduced by the genius of Von Graefe in 1856, after a long series of operations, experimentally performed upon animals, had demonstrated to him its utility in reducing the tension of the normal eye.

It still remains the most reliable remedy we possess against inflammatory glaucoma, in both its acute and chronic forms. An anæsthetic should be administered for either iridectomy or sclerotomy. Cocain will, as a rule, not suffice for the perfect quiet which is essential. Chloroform, if not contraindicated by the general condition, is preferable to ether, from the vascular congestion attendant on the latter. The operation is performed with a triangular knife or keratome, whose handle in the

immediate neighbourhood of the blade is bent upon the flat, for convenience of operating from above, the usual position. The blade should be of fair size, about 9 mm. in diameter at its widest, and of a length rather greater than this. Some use a smaller size, thereby necessitating a sideways movement in the act of withdrawal, a proceeding not unattended with risk of traumatic cataract. The point of the keratome enters the sclerotic at least 1 mm. behind the apparent corneal margin, care being taken to keep the incision parallel with this. The steady onward movement is facilitated by the use of the fixation-forceps, which take a firm hold of the conjunctiva near the lower corneal margin. So soon as the point of the keratome, which was at first directed towards the centre of the lens, is visible in the anterior chamber, it is turned more forwards, so that the instrument lies, in the rest of its course, perfectly parallel with the plane of the iris. It is quickly and steadily withdrawn so soon as it has traversed about three-fourths of the anterior chamber. During its introduction it should fit the wound so accurately that none of the aqueous fluid escapes by its side; otherwise the lens may be thrust forward on its point.

The keratome is now laid aside and the scissors taken in the right hand, and the iris-forceps in the left. Fixation of the globe by an assistant will probably be necessary. Should the iris not facilitate matters by prolapsing, the closed forceps are cautiously introduced into the anterior chamber, not quite so far as the pupillary margin of the iris, and then opened. The piece of iris grasped by them should be as large as can be safely managed. After being carefully withdrawn it is first cut with the scissors at the extreme right-hand angle of the wound by an incision extending radially to the pupil, and then torn cautiously from its peripheral attachments up to the left-hand angle, where a second radial cut frees it altogether. A certain amount of gentle traction during each cut will ensure that the remaining iris retracts sufficiently to prevent the risk of an anterior synechia. Otherwise, it should be pushed from the wound by some flat, blunt, spud-like instrument made of vulcanite or tortoiseshell. The removed iris should amount to at least one-fifth of the whole.

It is most important that the forceps during fixation should exert no downward pressure on the globe. Nor should it tend to lift it up, but rather rotate it very gently, slightly, and steadily towards the keratome. Some incline the point of the keratome sideways just before commencing to withdraw it, so as to make the length of the internal equal to that of the external wound. Both eyes are kept loosely tied up for two days, and the lint is kept wet and is occasionally changed. During this time rest in bed will be advisable. Then the unoperated eye may be opened under a shade, dry lint being henceforward used to the operated eye. At the end of ten days this may be cautiously exposed to the light, provided that the wound is healed and the anterior chamber fully re-established. But the rapidity of re-formation of the anterior chamber varies much, and may be taken as indicative of the future course of the case. In any case it is much slower, on the average, than after iridectomy on non-glaucomatous eyes. In rare cases the lens and iris remain permanently applied to the cornea without any reduction of tension at any time. To such cases the name of malignant glaucoma has been applied.

When the tension, though still exceeding the normal, has fallen somewhat after an iridectomy, it becomes a question whether a further removal of iris in an opposite direction (diametric iridectomy), or even a sclerotomy, may not be practised advantageously. Tension may, however, remain somewhat in excess, and the eye still be materially benefited by the operation. In such a case it would be prudent to go no further. A Graefe knife may be employed in making the first incision, when, from the great shallowness of the anterior chamber, the use of a keratome would appear to endanger the lens. If the condition of the second eye give rise to anxiety, it is advisable to instil eserine into it, both before and for a day or two after the operation, for the sake of guarding against the outbreak of tension to which the operation on the first eye appears to predispose it.

The accidents attending iridectomy are: wounds of the lens, escape of the lens or of the vitreous and even of the retina, entanglements of the iris in the wound, and intra-ocular hæmorrhages. An ill-made keratome, by allowing premature escape of the aqueous, is likely to be the cause of a traumatic cataract. A Graefe knife, though less likely to injure the lens, has the great disadvantage that, making a larger wound, it allows of a very sudden reduction of the intra-ocular pressure. Thus the danger of rupture of the lens-capsule and of escape of lens, and even vitreous, is greatly increased. The same with regard to intra-ocular

hæmorrhages, which, if in the anterior chamber only, may be safely disregarded, but, if in the vitreous, are apt to lead to serious loss of sight. If they are posterior to the retina they may cause an immediate exacerbation of tension, with such prolapse of vitreous, and even of the retina, as may render an immediate enucleation necessary.

Sclerotomy is performed by entering the point of a narrow-bladed Graefe knife 2 mm. behind the apparent corneal margin, and then traversing the anterior chamber parallel to and just in front of the anterior surface of the iris, till a corresponding counterpuncture is made. The incision should comprise a third part, usually the upper, of the entire circle in which it lies. The sclerotic is then divided by gentle sawing movements till only a narrow bridge, 2 mm. wide, remains unsevered. The conjunctiva, yielding to the knife, will only be cut at the points of puncture and counter-puncture. The knife is withdrawn with extreme care, so as to prevent prolapse of the iris. Eserine sulphate (gr. j. or ij. ad f ℥j.), is instilled as a further precaution, and repeated thrice daily for some days, provided always that it contracts the pupil. Otherwise the after-treatment is as in iridectomy. It is here also a special point that the bandage should not be firmly applied. The special risk attending sclerotomy, in addition to that of wounding the lens, is entanglement of the iris in the wound. Should this happen during the operation, it will be well to complete the incision, with the knife if it be still in the anterior chamber, or with scissors, and make the sclerotomy into an iridectomy. If the incision be too far back, we have all the risks attendant on wounds of the ciliary region, including those of sympathetic ophthalmitis and deep-seated intra-ocular hæmorrhage. The possibility of a glaucomatous outbreak in the second eye should be guarded against with eserine, as prescribed in iridectomy.

Either sclerotomy or iridectomy may be followed by the condition known as cystoid cicatrix, in which the operation scar at one point, usually near or at an extremity, remains thin, bluish, and prominent. The condition is most plausibly explained by entanglement of a point of iris in the scar. It is usually supposed that a cystoid cicatrix, by allowing occasional leakage, relieves exacerbations of tension. If so, this advantage is too often counterbalanced by the irritation to which this condition gives rise. Its treatment should not be lightly undertaken. It may be cut through with a Graefe knife, and afterwards treated with a compressive bandage and perhaps the occasional use of mitigated nitrate of silver stick. Such treatment, will, however, certainly not be ventured upon if the eye continues hard.

A sclerotomy may be repeated one or more times, or may be followed by an iridectomy. Sclerotomy is certainly preferable to the latter operation in glaucoma simplex, especially if attended with great limitation of the field of vision, also in the hæmorrhagic forms of glaucoma, and for increased tension in young subjects. It has the advantage over iridectomy that it does not deteriorate vision by altering the shape and size of the pupil.

Another operation sometimes employed in glaucoma has been called 'scleral puncture.' An incision, some quarter of an inch long (6 mm.), is made through the sclerotic into the vitreous chamber in an antero-posterior direction. It should lie entirely posterior to the ora serrata, that is to say, it should be at least 6·5 mm. from the apparent corneal margin. The knife, which may be an ordinary keratome, should pass some distance into the vitreous chamber, perhaps as far as the canal of Cloquet. The incision should be between two of the recti tendons, perhaps preferably between the superior and external. After the escape of some of the contents of the globe, such being lymph or thin vitreous, the eye is bandaged carefully, as after iridectomy. For the most part the more thoroughly tried procedures of iridectomy and sclerotomy will be preferred to scleral puncture. But the latter has this advantage, that little reaction follows it, and, being done without an anæsthetic, it can be readily repeated. Its results, provided that repetition be not feared, are spoken of not unfavourably. It is certainly the best operation in cases where the anterior chamber is entirely wanting. In these an attempt may at the same time be made to push back the lens by manipulation of the cornea. The lens may be wounded in an incautiously performed scleral puncture, or the operation may cause extensive intra-ocular hæmorrhage.

An incision through the ciliary body antero-posteriorly has also been recommended. A narrow-bladed Graefe knife is introduced near the corneal margin, usually the upper, and pointed directly backwards, so that its blunt back is toward the edge of the lens. The ciliary body is cut through right up to and against the sclerotic. Though this operation, which has been

named *hyposcleral cyclotomy*, sometimes reduces the tension, as indeed any incision near the sclero-corneal junction may, it can do much harm by causing intra-ocular hæmorrhage or inflammation, or by wounding the lens.

Trephining through the sclerotic has been recommended and practised by Argyll-Robertson in cases which seem not likely to benefit by the ordinary operations. The incision is made about the level of the ora serrata by the cutting extremity of a steel cylinder, which is rotated between the fingers. It is extended into the vitreous chamber, so that some of the contents of the latter escape. Subsequent treatment is by wet lint and quiet. The operation is attended with more reaction than iridectomy or sclerotomy, and should therefore, if only on this ground, be deferred in favour of a repetition of these more fully tried methods.

Any of the above described operations may be of benefit by the free drainage that must occur before the reunion of the wound; and, presumably also, by the relief to arteries and capillaries from removal of pressure from the walls of the different venous trunks.

The special beneficial action of iridectomy is due to the removal of a portion of the iris from its contiguity with, or close apposition to, the meshwork of the ligamentum pectinatum. This operation is consequently expressly indicated in cases of inflammatory glaucoma, especially where the anterior chamber is very shallow. It is less suitable to glaucoma simplex generally, and least of all to those long-standing cases where the field of vision is encroached upon nearly up to, or beyond, the fixation-point.

An ample and well-performed iridectomy may be followed by no reduction of tension, or even by an exacerbation. Such cases should be scrutinised carefully, since it is not impossible that the tension may be due to the presence of an intra-ocular growth. It must, however, be remarked that an eye may retain some hardness immediately after the performance of the operation, and yet regain normal tension in the course of a few days. These remarks apply also to sclerotomy.

The way in which this last-named operation reduces the tension is not quite so obvious. It certainly does not act by producing a permeable scar, across which fluid can pass from the anterior chamber to the exterior. More probably a new path is established by which fluid can reach the corneal and scleral lymph-spaces from the retraction of the cut membrane of Descemet (the posterior elastic lamina). However peripheral the operation wound may appear, it is almost invariably found, on post-mortem examination, to be substantially in advance of the ligamentum pectinatum and canal of Schlemm. Sclerotomy is especially indicated in glaucoma simplex, and in those cases where intra-ocular hæmorrhages are likely, such being the hæmorrhagic and very advanced forms of glaucoma, and also the glaucoma of young subjects.

An operation is indicated in all cases of inflammatory glaucoma, except where the perception of light is permanently gone. Its benefit is most doubtful in cases of glaucoma simplex, especially where there is much contraction of field. But it is to be said, even in such cases, that, after a trial of the drugs we have previously discussed, it is the only remedy remaining to us. It is proper to remember that the ultimate effect of an operation is often much better than would appear probable within a few weeks of its performance.

Some cases of glaucoma absolutum cause little or no inconvenience, but others are attended by severe peri-orbital or ocular neuralgia. For this, enucleation is our most sure resource; but, if it be a great object to retain the eye, stretching of the supra-trochlear branch of the fifth nerve may be tried. The operation is performed by making a skin-incision, some 10 mm. long, across the track of the nerve as it emerges from the upper and inner border of the orbit. A line drawn from the angle of the mouth through the inner canthus may be taken as a guide to the course of the nerve. It is best to extend the incision at once right down to the periosteum, at the extreme outer and inner ends of the wound, and then to divide or tear through the remaining bridge, bit by bit, upon a strabismus hook. The nerve, which lies very deeply, may be stretched on the hook till it ruptures. This operation has been vaunted by its introducer, Badal, and by others, as a remedy, not only against neuralgia, but also against increased tension. The writer, though admitting that it has undoubtedly some general effect upon the tension, has not found it of real service in ordinary cases of primary glaucoma. It may, however, be employed as a subsequent adjuvant to other operative procedures, and it is undoubtedly useful against the neuralgia of glaucoma absolutum.

W. A. Brailey.

GLEET.—This term is usually applied to the slight and chronic discharge from the

urethra, which so frequently follows an attack of acute gonorrhœa. The discharge is, as a general rule, very scanty, just rendering the surface of the urethral mucous membrane moist and sticky, passing away in the early morning in one or more drops of clear or slightly turbid fluid, and in the course of the day barely staining the patient's linen. This condition is sometimes associated with pain at the end of the penis, with slight itching along the urethra, and with a sensation of fulness in the perineum. It is, as a rule, a strictly chronic affection, and in most instances it is a direct continuation of the third stage of gonorrhœa, though occasionally it begins after an interval of two or three weeks from the date of complete disappearance of discharge from the urethra. The general condition in gleet is often faulty, the patient being feeble and pallid, and manifesting a tendency to chronic catarrh. The affection, though characterised by such mild local symptoms, is one of some gravity on account of its persistency, of the mental depression which it often induces, and of the decided and constant tendency in its subject to recurrence of acute inflammation of the urethra. Moreover, it is often indicative of prostatic and vesical mischief, and may be associated with stricture of the urethra.

The diagnosis of true gleet from the gleety discharges associated with hypertrophy of the prostate, old stricture, and warty or polypoid growths in the urethra, may, in most instances, be readily determined by inquiry into the history and clinical features of the case, or by instrumental exploration of the canal. In chronic gonorrhœa the discharge, as was pointed out by Fournier, is always profuse, and decidedly purulent.

The pathological condition, which gives rise to the symptoms of gleet, is very probably a chronic inflammation of the mucous membrane of the bulbo-membranous portion of the urethra. There cannot be any doubt that gonorrhœal inflammation, as it subsides, becomes restricted to the deep portion of the urethra, and has a tendency to persist there in a chronic form. Desormeaux, in his endoscopic researches on gleet, made out a granular condition of the urethral mucous membrane, which he regarded as the special lesion of the affection. According to this surgeon, 'When gonorrhœa passes into a chronic form, the mucous membrane of the urethra at the affected region becomes uneven, and, after a time, presents small hemispherical granulations which are irregularly and sometimes thickly dispersed on a deep red surface. These granulations, which vary much in size, frequently occupy from two to four centimetres of the extent of the urethral canal, and sometimes the whole of its posterior part, from the proximal end of the spongy region to the orifice of the bladder. One almost constant character of this lesion is its continuity. Whether it involve much or little of the urethral wall, there is no interruption between its two extremities, and there are no scattered patches separated by healthy mucous membrane. Sometimes the granulations swell, lose their hemispherical form, become softer, and acquire the aspect of the granulations of a healing ulcer. The affected surface then resembles, in the field of the endoscope, that of a suppurating wound. This ulcerative process may extend still further, and become fungous.' These lesions follow an essentially chronic course, and, Desormeaux asserts, inevitably lead to stricture. *See* Endoscope.

In the treatment of gleet it is very necessary to attend to the general health. The patient should be put on a plain but abundant and nourishing diet, and be advised to make frequent changes of air and scene, if possible, without going through too active exercise. He should abstain from wine, beer, and tea, and take as drink as much milk as he can digest, with small quantities of whisky or gin in some aërated water. Cold or tepid baths will be found beneficial. The medicinal treatment, unless the urethral discharge be kept up by some diathetic condition, should consist exclusively of one-drachm doses of the compound syrup of phosphate of iron every morning, and from three to five minims of tincture of cantharides, in one ounce of water, three times a day. The local treatment should consist in the introduction, every fourth or sixth day, of a metal catheter of such size as to permit its easy passage along the whole extent of the urethra, and in the daily application of an astringent solution to the posterior part of the canal by means of Tiemann's syringe, or of Harrison's irrigator. The following are some of the most useful injections that have been tried in the treatment of gleet:—Sulphate of zinc (gr. iij. to f℥j.), sulpho-carbolate of zinc (gr. jss. to f℥j.), nitrate of silver (gr. j. to f℥j.), bismuth (℈ss. to f℥j.), tannin (gr. v. to f℥j.), tincture of iodine (♏v. to f℥j.).

In any very obstinate case of gleet, it might be found advisable to apply, as a last resource, blisters to the perineum and the root of the penis. W. Johnson Smith.

GLIOMA. *See* ORBIT, Tumours of the; SARCOMA.

GLOSSITIS. *See* TONGUE, Diseases of the.

GLUE-BANDAGES. *See* IMMOVABLE BANDAGES.

GLUTEAL ANEURISM.—In cases of aneurism of the buttock, the gluteal is the artery most frequently affected, but the sciatic is not uncommonly involved, and cases are on record where the internal pudic crossing the spine of the ischium, or an abnormal 'sciatico-popliteal' artery has been diseased. To diagnose whether a 'diffused' aneurism implicates the gluteal or the sciatic artery, must always be difficult, and may be impossible; when sacculated, a sciatic aneurism will probably be lower and more deeply situated.

Gluteal aneurisms are spontaneous or traumatic, circumscribed or diffused. In the *spontaneous* variety the aneurism is more likely to be sacculated, and both the vessel itself and the iliacs diseased, than when it is traumatic in its origin; it is often not entirely extra-pelvic, small, deeply-situated, and consequently hard to diagnose. Pulsation and bruit may be detected in the sacculated form, but both may be absent if the sac has given way, and the aneurism has become 'diffused.' Other symptoms met with are pain, not only in the buttock but also along the back of the thigh from pressure on the sciatic nerve, flexion, and some loss of mobility of the limb. The integument may become inflamed from pressure in sitting or some local irritation.

Traumatic aneurisms, which are far the most common, are due to a wound or subcutaneous rupture of the artery. The vessel itself is more likely to be diseased in this latter case; in both the aneurism is probably entirely extra-pelvic; yet this is not necessarily so, for the artery may be wounded before it has passed through the sacro-sciatic foramen, or, when cut across or ruptured, retract within the pelvis.

A traumatic sacculated aneurism will give rise to much the same symptoms as a spontaneous sacculated one; but with the accompanying history of a wound or injury should be easier of diagnosis. The majority of these traumatic aneurisms have, however, no sac except such as is formed by the soft parts; and consequently present themselves as tense fluctuating tumours, devoid of pulsation, in which it may be very difficult or impossible to detect a bruit. Such a one may thus readily be mistaken for a simple blood-tumour, or even, if the integuments are inflamed, for an abscess. Careful search must be made for a bruit, supplemented if necessary by an exploratory puncture before a diagnosis can be arrived at or any treatment adopted. The same precautions must be taken in cases of spontaneous aneurism where the sac has given way and pulsation is absent. In all cases the surgeon should, by rectal examination (and in the female per vaginam also), see if the aneurism is at all intra-pelvic. The condition of the pelvic bones, of the large vessels, and the effect of compression of the latter, may also in this way be ascertained. More details as to the *diagnosis* are given in the article GLUTEAL REGION. It is enough here to say that pulsating gluteal aneurism, especially when spontaneous, has to be diagnosed from pulsating sarcoma of the bone; a non-pulsating aneurism from simple hæmatoma, abscess, non-pulsating sarcoma, enlarged subgluteal bursa, or possibly sciatic hernia.

The *treatment* must depend on whether the aneurism has, or has not, a proper sac, whether it is entirely extra-pelvic, and whether the vessels are likely to be found healthy. In cases of 'diffused' extra-pelvic aneurism, especially when traumatic, the old operation of Antyllus should be performed. It will be found that the sac, such as it is, is much nearer the surface than would have been supposed. In such a case, under the care of the writer, all hæmorrhage, during the operation, was readily restrained by Davy's rectal lever. If this is not used, pressure must be made on the common iliac artery or aorta by some abdominal tourniquet.

In the other forms an endeavour to effect a cure by pressure, under ether, on the large abdominal vessels, either from the rectum or by means of a tourniquet, should be made. Such pressure may be supplemented, when the sac is entire and the circulation commanded, by the use of coagulating injections or galvano-puncture. Pressure from the rectum for any length of time must be made by the hand; Davy's lever could hardly be safely employed for such a purpose. If these means fail to effect a cure, and the aneurism is increasing in size, other measures must be taken. When the swelling is partly intra-pelvic, ligature of the internal iliac may be the only resource left, although this proceeding is both difficult, and dangerous from the likelihood that the vessel itself will be found diseased; when extra-pelvic the old

operation is the safer proceeding, or Anel's operation in rare cases may be practicable.

Wound of the gluteal artery is the result of stabs or punctured wounds of the buttock, and it may be uncertain whether it is the trunk, or one of the branches, from which the hæmorrhage proceeds. If this be free and evidently arterial, the surgeon must at once, by enlarging the wound, expose the artery, and tie or twist it on each side of the opening into it. During the operation the rectal lever may be employed; and if the exact source of the hæmorrhage is not to be seen, the pressure should be momentarily relaxed, so that the bleeding may disclose the situation of the wounded artery. If this is intra-pelvic, out of the surgeon's reach, and the hæmorrhage continues, the internal iliac artery must be tied. GEORGE ROBERTSON TURNER.

GLUTEAL REGION.—The skin of the nates, when it is affected with *molluscum fibrosum*, may be much enlarged, loose, and pendulous, from an overgrowth of the subcutaneous tissue: more circumscribed *fibrous* or *fibro-cellular tumours* are also met with. These have a slow painless growth, do not implicate the skin, and, when occurring in the subcutaneous tissue, are freely movable. They are uniform in consistence unless, as sometimes happens, they have undergone cystic degeneration. *Sebaceous tumours*, when small, round, tense, and partially adherent to the skin, are easy of diagnosis; but when larger, may be confounded with *fatty tumours*. Both increase in size slowly, and without pain; but lipomata are lobulated, and often give rise, when compressed, to a characteristic dimpling of the skin over them. They are sometimes congenital. Much more frequently congenital, however, are *nævi*, which, when subcutaneous, form bluish masses, becoming tense when the child cries. They may undergo cystic degeneration, and possibly, if there is no accurate history, be confounded with fatty or fibro-cellular growths.

Gummata may occur in syphilitic subjects, either in the subcutaneous tissue, or more deeply in the substance of the muscles. They form rounded masses, which either yield to treatment, or soften and break down, eventually discharging their contents and leaving an excavated honeycombed ulcer. *Simple* or *hydatid cysts* may also be met with in the muscular substance, giving rise, if the swelling is at all large, to fluctuation. Exploratory puncture will lead to a diagnosis, but this may not be necessary if the thrill peculiar to hydatids is present.

Wasting of the glutei, leading to *flattening of the buttock* and loss of its fold, may result from simple disuse, infantile paralysis, morbus coxæ, congenital dislocation of the hip, sacro-iliac disease, and suppuration of the subgluteal bursa. Wasting from simple disuse is frequently seen where the long splint has been used, or where the limb in some other way has been kept motionless for any length of time. Other muscles than the glutei participate in the wasting, and, if the condition of parts is such as to admit of it, exercise and massage will soon be followed by a return of the muscles to their normal size. In infantile paralysis the onset of the disease is sudden, other muscles are usually implicated, and passive motion of the hip-joint is free; whereas, if disease of this articulation is present, movement, especially abduction and rotation outwards, is painful. The pain is often referred to the knee as well as to the hip, the thigh is flexed, and the joint fixed by muscular action so that the pelvis, which is usually tilted, moves with the femur. In *congenital dislocation of the hip*, which may affect one or both sides, the patient limps and waddles, if old enough to walk. There may be wasting of the muscles, but passive motion of the hip is painless; the trochanter major projects above Nélaton's line; there is shortening of the limb, great prominence of the buttock, lordosis of the lumbar vertebræ, and, if unaltered in shape, the head of the bone may be felt on the dorsum ilii.

Abscess of the buttock may be simple, or due to hip, sacro-iliac, pelvic, or vertebral disease. It may depend on suppuration of the subgluteal bursa, and in rare instances a parametritic abscess may show itself in the neighbourhood of the sacro-iliac joint. An abscess coming from a distance may pass through the sacro-sciatic foramen and present in the buttock. Such a one will be partly reducible, and perhaps have impulse on coughing. When due to *sacro-iliac disease* the formation of abscess has been preceded by muscular wasting, puffiness over the dorsal aspect of the joint, pain whenever the weight of the body is brought to bear on the pelvis or on pressing its walls together transversely; and although there may be lengthening of the lower limb on the affected side from tilting of the pelvis, measurement between the anterior superior spine of the ilium and the malleolus is normal. When due to *hip-disease* its formation has been preceded by the early

symptoms of that disease, and examination under ether will very likely disclose erosion of the cartilages and disorganisation of the joint; when due to *vertebral disease* there will be, even if there is no angular curvature, rigidity and pain on percussing the spines of the affected region. The abscess may have passed out of the sacro-sciatic foramen, or be due to caries of the last lumbar or sacral vertebræ. Abscesses *dependent on diseased bone* as a rule do not attain so large a size as when a joint is affected, and, until they burst or are opened, their origin cannot with certainty be determined.

Suppuration of the subgluteal bursa seems to follow blows on the great trochanter, and may in some cases closely simulate morbus coxæ. There may be the same flexion of the thigh, fixation of the pelvis, wasting of the buttock, and immobility of the joint; but under ether the muscular rigidity will subside, and the hip can be moved freely; there is no shortening, no pain in the knee, and the patient can bear pressure, either direct or indirect, on the joint. If the abscess is opened and the finger introduced, the disease will be found to pass beneath the gluteal aponeurosis over the great trochanter. In such abscesses the swelling extends over the upper third and outer part of the thigh, and consequently is on a lower level than that of a gluteal aneurism.

Simple *enlargement of the subgluteal bursa* may appear rapidly without constitutional disturbance, and subside with rest and blistering. If there is any doubt of the diagnosis exploratory puncture may be necessary. A blood-cyst or *hæmatoma* presents as a fluctuating swelling, rapidly following an injury, and may attain a large size in this region. The skin over it is often bruised and discoloured; it may be distinguished from abscess by its more rapid onset and—at least at first—by the absence of inflammation. In doubtful cases exploratory puncture may be necessary. A simple hæmatoma may be confounded with a non-pulsating aneurism, but it has no bruit, is less tense, and has less tendency to increase in size, usually becoming smaller from absorption of the effused blood. Blood-cysts have been known to pass through the sacro-sciatic foramen and present in the buttock.

Gluteal aneurism, when sacculated, presents as a swelling, usually about the size of a hen's egg, at the upper part of the sacro-sciatic foramen, and is accompanied by pulsation, bruit, and, it may be, thrill, together with pain in the buttock and along the course of the sciatic nerve, and often flexion of the limb. Such a swelling can only be confounded with a pulsating tumour of bone; but if the sac has in part given way, or the aneurism has from the first been without a proper sac, without pulsation, but fluctuating and with inflamed integuments, it may readily be mistaken for abscess, but may be distinguished from it by the existence of a bruit. This should be carefully sought for, on more than one occasion, with the patient in different positions. If it be not detected an exploratory puncture should be made before the supposed abscess is incised. *Malignant tumours of bone* have a rapid growth, and are soon accompanied by loss of flesh. They often pulsate, and, even when non-pulsating, they may be mistaken for gluteal aneurism. They are sarcomatous, and may be traversed by bony spicula, or may have an imperfect osseous envelope, and soon, even if they have commenced on the outer, involve the inner or pelvic aspect of the bone. This fact may be elicited under ether by careful examination of the iliac region, and rectal examination of the interior of the pelvis. A gluteal aneurism could hardly erode the bone to such an extent as to present in the iliac fossa. The pulsation of tumour of bone is unaccompanied by the lateral expansion of an aneurism, and the bruit, if present at all, is not so constant, distinct, or harsh, but rather of a soft cooing character. Pressure on the common iliac artery by Davy's lever, so as to command the circulation during the examination of the tumour, might possibly assist in its diagnosis; but the depth and smallness of the gluteal vessel is such as often to make it difficult for the surgeon to decide whether he is dealing with an aneurism or tumour of bone.

Sciatic hernia is most rare, and might possibly be mistaken for aneurism or abscess passing through the sacro-sciatic foramen. It would have impulse on coughing, and, if reducible, re-enters the pelvis with a characteristic gurgle. Even if irreducible, it is still devoid of bruit or pulsation, and probably is in part resonant on percussion. Cases are on record where the swelling disappeared on the patient lying down, to reappear when the erect position was assumed. In one case, where the tumour was large, it had passed down and bulged as a prominent swelling, as big as a fœtal head at full period, at the lower border of the gluteal fold over the upper and inner part of the opposite thigh. On reducing a

portion of the contents of the sac the edge of an indurated opening overlying the sacro-sciatic foramen could be felt.

Innocent tumours of the ilium are usually *enchondromatous*. They can be recognised by their slow growth, hardness, elasticity, broad base, fixed position, and evident connection with the bone. They are often nodulated, and perhaps can be felt in the iliac fossa as well as on the dorsum ilii. The diagnosis between them and *fibrous* tumours springing from the bone must be very difficult, if not impossible. An *exostosis* is hard, incompressible, usually sessile, grows slowly and regularly, attaining only moderate dimensions.

A specimen of *hydatid cysts* expanding the walls of the ilium is to be seen in the museum of St. Bartholomew's Hospital.

GEORGE ROBERTSON TURNER.

GLYCOSURIA. *See* BACK AND SPINE, Injuries of the.

GOÎTRE. *See* THYROID GLAND.

GONORRHŒA.—Gonorrhœa in the *male* is a specific and contagious form of urethritis, producing in its most advanced stage an abundant purulent or muco-purulent discharge. Whether gonorrhœal inflammation ever attacks the mucous membrane of the nose, mouth, external ear, or anus, still remains very doubtful.

In a very large majority of cases gonorrhœa is caused by contagion, and the direct application of gonorrhœal discharge to the male urethra during intercourse with a woman similarly affected. There can be no doubt, however, that urethritis closely resembling gonorrhœa, though perhaps not so acute nor so prolonged, may result from the contact of other morbid discharges from the vulva, and also from excessive irritation of the urethra, through much sexual intercourse, free drinking, violent and continuous catheterism, &c.

Symptoms.—The earliest symptoms of gonorrhœa are usually noticed in the course of the fourth day after exposure: sometimes, though very rarely, they occur as early as the second or as late as the seventh day. The patient complains at first of uneasiness about the meatus, and of slight smarting along the urethra during micturition. At this stage there is often a scanty discharge of clear mucous fluid from the end of the urethra. These symptoms become more marked in the course of the next two days, and are gradually developed into the distinctive signs of intense urethritis. The lips of the meatus are now very red and swollen, the prepuce has become slightly œdematous, and the glans penis is turgid and its surface congested and glossy. The discharge from the urethra is profuse and almost continuous, changing in colour as the inflammation increases, from white to yellow, and in very severe cases to pale green. The whole penis is hot and swollen, and its surface is slightly congested, and in some instances marked along the dorsum of the organ by red and inflamed lymph-vessels. Along the course of the hardened and very tender urethra one or more small swellings, caused by follicular inflammation or suppuration, may occasionally be felt.

The passage of urine over the inflamed mucous membrane of the urethra is attended with intense pain, and at the same time there is constant irritation at the neck of the bladder, and a frequent desire to micturate. At first the urethral tenderness is restricted to the region of the navicular fossa, and subsequently it passes gradually backwards towards the bladder until the whole length of the canal becomes very sensitive. The patient often complains of pain across the lumbar region, and a sensation of heaviness in the pelvis; the perineum becomes very sensitive, and the scrotum and testes may also share in this diffused irritable condition. The inguinal glands are usually swollen and painful, but very rarely suppurate. In this acute stage much suffering is caused by frequent erections, especially when the patient is warm in bed. In consequence of the distension being partial, the penis is bent so as to form an arch with its concavity downwards, and thus presents the very painful condition known as chordee. The acute stage usually lasts until the end of the second week. It is, as a rule, more severe in the first than in any repeated attacks of gonorrhœa. The more intense the inflammation in any attack, the less prolonged is the duration of the acute and painful symptoms of the affection.

In the next stage—that of decline—the urethral tenderness and the pain during micturition gradually diminish, together with all the objective signs of acute inflammation. At the same time the discharge becomes much less profuse and loses its purulent character. The duration of this stage varies much in different cases. In the most favourable attacks the improvement is steadily progressive, and the patient is quite well at about the end of the sixth week. More frequently, however, a clear mucous discharge, together with slight

tenderness along the urethra, and frequency of micturition, persists for several weeks or even months. During this period of persistent irritation the patient is very liable to relapse, particularly after imprudence in diet or conduct, or carelessness in keeping up the treatment.

An attack of gonorrhœa is often followed by a condition, more or less prolonged, of imperfect recovery, in which there is a scanty and occasional discharge of pale glairy fluid. This condition, which is seldom marked by any other local symptoms, is known as that of gleet. In some few instances a thick, yellow, and purulent discharge persists for a long time after the disappearance of all other symptoms of gonorrhœa. This Fournier distinguishes from gleet by giving it the name of chronic gonorrhœa.

The form and symptoms of the gonorrhœal attack vary infinitely in different cases. Occasionally the discharge remains as a viscid, clear fluid, and does not become purulent. The inflammation sometimes involves but a small extent of the urethra, and the symptoms do not become severe. In some cases there is profuse discharge and very little pain, and in others much suffering with little, if any, discharge. Some patients recover rapidly from a sharp attack of gonorrhœa, whilst others, notwithstanding care and perseverance in applying treatment, remain subject to a chronic discharge and frequent acute relapses during many months.

There is very little febrile disturbance, as a rule, in gonorrhœa, except the attack be very acute and the patient very feeble, or in cases of serious complication. The painful symptoms of the acute stage cause mental depression and irritability, and the patient suffers from loss of sleep. In cases of profuse and prolonged discharge of pus from the urethra, the patient often becomes slightly anæmic.

As indicated by the sensations of the subject of acute gonorrhœa, the inflammation commences near the external orifice of the urethra, and then spreads backwards towards the bladder, affecting, in its course, the whole extent of the mucous membrane of the straight portion of the penis, but being more intense probably in the region of the navicular fossa. On or about the eighth day, when it may be possible to make an endoscopic examination, the inflammation, according to Desormeaux, has involved the anterior half of the canal, the mucous membrane of which is then red and roughened, and presents superficial ulcerations resembling those formed on the glans penis in balanitis. As the gonorrhœa progresses, the lesion does not change its character but spreads towards the posterior segment of the urethra, involving in succession the bulbous, membranous, and prostatic portions of the canal. Subsequently, as the more severe symptoms of gonorrhœa subside, either the mucous membrane along the whole course of the urethra regains its normal pale colour, or, whilst the anterior and penile portion of the canal and the prostatic portion become quite healthy, the inflammation may persist for some time in the mucous membrane of the membranous and bulbous regions, and there give rise to the granular formations which, in the opinion of Desormeaux and Cruise, constitute the characteristic lesion of gleet.

Complications.—The following are some of the most frequently observed complications of gonorrhœa: phimosis and paraphimosis, due to œdema or serous infiltration, in the one instance of an elongated, in the other of a short prepuce; retention of urine, which, however, is rare except in subjects of organic stricture; follicular suppuration at one or more points of the urethral mucous membrane; circumscribed phlegmon and suppuration of the erectile tissue of the penis; inflammation of the lymph-vessels of the penis, and of the inguinal glands; perineal abscess; inflammation of Cowper's glands; sub-acute inflammation of the glandular tissue of the prostate; congestion or inflammation of the neck of the bladder; epididymitis. The last-mentioned complication presents a transition form between the above group and that of the more remote affections, such as gonorrhœal rheumatism, purulent conjunctivitis, and the so-called metastatic ophthalmia.

Hæmorrhage from the urethra is an occasional complication of gonorrhœa. In the acute stage of a gonorrhœal attack, blood is almost always effused in small quantities, and causes the green staining so often noticed in the purulent discharge. In instances of the rare form of *menstruiform gonorrhœa* described by Ricord, and of extreme congestion of the prostate and neck of the bladder, blood is mixed more freely with the discharge, so as to give it a decided pink or red colour. True urethral hæmorrhage, consisting in a flow of unmixed bright red blood, usually takes place in small quantities, but in some cases is so abundant and persistent as to create anxiety. The cause of this bleeding from the urethra is generally some laceration of the wall of

the canal, or rupture of one or more vessels, during severe and sudden chordee. It readily yields, in most instances, to the application of cold cloths to the penis and pressure on the perineum. If very profuse, it may be found necessary to pass a large metal sound along the urethra.

For descriptions of the sequelæ of gonorrhœa, of which gleet, urethral stricture, and chronic cystitis, are the most important, and also of many of the above-mentioned complications, the reader is referred to special articles.

Treatment.— But very little need be said here of the substitutive, or so-called abortive, treatment of gonorrhœa, in which an attempt is made to cut short the attack in its first stage, by setting up, in place of the specific gonorrhœal inflammation, a simple form of inflammatory action readily amenable to ordinary therapeutic means. With this object in view, some surgeons have applied strong solutions of irritants or of astringents to the urethral mucous membrane, and others have administered internally large and frequently repeated doses of balsamic remedies, such as copaiba and cubebs. The free use of balsams is not only useless as a preventive means, but is likely, as has been pointed out by Mr. Henry Lee, to cause much constitutional disturbance; and the local application of nitrate of silver, in strong solution, as recommended by Debeney, Diday and Carmichael, is very liable to result in serious and enduring mischief, and to prove worse than the disease. In the very rare instances in which gonorrhœa is met with while still in the first stage, much good may be done by associating with rest, and a general lowering treatment, frequent irrigation of the urethra with a warm and very weak solution of boracic acid, or of sulphurous acid (℥xv. to f℥j.), or of bichloride of mercury (gr. j. to f℥j.), or one injection daily of a weak solution of diacetate of lead (gr. ij. to f℥j.).

The treatment of gonorrhœa in its acute stage is, in most cases, rendered very difficult simply through the inability of the patient to remain at rest for a sufficient time, or from his disregard of instructions as to diet and general conduct. During this stage, he should, if it be possible, maintain almost constantly the recumbent posture, resting on a hard mattress at night, and on a couch during most of the day. The diet should be low, and consist almost exclusively of milk, eggs, and dry toast. Malt liquors, wine and spirits, and even tea and coffee, must be scrupulously avoided, and the patient should take, when thirsty, barley-water, or some effervescing alkaline drink, as soda, seltzer, or Apollinaris water. The bowels should be promptly relieved by some very active cathartic, and be kept open by a daily morning draught of Epsom salts, or of Pullna or Friedrichshalle water. In the course of the day some alkali should be frequently administered, with the object of reducing the acidity of the urine, and of relieving irritation of the urinary organs. The most effectual of alkaline remedies, during the acute and inflammatory stage of gonorrhœa, are the salts of potash; either the acetate or nitrate, in eight-grain doses, or the citrate in half-drachm doses, may be given with much benefit, every three or four hours, in association with half a drachm of spirits of nitre, and fifteen minims of laudanum or a drachm of tincture of henbane, in one ounce of water.

If the gonorrhœal inflammation be so intense as to cause febrile disturbance, a small draught of five minims of liquor potassæ and two minims of tincture of aconite to a teaspoonful of water, given every hour, will often do much good. If irritation of the genital organs and a constant tendency to erection be the most prominent symptoms of the acute stage, a draught containing fifteen or twenty grains of bromide of potassium, and five minims of liquor ammoniæ acetatis, should be administered every four hours. The patient, unless he be very feeble, should take a warm bath once or twice in the day. The best local treatment, during this stage, is the simple and very useful plan of applying very hot water to the penis.

For the treatment of chordee, many remedies, most of them of very uncertain action, have been recommended from time to time. The most promising is camphor, given at bed-time, in a large dose. Lupulin, bromide of potassium, ergot of rye, belladonna, and opium are each worthy of trial. A very efficacious remedy is a suppository containing a grain of opium and three grains of camphor. In a case of very painful chordee, the best treatment probably, if the patient be strong and vigorous, is for him to have a warm bath just before going to bed, and then, after having taken a drachm of tincture of camphor in an ounce of water, to rest, lying, as far as may be possible, on his side, and very lightly covered.

On the subsidence of the acute inflammatory symptoms, and when the pain, during micturition, has been much re-

lieved, it becomes necessary to vary the treatment. The diet may now be extended, but the patient must still be forbidden to take beer or wine. Continuous rest, also, is no longer necessary, though, of course, active exercise and much standing must be avoided. In this, as indeed in any stage of gonorrhœa, smoking is decidedly injurious, and, as has been insisted on by Dr. Bumstead, entire abstinence, or, at least, much moderation with regard to this habit, should be observed during the treatment.

In dealing with this stage of a gonorrhœal attack, the surgeon trusts mainly to the use, either combined or independent, of balsamic remedies and urethral injections. Of the former agents the best known are copaiba and cubebs. Copaiba is usually given in doses of from half a drachm to two drachms in the form of mixture or pill, or in capsules, and the average dose of cubebs is one drachm. Each of these remedies acts directly on the mucous membrane of the urethra, as it is excreted with the urine, after having undergone some change in the organism. The use of a balsamic remedy is indicated on cessation of pain during micturition, and when urethral tenderness and swelling and congestion of the glans penis have subsided. The selected remedy should be administered regularly, and four times at least in the twenty-four hours; and with respect to meals, one hour before or three hours after each. As a rule these remedies act tardily, and it is necessary, therefore, if no general disturbance is caused by their action, to persevere in their use for several weeks, combining with each, if there be any indications for such agents, tonics or sedatives. There can be no doubt that these remedies, if properly administered at the proper season, are very beneficial agents in the treatment of gonorrhœa; and that failure of a prolonged course of either is generally due to such causes as would neutralize the action of any other method. Copaiba, however, often causes much gastric disturbance and diarrhœa, and occasionally renal irritation: cubebs, it has been stated, may give rise to headache and nervous symptoms, and both remedies are extremely unpleasant to the taste and apt to cause nausea. The most valuable, probably, of the anti-gonorrhœal balsams is the oil of yellow sandal-wood. This is usually more rapid in its action than copaiba, far less unpleasant, and is not so liable to cause nausea or to affect the stomach.

It is very unadvisable to administer any balsam before the acute inflammatory symptoms have commenced to subside, and the remedy should be promptly withheld in case of any relapse during the period of decline. Whether speedy or slow in producing good results, the remedy, if tolerated by the system, should be given for at least a fortnight after the cessation of the urethral discharge. During a balsamic treatment, the patient should avoid taking fluid in abundance, lest the balsam, as it is discharged in the urine, be too much diluted. The agent that is selected, be it oil of sandal-wood, or copaiba or cubebs, if it does not cause any gastric or other disturbance, should be given a fair trial, and it will be found better to give each remedy singly than in combination with either of the others.

The following agents have been given in the third stage of gonorrhœa with such success as to justify a trial of any one in case of failure or contra-indication of the above-mentioned balsamic remedies: turpentine (℥ x.), Canada balsam (gr. v. in pill), infusion of uva ursi (f℥j.), tincture of perchloride of iron (℥x. to xx.), citrate of iron and quinine (gr. v.).

Astringent injections, when used with much precaution, are certainly beneficial in the passive stage of gonorrhœa when all inflammatory symptoms have disappeared. As, however, in the majority of instances, they are liable to be administered irregularly and without proper care, and may excite epididymitis, renewed urethritis and peri-urethral abscess, it will be found advisable, as a general rule, not to have recourse to this method of treatment unless balsamic remedies, after full trial, have failed or proved prejudicial. As some of the most useful of the many agents that have been used in injections may be mentioned: nitrate of silver (gr. ij. to f℥viij.), sulphate of zinc (gr. j. to f℥j.), chloride of zinc (gr. j. to f℥j.), sulpho-carbolate of zinc (gr. ij. to f℥j.). A very useful injection is that known as Ricord's combination of sulphate of zinc and actetate of lead (gr. v. of each to f℥j. of water).

The urethra having been injected with warm water, and the purulent discharge washed away, about half an ounce of the astringent injection should be slowly introduced, and be retained in contact with the urethral mucous membrane for about five minutes. Two, or, at the most, three injections should be given in the twenty-four hours. During a course of treatment by injection, the patient should take care to avoid irritating the genital organs by active exercise, imprudence in diet, or sexual ex-

citement. If blood appear in the discharge, or micturition become frequent and painful, the use of injections should at once be discontinued.

An antiseptic treatment, based on the assumption of a parasitic origin of gonorrhœa, has been strongly advocated by Mr. Watson Cheyne, who recommends the use of soluble bougies containing eucalyptus and iodoform, with a view of arresting, or at least checking, the acute inflammatory symptoms. W. Johnson Smith.

GONORRHŒAL EPIDIDYMITIS.
See Testis, Diseases of the.

GONORRHŒAL OPHTHALMIA.
See Conjunctiva, Diseases of the.

GONORRHŒAL RHEUMATISM is an inflammation of the joints or fibrous structures, dependent upon discharges from the genito-urinary organs. The most frequent cause is gonorrhœa, which may be in the acute or chronic stage. The disease may also be set up by any form of urethritis, or even by a balanitis, and in women a closely allied condition is apt to accompany obstinate leucorrhœa. In infants, as Mr. Lucas has recently shown, ophthalmia neonatorum may give rise to a similar affection. There are three well-marked varieties of this disease—viz. (1) an acute, (2) a chronic inflammation of the joints, and (3) an inflammation attacking non-articular fibrous tissues.

Symptoms and cause.—1. The *acute articular* form begins with slight feverishness and pains in several joints, which are somewhat swollen and tender. In a few days the inflammation appears to concentrate itself upon one of these joints, while the others recover. The swelling and tenderness increase; the tissues covering the joint and the adjacent parts of the limb become œdematous, and the skin is often reddened. There is acute pain, which is much increased by any attempt to move the limb. The tenderness is especially noticeable when pressure is made upon the stronger ligaments of the joint. Thus, when the elbow is attacked, the parts below the condyles of the humerus are excessively sensitive on account of the inflammation in the lateral ligaments. There is usually some serous effusion into the synovial cavity. The joints affected are almost invariably the larger ones, and especially the elbow and wrist. The patients are usually young adults, and the writer has seen more instances of the affection in women than in men. The discharge from the genital organs may be slight, or even a mere gleet. It does not appear to be diminished or otherwise affected by the outbreak of the joint-inflammation. The temperature is usually but little raised, and there is not much constitutional disturbance. The patient, however, is often anæmic and feeble, and the local pain, by interfering with his appetite and sleep, is apt to increase this debility. In the great majority of cases the disease gradually subsides, and leaves the joints in a more or less rigid condition. In rare instances the joint may suppurate and become disorganised. Occasionally other joints are successively attacked. The disease may recur with a subsequent gonorrhœa.

2. A *chronic articular* form of the disease is perhaps not more frequent, but it is certainly more often recognised. It appears as a sub-acute inflammation of the synovial membrane, which attacks especially the knee and ankle-joints of men. There is serous effusion into the synovial capsules, without any redness of the skin or superficial œdema. The pain is of a dull aching character, and does not prevent the patient getting about, in a more or less crippled condition. Two or more joints are often simultaneously affected. The disease is very obstinate, and it is liable to frequent exacerbations. It never suppurates.

3. A chronic or, in rare cases, an acute inflammation may attack the *non-articular* fibrous tissues, such as the fasciæ of the muscles, the annular ligaments, the sheaths of nerves, &c. It is attended by some swelling and tenderness, with severe pain in the affected structures, which are sometimes so softened as to allow of considerable yielding. Thus when the plantar fascia is attacked, the arch of the instep may fall in, and a flat foot may be produced. The sclerotic coat of the eye may be the seat of such an inflammation, indicated by a peculiar congestion which may accompany the acute or chronic form of joint-disease. Occasionally also the fibrous tissues of the heart are attacked, and valvular lesions have followed this complication.

Pathology.—The disease is probably of a pyæmic character, depending upon the absorption of inflammatory products from the genito-urinary tracts. Some writers, however, have attributed it to innervation, and have considered that the inflammation is set up by reflex action of the nerve-centres under the stimulus of the local irritation. In the acute form of joint-disease the fibrous tissues are especially affected, and they are frequently so much

softened as to permit of abnormal movements. There is often fibrinous exudation within the articular cavities, and the cartilage may be eroded, so that a rough or even grating sensation may be felt upon moving the joint. Adhesions are also formed in the peri-articular regions, and in the sheaths of the adjacent tendons.

The more chronic form appears to affect the synovial membrane, without any serious implication of the other structures of the joints.

Diagnosis. — The chronic forms are easily recognised. They resemble gouty or rheumatic synovitis, but the presence of the urethral discharge suffices for their discrimination. The acute form is at first very like a mild attack of rheumatic fever. Afterwards, when one joint is alone affected, it may assume an appearance similar to that of phlegmonous erysipelas, phlebitis, or acute suppuration of the joint. The discharge from the genital organs may be slight, and there is usually a disposition to conceal its presence. From overlooking this symptom serious mistakes have often been made. Frequently the red and swollen tissues have been incised under the idea that pus has formed. It is therefore wise in all cases of acute idiopathic inflammation of a single joint to examine into the condition of the genito-urinary organs.

Treatment.—By the use of astringent and soothing injections the urethral or vaginal discharge should be cured. In the acute form the joint should be kept at perfect rest, with gentle pressure and some anodyne application. Lint spread with a mixture of equal parts of ung. hydr. comp. and extract of belladonna should be wrapped round the joint, and a plaster of Paris bandage applied over all. As ankylosis may occur, the joint should be placed in the most useful position. As soon as the acute symptoms have subsided passive motion should be employed, and the still swollen joint should be supported by an india-rubber bandage applied over the greater part of the limb; or the limb should be swathed with five or six layers of cotton-wool, and then firmly compressed by a starch bandage. In the more chronic form this latter treatment is also beneficial, as it permits the patient to move about freely and to follow his ordinary occupation. Blisters or stimulating liniments may often be required for the cure of this obstinate form of the complaint. When the pain is severe the local application of some anodyne, such as the extract of belladonna, may be necessary.

Attention should be paid to the general health. A nutritious diet should be given, and the bowels should be relieved by gentle purgatives. But little benefit is obtained from the use of alkalies, iodide of potassium, salicylate of soda, or the other remedies for rheumatism. Some tonic preparation, such as a combination of quinine and iron with mineral acid, is usually more beneficial.

N. Davies-Colley.

GOOCH'S SPLINT consists of flat boards, about one-eighth of an inch thick, glued on to oilcloth or leather, and split into parallel strips about one-third of an inch wide by longitudinal incisions, which do not completely divide them. It is flexible in one direction and quite rigid in the other. It is a very useful material to have at hand for extemporising splints from, as it can be readily cut to the required shape and size with a knife. Its transverse flexibility renders it most comfortable to the patient, whilst its longitudinal rigidity fulfils the needs of the surgeon. It is the best material for stump-splints and short thigh-splints for fractures of the femur treated by simple extension; but it may be used, and is by the Scotch surgeons, for almost all regions.

Bilton Pollard.

GORDON'S SPLINT FOR COLLES' FRACTURE consists of an anterior splint, to the radial side of which is fixed a wooden pad shaped so as to fit the concavity at the lower end of the radius. From the lower end of the splint there is a prolongation adapted to receive the ulnar border of the hand in the adducted position. There is also a slightly hollowed dorsal splint, which is placed over the back of the forearm and dorsum of the hand.

Bilton Pollard.

GORDON'S SPLINT FOR FRACTURED CLAVICLE consists of a body-plate and an artificial clavicle or rod passing from it to a front arm-splint; to the anterior border of the latter a second arm-splint is attached. The splints are fixed in position by a complicated system of straps. The objects of the splints are to rotate the shoulder outwards and backwards, and maintain it in that position until union of the fracture has taken place. No attempt at elevation of the shoulder is made, as the author of the splint considers that the shoulder is not really depressed, and that pushing the shoulder upwards, backwards, and outwards would increase the deformity.

Bilton Pollard.

GORGET. *See* Lithotomy.

GRAFTING.—Skin-grafting.—Many large granulating surfaces, though at first healing with considerable rapidity, afterwards do so slowly, and the process may even come to a standstill owing to the resistance of the surrounding tissues to the further contraction of the granulations, and also probably on account of the attenuated condition of the epithelial cells at the border of the sore. In such cases in time past, flaps, including the entire thickness of the skin, were occasionally taken from another part of the body, and placed on the granulating surface; but this process, besides being painful, and leaving a large sore at the spot from which the flap was removed, was in so many instances attended with failure, that it was seldom resorted to. M. Reverdin of Geneva introduced the present method of skin-grafting. In 1869 he succeeded in transplanting small portions of skin from one part of a man's body to a granulating surface situated at another, and thereby greatly hastened the healing of the sore. This method has been widely adopted, and is now regularly employed to facilitate the healing of large granulating surfaces, such as may have been left by ulcerative processes, occasioned by large burns or by wounds involving an extensive destruction of the cutis. It is also of considerable value in obviating deformities, such as ectropion arising from contractions due to cicatrisation.

A granulating surface is covered with epithelium by segmentation or budding of the epithelial cells at the margin of the sore. These cells cannot arise from granulation-tissue, but must have origin in some pre-existing epithelium. If then minute portions of skin be transplanted on the granulation-tissue, the proliferation of the cells of these grafts leads to the formation of cuticular islands, which go on increasing until they coalesce with one another, or with the epithelium from the margin of the sore. By doing so the healing is greatly facilitated, and the process of repair is rendered much more complete and permanent.

The transplanted graft ought to consist of some of the protoplasmic cells of the rete. The Malpighian layer is supposed to be necessary, but any of the cells of the stratum granulosum, and even the deeper cells of the stratum lucidum, the writer considers quite sufficient for the purpose. The stratum cornium is of no value; neither does it serve any purpose, if indeed it does not hinder the process, to include the subcutaneous tissue. Practically, all that is necessary is to remove a minute superficial portion of the skin. This may be done in a variety of ways. The dissecting-forceps may be made to pinch up, or a needle to transfix, a small portion of the skin, which may be snipped with scissors or removed with a scalpel. A special instrument, a combination of scissors and forceps, is made by Krohne after Macleod's pattern, for effecting the removal of such portions of skin. The writer finds that a pair of sharp scissors curved on the flat is well adapted for raising a thin shaving of the cutis. The surface from which the skin is removed presents a reddened appearance, with at times a few minute points of blood. It may be covered for a few days with a small portion of protective oiled silk or other simple dressing, or better still dusted with iodoform, which stops the bleeding and acts as a good dressing.

When the portion to be grafted has been elevated, it is divided into as many minute particles as practicable: pieces the size of an ordinary pin's head are suitable. This may be done by means of a sharp knife, the finger-nail being used as a table. These grafts may be placed at any part of a healing granulation-surface, and may grow there, forming islets of skin. But all parts of a granulating sore are not equally prepared for the reception of a cuticular covering. Thus, at the centre of a healing sore the granulations are prone to be larger and the secretion more profuse than towards the margin, where they are at the proper level of the skin, and where the secretion is reduced to a minimum. Therefore if the grafts are placed within three-quarters of an inch of the margin of the ulcer, they will find a tissue suitable for their reception. They may be placed about an inch apart from each other. Not only is this zone of tissue more suitable for the grafts, but by their presence here, they seem to exercise a beneficial influence on the cutis at the margin of the sore itself; as, shortly after the grafts have become adherent, the marginal epithelium seems to be stimulated to more vigorous growth than formerly. The grafting may be repeated as often as required.

The grafts ought to be placed in intimate contact with the granulation-tissue, and retained in position by some convenient dressing. Some surgeons recommend that a wound be made in the granulation-tissue, and that the grafts be inserted into it. This is not advisable, but care is required to

prevent the grafts from being displaced, which may happen in one of two ways: first, by friction from the outside, and, secondly, by being floated from the granulations in the discharge. The means taken to obviate the former often facilitate the latter. If the sore be large, and a single piece of guttapercha tissue, or other waterproof material, be laid over the grafts in contact with the granulation-tissue, the secretion from the whole surface accumulates under the dressing, and is apt to float the grafts before they have become sufficiently adherent. The writer finds that a piece of freely perforated oiled silk or protective plaster, laid on the grafts and covered with sublimated wood-wool, is admirably suited for the purpose. The silk protects the grafts from injury, and as it does not adhere, there is no tendency to displacement of the grafts, while the numerous apertures in the oiled silk permit the secretion to come into contact with the sublimated wood-wool, which, being an excellent absorbent, the wound is kept dry, the necessity for frequent dressing is dispensed with, and the healing is facilitated. A week afterwards the wound may be dressed.

The superficial layer of the grafts sometimes separates, and is seen floating in the secretion while the deeper layer has united to the tissues. If this be not borne in mind when the surface of the granulation-tissue is being examined in order to ascertain whether the grafts have taken, it might lead one to suppose that they had failed. This mistake is all the more probable on account of the fact that the young epithelial cells are so transparent that they are barely recognisable, the granulations being seen through them, and therefore at an early stage they might be easily overlooked. The newly transplanted skin assimilates itself so thoroughly to the tissues that it soon becomes sensitive, and the cicatrix formed by its aid resists disintegrating changes much better than when unaided cicatrisation has taken place over a large surface.

In dealing with ulcers it is essential that all molecular disintegration should have ceased at the part on which the graft is to be placed. Occasionally skin-grafts do succeed when planted on granulations which are not quite in a state of health, and when this is accomplished they speedily effect an improvement on the granulations surrounding them. Though this be admitted, there can be no doubt that skin-grafting is most easily effected, and most successful when performed on a healthy granulating surface. As the condition of the ulcer depends greatly on the state of the patient's constitutional condition, the general health ought to be closely looked to.

The parts of the body from which grafts ought to be taken are those least exposed to friction, and which are at the same time not covered by a thick cortical layer. It is best to take the graft from the body of the patient for whom it is required. By doing so, the fear of introducing deleterious or poisonous elements into the blood is avoided. A mother might prefer to have the graft removed from her own arm for the sore on her child. If the graft is to be removed from another person, sanction ought to be sought and distinctly received before doing so. Although the epithelium is being constantly renewed during the whole life of the individual, yet in old age its vitality is somewhat impaired, and it is not so suitable for grafting as that of a young person. In a hospital, skin may be taken from a newly amputated limb—the sooner after removal the better, though the epithelium has been known to have retained its vitality for an hour after amputation, and to have lived on being grafted.

Transplantation of conjunctiva has been frequently successful. The transplants have been taken from the conjunctiva in the lower animals, and applied to the eyeball in man. The epithelium from the mucous membrane of the lip has been likewise used for this purpose, it is said with success. The cornea has been in a few cases transplanted; on one occasion at least it has been temporarily successful, the part remaining transparent for a considerable period, and only becoming opaque afterwards from an inflammatory attack.

Muscle and nerve have been transplanted, but the data given are not sufficient to warrant any practical deductions therefrom.

Bone-grafting. — Under this heading some include several distinct processes, re-implantation of bone, osteoplasty, and bone-grafting. The first of these consists in the replacement in its original position of a portion of bone temporarily removed by operation or by accident; such as the reimplantation of a disc of bone elevated by trephining the skull. In osteo-plastic operations, a portion of bone is detached, so that its osseous continuity is either wholly or partially severed, while its attachment to the soft parts from which its vascular supply is derived still remains more or less complete. This is illustrated

when one endeavours to fill up a deficiency in a long bone by detaching and shifting a portion of bone from the shaft in the immediate vicinity of the gap, while a pedicle of periosteum, or of the soft tissues, is left adherent at one extremity of the detached portion of bone. Neither of the foregoing should be properly included under the heading of bone-grafting, that term being reserved for such operations as involve the introduction of a portion of bone into the tissues altogether removed from its original seat, or of transplantation of osseous tissue from one animal to another.

Though in times past many attempts have been made to graft bone, or some of its elements, they have not been attended with practical success until within recent years. In a paper published in the *Proceedings of the Royal Society* in May, 1881, entitled 'Observations concerning Transplantation of Bone,' the writer referred to a case which he had of successful and extensive bone-grafting. The grafts in this instance were obtained from six limbs of three children who had to be operated on for tibial anterior curvatures, and a wedge of bone was removed from each limb. The grafting was performed on three separate occasions, two wedges being transplanted at one time. These wedges were divided into minute fragments, irrespective of periosteal attachments, and were placed in a sulcus made between the humeral muscles of a boy who had lost his humeral diaphysis more than a year previously. By these numerous grafts the two epiphyses were united together by a firm shaft, and the use of his arm was fully restored.

It is stated that bone cannot be transplanted from one species to another, and though definite proof to the contrary is wanting on this point, the writer has reason to doubt the accuracy of the statement. The best osseous grafts are obtained from young growing bone. Human bone may be obtained in hospitals from limbs which have been removed on account of accident or disease. In cases of anterior curvature of the tibia, causing marked deformity, and which demand straightening, it is often necessary to remove a wedge therefrom, and such wedges may furnish the material for grafting. The preservation of the periosteum is not essential to the success of the graft; it is important to preserve it, however, owing to the fact that in young bone it protects the underlying osteoblasts, and forms vascular connections with the tissues into the midst of which it is transplanted. Many portions of bone, even of the deeper layers, and those occupying a position midway between the medulla and the cortical substance, grow well when transplanted. After removal of the bone, it ought to be divided into minute fragments about the size of a pea. In doing this the fragments ought not to be broken or crushed, but cleanly cut. If the bone about to be taken for the graft be thin and vascular, it may live and grow in its transplanted situation without having been so minutely subdivided. Discs removed from the skull, when they are young and vascular, have grown when reimplanted after operation.

When an osseous graft is about to be effected, the part into which the graft is to be placed ought to be first prepared. The extremity of the bone, to which the graft is to be attached, ought to be refreshed, and the aperture between the muscles made of sufficient size to receive the osseous fragments without over-distension. After all bleeding has ceased, the part is ready for the reception of the grafts. The portion of bone to be transplanted ought then to be struck out of its normal position with a sharp chisel, and cut into small pieces, immediately thereafter placed in the sulcus prepared for it, and the soft parts closed over it. The entire operation ought to be performed under strict antiseptic precautions. The limb ought then to be fixed and kept at absolute rest. If healing by first intention is obtained, the parts ought to be tolerably firm at the expiration of a month, though it is better to maintain complete rest for six weeks or two months from the date of operation. On this point, however, something will depend on the extent of the graft employed, a small one becoming firm sooner than an extensive one. If suppuration follows, some portion of bone will be thrown off, and if the inflammatory process be great the whole graft may be shed. One of the chief points in securing success is obtained when the wound heals without suppuration.

The grafting of periosteum and of the medulla of bone have both been experimentally successful in the lower animals; but the data derived from these observations are neither so clear as to warrant definite conclusions being formulated from them, nor sufficient to establish their practical utility. It is difficult to see in what way either of these elements would equal the efficiency of bone-grafts for practical purposes.

Sponge-grafting.—With a view of expediting the healing of deep wounds in

which there has been a loss of tissue, Dr. Hamilton of Edinburgh introduced the practice of what he called 'sponge-grafting.' The sponge to be used is previously prepared by steeping it in dilute nitro-muriatic acid, to dissolve the silicious and calcareous salts; and when this has been effectually accomplished, the sponge is washed in dilute ammonia or potash, to remove all excess of acid. It is then placed in a 5 per cent. solution of carbolic acid, to render it aseptic, and it is stored in the same until required. A thin section of sponge prepared in this way, Dr. Hamilton recommends to be placed over such granulation-surfaces as are below the level of the skin, with the view of affording a support for the blood-vessels of the granulation-tissue which would push their way into the interstices, and so fill up the cavity, the sponge eventually becoming absorbed. He further recommends that, when one piece of sponge has been covered by granulations, another may be applied on the surface until the granulation-tissue reaches the proper level. Dr. Hamilton relates cases in which he believes that this process hastened the healing of the sores, and a few cases have been reported by other surgeons, all of them tending to prove that the so-called 'sponge grafting' is a successful means of healing such sores. The writer has carefully experimented in this direction, and, however interesting as a physiological phenomenon the penetration of the decalcified sponge by granulation-tissue may be, his observations have not led him to believe that the sponge hastened the healing of the sore, while in some instances it distinctly retarded it.

WILLIAM MACEWEN.

GRANULAR OPHTHALMIA. *See* CONJUNCTIVA, Diseases of the.

GRAVES' DISEASE. See *Exophthalmic Goitre*, under THYROID GLAND.

GREENSTICK FRACTURE. *See* FRACTURES.

GROIN.—The groin is the site of many important injuries and diseases, forming as it does the junction of the abdomen, pelvis, and thigh; and being the seat of four forms of hernia—inguinal, femoral, obturator, and ventral—and of many varieties of abscess and tumour.

Stretching between the anterior superior spine of the ilum and the pubic spine is Poupart's ligament. Below this is a hollow, corresponding superficially to Scarpa's triangle in the dissected part. Beneath the ligament is the pubic bone; and between the two, passing from the abdomen to the thigh, are the psoas and iliacus muscles; the femoral artery and vein; the anterior crural, the crural branch of the genito-crural, and the external cutaneous nerves.

Deeper than the horizontal ramus of the pubic bone, and under the pectineus muscle, is the opening whence obturator hernia escapes from the pelvis. Above Poupart's ligament is the inguinal canal, with the internal ring half an inch above the middle of Poupart's ligament, and the external ring above and internal to the pubic 'spine.' The femoral ring is immediately below and external to this bony process. The inguinal canal is concerned in hernia, various forms of hydrocele, undescended testicle, misplaced ovary, varix and fatty tumour of the cord. The superficial fascia over the groin is disposed in two layers—the subcutaneous fatty, and the deeper membranous, the latter being firmly attached to Poupart's ligament.

An inch and a half below and external to the pubic spine is the saphenous opening. The crural sheath has three compartments: the outer, lodging the femoral artery; the middle one, the vein; and the innermost—called the crural canal—a pellet of fat and a lymphatic gland. Femoral hernia occupies the last-named space. Between the layers of the superficial fascia are some blood-vessels, and lymphatic glands and vessels. The lymphatic glands of the groin are arranged in two primary sets, superficial and deep. The former consist of a horizontal series along Poupart's ligament, and a vertical in Scarpa's triangle. The deep set lie in the crural sheath beside the vein. A bursa lies between the ilio-psoas muscle and the capsule of the hip-joint. It may communicate with the synovial membrane of the articulation.

In the diagnosis of diseases and injuries of the groin it is important to determine whether the lesion is entirely confined to the part, or is connected with some other region either by continuity of solid tissue, by lymphatic vessels, or by a wider channel, as in psoas abscess and hernia. Immediate localisation is a further aid in estimating the nature of a given case; thus, a swelling above Poupart's ligament is suggestive of an enlarged gland, an undescended testicle, funicular hydrocele, and thickening of the cord.

Isolated nodular elevations of the skin indicate enlargement of the subjacent lymphatic glands. Nodulation *en masse* points

to a conglomeration of swollen glands, or to a lobulated tumour.

Congestion of the skin shows that the circulation in it is impeded. If the redness is diffused, it may be concluded that the morbid process has involved the skin. Distension of the cutaneous veins proves that there is deep-seated obstruction from compression or plugging of blood-vessels.

Flexion of the thigh is common to all painful affections of the groin. *Fixed rigidity* in this position is generally due to hip-joint disease, or deep-seated suppuration from any other source; it shows that the soft parts have undergone atrophic shortening. *Transient flexion* is entirely owing to spastic contraction of the muscles. Taken alone it is of little use in diagnosis, as it may be caused by a variety of pathological states. It disappears under the influence of an anæsthetic.

A pulsating tumour in Scarpa's triangle is probably an aneurism, or a vascular malignant growth; possibly a solid or fluid swelling, with pulsation communicated from the femoral artery.

If the tumour, after being emptied by compression, refills suddenly with a thud, and the bruit, when present, is conducted for some distance along the main artery, and the pulsation is markedly expansile, it is an aneurism. But when an aneurism is largely filled with clot, especially if it has ruptured, and the swelling is thereby more diffuse, its density is greater, whilst the bruit and thrill may be abolished and the pulsation reduced to a minimum. Attention must then be directed to the previous history of the case. The pulsation of a malignant growth is constant and progressive. Dilatation of other arteries would afford a strong presumption in favour of aneurism.

Dilatation of the superficial veins, with pulsation, bruit, and thrill, are the signs of *arterio-venous aneurism.*

A swelling which has previously pulsated, and subsequently become red and painful, is probably an *aneurism with inflammation or suppuration about the sac.* It must not be mistaken for an abscess with communicated pulsation. To avoid this, the various sources of abscess-formation should be carefully explored.

A non-pulsating, reducible swelling, giving an impulse on coughing, is either hernia, abscess—psoas, e.g.—or varix. If it is resonant on percussion, elastic, and *suddenly* reducible under pressure, it is *hernia.* The exact nature of the rupture is told generally by the situation of the swelling, and especially by the position of its neck. Thus if the hernia be limited above by Poupart's ligament, it is either femoral or obturator; if bounded below by that structure it is inguinal or ventral. The elasticity and resonance on percussion differentiate an inguinal hernia confined to the canal, from an enlarged gland or swollen undescended testicle; whilst resonance on percussion and sudden reduction by pressure distinguish it from encysted hydrocele of the cord. If the neck of the hernia lies immediately above and internal to the pubic spine, the rupture is inguinal. The neck of a femoral hernia is situated just outside and below the pubic spine. It is very important to note this fact, because it is not uncommon for a femoral hernia, after it has escaped from the saphenous opening, to turn upwards over Poupart's ligament and so simulate an inguinal rupture. In such cases the swelling passes outwards as a rule, but it may travel inwards and completely overlap the external abdominal ring.

Roundness of contour is suggestive of a femoral hernia, whilst an oval outline is presumptive evidence of a bubonocele.

A small, hard, tender, and painful swelling, at the site of the crural canal, is either an *inflamed lymphatic gland* or *a femoral hernia.* Palpation alone may fail to distinguish them. The signs of incarceration or strangulation—pain in the belly, vomiting, and obstruction of the bowels—when present suffice for the diagnosis, but they may be imperfectly developed and thus equivocal. Then, in the absence of enlargement of contiguous glands, the part must be cut down upon and recourse had to direct inspection.

A lobulated painless swelling, devoid of impulse on coughing, and possessed of considerable solidity, is probably *a fatty tumour.* A femoral epiplocele is usually painful on manipulation.

A slight fulness in Scarpa's triangle, accompanied by pain referred to some part of the obturator nerve, and by the symptoms of obstruction of the bowels, points to *obturator hernia.* The absence of swelling does not negative the diagnosis, for, in the majority of recorded cases, the existence of a tumour was not ascertained during life. A careful comparison of both limbs should be made, and the pelvis examined per rectum or per vaginam, and, if necessary, the obturator foramen must be explored—by incision through the thigh, or by opening the abdominal cavity.

A resonant swelling, which expands and becomes more tense on coughing, situated

above Poupart's ligament, but not occupying the inguinal canal, is a *ventral hernia*. The history of the bursting of a pelvic abscess, or of ligature of the external iliac artery, the presence of a cicatrix, and the condition of the femoral artery, afford corroborative evidence.

A soft swelling at the upper and inner part of the thigh—one which diminishes in size or disappears without gurgle or slip on elevation of the limb, and on the application of slight pressure—which returns of itself when the limb is pendent, even though compression be maintained over the crural ring and psoas tendon, is *varix of the saphenous vein*. The tributary branches are usually much dilated.

As regards the degree of impulse on coughing, it may be said that it is most forcible in hernia and least in varix. It varies in different cases of reducible abscess, according to the consistence of the pus and the width of the neck beneath Poupart's ligament. In some it is quite manifest, in others it is difficult to obtain.

The tumour is *solid, non-pulsating, and irreducible*. It probably consists of (1) enlarged lymphatic glands, (2) some form of new-growth, or (3) an undescended testicle.

If the swelling is multiple, and situated along Poupart's ligament, or in the course of the femoral vessels, it is *glandular* in nature. Then, if no lesion exists in the associated lymphatic vessels, the enlargement is almost certainly owing to some constitutional state — syphilis (excluding local infection), scrofula, or Hodgkin's disease.

The history of past infection, and the existence of other signs of syphilis, afford the required corroborative evidence on this head. The youth of the patient, and the past or simultaneous affection of other tissues, such as caries of bone, joint-disease, &c., point to *scrofulosis*.

If the tumour is of considerable size, and other groups of glands—axillary, cervical, &c.—are affected, it is a *lymphadenoma*. Excess of leucocytes in the blood and increase of the splenic dulness confirm the diagnosis. Suppuration and peri-adenoid induration are most marked in scrofula, least in lymphadenoma. Strain is not an infrequent cause of swelling of the inguinal glands.

If irritation of the peripheral lymphatics is discoverable, the glandular swelling is termed a *bubo*. This is said to be *sympathetic* when it is consecutive to acute inflammation, as from a chancre or a heel-gall, is accompanied by pain and tenderness, and shows a tendency to suppurate. Hard, painless, freely-movable glands constitute *indolent bubo*; and, from their prevailing size and shape, they are termed *amygdaloid*. The glands are welded into a confused mass from perilymphatic exudation. They are breaking down at several points, and the subject is of strumous habit. This is *scrofulous bubo*.

Cancerous disease—e.g. epithelioma of the penis or scrotum—is propagated, sooner or later, to the glands next in order; it also gives rise—notably when ulceration has commenced—to simple irritative enlargement. The differential diagnosis of the two conditions in the early stage is difficult. If removal of the primary growth is followed by marked subsidence of the sympathetic swelling it may be concluded that the latter is benign; if, on the other hand, the glands are very hard, massive, and a portion of it ulcerated, *the bubo is malignant*.

The *non-glandular solid tumours* of the groin include lipoma, osteoma, enchondroma, carcinoma of the skin, and malignant connective-tissue tumours, either purely sarcomatous or composite—e.g. myxo-sarcoma, osteo-sarcoma, &c. The special features of each are given fully elsewhere. If the tumour is freely movable, of doughy consistence, and lobulated, it is a *lipoma*; and the diagnosis is all the more certain if it is found that the growth has travelled from its original position. Or, the tumour is very hard, perhaps distinctly lobulated; it is fixed to the epiphysis of the femur or to the pelvis, either at the symphysis or sacro-iliac synchondrosis. It is an *enchondroma*, or, less probably, an *osteoma*.

Enlargement and rigidity of a muscle or tendon, especially near its attachment, is probably owing to ossification from strain. The adductor longus is peculiarly prone to this change. *See* Rider's Bone.

There is a swelling at the site of the inguinal canal; it gives the 'testicular sensation' on pressure, and the testicle is absent from the scrotum. It is a case of *undescended testicle*. Its solidity and want of translucency distinguish it from *encysted hydrocele*. The absence of impulse on coughing, and of resonance on percussion, prevent its being mistaken for *bubonocele*. Partial descent of the testicle predisposes to hernia; it is important, therefore, to bear in mind the possible association of the two.

A swelling in the groin which is marked by enlargement and accession of pain at the menstrual period, is very likely to be due to an *ovary* occupying the inguinal canal.

Several fluid tumours remain for consideration, viz.:—I. Cysts. (*a*) Enlarged bursa; (*β*) sebaceous tumour; (*γ*) encysted hydrocele of the cord; (*δ*) hygroma; (*ε*) hydatid cyst. II. Diffuse hydrocele of the cord. III. Effusion into the hip-joint. IV. Abscess.

If the tumour is situated over the hip-joint, and it is rendered more painful by abduction and extension of the limb, but not by percussion of the heel or great trochanter, it is probably caused by effusion into the *bursa* between the capsule of the hip-joint and the psoas tendon, and not by distension of the articular capsule.

A *sebaceous tumour* simulates chronic abscess and lipoma. To differentiate them, it must be ascertained if the swelling is lobulated, and the signs of local inflammation and the causes of glandular abscess must be looked for. In case of doubt a trocar and canula should be used.

A small tense and elastic swelling in the inguinal canal, which is possibly fluctuating and translucent, and is without resonance on percussion or impulse on coughing, is an *encysted hydrocele of the cord.* It has to be diagnosed from bubonocele, hernia, and undescended testis.

If the tumour dates from birth, and yields a clear lymph on puncture, it is a *congenital hygroma.* It may be purely cystic, or partly cystic and partly solid. It may be soft and puffy to the touch, or more or less tense and elastic, and its outline may be distinct and even, or indefinite and irregular.

If the tumour is marked by chronicity and painlessness, and the fluid drawn from it is clear, of low specific gravity, and free from albumin, it is an *hydatid cyst.* The finding of hooklets, echinococci, or secondary cysts in the fluid, settles the diagnosis.

Diffuse hydrocele of the cord may be reducible or irreducible. If reducible, the fluid flows steadily back under pressure; there is not the slip or gurgle as in reduction of a hernia. If irreducible, it is marked by fluctuation, absence of resonance, and possibly by translucency.

The chief varieties of *abscess* in the groin are—(1) Lymphatic and perilymphatic; (2) Psoas and iliac, including perityphlitic and perinephritic; (3) Articular and extra-capsular. Some of these are acute, others chronic. The majority of the first group are consecutive to irritation in the corresponding lymphatic areas.

If the tumour is reducible, and continuous fluctuation can be obtained above and below Poupart's ligament, whilst the spine shows angular curvature, it is an ordinary *psoas abscess.* There may be one on each side, and the two may communicate across the bodies of the vertebræ.

An *iliac abscess* may originate in the fossa of the same name, in the true pelvis, or about the kidney. These regions should be carefully explored. *A pericæcal abscess* is usually accompanied by the symptoms of obstruction of the bowels, and is commonly due to fæcal impaction.

It is difficult to diagnose with certainty suppuration within and immediately without the hip-joint. Pain on passive movement and percussion is generally greater in the former case.

Augustus J. Pepper.

GUINEA-WORM. *See* Filaria Medinensis.

GUM-BOIL.—This is an inflammation, usually running on to suppuration, about the apex of the root of a tooth, which comes to be enclosed in an abscess sac adherent to it at a little distance from its end. The pus from this abscess is very often evacuated through the pulp-canals, the pulp being almost invariably dead and decomposed in cases of gum-boil; but there is always some inflammation of the bone and periosteum overlying it, and if the exit *viâ* the pulp-chamber is not very free, the pus eats through the alveolar plate and appears on the surface of the gum, with more or less swelling; hence the name gum-boil.

The cause of the inflammation is, in the vast majority of instances, the escape from the pulp-chamber of the products of the decomposition of the pulp or of other matters which have found their way into the vacant pulp-chamber, thus making a poisoned wound at the apex of the root. The amount of pain and disturbance is pretty directly proportionate to the degree of confinement of the inflammatory products, so that the first thing to be done in the way of treatment is to open the tooth up freely and syringe it out, so as to enable the pus to well up through it, and to lance the gum deeply if it be much swollen. A gum-boil is in the best position for healing when there is an exit by way of the gum as well as through the root-canals; and if several drops of creosote, or other powerful antiseptic, can be pumped in through the tooth so as to find its way out through the opening on the gum, the abscess will usually heal immediately. When the inflammatory state has quite passed off, the tooth should

be sealed, so as to prevent the access of foreign matters by way of the pulp-canals; but it is not enough merely to fill the cavity of decay, the root-canals must also be solidly filled or the abscess will soon recur, perhaps from the accumulation of serum in the canals and its subsequent decomposition.

If left to itself, relief is afforded by the escape of the matter, which from time to time re-forms, and a permanent fistulous opening remains in the gum; ultimately the end of the root becomes rough and more or less absorbed, so that the tooth gets loose. When the roots of a tooth are so long as to reach beyond the reflection of the mucous membrane on to the cheek, there is much more danger of the abscess bursting on the cheek or beneath the chin. If this threatens, every endeavour should be made to get a free opening through the tooth, and the skin should be supported by painting with collodion, &c.; it need hardly be said that under no circumstances should a poultice be applied externally, though a small bread poultice laid in between the cheek and the gum is soothing and useful. Slight degrees of inflammation, short of suppuration, may be treated by painting the gums with iodine, or with tincture of aconite; sometimes a mixture of these in equal parts is applied with benefit.

In cases of exceptional severity, necrosis of portions of the alveolar processes may ensue; or suppuration of the lymphatic glands; or pus may burrow down the neck; or enter the antrum, and set up suppuration there. Pyæmia and death have occasionally resulted from Alveolar Abscess.

Charles Tomes.

GUMMA.—It might be well perhaps that this term should pass out of surgical use, for it is exceedingly difficult to define it or to state to what conditions it should be restricted. Conventionally, it is used for any chronic swelling occurring in connection with syphilis. Formerly its use was limited by many to tumour-like indurations occurring in the cellular tissue and viscera in the tertiary stage; but it is now not infrequently applied to papules and tubercles developed in the skin at much earlier periods; and histologists can draw no line of distinction between the chronic sclerosis which attends the primary lesion of syphilis and those of its later stages.

A gumma, it may be said, always begins in cellular tissue, and is always slow in its development. In its later stages it is often attended by inflammation, which may cause the skin to give way over it, and may expose a mass of sloughy tissue which has aptly been compared to sodden wash-leather. In degree of hardness gummata vary very much, and the close similarity to new growth which they sometimes present is such as to make diagnosis very difficult. The certainty and rapidity with which they yield to the use of iodide of potassium are, however, such that the diagnosis and cure are not infrequently simultaneously effected.

It is when they are met with in the substance of the tongue or in that of a voluntary muscle that gummata are most likely to be mistaken for new growths. In these situations they are not infrequently exceedingly slow in their processes of change, and very firm in structure. The tendency to break down or suppurate varies very much in different parts. When suppuration occurs, it is to be understood that it takes place around, rather than actually in, the tissue involved. The latter may, however, break down and disintegrate, or may be detached by exfoliation. Indeed, when an abscess occurs in connection with a gumma, it is almost always accompanied by a slough or sequestrum. When a gumma has ulcerated the diagnosis from new-growth of a malignant character may sometimes still remain very difficult, and especially is this the case in gummatous ulcers of the tongue. The undermined edges, the sloughy base, and the entire absence of anything like warty outgrowth, will, however, generally suffice as grounds for a decision. If they do not, a short course of full doses of the iodide of potassium may be tried. As a rule, when a gumma undergoes resolution by treatment it disappears entirely, leaving little or no thickening of the part; but occasionally, and especially in connection with the periosteum, some permanent sclerosis results. Even in connection with bones, however, the completeness of the final resolution of very chronic and very firm lumps is often most remarkable.

Although iodide of potassium, as a rule, displays its power most definitely and rapidly in reference to all stages of the gummatous process, there are some cases which yield to mercury even more quickly than to it, and a few in which the latter will succeed when it has failed. Especially is the latter the case in certain indurations of periosteum of bone, which will yield to nothing but the full mercurial influence. In the treatment of ulcers from gummata which have broken down, local remedies are of great importance, and in many instances will alone suffice for cure. Amongst

these iodoform is the chief. But not infrequently a free cauterisation with the acid nitrate of mercury will even yet more rapidly produce healthy action. The process of repair under appropriate treatment is usually rapid and complete. The scar left is often more or less peculiar, owing to the large amount of cellular tissue which may have been destroyed. In like manner, when a gumma in one of the viscera undergoes absorption, an internal cicatrix with surface depression is the common result.

Gummata have been recognised in almost all the viscera. They are common in connection with the testis, the liver, and the cerebral meninges. When occurring in the substance of the lung they lead to what is known as syphilitic phthisis, and both here, and in connection with the muscular substance of the heart, they are occasional causes of deaths directly from syphilis. In most of the positions just named, however, their recognition and treatment concern medical rather than surgical practice.

Amongst the peculiar forms of gumma may be mentioned those which develop in connection with the venous and lymphatic systems. In the late stages of tertiary syphilis we not infrequently witness a tendency to induration round the cellular tissue of the veins of the lower extremity, especially if these have been previously in a diseased condition. Lumps of induration, elongated in form, may be met with at more than one place on the same leg, and they may extend and become confluent, producing a large cake-like mass. Some of the most troublesome ulcers we encounter in the leg are the result of periphlebitic gummata. When the lymphatic system is affected we sometimes meet with little shot-like swellings, developed at variable positions in the course of lymphatic trunks. These are often very slow in their development, and remain for long without breaking down. They may occur at almost any stage of syphilis, but are less common in the later ones, and they appear, so far as the writer's experience has gone, to be more influenced by mercury than iodide of potassium.

Histologically, a gumma consists of what is known as granulation tissue, its softness or induration varying with the proportion of its cells. When its fluid constituents are abundant it presents on section a soft gelatinous appearance, from which its name is derived. JONATHAN HUTCHINSON.

GUMS, Affections of the.—HYPERTROPHY OF THE GUMS occurs as a congenital affection, and many cases of it have been recorded. In the *Medico-Chirurgical Transactions*, vol. lvi., is a record of three children of one family, who all presented hypertrophy of the gums, and were also the subjects of *molluscum fibrosum*. All three children were of weak intellect. The writer brought before the Odontological Society of Great Britain, in 1878, two remarkable cases of hypertrophy of the gums, one in a child of five years, and the other in a young man of twenty-six. In the child, the hypertrophy was general, involving the whole of the gums of both jaws; but, in the young man, it was partial, being confined to the gum and alveolus of the right side of the lower jaw, from the right wisdom tooth to the left canine.

A cure was effected in both cases by removing the affected alveolus with the contained teeth, by means of powerful cutting forceps, and nothing less severe is effectual, since it has been shown by Mr. Charles Tomes that, in these cases, the disease dips into the socket of the teeth, and that, therefore, mere paring away of the redundant gum does not effect a cure.

A *nævoid* condition of the gum is occasionally met with as a congenital affection, and co-existent with extensive port-wine staining of the face. In an otherwise healthy young woman, the nævoid growth appeared to take on greater activity with each pregnancy, and the writer removed the vascular outgrowth on two or three occasions, applying the actual cautery freely for the arrest of hæmorrhage.

A vascular, non-congenital tumour of the gum may originate from irritation of the teeth, especially in the region of the incisors. When small, these growths may be treated with caustics, but, if large, and causing hæmorrhage, they should be removed, and the surface from which they grew be touched with the actual cautery.

POLYPUS OF THE GUM, or simple hypertrophy due to irritation, is not uncommon in the neighbourhood of decayed teeth, or when an accumulation of tartar has been allowed to take place.

The affection, when of considerable size, may resemble epulis, but differs from it in being unconnected with the periosteum, and hence requires much milder treatment. The removal of the tartar or the decayed teeth and the use of an astringent wash are sufficient treatment in most cases, and if the growth is large it is generally pedunculated, and therefore readily snipped off with scissors, or, if sessile, may be cut off and cauterised with Paquelin's cautery.

Gingivitis, or inflammation of the gums, is a common affection in infants who are cutting their teeth. The mouth is hot and tender, there being a constant dribbling of saliva, and the child's health is interfered with by the loss of rest and by diarrhœa, and possible convulsions caused by the irritation of the system.

Free lancing of the gums is the only trustworthy remedy, and should be had immediate recourse to in all cases of severity, although in slight cases rubbing the gums with the *syrupus croci*, or one of the numerous but dangerously narcotic 'soothing syrups,' may be sufficient.

A *spongy condition* of the gums, often called scurvy, but which differs entirely from the gum of true scurvy, is common in persons who neglect the cleanliness of their teeth, or are in feeble health. According to Salter, the disease consists essentially in vascular dilatation of the papillary and other capillaries, with a general thickening of the gum itself. The treatment consists in improving the general health, and in using the tooth-brush vigorously with some astringent mouth-wash.

The spongy gum due to the administration of mercury differs from the preceding in presenting a well-defined red line along the margin of the gum before the sponginess comes on, combined with fetor of breath and a metallic taste. The blue line of plumbism is due to a formation of sulphide of lead, and the green line of copper-poisoning to the oxidation of copper in the superficial tissues of the gum.

In *true scurvy*, due to deprivation of vegetable diet, the gums are swollen and livid from submucous extravasations of blood, and they bleed on the slightest touch. In advanced cases the gums become black and sloughy, protruding between the lips, and are horribly offensive. Such cases are seldom seen except in seamen who have been improperly fed, and deprived of lime-juice during a long voyage; but mild cases of scurvy, characterised by subcutaneous ecchymoses in other parts of the body, may be met with, and, like the more severe ones, yield promptly to the administration of fresh fruit and vegetables.

Bleeding from gums apparently healthy is a common symptom of the hæmorrhagic diathesis, and may be best checked by pressure, and by the administration of hæmostatics in the form of iron and the mineral acids.

Epulis is a term often used to include any form of tumour involving the gum, but may be conveniently restricted to the fibrous form, which alone is strictly connected with the alveolus and gum. It is a slowly-growing tumour, arising most commonly between two teeth which may or may not be decayed. By pressure it tends to separate the teeth if they are healthy, or may completely cover in the stumps of decayed teeth. An epulis is closely connected with the periosteum of the alveolus. Mere cutting away of the growth is insufficient for its eradication, and nothing less than cutting away the portion of alveolus from which it springs, or inducing its exfoliation by the application of the actual cautery, can be relied on. In order to do this, it is generally necessary to sacrifice the tooth on each side of the growth, and occasionally in removing the tooth the whole growth comes away, being attached to the peri-odontal membrane in these cases, instead of to the alveolar periosteum. An epulis on section is found to consist of dense fibrous tissue, closely resembling the normal gum, and frequently contains masses of bone, which may or may not be directly continuous with the alveolus.

Myeloid Tumours are not uncommon about the alveoli (hence 'myeloid epulis'), but are only the superficial portions of deeper growths. The remarkable feature about these growths is the dark colour which is often to be seen on the surface of the gum-tumour, previous to or, more frequently, after removal. A very thorough and complete removal of these growths is necessary to ensure a cure, and hence they are more properly classed among tumours of the jaw, which they commonly involve.

Papilloma occasionally affects the gums, and requires free removal. Salter describes a case of the kind which occurred in Sir W. Fergusson's practice, where recurrence after removal had frequently taken place.

Ulceration of the Gum occurs in children as the result of stomatitis, but in the adult may be due to struma, syphilis, or epithelioma. Salter narrates a case of strumous ulceration affecting the gums and palate in a youth of nineteen, of highly strumous diathesis, and thinks the disease may be more common than is supposed. Syphilitic ulceration may affect the gums, as well as other portions of the buccal mucous membrane, and occurs, as a rule, below middle age.

Epithelioma affects the gum in patients over forty, and is often apparently connected with irritation caused by ill-fitting tooth-plates. Any ulceration in the mouth of an elderly patient, which does not heal

readily, should arouse a suspicion of epithelioma, and this is to be insisted upon the more strongly, because in the early stage, cases of this description are generally seen by dentists, who do not always appreciate the full gravity of the case, and the necessity for prompt interference.

When fully developed, the ulceration is ragged and irregular, and tends to spread from the gum to the cheek externally, or to the side of the tongue internally. The teeth in the neighbourhood are loosened, and possibly the submaxillary lymphatic glands may be enlarged, as they always are in the later stages of the disease.

Having treated several cases of epithelioma of the gum, the writer is convinced that nothing but very free removal offers the patient a chance of permanent relief. It is impossible to say how deeply in the jaw the epitheliomatous growth may have penetrated, and, therefore, it is better not to be content with simply cutting away the alveolus with bone-forceps, but to remove a piece of the whole thickness of the jaw well beyond the disease. It is true that this leads to a permanent deformity, which one would gladly avoid; but to do less is almost to court failure, with possible infiltration of the lymphatics and a rapid termination. CHRISTOPHER HEATH.

GUNSHOT WOUNDS.—All injuries caused by projectiles impelled by the explosion of gunpowder have been included under the term 'gunshot.' They differ from the accidents of civil life in the peculiarities of the conditions attending them, the producing causes, the dangers and complications liable to arise in their course, and the difficulties which surround their treatment, often under very unfavourable conditions. Gunshot wounds may be most trivial in degree, or productive of injuries of terrible severity; yet in all their phases, whether simple or complicated, the principles which mark the advance of modern surgical science are as applicable to gunshot wounds as to the injuries met with in civil practice.

It is not easy to define precisely a gunshot wound, because under this title is included so great a variety of injuries produced by different kinds of firearms. We have bullet wounds occasioned by conical and round bullets, pistol shot, and small shot, as well as the extensive injuries which result from shell explosions. The latter, when produced by minute fragments, possess some of the characters of bullet wounds. In some cases they may be very severe, and resemble somewhat the extensive injuries caused by machinery, and met with in civil practice. In other instances a limb may be carried away, smashed up, or large portions of the body shattered out of all recognition by a shell exploding near at hand.

BULLET-WOUNDS.—A wound by a rifle bullet may be defined in very general terms as a contused and lacerated wound, accompanied by loss of substance, and, in respect of its great length or depth compared with the size of the external orifice, it possesses peculiarities usually associated with punctured wounds. The gravity and relative importance of gunshot injuries are in relation to the region of the body struck, the structures implicated, the size, shape, density, and velocity of the projectile.

A bullet striking tangentially may inflict a mere contusion which, in the case of large projectiles, may be of the severest kind. It may groove the skin and subcutaneous tissue for a greater or less distance, or pass immediately beneath, causing the so-called seton wound. In other cases it may traverse the whole thickness of a limb, or the body itself, from side to side. It may go longitudinally, or in any other direction. In one case the soft parts only shall be injured; in others, the bone may be extensively comminuted and fissured. Vessels and nerves may be divided, viscera and great cavities wounded, and joints penetrated. In any of these cases, the ball or portions of clothing may remain embedded, entailing the evil consequences due to the presence of a foreign body. Again, the bullet shall emerge, often strangely altered in shape, or even divided into one or more portions. The track of the missile may be quite short, or extend along one-half or more of the body, bearing evidence of contusion throughout, and often perhaps of explosive violence.

In discussing the character and consequences of bullet injuries, reference will have to be chiefly made to those produced by conical projectiles. The old round ball is no longer in use. It was larger and softer than the modern bullet; but the chief differences in the wound it inflicted were due to its much lower velocity, the readiness with which it was deflected from the straight course, its very eccentric conduct in traversing the tissues, important parts lying apparently directly in the way being passed by uninjured or at most contused, and the frequency with which the bullet lodged. The conical rifle ball has an enormous initial velocity and great penetrating power. Its course through the body

is more direct. It is less liable to deflection, and the damage it occasions is greater.

The modern bullet exhibits several varieties in shape and size. Usually it is a cylinder of lead with a rounded extremity, or in some cases ovoid in form, like the projectile of the needle-gun. One result of the rapid flight of the projectile is that in half of the cases in which it hits the body it is altered in shape. And when it strikes a bone, it is flattened and twisted in all manner of ways, or even divided into two or more portions.

When a bone is struck by a bullet at full speed, perpendicularly to the surface, it is apt to punch a round opening in it with sharp, well-defined margins. A loss of substance, equal to the area of the ball, will be seen at the point of entrance; the exit opening will be larger, more irregular, and the bone-margins more or less everted. Fissures almost universally co-exist. This form of fracture is best seen in the spongy extremities of the long bones and in the flat bones. It is rare in the compact tissue of the shaft. When the velocity is diminished, the bone may be the subject of partial fracture, an indent, a fissure, or a mere contusion.

In the soft parts the entrance wound is sharply defined, and smaller in area than the bullet, while its edges are contused, inverted, and depressed. The exit wound is irregular, with everted margins resembling an ordinary lacerated wound. A diminished velocity, as a rule, causes the wounds to be less regular and larger. The subsequent course of the bullet deviates greatly from the direct path. It is, perhaps, capable of penetrating but a short distance; it may even fall out of the wound again, or finally it may inflict only a contusion without breach of surface.

Grooving, furrowing, or gutter wounds are produced when the bullet strikes obliquely, so that it travels for some distance parallel to the surface. They are most frequently seen on the head, face, and extremities. They vary in length and depth from a mere scratch to a deep channel, with irregular, contused, and lacerated margins. Sharp angular fragments of shell often produce them, and they are very painful and tedious in healing.

Seton wounds are similar in type to the last in being superficial, but the projectile travels for a certain distance close beneath the surface of the body before it emerges. They may be an inch or two or several inches in length; the manner of production is by a bullet striking tangentially at full speed. They may be seen on all parts of the body except the head. The track of the ball is easily traced by the bluish discolouration on the surface. As the bullet does not meet with any hard body it is rarely much altered in shape, and the distinctive features of the entrance and exit wounds are usually well marked.

Traversing wounds constitute nearly half of all the injuries inflicted by gunshot. Sixty-five per cent. occur in the extremities, twelve per cent. in the head, seven per cent. in the chest, six per cent. in the abdomen, five per cent. in the back, and three per cent. in the neck. The greater number of gunshot wounds traverse the tissues, inflicting a variable degree of injury according to the nature of the resistance which the traversing projectile meets. Bone offers the greatest obstacle and generally suffers the most extensive injury. Skin, tendons, and fascia come next; they also are capable of altering the shape of the ball. Small leaden projectiles flatten on tendons as they generally do on bone. In the muscles there may be much loss of substance, especially if they be in a state of tension when struck. The viscera offer least resistance.

It is rare, except after a ricochet shot, to have more than one wound of entrance produced by a single bullet, but it not infrequently happens that there is more than one exit wound; more than two, however, are rarely seen. The high velocity of the ball often causes it, as has already been stated, to split into two or more portions when striking a bone, and the over-heating or partial melting of the bullet from the same cause renders this still more likely to ensue. A gunshot track is by no means a perfect cylinder, the opening in the skin is slightly smaller in area than that of the bullet, but in the aponeurosis there is often a mere slit, so that when suppuration occurs, it will be confined beneath the fascia. This circumstance no doubt led to the formerly much-employed practice of *debridement* or free incision of gunshot wounds. Balls make the largest channel through muscles.

The direction of the wound when a rifle ball strikes at full speed at right angles to the surface may be straight, but often it is very devious. A contracting muscle, a tense fascia, a tendon, and of course, bone, generally deflect a bullet. Any change of posture after the receipt of injury alters the direction of the track, which might become straight again could the individual replace the body in the exact attitude assumed at the moment of injury. The length varies;

it may be quite short; on the other hand, it may extend half the length of the body, or more. The soldier generally shoots in the recumbent posture, and when struck as he lies upon his face, the bullet may travel the entire length of the back, or from the wrist up to the shoulder, or entering the neck pass through the chest and abdomen, from before backwards or diagonally.

Gunshot injury may be complicated by wounds of the blood-vessels, nerves, viscera, or by the penetration of a great cavity or joint. These wounds are always severe and their prognosis serious; they occur much more frequently since the introduction of arms of precision.

The relative frequency with which wounds are met in the different regions of the body varies with the circumstances of every war. It is calculated that of 100 wounds, by gunshot, 13 will be found in the head, 19 in the trunk, 28 in the upper extremity, and 38 in the lower. There has been an increase during later campaigns in the number of head wounds, which may be accounted for by the method of modern fighting. During sieges and in fighting from trenches, the proportion of head injury varies from 25 to 30 per cent. Here the frequency of injury in the upper extremity remains the same, but the number of wounds in the trunk and lower extremities diminishes in proportion.

Wounds inflicted by pistol balls, either of the conical form, or, less frequently, the round shape, are often met with in civil practice. Generally the injury is self-inflicted; sometimes it is accidental. In the former case the weapon is always fired at very short range or point blank. The surface is often discoloured or burnt. Particles of unconsumed powder are embedded in the skin or neighbourhood of the wound. These injuries resemble, on a smaller scale, the wounds by rifle bullet. The size of the ball is smaller, it is impelled with less force, and the damage it inflicts in general is not so severe.

Injury by Small Shot.—Wounds produced by the discharge of small shot from fowling-pieces is one of the most frequent forms of gunshot injury met with in civil practice. The amount of damage they inflict varies according to the distance from which the piece is discharged. A charge of shot, delivered point blank, inflicts most extensive injury, entering the body like a solid mass of metal, and then spreading in all directions. Here the entrance wound will be very large, its margins crenated. In a few instances the charge, or the bulk of it, may traverse the part wounded. The exit wound in that case will be very irregular and lacerated, and has a sieve-like appearance at the margins from isolated shot-pellets passing out separately.

Injury by Explosive Shells.—The explosive conical shell, used in modern artillery warfare, produces injuries of very varying degree. The injury is caused by the impact of the fragments into which the iron case of the shell bursts, and the leaden sheath which surrounds it. The damage depends on the number and the size of the fragments striking the individual, and the proximity of the explosion. The pieces vary in weight from half an ounce to half a pound or more, and are of all possible varieties of shape. They inflict lacerated wounds, often very irregular; tear away large portions of tissue or even an entire limb, smash the bone, or possibly reduce the entire body into a shapeless mass.

The proportion of men wounded by artillery fire, to those injured by rifle bullets, varies much in different battles. In the war in Bohemia, 90 per cent. of the wounds were caused by rifle bullets, only 3 per cent. by fragments of shell. At Plevna the wounds inflicted were all bullet wounds. In the Franco-German war, 20 per cent. of the wounded on the French side were injured by artillery, and 70 per cent. by rifle shot, while among the Germans only 5 per cent. were injured by artillery, but 94 per cent. received rifle wounds, so that the proportion varies much. In sieges the number of shell injuries always proves excessive.

Symptoms of Gunshot Injury.—There is very often a singular absence of severe pain at the moment of the infliction of a wound. This is true even when important nerves are severed. The greater the excitement, the less is the pain experienced. In a considerable number of instances, a man will be unaware that he is even hit until he becomes faint from loss of blood. The majority experience a sensation as if struck a severe blow by a stick, others a species of electric shock. In a few a severe burning pain is felt, rarely bad enough to occasion syncope. The pain is occasionally referred to parts other than the one struck, as in the testicle from a wound in the upper part of the thigh, or in the heel from injury to the buttock. Afterwards the amount of suffering will depend much on the circumstances in which the wounded man is placed. The beaten soldier will feel it more than the victor, or than one speedily and well cared for.

It is notorious how different various nations are in respect of endurance of pain. Pirogoff observed that Jews, Mussulmans, and Slavs bore pain well. Italians and Poles are very sensitive. The writer observed a total indifference to suffering among the Turks. He has often witnessed soldiers dying of mortal injury quite cheerful and unrepining, and he remembers well a man whose arm had just been amputated, insisting on seeing the next operation performed, to know how it could be done while the patient was unconscious of pain, and calmly smoking a cigarette the while.

As a rule, primary bleeding is an unimportant symptom in cases of gunshot injury which come under treatment, wounds of the face perhaps excepted. But hæmorrhage is nevertheless the cause of death in the majority of those who die on the field itself. Those wounded in the abdomen usually present a blanched appearance, and the same thing holds good of wounds of the thorax. There is often much blood on the clothing and ground, primary hæmorrhage from large venous trunks being as rapidly fatal as from important arteries. It has been recommended that every soldier should be provided with a tourniquet, but, as no instance has been recorded of life being saved in this way, the instrument would be quite useless.

Ligature of a large vessel for primary hæmorrhage is an almost unknown operation. Lidell records, as his personal observation after several severe battles, that he had not met with a single case of primary hæmorrhage which required a surgical operation such as the application of a ligature, and a similar statement has been made by other experienced military surgeons. It has often, of course, been performed for secondary bleeding. The results, which it is not needful now to particularise, have not been unsatisfactory.

Shock is a prominent feature of many gunshot injuries. It does not always stand in direct relation with the severity of the wound; it may be severe even after slight injuries. Local shock—the 'wound stupor' of Pirogoff—is confined to the injured part, which after a period of severe pain becomes cold, blue, numb, and difficult to move. The condition may pass off, or motor and sensory paresis, with general shock, may be developed.

General shock is observed in the more severe forms of gunshot injury, as, for instance, where a limb has been extensively damaged, or the viscera wounded; symptoms of severe shock often following injury by shell-explosions. The larger the area of the superficial injury and the nearer it is to the centre of the body, the more intense will be the shock. In some less severe cases of injury it can only be accounted for by psychical causes. It is always greater in nervous persons, and in injury of certain regions, as the abdomen, genital organs, the fingers and toes. The normal bearing of a wounded soldier, however, is usually one of much fortitude and endurance of suffering. In general shock the patient becomes pale and faint; he trembles, the skin is cold and sweating, the pulse small and irregular, the respiration shallow and frequent. In other cases there is extreme restlessness, anxiety, and a feeling of impending death. After an interval reaction sets in, the face becomes flushed and restlessness increases, accompanied perhaps by delirium, exaltation of the senses, small and frequent pulse and rapid breathing. The temperature generally falls two or three degrees below the normal standard. Cases where there has been great loss of blood generally suffer severely from shock; on the other hand it is sometimes entirely absent, even after very severe injury. The usual treatment should be employed, warmth applied, stimulants administered, all bleeding stopped, and the patient made to feel that he is being cared for.

Instantaneous rigor mortis is a condition occasionally observed after sudden death from gunshot wound. Instances of this almost inexplicable phenomenon are observed on all large battlefields. The bodies of the dead are to be seen with the action in which they were engaged during the last moments of life apparently continued; the position is probably one quite contrary to the action of gravity. The last muscular effort is stereotyped as it were. This condition may remain persistent for days, as the writer has personally witnessed. The expression of countenance at the moment of death is also preserved, and the body has the appearance of continuing the effort to accomplish some object desired at the moment of death. Dr. Dossbach mentions the case of six Frenchmen killed by a shell as they were taking breakfast; one appeared to be laughing, the man next to him was holding a tin cup to his lips between his thumb and forefinger. Dr. Brinton mentions the case of a cavalry soldier who was instantaneously killed while in the act of mounting his picketed horse; he was found with his foot in his stirrup, his left hand on the bridle and horse's mane, and when the body afterwards fell to the ground

it remained quite rigid in the attitude described. This condition occurs most frequently after injuries to the brain and spinal cord. Dubois-Reymond has called it cataleptic rigor mortis. Any explanation seems very difficult.

Progress of Gunshot Wounds of the Soft Parts.—Formerly suppuration was the all but inevitable result of gunshot wounds. An effort is now made to procure healing by scabbing, and if the circumstances be favourable, these wounds heal oftener without suppuration than is commonly imagined. The smaller the bullet the more likely is union without suppuration to follow. The writer has seen pistol wounds heal by first intention, and not infrequently wounds produced by a rifle bullet, more especially that of exit.

It is the absence of suitable treatment in the first instance, the too frequent interference with the wound, the introduction of septic matter from without, and the insanitary conditions in which the wounded are placed, which render healing without suppuration comparatively rare. Langenbeck in the war of 1850, Stromeyer and Beck in 1864, the English and French surgeons in the Crimea, had never seen cases of recovery without suppuration, and, without doubt, suppuration is the rule in such cases. Baudens and Jobert saw wounds unite without suppuration which had been inflicted during the street fighting in Paris. Pirogoff has noted cases of union occurring primarily after wounds by small copper bullets; and during the Franco-German and Russo-Turkish wars many instances are reported of this manner of healing. A scab is formed by the blood and serum drying up. Absorption of the poured-out fluids in the interior of the wound occurs, and perfect recovery follows. In some cases of apparent primary union suppuration sets in at a later period, generally spreading from the entrance wound, whose bruised margins are prone to suppurate; or suppuration begins afresh in the interior of the wound a considerable time after cicatrisation. This is usually caused by the irritation of a foreign body, such as pieces of clothing and the bullet, which, even after an interval of years of quiescence, may excite inflammation and suppuration afresh. When suppuration takes place, it is often tardy in its appearance. For a week, or even ten days, there may be only a bloody serous discharge, attended by some inflammatory swelling in the immediate neighbourhood of the wound. The degree of fever is variable. There is often little or none, or severe traumatic fever may set in, merging, in too many cases, into the septic form. When the wound is treated antiseptically, both local and general symptoms are minimised.

The secondary stage extends from the occurrence of suppuration to the time when all particles of dead tissue are cast off and a granulating surface takes the place of a contused one. The fever abates, the swelling diminishes, and the ordinary changes of repair follow. The duration of this stage varies with the extent of the injury, the method of treatment, the constitution of the individual, and the circumstances in which he is placed. Cicatrisation may occur in the centre of the canal, or one or other external wound may close, the wound of exit being the first to heal. The period required for complete healing varies very much. From three to six weeks is a common estimate, but in complicated cases from three to six months may elapse before final cicatrisation takes place. Wounds caused by splinters of shell heal more readily than those inflicted by rifle bullets. The cicatrix may be adherent. It is often painful and neuralgic, as well as very sensitive to changes of weather. When the wound is deep and extended, the venous circulation may be interfered with, and chronic œdema ensue. The writer has seen this invade an entire limb; the extremities, however, are the parts usually most affected.

Diffuse suppuration is a common result of gunshot injury, and very commonly associated with a septic condition. Before the introduction of antiseptic methods this was a frequent source of death. The writer has again and again seen this, both in simple wounds involving the soft parts and those implicating the bone. The pus spreads in the cellular tissue between the muscles, and in the neighbourhood of the bone. It is most common in deep-seated wounds. Septic phlegmon is a very common cause of death after gunshot fracture. It may also occur in wounds of the soft parts. The suppuration in this case becomes widely diffused beneath the fascia. There is often a hard œdema. The skin is red and shining, the wound grey and foul, with a profuse secretion of ill-smelling pus, high fever, albuminous urine, diarrhœa, delirium, and finally a typhoid state. Upon incision the tissues are found dense, with greyish infiltration. Death generally occurs through sepsis or exhaustion. There is no tendency to limitation. United fractures or partially cicatrised wounds break down again.

Septic suppuration, followed by infection, is common in all wars. Its frequency has been much diminished by the introduction of antiseptic methods. Formerly it more than decimated the wounded, and was especially common and fatal after gunshot fractures and operations which involved the bones.

Complications in the Course of Gunshot Wounds.—Secondary hæmorrhage is one of the most common and fatal of the accidental complications following gunshot injuries. The period of separation of the slough in the gunshot track is frequently associated with secondary hæmorrhage. Severe and fatal bleeding, however, may occur at any later period, and, as the writer has observed, even after apparent convalescence has taken place, more especially in wounds of the neck and face. In this case, perhaps, only a small fistula or trifling discharge persists. After ligature of the vessels, and after amputation, secondary hæmorrhage is very frequent. The operation may perhaps have been hastily done. The patient is transported a long distance afterwards, the wound suppurates, the after-dressing is imperfect, the food is bad, and the hygienic conditions probably even worse. The separation of a slough, and imperfect organisation of the clot, are the exciting causes. These are the principal conditions which occasion the distressing frequency of secondary hæmorrhage in time of war. It occurs most commonly in the evening or night, when the patient is feverish and restless. It may follow a prolonged dressing, accompanied by much syringing out of the wound, or a too frequent examination of the wounded part.

Warning bleedings to a limited amount precede the outbreak of the more severe hæmorrhagic attacks in about one-fourth of the cases. In only a small proportion does secondary hæmorrhage occur on a single occasion. It usually recurs twice, thrice, or even several times. Usually it is not difficult to distinguish arterial from venous and capillary bleeding; but when the blood comes oozing from a long, deep track, it may not prove easy to determine its source.

Secondary bleeding occurs early on the fourth or fifth day; it ensues with, perhaps, equal frequency till the eighth or tenth, reaching its maximum on the tenth and eleventh days, when the greatest number of hæmorrhages occurs. It then remains nearly stationary till the fifteenth or sixteenth day, when it begins to diminish in frequency, up till, say, the thirtieth day. After amputation, bleeding most frequently ensues at the period when the ligatures separate. The mortality after secondary hæmorrhage has been variously estimated at from 60 to 80 per cent. of the cases. It differs in the different regions of the body, but is greater in cases of gunshot fracture than where the soft parts only are concerned.

The *treatment*, in the first instance, is guided by simple principles. If the bleeding is severe, or cannot be arrested by pressure and other means, an effort must be made to stop the bleeding at the injured point. The ends of the vessels must be laid bare by dissection, and a double ligature applied; only where the attempt to secure the bleeding points in the wound fails may a ligature be applied at a distance. The mortality after ligatures in continuity is one-third greater than that following ligation in the wound. The results of treatment, as the high rate of mortality shows, are not favourable. In the wound itself there are always difficulties to be overcome in reaching the seat of hæmorrhage—difficulties which may prove insuperable. In regard to tying the artery in its continuity, the effect on the hæmorrhage is often very trifling, or only temporary; and, even if it be arrested, the bleeding often recurs at the time the ligature separates. The fact that the occurrence of secondary hæmorrhage so often depends on faulty hygienic conditions, overcrowding, and a foul condition of the wound, serves to explain the non-success of local measures for its arrest.

Tetanus is a somewhat rare complication of gunshot wounds, although it is commonly supposed to be frequent. It occurs oftenest in those who have been exposed to hardship, extremes of heat and cold, presence of bone-splinters, unskilful treatment of the wound, and in cases of injury to nerves. The writer only saw one instance in upwards of one thousand wounded at Sedan, and in that one the man had been exposed for three days on the battle-field before he was picked up. During the Revolution of 1830 three hundred and ninety wounded persons were carried direct from the streets of Paris into the Hotel Dieu. Only one of these suffered afterwards from tetanus. In the American war the frequency was only 0·2 per cent., or two in one thousand. It occurs with preponderating frequency, or in more than half the cases, after injury of the lower extremities. Tetanus is especially rare after wounds of the chest; the later the period of its occur-

rence after the injury the more favourable is the prognosis. Recovery occasionally takes place in the slighter or more chronic forms. It is exceedingly rare in the well-developed acute form, when death is apt to take place within three days. Out of 203 acute cases observed during the American war only 2 recovered. The total number of all kinds of cases was 337, of which 316 terminated fatally. *See* Tetanus.

In a few instances the symptoms abate on the removal of the projectile or foreign body. Amputation was successful in one-third of the cases in which it was resorted to. The treatment otherwise is purely empirical. All forms of narcotics have been tried in succession, with equally little effect upon the progress of the malady.

Gangrene.—Acute gangrene may take place as the result of the wound of an important blood-vessel. Division of the sciatic nerve seems sometimes to produce it, or the severe smash occasioned by a shell-explosion.

Dry gangrene is excessively rare.

In the vast majority of the cases—as many as 90 per cent.—gangrene of some kind is the result of injury to the extremities. In two-thirds of these cases the lower extremities, and in one-third the upper extremities, will be the part involved. The general mortality is about 50 per cent. Traumatic delirium soon occurs. There are great restlessness, want of sleep, and anxiety. Symptoms of septic infection frequently supervene. In a certain number of cases amputation may be resorted to.

Hospital Gangrene is an epidemic contagious disease occurring in over-filled, badly ventilated, foul hospitals. It is especially prone to attack gunshot wounds. The first great epidemics described occurred during the Peninsular campaign in 1810–13. The disease, however, seems to have been known to Paré. In the latter six months of 1813 Guthrie treated 1,614 cases, of which 512 were fatal. The disease at the same time overran all the French hospitals. Out of 1,900 wounded in the Hôpital St. Louis in Paris, 500 perished of hospital gangrene. It was very severe after the battle of Waterloo in the hospitals of Brussels and Antwerp. It was common at Scutari and Malta during the Crimean campaign, and very bad amongst the French troops, especially in their ill-equipped transport ships. At Lucknow, in 1857, nearly all the wounded were attacked. It was common in the American war in 1864, when 2,642 instances were recorded. Scarcely any cases were observed during the Franco-German war, except in some of the hospitals of the reserve and in the besieged fortresses of Metz and Strasburg. A good many, however, occurred in Orleans.

The presence of epidemic disease such as typhus, cholera, scarlet fever, and diphtheria, seems to promote the occurrence of hospital gangrene, which Pitha, indeed, terms 'wound cholera.' The virus is very contagious; it may be carried from one wound to another by sponges, instruments, even the surgeon's fingers or clothing. It may appear even on a recently blistered surface. Wounds of fascia, tendons, and soft parts generally seem more prone to it than gunshot fractures. *See* Hospital Gangrene.

Erysipelas is an uncommon occurrence after gunshot injury. American records place it at 4·0 per 1,000; it occurs after exposure to cold, and from great changes in temperature. The washing out of the wards is often followed by an outbreak of erysipelas. It occurs more especially on the head, face, and neck, or in about six cases in every thousand. On the trunk the proportion is 1·2, in the upper extremities it is 5·2, and in the lower 4·7 out of every 1,000 cases of wound. It may take place at any stage of the wound. It is very contagious. The duration averages ten days. It is often associated with or followed by pyæmia.

Generally the disease broke out in ill-ventilated, crowded hospitals, or was communicated by contagion.

Bromine vapour has been found a useful prophylactic, and without doubt the general introduction of disinfectants and antiseptic treatment will practically banish it. Sporadic cases, however, may ensue, even under what appear the best arrangements. These must at once be isolated, and otherwise the same treatment which is adopted in civil practice should be carried out. Antiseptic treatment to a large extent prevents erysipelas. Alcoholic stimulants, quinine, salicylate of soda, benzoate of soda, and narcotics are the remedies indicated, together with local subcutaneous injections of a third per cent. carbolic solution immediately around the diseased area, which prove especially useful at the beginning of the disease. *See* Erysipelas.

General Treatment of Gunshot Injuries.—The means for removing the wounded from a battlefield to the dressing-stations and field-hospitals is treated of under Ambulance. It is only necessary to say here that the simplest form of stretcher

—one that can afterwards be used as a bed—is the best. The recovery of many will depend on how this part of the work is carried out.

Cases of fracture bear transport badly, and the chances of recovery after gunshot fracture of the thigh depend, to a large extent, on the ability of the surgeon to treat the cases as near as possible to the place where the wound has been received.

At the first dressing-stations it is imperative that the best surgical opinion should be forthcoming, for on the early diagnosis of the nature of the injury will depend the success of the treatment. Here, too, must be decided what treatment—conservative measures with antiseptic occlusion of the wound, amputation, or resection—will be best. The surgeon should not waste time over hopeless cases. None but operations of emergency should be performed on the field. Bleeding must be arrested, fractured limbs supported, limbs completely smashed amputated, the wounded refreshed and comforted, and then despatched as quickly as is practicable to the field-hospitals. In them complete examinations can be made, thorough antiseptic precautions taken, and the needful operations performed. With regard to the much discussed question of first dressings, the writer is convinced that the first dressing should, if possible, be a final dressing, and that this should be the aim of all military surgeons. He has but a limited belief in the practical efficiency of the packet of first dressings as carried by the soldier himself.

The frequent necessity for the extraction of a lodged bullet, a fragment of shell, or portion of clothing is peculiar to gunshot injury. Popular belief ascribes a deadly influence to the presence of a bullet in the body, and the wounded man urgently begs for its removal, the surgeon too often making an extensive and damaging search for it. A great variety of ingenious bullet-extractors and bullet-searchers have been invented. We have plain probes, articulated probes, probes tipped with porcelain, electrical indicators, instruments gimlet and spoon-shaped. A strong slender bullet-forceps, like Luer's, or the American forceps with rat teeth at the extremity, is the best. It is narrow enough to enter an ordinary gunshot track; when closed it acts as a sound, and if it seize the ball, is not likely to slip. It is quite certain, however, that the former indiscriminate extraction of bullets was often attended with evil consequences, and that vastly more injury was inflicted by ill-judged efforts to remove the ball than its mere presence was likely to induce. If the ball, however, prove accessible, and its removal easy, it may be better to extract it; but long-continued search after a deeply placed ball, or extensive incisions for its release, are to be deprecated. The wound should be treated irrespectively of its presence. It may become encapsuled, or even be removed at a later period.

In cases where the bullet requires to be removed, as where it presses upon an important vessel or nerve, or excites irritation by its presence, the operation should be conducted with extreme caution and the avoidance of all needless suffering. The part should be placed, if possible, in the same position as at the time of the receipt of injury. The gunshot track is thus straightened and shortened. Care must be taken not to mistake a bony prominence for a bullet. Stromeyer mentions a case in which the head of the fibula was thus cut down upon. The writer has known more than one instance in which an attempt was made to extract the transverse process of a vertebra, fatal hæmorrhage resulting.

The treatment of shock after extensive injury first demands attention, especially when produced by shell-explosions. If very severe it may even terminate fatally. Brandy, wine, ammonia, injections of ether, heat to the surface, and sinapisms, as well as stimulating injections per rectum, may be resorted to. In cases of slight shock it is unnecessary to interfere, but excessive reaction must always be guarded against.

The dressing of a gunshot wound must necessarily be of a simple character. In those cases where it is possible, an antiseptic pad, composed of cotton wool impregnated with iodoform or corrosive sublimate, should be resorted to as soon as possible after the receipt of injury, and fastened with a bandage—not, however, too tightly applied. The method of antiseptic occlusion seems to promise the most favourable results, especially in cases of gunshot fractures and injuries involving joints. This is not practicable when the wound is very large, irregular, and with contused margins, or when a considerable interval has taken place after the receipt of injury. Provision should then be made for the freest possible escape of the discharges. Drainage-tubes may be inserted, counter-openings made, and antiseptic irrigation, with frequent change of the dressing, resorted to. The strictest cleanliness must always be enforced, and all used dressings be burnt at once.

The general treatment consists in absolute rest of body and mind. A generous

diet should be exhibited, but of a plain and simple description. The bowels ought to be kept regular with gentle purgatives. Anodynes are well borne, and should be given in sufficiently large doses to allay pain and excitement. In young, plethoric subjects, leeching is sometimes indicated, but general blood-letting is never likely to be required. If blood-poisoning threaten, quinine and opium are the most trustworthy remedies. Severe diarrhœa is a very common complication of gunshot injury, and for this, iron and opium are the drugs chiefly indicated.

Special Forms of Gunshot Injury.—Gunshot injuries of *bone* may be classified as contusions, simple fractures, partial perforating, penetrating, and complete fractures. Every form of projectile used in war may cause these various injuries. The nature, extent, and severity of the lesion will depend on the size, form, and velocity of the missile. The discussion as to the comparative effects of the round and conoidal bullets is no longer of practical value since the general adoption of arms of precision. To the cylindriform bullet all now agree in ascribing a greater destructive power. The frequency of gunshot fractures varies much in different campaigns. On the average they occur in about one-fifth of the total number of gunshot wounds.

Gunshot fracture of bone presents special features according to the character of the portion injured, the size and velocity of the projectile. Extensive damage to the bone is associated with comparatively trifling injury to the soft parts—a feature common to all kinds of gunshot fracture, and the converse of what obtains in fractures met with in civil practice. A bullet striking at right angles at full speed makes a canal in the bone, of the same size as the ball itself; the wound of entrance being a clearly-defined, circular opening in the cortical tissue, from which fissures extend upwards and downwards, the exit wound being larger, more irregular, more extensively comminuted and fissured than that of entrance. When the ball strikes obliquely, the bone will be comminuted. If it strikes tangentially, a piece of bone may be carried away, thus producing partial fracture, which may or may not be afterwards rendered complete by the weight of the body or the application of some indirect force.

The simplest form of injury is that in which the bone is contused. In some cases the surface may be depressed, the injury taking place in conjunction with wounds of the soft parts. There will be extravasation of blood beneath the periosteum and in the medulla. The injury most frequently occurs in the exposed bones, especially the lower jaw, the tibia, and the skull. The diagnosis is difficult, as the slighter forms of injury are mostly overlooked at the time. They are generally only recognised by the after-consequences. Their presence may be inferred when the wound is close to a bone, when the ball is found to be altered in shape during its passage, or by a sudden invasion of bone-inflammation or osteitis.

The symptoms are obscure, but a peculiar boring, burning pain is experienced in the bone, the functions of the limb are interfered with, and a swelling may be felt beneath the periosteum. In slight cases, where the conditions are favourable, desirable results may follow, the extravasation is absorbed, and some local formation of new bone may take place. In unfavourable cases, suppurative periostitis commonly occurs, and necrosis. The sequestrum may separate in the usual way, or osteo-myelitis and septic poisoning may take place. The injured part must, in any case, be kept at rest, and symptoms dealt with as they arise.

The bullet may merely groove or furrow the bone, either superficially or deeply, or drive the cortical portion into the medulla. Portions of the bullet are often found embedded, or the ball may be altered in shape or lodge at the end of the furrow. Fissures will probably be always found. This kind of injury generally takes place at the junction of the epiphysis and the shaft. A ball passing between the radius and ulna, or the tibia and fibula, will very often groove both bones. In other cases the ball may pierce the cortical tissue and lodge in a blind canal in the bone. This occurs in the epiphysis and spongy bone. In some of these cases there will be fissures, in others none. The diagnosis is difficult, and the nature of the injury is often only discovered by the subsequent progress of the case. If the ball can be extracted, these fractures will resemble in their progress simple grooving wounds. If not removed, the bullet may become encapsuled or excite inflammatory processes at some subsequent period.

The bullet may pass through the entire thickness of the shaft or extremity of a bone, cutting a channel through it without causing complete solution of continuity. This form of fracture is called *Lochschuss*, or key-hole. It is usually met with in the spongy extremities of the long bones near their junction with the shaft, and is more frequently produced by small bullets. The

entrance wound in the bone is the same size as the ball, circular in form, the edges sharp and depressed. The exit wound is large, irregular, the margins everted. Longitudinal fissures are almost always present. At fifteen yards' distance, a chassepôt bullet, fired through the lower epiphysis of the femur, makes a perfectly round wound of entrance, the exit orifice being about ten times as large. The ovoid needle-gun ball, at the same distance, also makes a round entrance-hole in the bone, the exit wound being two or three times larger. The Martini-Henry effects a round entrance, a larger but also rounded exit wound, with limited fissuring. An exact diagnosis, even with the aid of the finger, is sometimes difficult. When recovery ensues, small fragments of bone exfoliate, and the canal becomes filled up, either by callus or fibrous tissue.

The successful treatment of gunshot fracture depends in a great degree on the possibility of antiseptic occlusion, careful immobilisation, and the absence of prolonged transport. Although much longer delayed than in any other kinds of fracture, final consolidation is almost the constant result. The average period of union is one month for the forearm, two months for the arm, three months for the leg, and six for the thigh. A useful limb is generally obtained, but always more or less deformed and shortened. Non-union is exceedingly rare. Death may ensue soon after the injury from shock, hæmorrhage, or injury to some important organ.

After a battle hospitals are filled with cases of fracture. A great many of the subjects die from acute septic poisoning. In some the fatal result may be averted by timely amputation; but when a septic condition is developed, amputation is exceedingly fatal. At a later period amputation may become necessary from the extent of the necrosed fragments, a profuse suppuration exhausting the patient, suppuration taking place in an adjacent joint, or large bed-sores forming by reason of defective nursing.

The practice, formerly much in vogue, of extracting and excising fragments of broken bone is now very properly abandoned. Primary resection of the extremities of the fracture should never be performed; it leads to delayed union, false-joint, or sets up osteomyelitis and necrosis. Pieces apparently loose will often unite quite well, and the attempt to remove them may seriously damage the soft parts. It will, however, in some instances be desirable to remove a fragment of bone pressing upon a nerve or artery, and lying quite loose in the wound or transverse to the axis of the bone.

After the wound has been dressed the fractured limb must be immobilised, the joint above and below the seat of fracture included, and this must be thoroughly done, especially in cases which involve transportation. For these nothing can be better than some modification of the so-called Bavarian splint. Plaster of Paris properly employed, the writer considers, is invaluable. In the treatment of fractures Stromeyer strongly objected to it, and pointed to evil consequences resulting from its use; but these, with reasonable care, may be avoided. His great contemporary, Langenbeck, is very strongly in favour of its employment.

Fracture-apparatus for use in war must be simple, light, strong, and portable. Splints have been supplied of all possible material —tin, zinc, iron, wood, rattan, and wire, but all military surgeons should learn to utilise every available material on the spot. For almost all injuries of the upper extremity Stromeyer's triangular cushion will be found to yield adequate support; in the first instance, at all events, in the lower limb. The straight position, combined with continuous extension, is the best for all kinds of fracture of the thigh. Nathan Smith's or Hodgen's anterior wire-splints, with suspension, are admirable. These splints help to prevent bed-sores—not the least of their many advantages.

In fractures of the leg plaster of Paris splints may be used, a window being left at the wound. Starch, dextrine, white of egg, and water glass are much less desirable media, and are supplanted completely by plaster of Paris. Unfortunately it requires a considerable time to apply plaster splints properly; the weak parts, where windows occur, may be strengthened by slips of thin wood or iron. Undue pressure must be avoided at first, and subsequently the limb must not be allowed to become loose in the splint. Gunshot fractures of the leg are the most frequent variety of fracture of the long bones, amounting to about 31 per cent. of the total number of cases. Those of the humerus come next in frequency, being 28 per cent.; gunshot fractures of the femur amount to 22 per cent., and of the bones of the forearm to 18 per cent.

The views of surgeons as to the methods of treatment and propriety of amputation have greatly differed. At the present time, however, they are decidedly in favour of conservative measures in the majority of cases, especially of fracture of the shaft of the bone. When the fracture is near

the ankle or the knee, these joints will probably be involved, and amputation may be the safer proceeding. In choosing a line of treatment, much will depend on the facilities which circumstances afford for satisfactory after-treatment, and the absence of long transport. The limb should be immobilised in a fracture-box or plaster of Paris. Union takes place very slowly; detached portions of bone may be removed, but any more formal resection of the extremities of fractured bones is strongly to be deprecated. When conservative treatment, from any cause, fails, amputation may be practised subsequently. In these, as in other cases, the results will depend on how far antiseptic methods of treatment have proved successful.

Gunshot Injury of Joints. — The number of these wounds varies in different campaigns, but the difference may be accounted for to some extent by the accuracy of the diagnosis. It is estimated that they form from one to two per cent. of the total number of injuries, but they amounted to as much as six per cent. during the Franco-German war. Their frequency is about equal in the upper and lower extremities. The shoulder and knee are the articulations most frequently implicated, the elbow comes next in order, the hip and wrists being the least frequently wounded. The left shoulder is more frequently injured than the right, and the right elbow than the left, which may be explained by the position which a man assumes in firing.

A joint is frequently injured, as before stated, by fissures issuing from an adjacent fracture. In fractures of the upper end of the tibia, fissures almost invariably extend into the knee-joint. Formerly contour-wounds, passing around the joint without opening into it, were described as of frequent occurrence. They certainly are not so now. Wounds apparently of this nature generally implicate the articulation. Injury to the joint-capsule alone is of somewhat common occurrence; this may take place in the knee without injury to the bone, but a gunshot wound implicating the capsule of the hip-joint invariably damages the acetabulum or the head and neck of the femur.

One or both of the joint-surfaces may be grooved or extensively comminuted and fissured by the bullet; the bullet or a portion of clothing may even find admission; the importance of the injury depends upon the extent to which the bone is damaged. It is often extremely difficult to decide if a joint has been opened or not, and to what extent the bones are injured; this will be especially so where the articulation is covered with a great thickness of soft parts. A diagnosis may be arrived at from the position and direction of the wound, and presence or absence of crepitus; an escape of synovia is seldom observed. Sudden swelling immediately following the injury is a very definite symptom, but it is often absent, or, as in the case of the hip-joint, difficult to determine distinctly. Pain is not a prominent symptom. When the bullet has traversed a joint, the patient cannot use it; sometimes, however, he may be able to walk a certain distance, and this has been repeatedly observed even when the head of the femur has been comminuted and the bullet lodged in the bone. In the case of the hip-joint the direction of the wound offers the best indication.

Formerly a gunshot wound implicating a large joint was regarded as certain to occasion suppuration and necessitate amputation. During the Crimean War and in the Italian campaign, the French surgeons amputated the limb for wound of the elbow, and amputation was almost universally considered necessary for penetrating wounds. It is now certain, however, that many gunshot fractures, even of the lower joints, may be recovered from with little or no inflammatory reaction. In many cases a changed position of the limb will alter the wound from a direct to a valvular one, and thus shut off the interior of the joint from external influences, especially in the case of the knee; the great thickness of soft parts covering the hip and shoulder may procure the same result for these joints. But in the wrist and elbow recovery has also been observed without suppuration.

Langenbeck informed the writer that during the war of 1870 and 1871, he had seen a hundred cases of penetrating wound of the knee-joint, in which recovery had ensued without suppuration. Socin has recorded fifteen cases of gunshot fracture involving the knee-joint which he had observed during the same war. In eleven of these recovery took place without suppuration in the joint. In some there was no reaction; in others, a limited amount of swelling and pain took place in the joint, or a trifling suppuration in the external wound.

The brilliant results obtained by Bergmann and Reyher in the Russo-Turkish war, lead us to hope much from the application of antiseptic treatment in gunshot injury of joints. It is necessary to bear in mind, however, that joint-inflammation

often sets in very late, especially in wounds of the hip, and doubtless it is sometimes excited by untimely transport in wounds which might otherwise have remained quiescent. Suppuration is, unfortunately, the common consequence of gunshot injury involving an articulation, either from fracture of the joint or a fissure extending into it.

All gunshot injuries of joints are severe, and their danger is in proportion to the extent of the synovial surface. Pyæmia is the almost constant cause of death, amounting to as much as 90 per cent. The mortality after the Franco-German and American wars amounted, for the wrist to about 12, the elbow 20, the ankle 24, the shoulder 33, the knee 50, and the hip 80 per cent.

In all cases where antiseptic occlusion can be resorted to, this method of treatment should be adopted, together with perfect immobilisation of the part. Where inflammatory reaction has already taken place, the joint may still be immobilised, free incisions made into the articulation, all foreign bodies and loose fragments of bone removed, the interior thoroughly disinfected, and efficient drainage provided for. When the damage is too extensive to admit of conservative treatment, excision may be performed or amputation prove necessary. Formerly the universal practice was to amputate in all cases of injury to joints.

External circumstances may sometimes render amputation the better course: want of nursing, long transport, a badly equipped and ventilated field hospital. Of course antiseptic treatment when applied helps to neutralise these. If septic changes have taken place in the wound, amputation is best; secondary incisions and drainage under these circumstances used to prove very fatal. This difficult question must be decided at the first dressing-place—whether a comparatively easy amputation or the more difficult conservative treatment should be adopted. Secondary amputation generally comes too late, and in respect of mortality, as compared with primary amputation, one may say with Hueter: 'It is as the difference in pulling a sinking man out of the water after one or after ten minutes' immersion.'

When the occlusive treatment has been begun at the first dressing-place, it should be continued in the field-hospital, unless some pressing contraindication occurs. To realise healing under a scab, the dressing should remain as long as possible without change. When this becomes necessary, fresh pads should be applied. If fever, however, arise with the evening increase of temperature, œdema of the limb, pain in the joint, or rigor, the part must be carefully examined. If the suppuration be not extensive, the joint may be washed out and the wound utilised for drainage purposes, or, if unfavourably placed, a counter-opening may be made. If phlegmonous inflammation be great, the joint must be washed out antiseptically, the plaster splint removed and a posterior splint substituted. If the septic processes be not thus arrested, excision or amputation will become necessary.

In cases where antiseptic drainage has already been adopted, the dressing must be practised only when absolutely necessary, and washing out should be sparingly resorted to. If sepsis sets in, the rules previously laid down are to be followed. In cases of profuse and long-continued suppuration, the joint should be examined for foreign bodies and loose fragments of bone. If the patient arrives at the field-hospital with the joint already in a septic condition, an attempt should be made to purify it, although this may often fail. When the joint-cavity becomes shut off, and the external wound remains open, simple dressings only will be required. Fistulæ may be cleaned with a sharp spoon. Inflammation in the perisynovial tissue, or serous effusion into the joint, may be treated by iodine applications and methodical compression. Passive movements should only be begun, with great caution, after the joint has quite healed and is free from pain. For the after-cure, electricity, douches, and massage must be vigorously carried out.

It may be stated, generally, that in the slighter forms of gunshot injury to the *shoulder*, expectant treatment is justifiable. If a ball be lodged in the head of the humerus, and the bone much comminuted, or if there be considerable damage to the soft parts, primary excision should be performed, unless some additional severe injury contraindicate it. When the attempt to preserve the joint fails and suppuration ensues, the secondary period should be awaited, as no operation should be attempted in the intermediate stage. The after-treatment consists in immobilising the joint until healthy action is set up in the wound, and then an early employment of passive movement. During the Franco-German war ankylosis occurred in rather more than half the number of cases treated conservatively. In 10 per cent. there was free mobility, in the rest more or less impairment of motion. The final results would seem to prove that

the function of the limb is better preserved after conservative treatment than it is after excision.

In the *elbow-joint* expectant treatment should, as a rule, be adopted, the mortality being only ten per cent. Excision gives a mortality of rather more than double that, and amputation about the same. In a few instances movement was preserved, but in the great majority ankylosis ensued. During the campaign of 1870 a free use of the joint took place in about 6 per cent. of the cases. Eleven recovered imperfect movement, while in 81 per cent. there was ankylosis. When the limb is in a good position a very useful arm will be the result. The limb should be immobilised on an angular splint, and the wrist kept midway between a position of pronation and supination. Care should be taken to prevent the fingers becoming stiff by early passive motion. Primary excision should be performed in cases of extensive fracture of the bones with injury to the soft parts. It may be either partial or complete. In this case it will be only requisite to remove the portions of bone that are damaged. Complete restoration of function is very rare, but a fair proportion recover, more or less completely, the use of the joint and power over the hand and forearm. In some there was a flail-joint, and many had to be amputated.

Wounds of the *hip-joint* are most severe; expectant treatment is the least dangerous course to pursue. Excision of the hip-joint is only to be performed as a primary operation, and in uncomplicated cases of fracture of the head or neck. The mortality is very great. Amputation at the hip is scarcely justifiable, judging by the terribly fatal consequences following it. Otis states that, in 49 cases of recovery after expectant treatment, in only one was it positively established that a fracture extended into the joint, and he doubts the accuracy of the diagnosis arrived at in many of the others. On the other hand, it would seem that recent experience has been more favourable. Langenbeck records 88 cases of wounds implicating the hip-joint treated expectantly, during the war of 1870, of which 25 recovered. In 39 cases of which the cause of death was known, 34 died from pyæmia and septicæmia. The American reporter pronounces in the most emphatic manner against expectant measures in gunshot fracture of the hip, the mortality of which he estimates amounts to 98·8 per cent. But the writer finds that after primary excision it was 96·9 per cent., and after primary amputation 91·4. Although expectant treatment is therefore, he thinks, to be condemned whenever direct injury to the articulation can be positively affirmed, the margin is very small indeed, and the difficulty of diagnosis admittedly often extreme.

Excision of the *knee-joint* has hitherto been attended with hardly any success in military surgical practice. Formerly amputation for gunshot injury to this joint was the universal rule; now, however, expectant treatment is recognised as the proper course to adopt, especially since the introduction of antiseptic methods. Bergmann reports 33 cases during the Russo-Turkish war, of which 20 made a good recovery and only one died. Sokolow has collected 140 cases of gunshot wound penetrating the knee, of which 100 recovered. If this be even approximately correct, it proves the mortality to be very much less than it ever is after amputation of the thigh. According to Heinzel's table of 117 cases of amputation of the thigh for gunshot injury of the knee, the mortality was 60 per cent. No doubt this list included all the more severe cases. Excision is still more fatal; the percentage of mortality amounted to 86·6 during the American war, and the experience of subsequent campaigns has been the same. We must emphatically pronounce against its performance as a primary operation during a campaign. The results of the excision of the knee performed by Nussbaum at Bazeilles, in 1870, where all but one died, sufficiently endorses this opinion.

Excision of the *ankle*, as a primary operation, is followed by very indifferent success, and, where the injury cannot be treated expectantly, amputation is the preferable course to adopt

Gunshot Injuries of the Head.—The proportion of these injuries varies much in different campaigns. It is always in excess in fighting from trenches and during sieges. In the Crimean war, one out of every three men killed in the trenches before Sebastopol was wounded in the head. On the average, injuries of the head constitute about 8 per cent. of all gunshot wounds. According to Gross's statistics, rather less than three-fourths are confined to the scalp, and one-fourth, or rather more, of the cases involve the skull and its contents.

Gunshot injuries of the head may be classified into:—

1. Scalp wounds without lesion of the bone.

2. Contusion of the bone with and without lesion of the scalp.

3. Gunshot fracture involving the outer table alone.

4. Isolated gunshot fracture of the inner table.

5. Gunshot fracture of both tables:—(*a*) Without depression, (*b*) with depression.

6. Gunshot fractures with perforation of the skull and penetration of foreign bodies: (*a*) those in which the projectile escapes, (*b*) those in which the projectile lodges.

Mortality after Injury of the Skull. In the 4,000 cases recorded during the American war the mortality after gunshot fractures of the skull was 60 per cent., while Chenu reckons the mortality in the Crimea at 74 per cent.

In the American report the following results are tabulated of the rate of mortality in different forms of injury:—

	Cases	Mortality
Contusions of the skull	328	16·8 p.c.
Fractures of outer table alone	138	8·7 „
„ of inner table alone	20	95·0 „
Linear fissure of both tables without known depression	19	36·8 „
Fracture of both tables without ascertaining depression	2911	64·6 „
Depressed fractures	364	35·8 „
Penetrating „	485	85·5 „
Perforating „	73	80·0 „
Ecrasement or smash	9	100·0 „
Contre-coup	2	50·0 „

A total of 4,350 cases, with 2,574 deaths, or about 60 per cent.

The following results followed operative treatment:—

	Cases	Mortality
Extraction of missiles in or within the bone	175	48·3 p.c.
Ligations of bleeding vessels	33	36·3 „
Removal of bone-splinters or elevation of the bone	454	39·0 „
Formal trephining	220	56·6 „
Operations for hernia cerebri	29	75·8 „

In regard to trephining, the primary operations were more than twice as fatal as those performed in the later stages. The operations proved most fatal when performed on the frontal bone, a little less in the case of the parietal and occipital, and least in the temporal; but of this last there were but few cases.

In gunshot injuries of the head the damage to the brain is localised, and symptoms of concussion are very rare. Symptoms of compression are more frequent as the result of gunshot injury. Depressed bone is the usual cause; it also occurs as the result of the presence of a foreign body, and from extravasation of blood between the dura mater and skull, upon the surface, or into the substance of the brain. According to Gross, extravasation of blood is the cause of the symptoms in one-half the cases. Hæmorrhage to a greater or less extent is present in every instance of severe fracture of the skull, especially when accompanied by extensive fissuring. The most frequent source of the bleeding is the anterior branch of the middle meningeal artery. This injury is by no means universally fatal. In a few cases trephining over the seat of injury has enabled the surgeon to secure the bleeding points, providing at the same time an escape for coagula. In several instances fractures of the parietal bone, involving laceration of the middle meningeal artery, have been discovered upon post-mortem examination to be united, as in the case of an English officer who was wounded in the parietal region at the storming of the Malakoff. After an interval he became unconscious and hemiplegic. Finally he recovered, but death took place three years later from pneumonia. On examination after death, a united fracture was found in the parietal bone, and a rupture of the middle meningeal artery close to its division into its anterior and posterior branches.

The other causes of compression or interference with brain function are traumatic meningitis or encephalitis. Suppuration occurs in a large number of cases. In about 5 per cent. it is between the dura mater and the bone. It is the result of meningitis in about 25 per cent., and in the form of a localised suppuration or abscess in the substance of the brain in about 70 per cent. of the cases. The symptoms of compression, the result of depressed bone, are often late in making their appearance, and as the result of inflammatory changes seldom arise before the tenth day. When they do occur immediately in cases without manifest depression of skull, they must be due to the extravasation of blood within the cranium. If they supervene within a few hours after the receipt of injury, reactionary hæmorrhage is probably the cause. When they take place after an interval of ten days or longer, they are dependent on inflammatory changes or the formation of an abscess.

The symptoms do not essentially differ from those observed in cases of injury to the skull from other causes. The progress and result depend entirely on the disappearance or removal of the cause. Surgical means may be employed to elevate a depressed portion of bone, remove a foreign body, provide an escape for hæmorrhage, or to seek for and evacuate pus. On the other hand, a blood-clot may become gradually absorbed, and it must be remembered that the brain is able to accommodate itself to a considerable diminution in the capacity of

the cranium. The longer the condition of compression is allowed to endure, however, the greater is the risk to the patient's life. *See* Brain, Compression of the.

The symptoms of injury to the brain vary with the position of the wound. In the upper part of the calvaria a gunshot wound of the brain often produces paralysis of the lower extremities; sometimes both upper extremities and the lower of the opposite side are affected. Injury involving the region of the motor centres may produce paralysis of the motor oculi, facial paralysis, or paralysis of groups of muscles in the extremities, consciousness remaining unimpaired. Aphasia may be present, either alone or in association with facial paralysis, or paralysis of the upper extremities may be associated with agraphia. Bergmann, who has devoted much attention to this subject, observed areas of localised loss of sensation after gunshot injury, the motor power remaining intact, especially in injury of the parietal region. Clonic spasm of the muscles, involving certain groups, or sometimes extending over the whole of the opposite side, generally indicates injury to the cortical substance. Paralysis and spasm are alike uncommon after injury involving the occipital and temporal regions. Injury to the medulla oblongata may be recognised by the change in the respiratory function, Cheyne-Stokes respiration, slow pulse, and a sub-normal temperature. When the cerebellum is involved, there will be faulty co-ordination of movement. The paralysis of certain cerebral nerves may serve to localise injury involving the base of the skull. The symptoms, however, are often obscure, and an exact diagnosis will always be difficult to arrive at. Injury to the base or sides of the brain is more dangerous than to the upper surface.

Hernia cerebri is not an uncommon sequence of gunshot injury to the brain. It generally takes place after an interval, and is the result of the increase of intracranial pressure or the formation of abscess. Generally it is small, but it may attain the size of a man's fist. The condition is a very fatal one, 44 patients dying out of the 55 cases recorded during the American war. The majority occurred after the secondary removal of fragments of bone. The diagnosis is easy, as a pulsating tumour, covered by granulation-tissue, is observed projecting from the wound. Simple treatment should be adopted, the surface kept as pure as possible, protected from external injury, and cicatrisation thus promoted. In favourable cases the inflammatory swelling subsides, and the tumour recedes within the skull. A fatal issue is the rule, from extension of the brain-inflammation, or the formation of an abscess, which is so frequently associated with hernia cerebri. The tumour should never be sliced off nor pressure be applied to it. The knife, caustics, or écraseur are alike inapplicable. *See* Hernia Cerebri.

The great majority of gunshot injuries to the brain terminate in a fatal suppurative meningitis. The most common period of its occurrence is from the second to the sixth day after the injury. Bergmann found, however, extensive suppuration actually present in cases which had survived only thirty-six hours. In almost every instance this is associated with septic changes occurring in the wound. At a later period the disease may originate in a suppurative periostitis or ostitis of the broken fragments, thrombosis and phlebitis of one of the sinuses of the dura mater, or in abscess of the brain. The period of its occurrence is quite indefinite.

Cerebral abscess is a common result of gunshot wounds of the head. Most frequently it occurs from two to three weeks after the injury. It may be the consequence of a contusion of the brain, the presence of a foreign body, or more often of purulent inflammation of the skull, or necrosis of a fragment of bone. It may form either in the cortical or white substance, and vary in size from a pigeon's egg to a small orange. The wall of the abscess is irregular, and the contents may be either green, brown, or yellow. The symptoms are indefinite and the diagnosis difficult. Headache is usually present, often of excessive severity; fever, with very irregular exacerbations, and, later on, convulsions and paralysis.

In the treatment of gunshot fracture of the skull, mental and bodily rest is necessary. Transport should be avoided, the secretions regulated, and easily digestible food administered. Simple fractures are, of course, very rare, and must be treated expectantly unless symptoms of compression supervene. In compound fractures antiseptic precautions are of the first importance. Loose fragments should be extracted, and any that are depressed elevated or removed. If a foreign body have penetrated deeply it must be let alone, as the search for it would entail extensive damage to the brain. Projectiles and foreign bodies which can be readily got at should be removed with great care, in order to avoid further injury to the brain or its membranes, or hæmorrhage.

In perforating wounds of the skull, it may be necessary to trephine in order to reach fragments of the internal table, which is always more extensively comminuted and depressed. The bullet at the same time may be discovered. In cases where fracture of the internal table only is suspected, a diagnosis cannot be made, and expectant treatment must be adopted. In contusion or wound of the brain, the chief thing is to purify the part thoroughly, keep the patient at rest on a low diet, and apply cold to the head. Beyond this, there is in the first instance but little to do, and later on but little can be done. Should an abscess form, the evacuation of the pus affords the only prospect of recovery.

In cases of compression, when the symptoms are due to hæmorrhage, an attempt may be made to discover the source of the bleeding, and for this purpose the external wound may be enlarged and also that in the bone. The blood-clot, however, should not be interfered with. In progressive hæmorrhage blood-letting is sometimes useful. The ligature of the common carotid on the injured side is an operation likely to be of only temporary benefit. Where the symptoms of compression depend on depressed fracture, the depressed fragments of bone should be elevated or removed.

Gunshot Injuries of the Spine.—In these, as in head injuries, the matter of first importance is the degree of damage to nerve-tissue. Injury of the spine is very generally complicated with wounds of the chest, neck, or abdomen. Otherwise the mortality varies with the part of the spine wounded. The higher up the injury is, the greater the mortality. Gunshot fracture of the spine is always serious, especially when it involves the bodies of the vertebræ. When recovery does take place, the transverse or spinous processes are alone affected. Concussion of the spine and temporary paralysis may be produced by shell-explosion, but frequently some further injury has been inflicted. Wounds of the spine from heavy projectiles nearly always prove rapidly fatal. Very few injuries of the cervical spine have recovered, and in these the injury was confined to the spinous processes, and was followed in all the cases by stiffness of the neck, with paralysis of the arm.

Associated with gunshot injury of the dorsal spine there is frequently a penetrating wound of either the chest or abdomen, followed by speedy death. When the processes or laminæ only are involved the fatal termination is protracted, death taking place from secondary causes. Recovery most frequently ensues in fractures of the lumbar spine. Seventy cases were observed in the American war, but in these the processes of the vertebræ were the parts injured. In many, paralysis continued for the remainder of life; in others there were repeated abscesses, exfoliations of bone, and sinuses. In a few cases the bullet lodged either in the spinal canal or the bone. In three-fourths of the cases of fracture of the spinal column the cord was injured at the same time. There are, however, no reliable statistics of the frequency of the various kinds of injury. The symptoms may be immediate or secondary, and their character will depend on the portion of the cord injured. They may come on after an interval of weeks, months, or even years.

In some cases the cord will be merely contused, a kind of injury more frequent than is commonly supposed, producing symptoms dependent on the particular region involved. In other cases the cord may be compressed by an extravasation of blood, or a fragment of bone, or an embedded projectile. Here, also, the symptoms will depend on the particular part which has been wounded. In a few cases, when the cord has not been permanently damaged, if the cause of the compression can be removed recovery may follow; but in those cases which do not terminate fatally the usual result is permanent paralysis, complicated by bedsores and chronic catarrh of the bladder. When the injury is inflicted from behind, the gunshot track will be short; but from in front it is necessarily long, and the nature of the injury difficult to diagnose, complicated as it probably will be with perforating wound of the thorax or abdomen. The cord may be either partially or completely divided, and there will always be more or less extravasation of blood. When the cord is completely divided, the reflex excitability will be increased. The nature and extent of the paralysis are generally sufficient to establish a diagnosis.

With injury in the region of the lumbar spine there will be loss of sensation and motion in the lower extremities, retention of urine in the first instance, followed by stillicidium, incontinence of fæces, and priapism. The upper extremities are unaffected.

In the dorsal region there is dyspnœa from paralysis of the abdominal and intercostal muscles, and if the lesion be in the upper part of dorsal spine, the upper extremities are involved as well. The temperature in the paralysed parts is at first

increased. The functions of the bladder and rectum are generally interfered with; priapism is infrequent; bedsore is prone to form at all points where pressure exists.

In the cervical region the upper and lower extremities are paralysed, there is difficulty of swallowing, difficult respiration; inequality of the pupils is occasionally observed; there may be increase of temperature in the paralysed parts.

Injury to the cord itself is fatal sooner or later almost without exception,—in the upper cervical region, after a very few days, from interference with respiration; in the lower, seldom later than the first week. Only in the lumbar region may the patient live a few months. Death generally takes place from suppurative meningitis or from exhaustion.

Gunshot Injury of Nerves.—Wound of the cerebral nerves is very rare, except in conjunction with other severe injury. Branches of the fifth are sometimes wounded, and also the facial nerve. The pneumogastric has been sometimes divided in the neck, generally with an immediately fatal result, from wound of the adjacent vessels; otherwise the respiration becomes slow and laboured, the voice is lost, the pupil on the injured side contracted, and pneumonia supervenes.

In wounds of the extremities, the great nerve-trunks, as a rule, escape; they are elastic and protected by their sheath, but one of them may be lacerated, completely divided, or more or less contused. In these cases, if any foreign body be found pressing on the nerve, it must be removed. If the nerve be wholly or partially divided, the seat of injury should be exposed; the injured part must be excised, and the cut ends sutured together with fine carbolised silk, as was first recommended by Nélaton in 1864. It does not seem a matter of much importance whether the suture be passed merely through the sheath, or through the nerve-substance as well. Restoration of function has followed in a large proportion of cases. In some, atrophic changes have occurred even after apparent recovery. Where the first attempt ends in failure, a second may be made. Galvanism should be employed at an early period to stimulate the atrophied muscles. The frequency of injury to the nerve-trunks is much greater in the upper than the lower limb. In the latter the sciatic nerve is most frequently damaged, in the former the brachial plexus or median nerve.

Gunshot Wounds of the Eye.—During the Franco-German war these amounted to 10 per cent. of the total number of wounds. In regard to impairment or loss of function the vulnerability of the eye stands high. It may be directly injured by the projectile, or contused or burst through the medium of adjacent parts. If penetrated by a pellet of shot or fragment of bullet, the sight is invariably lost, either by the escape of the contents of the eyeball through the wound, or the subsequent intense inflammation which sets in. The sight is, as a rule, destroyed by gunshot injuries; a less severe injury may induce traumatic cataract, iritis, or glaucoma. Sympathetic inflammation of the other eye is a frequent and serious result of damage to one. Gunshot injury, as a rule, destroys the eye, and enucleation becomes necessary to avert the occurrence of sympathetic ophthalmia.

Gunshot Injury of the Ear.—These injuries are very rare, and are usually associated with damage to other organs. In some cases the sense of hearing is temporarily or permanently damaged by the explosion of shells in close proximity, causing rupture of the membrana tympani. In a few cases the mastoid cells have been opened, or a fracture traverses the middle ear. The ear has frequently been injured by wounds inflicted from the mouth. Inflammation and suppuration in the bone are frequent and dangerous consequences, as the inflammation may spread inwards at any time to the brain. The external ear may be torn off in part or altogether. The detached portion should be sutured. After gunshot injury, however, the damaged portion generally sloughs off.

Gunshot Wounds of the Face.—Very extensive wounds of the nose and cheek, followed by great deformity, are the result of gunshot injury. Much may be done to relieve the condition of the patient by subsequent plastic operation. Lacrymal fistula may occur, or fistula from injury to Steno's duct, or facial paralysis from division of the portio dura. Gunshot fracture of the upper jaw is a serious accident. Death from hæmorrhage frequently occurs in the first instance, and pyæmia and erysipelas, sinuses with prolonged discharge, and exfoliation of necrosed bone are common after-consequences. Gunshot fracture of the lower jaw is three times more frequent, and in some respects more serious, than fracture of the upper jaw. The large number of cases recorded, however, in the American reports, prove the risk of life to be about equal in the two forms of injury, the mortality after gunshot wound of the upper jaw being 8·1 per cent., and of the lower jaw 8·3.

Any loose fragment should in the first instance be removed; a piece of moulded pasteboard applied over the chin and secured by a four-tailed bandage. Suppuration is always abundant, but extensive necrosis is rare. The mouth should be frequently washed out; iodoform is an excellent application in all cases of buccal wound.

Secondary hæmorrhage has proved exceedingly frequent and difficult to control, after injury to the face. The carotid artery has been tied in many instances, but the result has been most unsatisfactory, the hæmorrhage usually recurring and causing a fatal termination. The mortality after ligature amounts to more than 70 per cent. In a few cases the external carotid has been ligatured successfully.

Gunshot Wounds of the Neck.—Those of the lateral aspect may involve the great vessels; the pneumogastric or sympathetic nerves from behind. Unless deep enough to involve the spine, a gunshot wound here is comparatively unimportant. In front the hyoid bone, the larynx or trachea, may be injured; and in a few cases the pharynx or œsophagus. Where the air-passage is opened the symptoms are evident. Air escapes from the wound, and probably there is emphysema in the neck. Power of speech would be lost, there would be difficulty of breathing and swallowing, and risk of asphyxia from inflammatory swelling, or from deep-seated inflammation in the neck. Laryngeal or tracheal stenosis may occur from subsequent cicatricial contraction, necessitating tracheotomy and the permanent wearing of a canula. The prognosis is in these cases unfavourable.

In all cases of injury of the larynx and trachea the patient must be kept quiet; sudden œdema may necessitate tracheotomy. When a foreign body in the neighbourhood of these organs interferes with respiration, and cannot be safely removed, the earlier tracheotomy is done the more favourable is the prognosis. Superior tracheotomy is the easier method. An elastic catheter, a drainage-tube, or the end of a large silver catheter, may be used in case of need in place of a canula.

Gunshot wound of the œsophagus is very rare, and nearly always associated with damage to other important structures in the neck. The bullet may traverse the tube, making two openings in it, or tear a portion completely away. Fracture of the spine, and injury to the cervical vessels and nerves are frequent complications. Swallowing is usually very difficult or impossible. The prognosis is bad, death taking place from hæmorrhage, asphyxia, or, at a later period, from diffuse cellulitis in the neck, pneumonia, secondary hæmorrhage, or exhaustion. A few have recovered with a permanent fistula and traumatic stricture. In gunshot wounds of the œsophagus the nutrition of the patient is the chief difficulty. He should be fed by the mouth if possible, or else through the wound with a tube.

Gunshot Injuries of the Thorax.—The proportion of these to the total number of wounds varies in different wars from 1 in 10 to 1 in 16. The latter was the proportion in the Crimea. In the American war it was 1 in 12. In 1870, before Metz and Strasburg, it was 1 in 12. The ratio of non-penetrating to penetrating wounds varies from 25 to 53 per cent. In the Crimea penetrating wounds amounted to 31 per cent. of the chest wounds, during the American war to 42 per cent., and among the Prussian wounded in 1864 to 53 per cent. During the war of 1870–71 different observers estimated the percentage at from 44 to 89 per cent. The nearer the hospital is to the battlefield, the more numerous the penetrating wounds of the chest received into it will be.

In uncomplicated gunshot wounds of the superficial parts covering the chest the mortality is very small, probably not more than one per cent. They seldom occasion much pain or cause implication of the lung. They heal slowly, on account of the mobility of the chest-wall, especially when of the variety called seton wounds. It is not uncommon to find the ball or fragments of cloth or other foreign substances lodged. In a certain number of cases the ribs were injured without opening the pleural cavity, or directly injuring its contents. In many instances these cases did well, but they were often complicated with pleuritis or pneumonia from the irritation of the fractured bone, or abscess and necrosis taking place. The scapula and clavicle as well as the ribs may be fractured without the pleura being penetrated.

Penetrating Wounds of the Chest.—Penetrating wounds may take place either with or without fracture of the ribs. The projectile, when small, may pass between two ribs without injuring them. This was found to be not infrequently the case with the chassepôt bullet during the war of 1870, but the needle-gun bullet invariably fractured the ribs, and so did the Russian Berdan ball. Fracture of the ribs at the entrance-wound takes place in the majority of cases, and greatly enhances the

severity of the injury, as fragments of bone are generally carried in with the ball and seriously damage the lung. At the wound of exit fracture of the rib is of less importance. In a few cases the pleura has been found wounded without injury to the lung. Several cases of this kind were observed during the war of 1870. It is probably caused by the bullet striking tangentially or at a slow velocity. Klebs mentions a case in which the ball traversed the right pleural capity, entering in front on a level with the fourth rib and emerging opposite the tenth, behind, without wounding either the lung, pericardium, or diaphragm. The nature of such an injury would be impossible to diagnose during life.

Penetrating gunshot wounds of the chest may not only be associated with fracture of the ribs, but very frequently with fracture of the scapula as well; less commonly, the sternum or clavicle. Fractures of these bones are very serious complications, as fragments of them often lie embedded in the lung and produce most extensive suppuration. The bullet may traverse one pleural cavity from side to side, or both pleuræ. It may lodge in the lung-tissue, the wall of the chest, or the body of a vertebra; or pass through the diaphragm and wound the abdominal viscera.

The diagnosis of a wound penetrating the pleural cavity and wounding the lung, which it does in the great majority of instances, is generally sufficiently clear. Air passes in and out through the wound. There will be always more or less dyspnœa present, and in some cases this is exceedingly urgent. Hæmoptysis is by no means a constant symptom of wounded lung. Probably it does not occur in more than one-fourth of the cases; indeed during the American war it was, it is stated, present in only five or six per cent., but when observed it will afford valuable, although by no means conclusive, evidence of the nature of the injury. Pneumothorax is always present, and collapse of the lung, unless the pleural surfaces be adherent at the seat of injury. Hæmothorax is an almost constant consequence of injury to the lung. It is very variable in amount; in many cases it will be very slight, from the collapse of the lung closing the wounded vessels, in others the blood may fill the pleural cavity.

The symptoms of hæmothorax are frequent laborious respirations and orthopnœa. There is urgent anxiety and distress, the patient turns about or can only rest on the injured side; great sense of constriction around base of chest. There is also evidence of loss of blood, pallor, cold surface, frequent small pulse, or there may be complete collapse. The percussion note is dull and the respiratory murmur absent, the ribs separated, the hypochondrium prominent. Surgery has hitherto availed but little to relieve the urgency of the symptoms. The question of reopening the wound or keeping it closed is a disputed one. Cold should be applied to the chest and warmth to the extremities. Only when the symptoms become very urgent should the wound be reopened. The intrathoracic pressure may of itself stop the bleeding. Subsequent symptoms must be treated as they arise. Emphysema after penetrating wounds is uncommon, occurring perhaps once in every 200 cases. It is usually limited to the neighbourhood of the wound; very rarely is it of any great extent.

The fatality of penetrating gunshot wounds is very great. A large proportion quickly die upon the field. Where both pleural cavities are involved, or the heart or its great vessels wounded, death will be always instantaneous. Amongst those treated in hospitals, more than half terminate fatally in the first few days from acute inflammatory processes in the lung and pleuræ; others who survive this period die from fever and exhaustion, the result of the septic changes in the fluid contained in the cavity of the wound; while in many cases of so-called recovery there are sinuses constantly discharging, necrosis of portions of rib, empyema, chronic cough, and other evidence of lung-mischief. The mortality probably is not less than 70 to 75 per cent.

In a few favourable cases the wound will heal under a scab, and this led to the practice, proposed by Surgeon Howard during the American war, of hermetically sealing perforating gunshot wounds of the chest. All accessible foreign bodies and fragments of bone having been removed, the edges of the wound are pared, sutured together, and covered with lint saturated in collodion. In 69 cases treated in this way, the lung being wounded in all but 15 of them, recovery took place in 27—a mortality of 68 per cent. The mortality is not, perhaps, excessive, especially as two-thirds were believed to be associated with lung-injury; but the American reporter thinks that, in many of these cases, the evidence of wounded lung and perforation of thorax is quite insufficient; besides, in many of the so-called cases of recovery, interminable sinuses, necrosis, empyema, chronic cough, and other evidence of lung-mischief remained. Sometimes occlusive treatment relieved the dyspnœa and the more urgent primary symptoms, with tem-

porary improvement as a result. But the careful examination of the evidence proves that this plan has not lessened the mortality, and has been sometimes attended by disastrous consequences. Fragments of clothes and other foreign bodies are sewn up, and blood and fluid accumulate and decompose in the interior.

The fatality of gunshot wounds really perforating the lung is very great. In unfavourable cases pneumonia follows more frequently than is commonly supposed, though by no means invariably, especially where foreign bodies have entered and air gains free admission. It is very fatal when it takes place. In 20 autopsies by Klebs of gunshot wound of the lung, pneumonia was only once observed. Probably this is due to the collapse of the organ. In other instances an abscess develops which may open into a bronchus and the patient recover, or burst into the pleural cavity and produce septic pleuritis. Gangrene of the lung is rare. Inflammation of the pleura is often more serious than inflammation of the lung, as it so generally assumes a septic form, or an empyema develops, accompanied with hectic fever and rigors.

Hernia of the lung, the result of gunshot injury, is very rare. Only 7 examples are noted amongst 20,000 cases of chest wounds. No case was observed during the Franco-German war. The explanation of its occurrence is difficult and unsatisfactory. The tumour moves with the act of respiration. Reduction without excision cannot be accomplished. An intercostal omental hernia may be mistaken for pneumatocele. The better course is to leave the tumour alone without active surgical interference. It may be protected subsequently with a hollow pad, or retract spontaneously. Cases of hernial protrusion of the liver and omentum have also been observed. Wounds of the diaphragm never unite. If recovery ensue, a diaphragmatic hernia will occur.

Immediate Treatment of Gunshot Injuries of the Chest.—If the wound is small, the injury to the bone not great, and no foreign body has been carried in, the best course will be to treat by antiseptic occlusion. If extensive, with much injury to the bone, loose fragments and foreign bodies are to be removed, counter-openings made, free drainage provided for, and antiseptic dressing applied. If this fail, frequent washing out of the cavity with warm salicylic solution must be adopted. The same rules apply for the extraction of foreign bodies here as elsewhere. If the projectile be lodged in the wall of the chest, it may be removed; if within the cavity, no attempt to extract it or to examine the wound with a sound should be made.

The patient must be kept very quiet, in a moist, warm atmosphere. A half-sitting posture is a good one, with the body turned to the injured side. Transport is impracticable. Formerly, copious blood-lettings were practised; but this is undesirable, unless the dyspnœa go on increasing and is not relieved by subcutaneous injections of morphia. The quantity of blood removed should be in proportion to the strength of the patient. In constantly increasing hæmothorax bleeding has been practised, but it is better to lay the patient on the injured side, close the wound, and apply ice to the chest. To open the cavity and evacuate the blood would probably renew or increase the bleeding. If the extravasation decompose, free incisions and drainage must be resorted to. Opium administered internally gives great relief in these cases. Emphysema does not often cause great dyspnœa; it may be relieved by small punctures. Pneumothorax had best be let alone; in extreme cases the wound may be opened again.

Hæmoptysis requires rest, nourishing diet, styptics, and opium internally, and cold to the chest. Serous effusions are seldom observed, except after contusions. The treatment will be expectant in most cases, or simple puncture if the effusion be great and cause severe symptoms, or is not absorbed after a few weeks. Traumatic empyema is more common. For this condition free drainage and antiseptic irrigation must be practised. Generally two openings are required. Excision of the ribs is a very old operation, seldom applied to cases of military surgery as a primary operation. It will often prove useful in cases of empyema. A piece of one or more ribs may be excised for the purpose of securing a freer opening; the cavity must be daily washed out with warm salicylic solution and antiseptic protection given. Sometimes the cure is rapid; generally it is slow, with associated curvature of the spine and falling in of the chest-wall. A fistula often remains open for a long period. In two instances in which the writer treated a gunshot penetrating injury of the chest by excision of a rib for subsequent empyema, the result proved most satisfactory. *See* Empyema.

Gunshot Injuries of the Abdomen.—These may take the form of contusion, or of wound involving the parietes only, or, lastly, be penetrating, a variety which forms more than half the total number. The projectile may penetrate and lodge, traverse the ab-

domen and emerge by a second wound, or become arrested at some point beneath the skin. As a general rule the viscera will be injured; in a few cases they escape. Abdominal wounds may be complicated with injuries of the chest or pelvis. Contusions occur from the blow of a spent shot, and may occasion extravasation in the abdominal wall or cavity. Laceration of the viscera occurs in about 1·5 per cent. of these cases. The liver or spleen is the organ generally affected. The only treatment is an expectant one, as an accurate diagnosis is scarcely possible. Wounds of the parietes may be simple or severe. Their chief importance consists in an associated injury to the viscera, or the spread of subsequent inflammatory processes in the interior of the abdomen.

The symptoms of injury to the intestine are often indefinite. The contents of the bowel may or may not escape externally. There is always more or less extravasation into the abdominal cavity, which usually sets up a rapidly fatal peritonitis, accompanied by great pain, tympany, vomiting, hiccough, and collapse. In some few rare cases the extravasation may become encapsuled, and an abscess forms, followed by fæcal fistula. The diagnosis of the exact extent of the injury is scarcely possible, short of making an abdominal section. The great majority prove fatal in twenty-four or thirty-six hours. During the American war the mortality was 83 per cent.

Gunshot wounds of the large intestine do not present any special symptoms. They are less dangerous than those of the small intestine, because the injury is sometimes extra-peritoneal, and, especially in the descending colon, recovery may ensue after the formation of a fæcal fistula. Recovery is rare after injury of the ascending or transverse colon. Gunshot wounds of the rectum are not uncommon. They are usually complicated with fractures of the pelvis or wound of the bladder. The writer remembers cases of this kind in which fæcal matter escaped from the posterior wound and urine from the anterior. Recovery sometimes takes place, but diffuse pelvic suppuration is apt to be induced, and both primary and secondary hæmorrhage are very frequent. In cases which do survive, fistulous openings persist for a long period.

Gunshot wounds of the stomach are usually immediately followed by vomiting of blood, severe collapse, epigastric pain, intense thirst, hiccough, and extravasation of blood; the escape of the contents of the stomach will depend on its empty or distended condition at the moment of injury. The stomach is seldom wounded alone, the lungs and diaphragm, liver, spleen, or colon being generally also wounded. The injury, as a rule, proves rapidly fatal. A few well-authenticated cases of recovery are recorded. Six are mentioned in the American report, and Fischer exhibited a stomach at the meeting of German surgeons in Berlin, with a circular cicatrix caused by a bullet in the central part of the anterior and posterior surfaces. The patient died of an attack of cholera two years after having recovered from a gunshot perforation of the stomach. In some cases, as that of Alexis St. Martin, recovery is followed by a permanent gastric fistula.

Gunshot Injuries of the Liver.—This organ may be subcutaneously ruptured by a blow from a heavy projectile. Bullets may produce wounds of almost any extent or variety. The convex surface is generally most frequently injured, and in some cases these wounds may be recovered from. Wounds of the concave surface are almost immediately fatal. Death occurs from severe hæmorrhage or rapid peritonitis. In cases which are not immediately mortal an abscess will form. The older surgeons considered this injury as fatal as a wound of the heart; but Otis has proved that in a few instances of undoubted injury to the liver recovery has taken place. Generally a fatal result sooner or later ensues, as the injury is seldom confined to the liver itself. Where the gall-bladder is wounded death has almost always followed.

Gunshot Wounds of the Kidney are not very common, from its deeply-placed, protected situation. As in the large intestine, the injury may be either intra- or extra-peritoneal. The wound may involve the cortical portion, the pelvis, the renal vessels, or all of these parts. The termination is generally fatal from peritonitis and hæmorrhage, but a number of recoveries are recorded. Urinary fistula and exhausting suppuration continue for a long time. The prognosis is bad, although the injury is probably less fatal than that of the liver or spleen. The chief symptoms are hæmorrhage from the wound, blood in the urine, shock, pain in the loins and testicle, and an area of dulness in the region of the kidney. Persistent vomiting is frequent.

In the first instance expectant treatment is to be recommended for wounds of the kidney. Many cases of injury to the kidneys during the last wars have recovered. Care must be taken that the secretions are allowed to escape freely, the interior of the

wound must be cleansed with carbolic injections; perinephritic abscesses diagnosed as early as possible and opened by lumbar incision. Where the suppuration surrounds the entire kidney, or septic symptoms appear, it may be best to extirpate the organ. *See* NEPHRECTOMY.

GUNSHOT WOUNDS OF THE BLADDER may occur in those parts invested by peritoneum, or be extra-peritoneal. The former prove rapidly fatal; of the latter a certain proportion recover. Excluding those who die on the field, 65 deaths (according to Bartels) took place in 285 cases. The wound may either traverse or merely penetrate the bladder. Wounds from before backwards and from behind forwards occur with almost equal frequency. The latter appears to be the more dangerous, and a traversing wound than a single opening. All cases in which the peritoneal cavity was involved proved fatal, and a large proportion of the others died from urinary infiltration and septic poisoning. About one-half are complicated with fracture of the pelvis, which considerably increases the risk of life. The pubic bone is most frequently involved, next the sacrum, then the ilium, and least frequently the ischium. In many cases the projectile, a piece of clothing, or fragment of bone lodges in the bladder. If recovery ensue, these become encrusted with triple phosphates and give rise to symptoms of calculi. Gunshot wound of the bladder is attended by the escape of urine mixed with blood from the wound, by vesical tenesmus, great pain in the abdomen, groin and testicle; fever sets in on the second or third day, and urinary infiltration followed by septic suppuration takes place in the pelvic cellular tissue.

It is essential in the treatment of bladder wounds to make provision for the escape of urine; otherwise we adopt expectant treatment. The rapidly fatal nature of the injury when the peritoneal cavity is involved does not permit an exploratory operation to be performed. A permanent catheter should not be left in the bladder, because it induces bladder-catarrh and ulceration of the mucous membrane. Fistulæ often persist after recovery, and are difficult to treat or cure.

A foreign body in the bladder should be removed at once. Its presence, however, is often not recognised till a later period. Then it may be removed through the wound after enlarging it, or by lithotomy. The function of the bladder is often permanently damaged.

Mortality.—In the field-hospitals the mortality from perforating gunshot wounds of the abdomen is at least 80 per cent., and a large number die from injury to the abdomen on the field. In respect of mortality, the individual organs stand in the following order:—The most fatal is injury of the small intestines, next the stomach, the spleen, large intestine where invested by peritoneum, liver, kidneys, large intestine outside the peritoneum, lastly the rectum. Hæmorrhage is the most frequent cause of death; some appear to die from shock. If the first period be survived, septic absorption and general peritonitis, still later secondary hæmorrhage and exhaustion, are the causes of a fatal termination.

Treatment of Injuries of Abdomen and Pelvis.—Gunshot wounds involving the parietes only should be treated antiseptically, as similar wounds elsewhere. When the peritoneum is simply opened, an effort should be made to close it by suture. Any uninjured organ which may protrude should be cleansed and returned. Protrusion of the abdominal contents after gunshot injury is very rare. The traumatic peritonitis which so commonly ensues may be treated by ice, calomel and opium internally, but this will be all but useless. Effective drainage, combined with antiseptic washing out of the abdominal cavity, making, if necessary a free incision through the parietes for the purpose, affords better prospects, but hitherto these injuries have been almost uniformly fatal. Isolated collections of pus should be freely opened and drained. Simple blood extravasation should not be interfered with.

When the stomach is wounded, the hæmorrhage is always most serious, and there is the additional risk of extravasation of its contents. When a diagnosis can be made, the existing wound in the parietes should be enlarged, or an incision of sufficient length made in the linea alba; then after the wounded organ is fully exposed the stomach must be drawn out and the wound in it closed with a double row of sutures; the peritoneal cavity must afterwards be thoroughly cleansed with a warm antiseptic solution. The external wound can now be sutured, and the part dressed antiseptically. Nothing should be given by the mouth for some days, and the strength maintained by nutrient enemata. Opium must be freely administered. Although in civil hospitals operations on the stomach have proved successful, a like result is improbable in time of war. Recovery is, however, possible. A gastric fistula is an unfavourable

result, as it is exceedingly difficult to cure, and interferes with the nutrition of the patient. A flap of skin may in some cases be transplanted in order to close it, or the abdominal wall incised, the adherent stomach separated, and the opening in it closed by Lembert's sutures, then the margins of the fistulous track in the parietes must be pared and united. Several cases of recovery are recorded after this operation. It was first performed by Billroth.

Gunshot wounds of the intestine seldom come under treatment, or only too late for effective interference. Where the injured intestine is prolapsed and the wound in it small, we may close the opening by suture, and carefully cleanse all the parts before reduction. In cases where an injury to the intestine is diagnosed, the patient should no longer be left without an effort made to preserve life. An incision must be made in the median line, or the existing wound may be enlarged sufficiently and a search made for the injured bowel. This must then be dealt with according to the amount of damage it has sustained, either by simple suture of the opening when it is small, or when more extensive by resection of the damaged portion of bowel and suture of the cut extremities together by Lembert's method. It will be necessary to take care not to detach the mesentery from the intestine and thus rob it of its vascular supply. Where any considerable part of the intestine requires removal a V-shaped portion of mesentery must be excised. Then the edges of the bowel and the cut margins of the mesentery are sutured together, every portion of the wound purified, the injured part restored to the abdominal cavity, and the external wound closed. *See* Lembert's Suture.

All parts of the abdominal cavity into which extravasation might have occurred must be thoroughly purified with clean sponges dipped in a warm 1 per cent. carbolic solution. Thorough cleansing of the abdominal cavity and the intestine is an important part of the operation. If this can be perfectly accomplished the external wound can be closed without inserting a drain, but drainage is, as a rule, necessary.

The operation of suturing a piece of wounded intestine and, still more, resecting it, lasts a long time. The patient must be kept warm, the intestine protected by compresses wrung out of warm 3 per cent. carbolic solution, frequently changed. Afterwards ether injections may be given to prevent shock, and opium. Nothing should be taken by the mouth for the first few days except a little milk and ice. Nutrient enemata must be administered. After the fifth day milk, soup, and a little bread may be taken, and in a week or ten days ordinary simple food.

The most dangerous period is from the third to the fifth day, when the sutures cut their way out. Union takes place by fibrinous exudation and adhesion of the adjacent omentum and loops of intestine. It is only as a rare exception that such a measure as this can be carried out successfully or even attempted in cases of gunshot injury; but we are justified in making the attempt rather than permit the inevitably fatal result to take place.

Artificial anus sometimes persists after recovery from a gunshot wound of the intestine. It is a painful infirmity, and, if high up in the intestine, interferes very seriously with the patient's nutrition. A fistula which is not associated with much loss of substance of bowel, such as a pistol-bullet may produce, can spontaneously close, or with the aid of a plastic operation. Where there has been loss of substance the éperon of Dupuytren will form. The fistula may sometimes be cured by dividing it; otherwise the abdomen must be opened, the ends of the intestine detached from the abdominal wall, resected and sutured together as before described, and the external wound then closed. In civil practice these operations have been followed by a large measure of success. *See* Artificial Anus.

Several times during the war of 1870 a fistulous communication between the bladder and rectum was observed to follow a wound traversing the pelvis. A spontaneous cure sometimes occurred. In others the fistula persisted. In some of these the rectum has been incised towards the coccyx to afford room for more ready access to the fistula. The margins of the fistula may be then excised and deep silver-wire sutures inserted, superficial silk ones being introduced as well. The result is uncertain. In cases of failure an opening in the descending colon will afford much relief. When the bladder and small intestine communicate abdominal section is the only means of dealing with the fistula. The adhesions may then be separated and the openings closed by suture. A portion of intestine may have to be excised as well. An operation of this kind is of course very severe, difficult, and dangerous to life, and the cases in which it is likely to be undertaken must be very few.

Gunshot Wounds of the Genital Organs are comparatively rare. The

body of the penis may be traversed by a bullet without injury to the urethra, or the urethra alone may be divided by the ball. In most cases there is also a wound of the thigh, scrotum, testicle, or perineum. In one case the bullet lodged in the corpus cavernosum, and when this body is wounded there is always severe bleeding. After recovery the cicatrix will interfere with erection. When the urethra is wounded urination will be difficult, or there may be complete retention; the tube may be partially or completely divided. Infiltration of urine generally takes place. The mortality is considerable—about 20 per cent.—and when recovery takes place urinary fistula and traumatic stricture are the inevitable results. When the urethra is torn through by a bullet, a catheter should be introduced if there be retention; if this be impracticable, external urethrotomy may have to be performed. It is often very difficult to find the proximal end of the urethra, which will be retracted or buried in the tissues. A catheter should never be left for a long time in the bladder, as it excites cystitis. Urinary fistulæ are difficult to cure. Various forms of plastic operation have been devised for the purpose. Scrotal wounds are common, and the testicle is at the same time more or less damaged; inflammation is set up in it, and it may either atrophy or its secreting structure become destroyed as a result of suppurative inflammation. In about half the cases both testicles are injured. There is usually considerable shock and severe pain experienced at the time. Neuralgic pain, often severe enough to demand castration, is not an infrequent consequence. A gunshot injury of the testicle should be treated as conservatively as possible. Scrotal fistulæ usually heal after scraping with a sharp spoon and dusting the surface with iodoform.

As a matter of fact, gunshot injuries of Arteries and Veins comparatively rarely come under treatment. This infrequency of wounds of the arteries by gunshot injury is more apparent than real, as, almost without exception, a man wounded through one of the main arteries dies where and when he falls, before aid can reach him. Stromeyer estimated the number of vessel wounds at 3 per cent. of the total of those wounded. When the artery is fixed, especially if it be enclosed in a bony canal like the vertebral or middle meningeal arteries, it is more liable to injury.

The bullet may directly injure the vessel, cause a fragment of bone to be driven against or into it, or pass partially round the vessel, contusing and separating it from its vascular connections, especially in the thigh. This is liable to be followed by sloughing or ulceration. The fact of gunshot contusion is rather inferred from the clinical history of the cases and the frequency of secondary hæmorrhage than proved by post-mortem demonstration. The artery may be lacerated, and completely or partially divided by the bullet. The bullet or a fragment of bone may lodge in the vessel-wall itself, causing a temporary obliteration which is rarely definitive, but mostly followed by secondary hæmorrhage. When the projectile lodges in the vessel-wall it soon becomes displaced by its weight. This lodgment is not infrequent. It is a common experience for fearful hæmorrhage to follow attempts at extracting either a bullet or a fragment of bone, and in some cases it may be due to this circumstance.

In large vessels the bullet may traverse the vessel, and make an entrance and exit wound. The writer amputated a thigh for gangrene in Servia, in which a subsequent examination showed two well-defined circular apertures of this kind in the popliteal artery caused by the bullet traversing it. The same thing has occurred in the aorta, and the iliac and carotid arteries. In other cases the ball cuts out a portion from the side of the vessel. When a limb is carried away by artillery fire there is often no bleeding, the elasticity of the main vessels allows of their being drawn out of their sheath before giving way, and, in a manner analogous to that of torsion, their lumen will be closed by retraction of the inner and middle coats.

When a large vessel is wounded the hæmorrhage is usually directly fatal. If otherwise, spontaneous arrest may occur until the man is carried to the nearest field hospital. The provisional clot arrests the bleeding for a time. Severe bleeding is still less frequently observed from wounds of large veins. In gunshot wounds of the head the bleeding may be copious from one of the sinuses, and may be recognised by a rhythmical increase during expiration. In a few cases there has been an entire absence of bleeding at first, and after an interval a sudden hæmorrhage may take place. Probably the artery has been injured by a ball or fragment; the foreign body remains lodged and occludes the wound, and on its removal or separation by inflammatory processes, usually ten or twelve days after the injury, sudden bleeding occurs.

Secondary hæmorrhage frequently occurs about two or three weeks after the injury from separation of a contused portion of the artery, or an unhealthy suppuration in the wound causing ulceration of the arterial tunics. The increased action of the heart, due to fever, may dislodge the clot and give rise to hæmorrhage. Generally during the first week, or up to the tenth day, rough manipulation, difficult transport, cough, vomiting, straining at stool, may excite it. The same principles which are adopted for hæmorrhage occurring in civil practice are applicable to its occurrence after gunshot wound. In all cases of primary bleeding the wound in the vessel should be, if possible, exposed, and a ligature applied above and below the injured point. Where the position of the injury is such as to render it anatomically inaccessible, a ligature may be applied to the main trunk on the proximal side. *See* Arteries, Wounds of.

In secondary hæmorrhage the same rules apply; but the difficulty of finding and securing the bleeding points in the wound is greater. Nevertheless the attempt should always be made; where it fails we may tie the main artery in its continuity, but the results are most unsatisfactory. The circumstances which conduce to the frequent occurrence of secondary hæmorrhage continue, and it is apt to recur either in the original wound, or from that made in order to secure the artery about the time the ligature separates.

Question of Operation for Gunshot Injury.—The majority of gunshot injuries in time of war take place in the extremities—three occurring in the upper to four in the lower. The gravity of the injury depends as a rule on the extent to which the bone is fractured or a joint involved. It is for cases such as these that the majority of amputations, either in continuity or through an articulation, require to be performed. It may be laid down as a rule that primary amputation of part or whole of the upper extremity is seldom if ever required for bullet wound, however extensively the bone may be fractured; even in cases where the brachial artery has been divided an attempt should be made to save the limb, although amputation may become necessary at a later period.

The injuries of the upper limb which may demand amputation are extensive lacerations of soft parts produced by shell-fragments. In civil practice it may be necessary from a charge of shot fired into the axilla, destroying the axillary vessels and nerves, or the structures in front of the elbow. In the case of injury to the joints, conservative treatment should always be first adopted. Primary excisions are more dangerous to life than those performed at a later period, and the results, as regards the function of the limb, much less satisfactory.

In the lower limb, other things being alike, the effects of gunshot injury are more severe than in the upper, and amputation more frequently called for. In the lower extremity, flesh wounds, except those produced by extensive shell-injury, or complicated by injury to the principal nerves or vessels, seldom demand amputation. Gunshot fracture of the femur is the most frequent form of fracture of the long bones, and the most dangerous to life, the mortality being, in wound of the upper third, 72 per cent.; middle third, 60 per cent.; lower third, 53 per cent. Formerly amputation was generally performed for this injury; but recent experience proves that expectant treatment affords the best results, especially when the wounded can be properly treated from the time of injury, and have not to be transported. Stromeyer has done much to establish this principle of treatment. After the battle of Langensalza, out of 38 cases of fracture of the femur, 28 recovered under conservative treatment; and the writer had an opportunity of seeing the cases under Stromeyer's care in the field hospital at Floing, close to Sedan, where 24 cases of fracture of the femur recovered out of 34—a per-centage of 70·6 per cent.

Fractures of the leg are not nearly such dangerous injuries as those of the thigh. When produced by shell-fragments the damage is often so extensive as to demand amputation, especially when in the neighbourhood of the knee. Bullet wounds often cause very extensive fissuring, which may involve either the knee or the ankle joints. In these, although primary amputation may not be deemed necessary, subsequent inflammatory changes may render it imperative at a later period; otherwise, expectant treatment yields, in general, better results than operative interference.

The mortality after amputation of the leg varies in an extreme degree in different campaigns. During the American war it was only 26·02 per cent.; in the English army in the Crimea 34·52 per cent., whilst among the French it reached 71·95 per cent.; among the Germans in the war of 1870–71 it was about 36 per cent., whilst among the French troops during the same campaign the deaths after amputation of the

leg amounted to the frightful mortality of 82·34 per cent.

In injuries of the foot and ankle, conservative treatment is in the first instance to be adopted. If this fail, secondary excision of the ankle-joint may be performed —an operation which has attained, in Langenbeck's hands, the most brilliant results—or such portions of the foot only amputated as it may be impossible to preserve. The death-rate after amputation at the ankle-joint is not great. During the American war it amounted to 13 per cent. Gunshot injuries to the tarsus generally are not very dangerous, and often heal, as Stromeyer has pointed out, with unexpected facility after the extraction of the bullet. When, as the result of inflammatory processes, caries or necrosis of these bones is set up, the methods of treatment adopted will be identical with those employed for similar conditions occurring in civil practice.

The difference of opinion amongst the older surgeons as to the comparative merits of primary and secondary amputation has long since been settled in favour of the former.

As regards the place of amputation, only what is irretrievably damaged should be removed. The maxim 'Jeder Zoll, dem Leben naher!' should be borne in mind. Every inch removed adds to the patient's risk. It is, however, sometimes difficult to determine the degree of injury inflicted on the soft parts. In cases of severe contusion and laceration, the damage to the skin and muscles often extends further than is apparent, and after operation, gangrene of the flaps, necrosis of fascia, and suppuration in the intermuscular cellular tissue follow. Where the amputation is performed during the secondary period it is easy to determine the place of operation, and it is by no means necessary to discard the infiltrated and inflamed skin, or tissues through which fistulæ pass; they may often be used for covering the stump, all granulation tissue being previously scraped away, the surface disinfected, and good drainage provided for. At one time a limb was often amputated at a higher point than the injury rendered necessary in order the more readily to accommodate the stump to the instrument-maker's apparatus, a proceeding now properly abandoned. The instrument-maker should accommodate his apparatus to the stump just as much as a shoemaker fits his boot to the last.

This is not the proper opportunity to discuss the various methods of operation. Suffice it to remark that the flaps to cover the bone must be made much more ample than is needful in cases of disease. This is especially true of muscular flaps. The muscles are large and thick, and the skin retracts to a greater degree than in a limb the subject of disease; the operator is therefore not unlikely to underestimate the amount of covering required. As a rule, only a limited amount of muscle should be preserved in the flaps. In all cases where it is practicable, a circular or flap-shaped piece of periosteum should be detached from the bone to a sufficient extent to allow the cut end to be covered by it. The subsequent risks are thus diminished, the periosteum protects the medullary cavity, there is less chance of necrosis, and the stump subsequently is less sensitive and better able to sustain pressure. It is easy to separate the periosteum with an elevator, and it should be detached from the bone in such a manner as to retain its connection with the external soft parts. The more quietly and deliberately an operation is performed the better. Bleeding points should be secured as soon as possible with pressure-forceps. Too much pains, time, and attention cannot be bestowed on the task of thoroughly arresting the bleeding from every point. The occurrence of reactionary bleeding, necessitating as it does a change of dressing, diminishes considerably the chances of the patient's recovery. So far as they are practicable, strict antiseptic precautions should be adhered to throughout.

The rules laid down with regard to amputation are equally applicable to disarticulations. The operation is scarcely so favourable as amputation. It is more difficult to execute, and often involves a larger sacrifice of tissue, while artificial apparatus is more difficult to apply. For some of the joints the flaps are made of skin only, and in some, as at the knee, they are so long as to be extremely liable to gangrene; in others, as at the hip, muscle is usually included.

The mortality after amputation has very much diminished during recent wars; there are, however, no considerable statistics giving the results of operations performed with antiseptic precautions, and the tables of mortality hitherto recorded can only afford us the comparative rate of death after operations in different regions. Fischer has added together the results of the Crimean, Italian, American, Schleswig-Holstein, and Franco-German wars. He finds the mortality after amputation of the thigh is 82·6 per cent.; of the leg, 61·3; of the foot, 46·7; of the arm, 37·4; of the forearm, 21·2.

The comparative mortality of disarticulation arrived at in a similar manner is, after the disarticulation at the knee, 68 per cent.; at the shoulder, 62·8; at the elbow, 24·0; at the wrist, 42·2. Disarticulation at the hip-joint gives a mortality for primary operations of 91·6 per cent.; intermediate, 95·2; secondary, 76·6.

The antiseptic method of treatment will change all these figures. Schede gives tables of 321 cases of amputation treated antiseptically, in which only 14, or 4·4 per cent., died. 86 of these cases were amputations of the thigh, with 6 deaths, or 6·9 per cent. 69 amputations of the leg, with 1 death, 1·4 per cent. Amongst the 14 deaths, there were only 2 cases of pyæmia. Of 387 cases of amputation of equal importance, treated according to the old plan, 110, or 29·18 per cent., died, and there were 98 cases of pyæmia. Schede further calculates that, if the cases of pyæmia be omitted, the number and causes of death were almost identical in the two series.

The chief causes of death shortly after the operation are shock, hæmorrhage, and exhaustion; those occurring later are almost always from septic poisoning. It has been observed in recent wars, by the majority of surgeons, that pyæmia becomes much more frequent during the later periods of the war than at the beginning.

The operation of excision of joints is more generally applicable and followed by better results in the upper than in the lower limb. As regards the function of the limb afterwards, secondary resection is better for the function of the part than primary. This is especially true of the shoulder, elbow and ankle. The mortality is, however, higher. According to the returns in Circular VI., the results ascertained in these cases were as follows:—

	Deaths	Mortality
Of 210 primary resections . .	50	23·8 p.c.
Of 298 secondary ditto . . .	115	38·8 „

When the Shoulder-joint is largely opened into, and the head of the bone or glenoid cavity fractured, excision may be performed, and the same rule holds good in the elbow and wrist. The best method of operation is by means of a straight incision in front of the shoulder-joint, and at the back of the elbow and wrist joints. The periosteal investment of the bone, together with the muscular attachments, should be scrupulously preserved. It materially diminishes the amount of bleeding at the time, and enhances the power of joint-movement afterwards.

Esmarch has published the results of 40 cases of excision of the Elbow; 6 only died, while 32 recovered with a more or less useful arm. One of the two remaining cases was amputated; the other never healed.

In 285 cases of excision of the elbow recorded in the American reports, the mortality amounted to 21·67 per cent. According to Billroth, the mortality after excision of the shoulder is 35 per cent., whilst among the injuries of that joint treated conservatively the mortality was 52 per cent.

The after-treatment of cases of excision in the upper limb should be simple. Stromeyer's cushion is the best apparatus for shoulder and elbow excisions, and as free movement is the result sought for, passive motion should be resorted to as early as possible.

Gunshot injuries of the Hip-joint have been regarded as very hopeless cases. Great doubt must exist in many cases as to the exact extent of the injury; the parts are very inaccessible, the symptoms uncertain, and a precise diagnosis often impossible. Out of 385 cases observed during the American war in which gunshot fracture was believed to have involved the joint-surfaces, 304 were treated expectantly, in 55 excision of the hip-joint was performed, and in 27 the limb was disarticulated. In the 304 cases the mortality was 81·9 per cent. Of 33 cases involving the acetabulum and head of the femur, only one recovered. The other cases of recovery were fractures in the neighbourhood of the joint, in a few of which it was undoubtedly involved.

Langenbeck has recorded 25 cases of injury of the hip followed by recovery during the war of 1870–71. It would be for the interest of surgical science that the precise extent of the injury to the joint in these cases should be ascertained by post-mortem examination.

During the American war the mortality after excision of the hip-joint was 90·6 per cent. In a total of 171 cases of excision collected from various sources, the death rate was 86·5, the mortality following the operation being somewhat less during later wars. Both after excision and amputation the mortality is greatest among those cases operated on during the intermediate period. It is least during the secondary period, when it closely approaches that for similar operations performed for disease in adults of the same age. Nevertheless, the disastrous results following gunshot fracture involving the hip-joint will prompt the surgeon to perform primary excision, rather than to

expose his patient to the enormous risks of the inflammatory period; the fact that 23 survived out of 171 cases of excision, 1 being amputated and 22 possessing a more or less useful limb, is an encouraging result in a very hopeless class of cases.

In 250 cases of amputation at the hip-joint for gunshot injury, collected from different sources, 27 recovered, the mortality being nearly 90·0 per cent.

Of 27 primary amputations, 3 recovered. Of 23 intermediate amputations, all died. Of 9 secondary amputations, 2 recovered. The operation had therefore better be performed at once, unless it can be more safely delayed until the secondary period.

Secondary excision is demanded in cases of caries or necrosis, or secondary implication of the joint-surfaces.

Disarticulation at the hip-joint should be performed when the thigh is torn off; the upper extremity of the femur comminuted, with great laceration of the soft parts too high for amputation in continuity; for fractures of head, neck, or trochanters, complicated with wounds of the femoral vessels; for fracture involving the hip-joint, complicated with compound fracture lower down, or wound of the knee or ankle joints.

Knee-joint.—During the American war the opinion was generally in favour of immediate amputation for gunshot injury of the knee, and with few exceptions this also was the opinion of all former writers; in about one-fourth of the cases expectant treatment was adopted, with an attendant mortality of 60·6 per cent. The cases reserved for expectant treatment were the most favourable ones, and in 117 of the cases which recovered the patella only was fractured, and the synovial cavity not opened in the first instance. The result, nevertheless, contrasts unfavourably with the mortality after amputation of the thigh for gunshot fracture of the knee, which was only 51·1 per cent.

In a certain number of the cases the capsule only was injured, or only trifling damages inflicted upon the bone. In these the mortality was only 27 per cent., and such cases should when diagnosed be treated conservatively. Bergmann reports 21 cases without bony lesion during the Russo-Turkish war; 18 recovered, in 3 the result was unknown, and in 31 cases involving the bone 20 recovered and only 1 died. Langenbeck believes recovery to be much more common than is generally supposed in gunshot fractures of the knee-joint.

Primary excision of the knee is an operation which is scarcely justifiable in military practice, the mortality being 86·6, far in excess of amputation of the thigh, and the experience of later wars shows a similar excessive mortality. With our present knowledge we must pronounce an emphatic opinion against it. Amputation through the knee-joint itself is a little more unfavourable as regards mortality than amputation of the thigh. In 10 per cent. of the cases, re-amputation was found to be necessary. The stump, however, after recovery is a very good one.

Ankle-joint.—During the American war the general opinion seems to have been in favour of amputation for gunshot fracture involving the ankle-joint. In 159 cases of amputation of the ankle-joint itself the results were ascertained, the mortality being 25·1 per cent., or 7·8 less than the death rate after amputation of the leg. These operations include Syme's and Pirogoff's amputations, with their modifications.

Excision of the ankle seems to be rather more dangerous than amputation; the operation was seldom complete. The primary operation was the more favourable as regards life. Langenbeck is in favour of secondary excision on account of the more complete restoration of the portions of bone removed. The mortality after excision varies in different estimates from 29 to 33 per cent. Among cases treated expectantly, the mortality appears to have been 20 per cent. Where amputation is required it will generally have to be performed in the leg. The mortality after primary amputation is 5·3 per cent.

It is hardly necessary to go into details with regard to partial amputations of the foot. Individual bones may often require to be excised in addition to the performance of the more recognised operations.

William MacCormac.

GUSTATORY NERVE, Division of; Stretching of.—Division of the gustatory nerve for the relief of pain, caused by cancer of the tongue, was practised by Hilton and, subsequently, by Charles H. Moore. By Moore's operation—in most cases preferable—the nerve is cut a little in front of the point at which it emerges from between the ramus of the lower jaw and the internal pterygoid muscle, to cross obliquely to the side of the tongue. At this point it lies near and just below a ridge, which can be felt by the fore-finger, on the inner aspect of the lower jaw.

The point of a curved bistoury is introduced well through the mucous membrane of the floor of the mouth, at about the

level of the last molar tooth, internal to the course of the nerve, and then made to cut out to the lower jaw and upwards, along its inner surface, in a direction corresponding with a line from the angle to the last molar tooth.

The relief may be considerable, at all events until the ends of the nerve have again united; but, unfortunately, the cases in which this operation is most likely to be required are those in which, from infiltration by cancer, the tongue is so fixed, and the landmarks are so obscured, that it becomes difficult to ensure division of the nerve excepting by incisions, which are by no means free from trouble in respect of hæmorrhage. Chloroform, also, may be necessary, and, in that case, the guide as to the division of the nerve, given by the patient's sensations, will be lost. On these accounts the operation is not now very frequently performed. In many cases, too, relief can be given in other ways. See *Palliative Treatment* under TONGUE, Diseases of the.

The gustatory nerve has been divided for the relief of obstinate neuralgia. Its division, in such a case, presents no difficulty. The nerve has also been *stretched* for the relief of the same complaint. Clement Lucas observed, in a case under his care, that on pulling the tongue strongly forward and to the opposite side, the nerve stood out as a cord beneath the mucous membrane, and could be readily fixed by passing a small, sharp hook around it. On dividing the mucous membrane, the nerve was then easily caught up by an aneurism needle. The same operation may be performed when it is desired to excise a portion of the nerve; or the latter may be dissected out at about the level of the last molar, through a vertical incision extending through the mucous membrane and margin of the sublingual gland (Hilton's method).

W. MORRANT BAKER.

H

HÆMATOCELE. — Any effusion of blood into the tunica vaginalis, testicle, or spermatic cord is called a hæmatocele. We must speak separately therefore of (A) *Hæmatocele of the Tunica Vaginalis*; (B) *Hæmatocele of the Spermatic Cord*; and (C) *Hæmatocele of the Testicle.*

(A) HÆMATOCELE OF THE TUNICA VAGINALIS.—1. *Causes.*—These may be classified as predisposing and exciting. The predisposing causes are, atheroma of vessels, leading to their brittleness and loss of due elasticity, by which they are rendered liable to rupture from sudden increase of internal pressure; chronic inflammation of the tunica vaginalis with the formation of vascular granulation-tissue on the inner surface of the serous sac, and very delicate vessels easily ruptured; and hydrocele. The second of these causes is laid stress upon by Gosselin; but other authorities consider the appearances on which he relies for evidence in support of his view, as really secondary to the effusion of blood. Hydrocele is of extreme importance, as predisposing to hæmatocele; for not only does it very commonly necessitate an operation for its relief, during which some vessel may be punctured, but the distension of the tunica vaginalis renders the scrotum far more liable to contusions than it is in its normal condition. Owing to the testicle being immovable in the scrotum, all violence applied to this part acts upon the testicle, which is frequently ruptured by squeezes and blows that would be harmless in the normal state. The exciting causes of hæmatocele are strains rupturing vessels into the tunica vaginalis, blows and punctures. When a hydrocele is tapped, the mere removal of the pressure to which the vessels of the serous membrane have become habituated may lead them to rupture; or the lancet or trocar may wound a parietal vessel, or be thrust into the cord or testis. This is more liable to happen when a lancet is used than with a trocar, and this fact is a sufficient reason for preferring a trocar to a lancet in cases where the tunica vaginalis requires puncture. Strains and blows of moderate severity are causes of hæmatocele probably only when the natural resistance of the vessels is diminished by previous disease.

2. *Pathology.* — The tunica vaginalis may contain a mixture of serous fluid and blood in various proportions, in which coagula of blood are sometimes found floating; at other times the blood is altered and becomes converted into a dark fluid of syrupy consistence, resembling treacle in appearance, or, becoming still thicker, it looks more

like coffee-grounds, and contains cholesterine. When the sac contains pure blood, this may coagulate into a spongy mass, which may present quite a honeycombed appearance, being riddled with spaces containing serum. In other cases the fibrin separates from the blood in dense layers, like those usually found lining the sac of an aneurism, and a certain amount of dark blood-clot may be found in places between the concentric laminæ of fibrin, or filling up a central cavity. The tunica vaginalis itself is thickened by a deposit of vascular 'false membrane' on its inner surface; this is generally considered to be secondary to the effusion of blood, but Gosselin argues that it is really primary, and that the hæmatocele is due to the rupture of delicate vessels in this membrane. The testicle is generally found in the lower and posterior part of the sac; but in cases of inversion of this organ, it will be found in front. It may be unaltered in outline and structure, but usually it is flattened out by the pressure of the effusion, and in cases of long-standing hæmatocele the testicle may be greatly wasted. Occasionally the occurrence of hæmatocele is followed by inflammation and suppuration of the scrotal coverings, and the sac of the tunica vaginalis is then found to contain a mixture of pus, fibrinous coagula, and blood-clot. In very chronic cases, the sac may become calcified.

3. *Symptoms and Diagnosis.*—The sign of most constancy and value in the diagnosis is the rapid development of an opaque scrotal tumour after a strain or local injury, or the sudden enlargement of a hydrocele with loss of its former translucency. The tumour is limited to the scrotum, is ovoid in shape, sometimes becoming globular, smooth in outline, always opaque throughout, and often fluctuating; but this varies greatly in different cases or in the same case at different times, for when the blood coagulates, the tumour, like other solid tumours, is devoid of fluctuation. There is at the time of its early formation an absence of signs of acute inflammation, but these may develop later on; the skin may quickly become mottled or deeply stained with blood. If the finger be pressed into the tumour at different places, 'testicular sensation' may be excited at one particular part of the tumour, and indicate the position of the testicle. The cord above the tumour is not enlarged, and there is no swelling of the iliac or lumbar glands. It is usually stated that a hæmatocele is a heavy tumour; but it is very doubtful if this is of any value for diagnosis, and if, indeed, it is possible to detect the difference in weight of hæmatocele, hydrocele, and sarcocele. If a rapid effusion of blood occur, the patient may experience symptoms of syncope at the time. The tumour may remain stationary as a fluctuating swelling; or it may solidify and contract; or the parts may become inflamed, the swelling increasing, the skin becoming hot, bright red, and tender, and at length an abscess points and bursts, discharging pus mixed with 'coffee-grounds' material, or masses of laminated fibrin. The diagnosis largely rests upon the history of the first formation of the tumour—its suddenness or marked rapidity without signs of inflammation, and its connection with strain, a blow, or the tapping of a hydrocele. In some old cases of hæmatocele it is impossible to make a certain diagnosis from tumour of the testicle without exploratory puncture (where the tumour is fluid), or incision (where the tumour is solid); but the absence of persistent growth, enlargement of the cord, and glandular implication, and the detection of the testicle at one particular part of the swelling, are the signs on which reliance is to be placed. An exploratory puncture may evacuate treacly fluid or 'coffee-grounds' material, and lead to the partial or total collapse of the swelling; exploratory incision, where the tumour is solid, will show thick masses of laminated fibrin or spongy blood-clot. *See* Testis, Diseases of the.

4. *Treatment.*—If seen immediately, the patient should be put to bed, and the scrotum be raised on a pillow placed between the thighs, and a light bag of crushed ice and salt applied. The bowels should be freely opened with a dose of calomel, followed by a saline draught; the diet should be light and unstimulating, and at the same time the patient should lie as still and quiet as possible. This may succeed in leading to the absorption of the blood. Should absorption not occur, and the blood continue fluid, the tumour should be tapped in the same way as a vaginal hydrocele, care being taken not to injure the testicle, and if after the blood is withdrawn much thickening remain behind, the part should be firmly strapped—this will accelerate the absorption of the fibrin and blood-clot. If the tumour be wholly or largely solid, a free incision should be made into it. This should be done carefully and gradually, as it may be impossible in these cases to localise precisely the testicle, and the surgeon should therefore cut slowly down, examining each

section before deepening it; the softer central parts may be easily evacuated, and then the firmer outer layers should be stripped off the tunica vaginalis, and the wound plugged and allowed to granulate up from the bottom; or if the surgeon prefer it, he may place a drainage-tube in the cavity, and stitch up his skin-incision. Where the tumour is of very long standing, and the fibrinous masses are so adherent to the thickened sac that they cannot be detached from it, the whole mass—testicle and all—should be excised. Where, too, the surgeon is so unfortunate as to inflict an extensive wound upon the testicle, castration should be performed. When inflammation occurs, the patient should be put to bed and the scrotum be treated with hot belladonna fomentations; or equal parts of extract of belladonna and glycerine may be smeared thickly over the part, and plain hot fomentations applied over it. When suppuration is suspected or has evidently occurred, a free incision should be made into the tumour, all the pus and clots turned out, and the cavity allowed to granulate up from the bottom.

(B) Hæmatocele of the Spermatic Cord.—1. *Causes.*—This may result from direct injury—blows and the like—or from strain, and it may be predisposed to by the presence of an encysted hydrocele of the cord.

2. *Pathology.*—The blood may infiltrate the cellular tissue of the cord and its coverings, or it may be effused into the sac of a hydrocele, or, being small in quantity, may become circumscribed in the cord. In the first case the tumour may attain an enormous size, and is known as a diffused hæmatocele of the cord; in the two latter instances the tumour is small, and is known as encysted hæmatocele of the cord.

3. *Signs and Diagnosis.*—Hæmatocele of the cord is a very rare affection. When diffused it may attain an enormous size, forming an elongated tumour, which may overlap the thigh for many inches; the tumour is boggy to the touch, dull on percussion, and the skin over it is freely movable. When encysted, the tumour is much smaller, tense, globular or ovoid in shape, opaque, with more or less distinct fluctuation, and fixed to the cord. Such a tumour may have been preceded by a smaller, translucent tumour. In either case the tumour will have followed more or less immediately upon a strain or blow on the part.

4. *Treatment.*—A diffused hæmatocele, when recent, should be treated by rest, and the local application of cold, aided by a free purge and low diet. When this proves ineffectual, or the case comes for treatment at a later stage, absorption of the blood may be aided by counter-irritation by means of fly-blisters to the part, or painting it with tincture of iodine night and morning. Should these measures fail after a fair trial, and the tumour be of distinct inconvenience to the patient, the surgeon should make a free incision into it for its whole length, let any blood that will, escape, and then plug the wound and allow it to granulate up. Encysted hydrocele in the acute stage may be treated like the diffused; if absorption do not occur and the blood remain fluid, it may be tapped with a trocar; and should this fail to effect a cure or the tumour be found to be solid, it should be freely incised and the entire sac dissected carefully out from the cord; or the surgeon may content himself with turning out all the contents of the cyst and plugging the wound.

(C) Hæmatocele of the Testicle consists of two distinct affections: hæmorrhage into an encysted hydrocele—encysted hæmatocele of the testicle; and hæmorrhage into the substance of the gland itself—parenchymatous hæmatocele. Both are rare, the latter especially.

Encysted Hæmatocele of the Testicle.—1. *Causes.*—This condition only occurs secondarily to an encysted hydrocele of the testicle, the effusion of blood being due to injury, such as a blow or squeeze rupturing a vessel in the cyst-wall. Tapping such a cyst may be followed by hæmorrhage, as in the case of vaginal hydrocele.

2. *Pathology.*—The pathology is exactly similar to that of vaginal hæmatocele. *See* also *Encysted Hydrocele*, under Hydrocele.

3. *Symptoms and Diagnosis.*—In its position and general characters the tumour resembles an encysted hydrocele, being tense, globular, and adherent to the testicle or epididymis. It differs, however, in being opaque; the fluctuation in it is less distinct, and there may be marked tenderness. The diagnosis is further aided by the fact that the swelling, which is of a chronic nature, has rapidly or suddenly increased after a squeeze or some similar injury to the parts, or that the swelling has rapidly re-formed after tapping a hydrocele.

4. *Treatment.*—In the acute stage, rest and cold applications are indicated. Later on the cyst may be tapped and injected with iodine, or freely incised, evacuated, and dressed from the bottom; where the blood has coagulated but is not absorbed, the latter is the only appropriate treatment.

Parenchymatous hæmatocele is an effusion of blood inside the tunica albuginea. It is always the direct result of a severe injury to the testicle, and is a cause of acute pain. The blood is poured out from the layer of fine vessels beneath the tunica albuginea called the tunica vasculosa. This condition is probably in all cases associated with vaginal hæmatocele, which obscures the enlargement of the testicle. The blood may be absorbed, or may remain as a firm or friable mass, or may lead to the softening of the tunica albuginea and its ultimate rupture. The tubular structure of the testicle is compressed, and the organ probably never regains its former size or functional activity.

1. *Symptoms and Diagnosis.*—When, combined with the signs of vaginal hæmatocele, there is severe and persistent pain in the testicle, extending up along the groin to the loin, and the testicle is found very sensitive to pressure, a parenchymatous hæmatocele may be suspected. When, on tapping, or otherwise evacuating the vaginal sac, the testicle is found to be enlarged and tender, this diagnosis becomes assured. If the scrotum is freely incised, the wound does not heal and the enlarged testicle presents, and a dark or livid protrusion from its surface may be recognised; in some cases fluctuation may be detected in this projection.

2. *Treatment.*—When there is reason to suspect this condition, great care should be taken to ensure absorption of the effused blood by rest, cold applications, purgatives, and suitable diet. Should the vaginal hæmatocele be absorbed or yield to simple tapping, the enlarged testicle should be carefully strapped. If the scrotum is incised, and the position of the parenchymatous hæmatocele can be verified by fluctuation, livid colour, or obvious protrusion, a free incision should be made into it and the blood be turned out. Great care should be taken to render such a wound aseptic.

A. Pearce Gould.

HÆMATOMA. *See* Bruises; Head-injuries; Scalp, Injuries and Diseases.

HÆMATOMA AURIS. *See* Ear, External, Diseases of the.

HÆMATURIA.—*Definition.*—Blood derived from any part of the urinary system—be it from its secreting, conducting, or collecting divisions—and passed pure, or mixed with urine, constitutes the symptom known as hæmaturia. It will be observed that the above definition is so framed as to include urethral hæmorrhage, which is always admitted for convenience' sake under this heading, though not strictly speaking hæmaturia. Hæmaturia is a symptom which may occur, not only in the course of most of the diseases and injuries to which the tract is liable, but also in some morbid conditions of the blood, e.g. purpura, scurvy, smallpox, typhoid, &c., and in some cases of metallic poisoning, e.g. mercury, lead, arsenic. The colour of the urine may vary through many shades, from a cherry red (1 in 800, Ralfe), to a maroon colour, or from a smoky or beef-tea aspect to a porter-black, according to the proportionate admixture of the two fluids, and the extent to which the methæmoglobin, or the oxyhæmoglobin has been altered by the action of the urine.

Fallacies.—These colours may be simulated by the effect upon the urine of particular drugs or certain articles of diet—e.g. senna and rhubarb give a reddish tinge to alkaline urine; carbolic and salicylic acid impart a brownish colour, while beetroot, sorrel, and prickly pear produce a blood-red aspect. Again the urine in certain pathological conditions—e.g. in severe jaundice, melanosis, and splenic fever—assumes a deep brown colour, while in the female the mere admixture of menstrual discharge may deceive by its colour a careless or superficial observer.

Tests.—The following are reliable:—

Microscopical.—Blood-corpuscles are seen more or less altered by the action of the urine. *Fallacies.*—In hæmatinuria they are absent, and in very alkaline urines they are only detected with difficulty.

Spectroscopical.—Blood, even in minute quantities, will give two absorption-bands between the Frauenhofer lines D and E in the yellow and green of the spectrum.

Chemical (*a*). The formation of Teichmann's crystals on heating traces of blood with glacial acetic acid and a crystal of salt; (*b*) invariable presence of albumen; (*c*) a particoloured fluid being left after the settling of the brick-red precipitate produced by boiling the urine with caustic soda.

It is imperative to ascertain the site and cause of the hæmorrhage. We may divide these sources into three groups: (*a*) renal, including the pelvis of kidney and ureter; (*b*) vesical, including the prostate; (*c*) urethral.

Differential diagnosis of source of blood.—1. *Colour*, in bright florid urine it is probably of vesical, in dark or smoky urine of renal origin. *Fallacies.*—If from any cause the blood has been retained in the bladder, it will assume a dark colour in proportion to the action of the urine upon

it; indeed, sometimes, if long pent up in that viscus, it may be evacuated like tar or molasses. Again, if the blood issues in large quantities from the pelvis, rapidly traverses the ureter, suddenly distends and thereby stimulates the bladder, it will be expelled thence, bright, fluid, and unchanged.

2. *Reaction.*—Bloody urine, if acid, is generally of renal source; if alkaline, of vesical origin. *Fallacies.*—(*a*) ingestion of alkalies (inducing alkalinity of urine); (*b*) a profuse effusion of blood, or (*c*) an excessive production of pus, may mask, by their alkalinity, the natural acidity of the renal secretion. In these cases the hæmorrhage may be from the kidney, although the reaction would point to vesical mischief.

3. *Aspect of clots.*—By floating the coagula in water, they may so unravel as to afford us a clue to the seat of the hæmorrhage. The softer, the brighter, the plumper the clot, the fresher is the effusion and the nearer is the site of the hæmorrhage to the outlet. The more decolorised and eroded the clot, the longer has been its retention in the tract. Slender cylindrical worm-like clots are generally moulds of the ureter; thus they localise bleeding in or above that canal. Large, irregular, shapeless, edge-eroded clots are usually of vesical origin. Leech-like, ovoid clots are from the posterior portion of the urethra, and long bougie-like coagula are from its anterior part. *Fallacy.*—The blood may have been of renal origin, or have regurgitated from the urethra and become moulded in the bladder; thus renal or urethral hæmorrhage may simulate vesical.

4. *Aspect of urine on micturition.*—If the blood issues independently of micturition, or if it is evacuated first and then followed by clear urine, the source is urethral. If the urine is at first clear, or only tinged with blood, becoming darker, or even like pure blood, at the close of the act, it is vesical. If uniformly mixed, it is, most likely, renal. *Fallacy.*—Blood issuing from the bladder-wall, or regurgitating from the urethra, may become so intimately mixed with the urine there collected—especially if the quantity of the blood be small—as markedly to simulate renal hæmaturia.

5. *Microscopical.*—Blood-casts are conclusive proofs that the secreting substance of the kidney is involved. Triple-phosphate crystals in freshly passed urine are tokens of vesical mischief.

6. *Instrumental.*—Wash out the bladder very gently, three or four times, and notice the colour of the washings; now insert a gum-elastic or flexible catheter just within the thus emptied bladder; the urine will trickle directly from the ureters into the eye of the instrument (Sir H. Thompson). Compare carefully the samples thus obtained.

7. *Symptoms.*—Certain symptoms referable to source are usually obtainable. Heat, tenderness, aching or pain in one or both loins, numbness of leg, retraction of testicle (in stone, not carcinoma) would point to renal origin; supra-pubic, perineal, or penile pain, dragging weight in perineum, dysuria would indicate a vesical source, or at least implication of that viscus.

Pathology and Etiology.—Any active or passive hyperæmia, any inflammation or ulceration, any vascular rupture in any section of the urinary tract, may give rise to hæmaturia. *Renal:* active hyperæmia (cantharides or turpentine), passive hyperæmia (thrombus of renal or inferior caval veins), embolism, renal diseases, traumatism, stone, neoplasms, calculous or tubercular pyelitis, transit of ureter by a stone. *Vesical:* traumatism, inflammation, ulceration, or enlargement of prostate; sudden evacuation of a chronically distended bladder; stone or foreign body, neoplasms, cystitis, varix vesicæ, ulcerations (tubercular, diphtheritic), parasites, (Bilharzia hæmatobia). *Urethral:* traumatism, stricture, impacted stone, acute gonorrhœa, chancre, neoplasms.

Diagnosis of cause.—The history and age of the patient are to be considered, all subjective and objective phenomena carefully weighed, and thorough examination of the abdomen and urine undertaken; but space will only permit us to point out that abdominal palpation may reveal a renal tumour, supra-pubic and rectal examination may disclose an infiltration or growth of the bladder, maybe an enlargement, or a deposit or growth in the prostate. The sound may detect a stone, or, by a sense of resistance, a vesical growth. The catheter may withdraw in its eye a shred of growth or disintegrating villus. Again, the microscope may confirm our suspicions of malignancy, aroused by the passing of small semi-gelatinous masses; or it may give us a clue to the calculous diathesis or formation, by the aspect of the crystals found in the urine; or it may demonstrate the bacillus tuberculosus in the small whitish clumps passed in pyuria mixed with blood, when these are stained with Ehrlich's solution; or, lastly, it may reveal the ova of the Bilharzia.

The hæmorrhage may be profuse in

traumatism, stone, or neoplasms. It is generally slight in active or passive renal hyperæmia, in embolism, in inflammation or superficial ulceration of the tract. Dark, porter-like urine, passed without pain or any other symptom, is most probably renal. Hæmorrhage in vesical carcinoma is generally sudden, profuse, and irregular in its occurrence; in villous disease it is slight but persistent.

In non-malignant vesical growths the hæmorrhage occurs suddenly, and usually precedes the pain and dysuria. In malignant disease this is generally reversed.

Prognosis.—If the hæmorrhage occurs in the course of febrile disease, it is unfavourable; without reference to the cause it may be said to depend upon the suddenness of the onset, the amount lost, the capability of bearing that loss, and the age and sex of the patient. The dangers which may arise from the *clot* are (*a*) absolute retention, (*b*) pyelo-nephritis from its decomposition, and (*c*) the formation of a stone upon it as a nucleus, all of which are luckily rare.

Treatment.—Enforce, if possible, (1) absolute rest in the recumbent posture; (2) efficient application of cold. If renal, Leiter's tubes moulded to the loin; or, failing this, ice-bags or cold wet wraps to the same part. If vesical, Leiter's tubes or ice-bags adjusted to the supra-pubic and perineal regions. Ice in the rectum; ice-cold vesical and rectal injections. If urethral, pass a full-sized sound and gently apply a finger-bandage to the penis; apply ice-bag to the perineum.

Internal hæmostatics: Ext. ergotæ liq. fʒss.; Acid sclerotici (hypodermically), gr. ¼ to gr. j.; Liq. ferri perchlor. ♏x. to fʒss.; Liq. ferri pernitratis ♏x. to fʒss.; Acidi gallici gr. x.; Acidi tannici gr. x.; Infusi matico, fʒij. Tr. Hamamelis Virgin. fʒss.; Plumbi acetat. gr. iij.; Ol. terebinth. ♏v. in passive hæmorrhages, administered cautiously.

Opium is of great value in every case, except it be in renal disease.

The following injections in vesical hæmaturia are of value: Alum gr. xx. to the pint; Nitrate of silver gr. j. to gr. iij. in fʒviij.; Liq. ferri perchlor. ♏xx. to ♏lx. in fʒviij.; Tr. Hamamelis Virgin. fʒj. ad fʒiv. Should the bladder become distended with coagula, it will be felt above the pubes as a hard round mass. Opium must be given freely to allay the dysuria, and the clot allowed to come away by itself.

If, however, absolute retention ensues, which is rare, or if enlarged prostate or atony of the bladder co-exist, a soft rubber catheter must be introduced, and a lithotrity evacuator adapted to it; thus the coagula can be carefully, slowly, and safely withdrawn.

E. Hurry Fenwick.

HÆMOPHILIA.—A hæmorrhagic diathesis, which is usually inherited, and in nearly all cases manifests itself during the first few years of life. Painful swellings of the joints are frequently associated with the disorder.

Cause.—Hæmophilia seems to be more common among the inhabitants of northern countries, but probably occurs in all parts of the world. Heredity is the only undoubted etiological factor, though gout, scrofula, tuberculosis, frights received by the mother during pregnancy, and consanguinity of parents, have all had a certain influence ascribed to them.

The hereditary transmission of the disease is usually characterised by a peculiar and definite order. For whereas the male sex is specially prone to hæmophilia, the disease is handed down through the females. In a typical case the children of a bleeder remain free from the disease, but hæmophilia reappears in the daughter's sons; these, again, beget healthy children, and transmit the disorder through their daughters to their grandsons. The daughters of a bleeder may also pass on the hæmorrhagic tendency, through their own daughters, to the sons of the latter. In none of these cases, as a rule, are the females themselves bleeders. The healthy brothers of a bleeder appear not to transmit the disease to their descendants. In rare cases the children inherit the tendency directly from their father or mother. More rarely still the females in a bleeder family manifest a greater proclivity to hæmophilia than the males. Bleeders are extremely prolific, but the proportion of the members of a given family that manifest the disease varies considerably. In some instances, hæmophilia seems to arise *de novo*.

Pathology.—No constant morbid changes have yet been detected in any part of the body. The blood shows no alteration whatever, and coagulates naturally until repeated hæmorrhages beget a condition of hydræmia, similar to that produced by any profuse bleeding. Coagulation then becomes defective. Changes have been found in different parts of the vascular system, but with no constancy. It is probable, nevertheless, that there is some subtle change in the small vessels. In certain cases there seems to be a state of plethora. A more

intimate knowledge of the chemistry of the blood may possibly enable us to detect some error in its composition. The pathology of hæmophilia is still obscure.

Symptoms and Diagnosis.—Bleeders present no characteristic appearance whatever. Profuse and repeated hæmorrhage is the only positive symptom of the disease. The bleedings may take place from some free surface or cavity of the body, or they may be interstitial. They may be divided into two varieties, spontaneous and traumatic, which are often combined in the same subject. The spontaneous bleedings usually arise from some mucous membrane, less frequently they occur beneath the skin. In the traumatic form, the blood may come from almost any part of the body. The traumatic type is almost confined to the male sex. Both sexes, however, are liable to the spontaneous form of hæmophilia, which commonly takes the shape of epistaxis, or profuse menstruation in women. In fully half the cases recorded, hæmophilia declared itself during the first year, and in seventy per cent. the bleedings began before the end of the second year. The disease rarely makes its appearance later than the tenth year, and in no instance has it developed after the age of twenty-two.

As a rule the child is born without suffering any loss of blood, and division of the umbilical cord rarely causes serious hæmorrhage. Separation of the stump of the cord has occasionally been followed by considerable bleeding. More often the child seems healthy for some weeks or months after birth, until it is suddenly attacked by profuse hæmorrhage. This frequently takes place at the period of the first dentition, when the child begins to crawl about and is liable to slight injuries. In most cases the first bleeding is traumatic, though a tendency to spontaneous hæmorrhages usually develops subsequently. A tendency to traumatic hæmorrhage is found in the most marked cases, but is often characterised by great fluctuations in intensity. At times, the slightest injury is sufficient to cause alarming loss of blood. Similar or even graver accidents may lead to comparatively trifling hæmorrhage on other occasions.

Analogous variations in the tendency to spontaneous bleedings are also observed. Some bleeders recover rapidly from the effects of severe hæmorrhage, while others become profoundly anæmic and succumb, at last, to repeated losses of blood. Most of the well-marked cases of hæmophilia terminate fatally after frequent hæmorrhages. In some cases the hæmorrhagic tendency gradually declines with advancing years, and in one or two instances has suddenly and completely disappeared. If the period of puberty be safely passed, there is a fair chance that the patient may outgrow the disease.

The attacks of bleeding are sometimes preceded by symptoms of congestion of a more or less definite nature. Generally they come on without any warning, often in the night. Except when a large artery is injured, the blood oozes continuously from the affected part, and probably comes from the capillaries. The mucous membrane of the nose is the most frequent source of the bleeding. Next in order comes the cavity of the mouth and the gastro-intestinal canal. Subcutaneous hæmorrhages are not infrequent, and usually appear as irregular ecchymoses; at times they give rise to large fluctuating blood-tumours. The blood, in such extravasations, has a tendency to remain fluid for a long time. The skin of the extremities is the part most frequently affected. The uro-genital and respiratory tracts are less often the seat of bleeding. Cerebral and meningeal hæmorrhages are very rare. Extraction of a tooth is one of the most dangerous and fatal of all injuries, as the bleeding in such cases sometimes resists all treatment. Friction of a jagged tooth against the cheek or tongue, and the slightest abrasion of the gums, such as that caused by a toothbrush, have produced alarming results. Division of the frænum linguæ, circumcision, and blood-letting are also fraught with great danger. It is remarkable that serious bleeding is hardly ever caused by vaccination.

The peculiar joint-affection of hæmophilia, long considered to be rheumatic, has now been proved in some cases to be due to hæmorrhage into the joint, and this would seem to be its usual cause. It is probable, however, that some of the swellings are purely inflammatory. The affection consists in painful effusion into the joint, combined, at times, with ecchymoses of the skin. Any of the larger joints may be attacked, but especially the knee. The swellings are very apt to recur, and may lead to permanent enlargement or destruction of the joint, or to anchylosis. As a rule the swelling occurs spontaneously, especially in cold, damp weather, and is only exceptionally the result of an injury. The joint-affection is almost confined to the severe traumatic form of hæmophilia, and is rarely seen except in the male sex. Pains in the limbs are very common, and are often

due, probably, to small hæmorrhages into the muscles and other tissues of the part. The urine and other secretions appear to undergo no important alteration.

Diagnosis.—Hæmophilia in its traumatic form, or when it is both congenital and hereditary, can be mistaken for no other disease. Difficulties in diagnosis arise when a tendency to spontaneous bleedings appears in a member of a healthy family. If the diathesis show itself within the first two years of life, and especially in a male child, the disease is probably hæmophilia. The diagnosis is more doubtful in the case of a girl, or when the tendency appears at a later age.

A hæmorrhagic diathesis, in women who are not of a bleeder family, must not be taken for hæmophilia unless the hæmorrhages has begun during early childhood. In the case of umbilical hæmorrhage, the diagnosis would turn on the presence or absence of hereditary disposition.

Hæmophilia can scarcely be confounded with purpura or scurvy, which are transitory disorders, and are neither congenital nor inherited.

Treatment.—A bleeder must of course be protected as far as possible from all accidents, and should avoid excitement of any kind. A nutritious and digestible diet, without alcohol in any form, warm clothing, gentle exercise, and residence in a temperate climate are desirable. Vaccination should not be omitted. No woman in a bleeder family, whether she be a bleeder or not, and no man who is himself the subject of the disease, ought to marry. The treatment of the hæmorrhage is generally unsatisfactory. Complete rest in bed is to be insisted upon invariably. Although internal medication alone avails little, it seems well to combine the use of drugs, like acetate of lead, ergot, turpentine, &c., with local applications, whenever it is feasible, and to administer a saline purge. Frequently, however, all treatment fails, and the patient bleeds to death. At other times the bleeding stops of itself after profound anæmia, or even syncope, has been induced. In traumatic external hæmorrhage the part should be elevated, and careful pressure applied with a pad steeped in liq. ferri perchlor. It must be remembered, however, that excessive pressure is liable to cause gangrene. Ligature of a large artery has only once been successful hitherto, and cannot be recommended. Experience of the use of the actual cautery is not encouraging. In spite of its risks, transfusion seems justifiable as a last resource. The hæmorrhage resulting from extraction of a tooth should be treated by plugging the cavity with lint saturated with liq. ferri perchlor., which may be secured by a small gold plate wired to the adjoining teeth. Ligature of the common carotid, in one case, arrested the dental hæmorrhage. Extraction of teeth must on no account be attempted in a bleeder, and warning should be given of the risk of the operation when the disease can be recognised. Subcutaneous extravasations and blood-tumours must not be opened unless gangrene be threatened, but are to be treated by rest. It is important to deal promptly with the joint-swellings by means of splints and confinement to bed, as the affection is apt to become inveterate. It is hardly necessary to state that all cutting operations are inadmissible; even such measures as leeching, cupping, and blistering should be avoided.

PERCY KIDD.

HÆMOPTYSIS FROM INJURY.—The spitting of blood which takes place after injury to the chest is almost certainly pathognomonic of some lesion of the lung or trachea. It is characterised by the expectoration of frothy light-red blood, which, from being mixed with a large proportion of mucus, but rarely coagulates. Its amount is seldom large, and its colour speedily changes to the rust-red of pneumonic sputum. Should any very large amount be expectorated, it should lead to the suspicion of some previously existing cavity or tubercular disease of the lung. A penetrating wound involving the trachea and some large blood-vessel may, however, give rise to extensive hæmorrhage, which is coughed up, and thus simulates hæmoptysis. The bleeding in such a case is not exactly like an ordinary case of hæmoptysis. Although the blood is coughed up, it comes away more in gushes, is less frothy and deeper red in colour than in hæmoptysis, and has a greater tendency to coagulate. This arises from the blood of true hæmoptysis being more mixed with the mucus and air of the lung than in the cases where it comes from a wound in the trachea.

The blood of hæmoptysis may be distinguished from that coming from any other source by its light-red, frothy character, showing that it has been intimately mixed with the air of the vesicular tissue of the lungs. This admixture never takes place with the same completeness, even when the bleeding takes place from any other part of the air-passages. Thus the hæmorrhage of epistaxis is often abundant

and florid in colour, but does not possess the frothy character. On the other hand, blood coming from the stomach or throat scarcely ever is florid, and is never frothy. Blood from the stomach is generally more or less dark in colour, in accordance with the length of time it has stayed in that viscus; and when it has been there sufficiently long to undergo the action of the gastric juice we get the well-known coffee-ground or black vomit of hæmatemesis.

The *treatment* of hæmoptysis from injury will be found detailed under Pneumonia, Traumatic. H. G. Howse.

HÆMORRHAGE.—This signifies the loss of blood from some part of the arterio-venous system. It need not necessarily flow out of the body, for bleeding, even to a fatal amount, may occur without external lesion. Sometimes, for instance, it will flow into one of the natural cavities. Thus the pleura or peritoneum may be distended with blood, constituting what is known as internal hæmorrhage; or blood from a ruptured vessel may be effused into the neighbouring areolar tissue, a condition known under the name of extravasation.

Bleeding may occur from arteries, veins, or capillaries. Arterial hæmorrhage is, as a rule, the most serious, owing to the high blood-pressure in the vessels, and thus, in a given time, a far larger amount of blood is lost from an artery than from a vein of the same magnitude; nevertheless a fatal hæmorrhage may readily occur from a wounded vein of any size. Capillaries or minute vessels, when injured, bleed freely for the moment, but rapidly close and the bleeding ceases. To this rule, however, there is sometimes a remarkable exception, and occasionally an uncontrollable hæmorrhage occurs from vessels too minute to be recognised by the naked eye. The peculiar constitutional state that leads to this form of capillary bleeding is known under the name of the Hæmorrhagic Diathesis.

Patients with this diathesis will bleed persistently from the slightest injury. The blood does not flow rapidly away, but escapes as a continuous slow oozing, and the writer has seen a case of death in these circumstances following a cut on the lip of the most trivial nature. In the victims of this diathesis capillary bleeding not only takes place from external wounds, but extensive subcutaneous extravasations occur from the slightest violence, or even spontaneously. In such patients the strain of a joint, instead of being followed by a synovial effusion, may cause the membrane to be filled with blood, while a blow so slight as not even to bruise a healthy person, will often, in such a constitution, be followed by an extensive discolouration and subcutaneous extravasation, a circumstance which may be usefully borne in mind in some cases of medico-legal inquiry.

Classification of Hæmorrhage.—Surgeons generally classify hæmorrhage into primary, recurrent, and secondary.

Primary Hæmorrhage is that which takes place when a vessel is first wounded.

Recurrent Hæmorrhage. — Some confusion has arisen between the terms secondary and recurrent hæmorrhage, but a clear distinction is very necessary, not only as indicating a different pathological condition, but, also, as materially affecting the question of treatment. Recurrent hæmorrhage is the bleeding that recurs soon after an operation, generally speaking within twelve hours; very rarely it may happen as late as the second day. It is due to some vessel or vessels which have ceased bleeding at the time of operation, thus escaping ligature, but from which, when the patient becomes warm in bed and reaction is established, blood begins to flow. Recurrent hæmorrhage is not, as a rule, sudden and severe, like secondary hæmorrhage, for the vessel furnishing it is generally small. The blood begins slowly to trickle through or by the side of the dressings; or, if the wound has been united without a drainage-tube, the flaps will be slowly distended and separated.

Secondary Hæmorrhage.— This is the bleeding which occurs several days after an operation. It results from the obliteration of a vessel not being complete at the time the ligature separates, or from the vessel being opened by some sloughing or ulceration in its neighbourhood. The period of its occurrence depends upon the size of the vessel; the larger the vessel, the later, as a rule, secondary hæmorrhage occurs. In an artery the size of the femoral, it is generally between the tenth and the fifteenth day. The blood in these cases is often furnished by the main vessel, and it generally flows suddenly, in considerable quantities. Although the actual onset of the bleeding is sudden, it may be preceded by a slight staining or rust colour of the discharge, so that when a large artery is involved, the surgeon should be on his guard when the discharge becomes discoloured or blood-stained. Recurrent hæmorrhage, being due to mechanical causes, may occur in the most perfectly healthy individual. Secondary hæmorrhage, on the other hand, is only liable to happen

in those who have some defective condition, either of the vessels or constitution, retarding the proper healing of the wound. Thus it is found that patients with either calcareous or atheromatous degeneration of their arteries are peculiarly liable to this accident; while drunkards, or others with broken constitutions, possessing tissues easily inflamed and slow to repair, are likely subjects for secondary hæmorrhage.

Symptoms of Hæmorrhage.—The symptoms of bleeding are both local and general. The local symptoms, if an external wound exist, are obvious, and it merely remains for the surgeon to distinguish whether the source of the blood be venous or arterial.

Difference between Arterial and Venous Bleeding.—Arterial may be distinguished from venous hæmorrhage by observing the following points:—

1. The colour of the blood. 2. The method of its flowing. 3. The amount and position of pressure necessary for its control.

1. *Colour of the Blood.*—Blood from an artery is of a bright scarlet, while that from a vein is claret-coloured or purple. There are certain exceptions, however, to this rule. If the patient be under the influence of nitrous oxide gas or ether, the arterial blood becomes so dark as to resemble venous bleeding, while, on the other hand, venous blood, if trickling slowly from a wound, becomes much brighter than normal from its prolonged contact with the air.

2. *Method of Flowing.*—Blood from an artery escapes in pulsatile jets, synchronous with the heart's beat. In a deep wound, by the time the blood comes to the surface it probably no longer spouts, the intermittent stream having been converted into a more or less constant one, owing to the wound itself acting as a reservoir; but, even here, although there is no actual jetting, the stream has a pulsatile flow. Blood from a vein escapes in a steady continuous stream. It should be borne in mind that, although the flow from a vein is continuous, if the wound into it be small, and if there be any pressure between it and the heart, the jet of blood may be thrown out a considerable distance, a phenomenon illustrated by what occurs when a vein is opened for the purpose of bleeding.

3. *Effects of Pressure and Position.*—Arterial bleeding is only affected to a limited extent by position, or stopped by a considerable amount of pressure. On the other hand, venous bleeding nearly ceases on simple elevation of the part, while it can be completely arrested by a slight amount of pressure. Firm pressure over the main vessels of the limb will generally arrest bleeding, whether venous or arterial; but slight pressure of the part above the wounded vein immediately increases the flow, which at once stops on the same amount of pressure being exercised on its distal side.

When blood is extensively extravasated into a limb, the whole member becomes swollen, and has a tense, elastic feel, while the skin is usually mottled and discoloured with venous congestion. If the hæmorrhage be from the main artery, the limb is often cold, with diminished sensibility, while there is loss of pulsation in the vessels below the injured trunk, and not infrequently such cases run on into gangrene. It might be supposed that, when blood was thus extravasated into a limb from a wounded artery, there would be pulsation in the swelling; but this is rarely the case. This absence of pulsation is probably due to the cessation of the bleeding, or to its flowing but feebly at the time of examination.

In internal hæmorrhage the local symptoms depend on the situation of the bleeding. Thus, when the pleura is filled with blood, there will be physical signs of fluid in that cavity. In the peritoneum the local symptoms are often very obscure. If the hæmorrhage be extensive, there will be dulness in the flanks, as in dropsical effusion, for it must be remembered that the blood does not at first coagulate in serous sacs. In two instances of fatal hæmorrhage into the peritoneal cavity, which the writer had an opportunity of observing at St. Bartholomew's Hospital, there was considerable abdominal distension, while, in both cases, the vomiting was so persistent as to suggest the idea of intestinal obstruction.

General or Constitutional Symptoms of Hæmorrhage.—These require to be carefully considered, for they often have to be solely relied upon for the diagnosis of internal bleeding, while, even in wounds, they form a valuable guide as to the amount of blood lost. The effects of bleeding depend, not merely on the amount but, in some measure, on the rapidity of the flow; thus, a sudden loss of blood, occurring in a few seconds from a large vessel, produces a constitutional effect far more marked than an oozing of the same amount extending over some hours. Individuals, too, bear bleeding very differently. Speaking generally, infants and young children bear

hæmorrhage badly, and the same relative loss of blood that can be borne with impunity by a healthy adult, may, at the extremes of life, lead to a fatal termination, while patients, already debilitated by illness or previous hæmorrhage, often succumb to even a trifling loss of blood.

Constitutional Symptoms of Sudden Hæmorrhage.—Fainting, shock, or collapse is the first prominent effect on the body of a sudden copious loss of blood. The patient loses consciousness, and falls to the ground in a fainting fit. If the loss of blood be but slight, he will remain in this condition for a few seconds only, but if severe he may be in a state of collapse, hovering between life and death for a considerable period. The pulse is absent at the wrist, or at the most gives but an intermittent feeble pulsation. If the stethoscope be applied over the heart, its sounds will be scarcely audible, while its working is irregular and intermittent. Respiration is almost suspended, requiring close observation to detect the movements at all, the inspiration being extremely shallow and wholly diaphragmatic—occasionally, however, relieved by sighing or yawning. The extremities are cold and damp, while the face is bathed with a clammy sweat. Muscular debility is almost complete; even the power of the levatores palpebrarum is lost, the lids drooping over the half-closed eyes; a deadly pallor pervades the surface of the body, the blanched, bloodless condition of the lips, finger-nails, and conjunctivæ bearing unmistakable evidence of a failing circulation.

Should the case end fatally, the pulsations grow feebler, and the breathing more and more shallow, death stealing over so gradually that the exact moment of dissolution escapes observation. Even after the heart has apparently ceased to beat, a faint, quivering throb may now and again be detected for some minutes. In other fatal instances the patient rallies somewhat from his first collapse, and the condition of complete muscular debility is replaced by extreme restlessness. The sufferer tosses from side to side, vainly seeking repose, and it is with great difficulty that he can be kept quiet. It may so happen that the restlessness decreases as the patient gradually regains strength, or it may be but the prelude to a second collapse from which he never rallies. It is often many days, or even weeks, ere the patient recovers from the effects of severe bleeding, while elderly people sometimes never really recover, dying some months later from intercurrent disease starting in a constitution already debilitated by hæmorrhage.

Constitutional Symptoms of Chronic Hæmorrhage.— The symptoms of chronic hæmorrhage, which arise from small losses of blood frequently repeated during many weeks or months, are very characteristic. The whole complexion slowly assumes a faint yellow or waxy hue. The pallid lips and the blanched conjunctivæ clearly indicate the anæmic condition of the tissues. Muscular weakness, shown by a distressing breathlessness upon the slightest exertion, is always present, while the sudden assumption of the erect position produces giddiness or fainting. The lower limbs are apt to become œdematous, and the pulse, excessively soft, constantly exceeds its normal rate, while palpitation follows on any exertion. Noises in the head are commonly complained of. In these cases of chronic hæmorrhage the blood is at first of normal constituency, but it gradually becomes thinner and, from a diminished proportion of its solid constituents, grows so watery as rather to resemble a red-stained serum than the natural fluid.

NATURAL MEANS BY WHICH HÆMORRHAGE IS ARRESTED.— Before considering the treatment of hæmorrhage, it is necessary to understand Nature's method of stopping bleeding from divided vessels, for it is by aiding this natural process that many severe cases are brought to a successful issue, without the necessity for any active surgical interference. Nature's method may be considered under the headings *constitutional* and *local*.

Constitutional.—During the period of collapse the action of the heart is reduced to the smallest amount, the pulsations becoming so feeble as barely to keep the blood circulating. The blood accordingly ceases to flow from the wound, and thus the patient is prevented from at once bleeding to death when an artery of any magnitude is divided. During this temporary respite, time is allowed for those earlier changes to take place in and about the wounded vessel, which form the first line of defence against the recurrence of bleeding as the heart regains its power.

Local.—These affect both the vessel and the blood. An artery upon being divided at once retracts, from its elasticity, a short distance within its sheath, while, owing to the contraction of its circular muscular fibres the end becomes conical, thus materially diminishing its calibre at the divided point. The changes in the blood consist of the formation of coagula known as the temporary

and permanent clots. The temporary clot is a simple coagulation of the blood. It appears to commence on the inner margin of the sheath, and, quickly increasing, only leaves a narrow channel through its centre, which channel rapidly becomes blocked up. Coincidently with this coagulation within the sheath and about the wound, the clot extends upwards within the vessel itself as high as the nearest collateral branch, closing the vessel by a soft blood-coagulum. The protection afforded by this temporary plugging of the vessel doubtless depends upon the distance to which the clot extends. Sometimes it is so slight as to be immediately washed away as the patient rallies; but often, frail as the protection may appear, it is sufficient to guard against bleeding until Nature has time to construct a more permanent barrier.

Permanent Clot.—If a divided artery be examined twenty-four hours after the cessation of bleeding, it will be found that a marked change is taking place in the constituents of the temporary clot. At its base —that is to say, at the line of the divided coats of the vessel—the clot has a whitish appearance, so that at this time it may be described as possessing a light-coloured base, which during the next forty-eight hours has extended upwards into the red blood-coagulum, causing, by the end of the fourth or fifth day, its total absorption. Under the microscope it can be seen that this white coagulum consists mainly of leucocytes, which have been climbing as it were into, and dissolving, the original blood-clot. The source of these leucocytes is apparently from the cut edges of the vessel, to which the base of the permanent clot is from the very first adherent, though there is some question as to whether they may not be in part derived from the endothelium lining the vessel. At any rate the endothelium rapidly disappears, the leucocytes of the clot becoming ultimately adherent to the inner coats of the vessel. The development of these leucocytes into fibrous tissue ultimately transforms the artery, as high as the nearest large branch, into a permanent fibrous cord.

By a proper understanding of the process just described, the successful treatment of hæmorrhage is more likely to be effected, since it explains why pressure, if properly applied, by allowing time for nature to seal the vessels with lymph, is often so successful a method of dealing with arterial hæmorrhage.

Treatment of Hæmorrhage.— This resolves itself into the general treatment of the shock or collapse induced by the bleeding, and the local measures required for the arrest of the hæmorrhage.

Treatment of the Collapse.— If the collapse induced by hæmorrhage is marked and profound, and the patient in the condition already described, the greatest care and gentleness will be demanded; for he is so near the invisible boundary dividing life from death, that neglect of the slightest precaution may place him for ever beyond the reach of surgical aid. To expose or roughly handle such a patient, or, above all, to lift him suddenly from the recumbent to the sitting or upright posture, is to court disaster. In hospital practice such a patient should on no account be lifted off the stretcher, but should be carried to the ward, and the stretcher be placed with a screen round it before the fire. The clothes must be rapidly cut off and the body covered with warm blankets, it being of extreme importance that the head be not raised or the body pulled about.

If the bleeding vessel has already been secured, the indication for treatment is to bring about reaction. Hot bottles may be placed between the thighs, under the arms, and over the pit of the stomach. The lower limbs should be slightly raised on pillows, so as to allow the blood to gravitate as much as possible towards the body. Hot dry flannels may be applied over the chest, while a sponge wrung out of very hot water may be placed over the region of the heart. Equal parts of hot brandy and water may be given. This should be done extremely slowly, drop by drop, on a quill pen. If given hurriedly it cannot be swallowed, and will run into the larynx. In extreme cases a subcutaneous injection of a few minims of ether by a hypodermic syringe has proved serviceable, while if the patient show no signs of rallying, direct transfusion of from four to six ounces of blood may be tried. *See* Transfusion.

If, however—as is not uncommonly the case—the collapse is due to violent hæmorrhage from some punctured wound of a deep vessel, which has spontaneously ceased to bleed before the surgeon's arrival, he should not be in too great a hurry artificially to bring about reaction. There is no time when an efficient coagulum is so likely to form as during the collapse immediately succeeding a sharp hæmorrhage, for, at this period of feeble circulation, the coagulum is not merely forming around the wounded orifice, but it is extending within the canal of the vessel itself, and every minute gained makes it

stronger. Unless the collapse be very profound, surgeons should be satisfied with merely covering the patient with warm blankets. Brandy should on no account be given. Artificially to excite by stimulants a more powerful action of the heart is in these circumstances fatal. Nature has done her best to reduce the heart's power, and, if time be given, an effective clot will be formed; while a premature reaction, brought about by stimulants, may be followed by a breaking up of the clot and a recurrence of the bleeding. Urgent thirst is a common symptom of severe bleeding, and there is no reason why the sufferer should not be allowed a moderate amount of cold water, and small pieces of ice to suck are often specially grateful.

Local treatment of hæmorrhage.—The treatment of arterial bleeding will be found under Arteries, Wounds of; the milder forms of hæmorrhage from the veins or capillaries will be here considered.

Treatment of Venous Bleeding.—In an open wound there can be no doubt that bleeding veins should be tied. The old fear of inflammation following ligature of the veins has long since been proved to be utterly groundless. In punctured wounds, elevation of the limb on a pillow with a moderate amount of pressure directly over the bleeding point, or on the veins a little below it, effectually arrests the hæmorrhage. The use of the tourniquet or bandaging above the wound should on no account be permitted.

The veins of a limb can be closed by a far less amount of pressure than is required to arrest the circulation through the arteries, so that if a circular bandage or tourniquet be not applied so firmly as completely to stop the arterial circulation, it will, to a certainty, increase the venous bleeding, for the blood finds its way into the limb and cannot return. The blood thus retarded flows out through the wounded veins. It may be frequently observed that a severe hæmorrhage from a wound is at once stopped by removing all bandages and compresses which have been applied above the wounded part. Shortly, then, it should be borne in mind that the very pressure over the main vessels of a limb, so efficient in arterial wounds, may actually prove fatal to the patient, if employed for venous hæmorrhage. If a large vein has only been punctured, it will suffice to pick up the portion wounded and tie it without including the whole calibre of the vein. A wound of one of the intracranial sinuses by the trephine, or a compound fracture, bleeds very copiously; nevertheless it can be easily restrained if the patient's head be raised and the most moderate amount of pressure applied locally.

Capillary Bleeding.—This does not mean that the hæmorrhage necessarily proceeds from the actual capillaries, but that it flows from vessels too small to be distinctly recognised as arteries or veins. Thus it will sometimes be observed that, after an amputation, especially when an Esmarch's bandage has been used, after all visible vessels have been secured, blood will continue to ooze from a number of minute points. Hæmorrhage of a similar nature occasionally follows the evacuation of an abscess, from the minute vessels in its walls losing their support. It is in patients with the hæmorrhagic diathesis that a serious or even fatal bleeding may result from the division of the minutest vessels.

The troublesome oozing which may occur from the surface of a wound will nearly always cease when the sides are brought together or the flaps adjusted, but it is sometimes undesirable to close a wound when the oozing still continues. It is a common practice to dash cold water over the surface, but if the wound has been long exposed, and the surface is already cold, this often aggravates rather than restrains the bleeding. In these circumstances nothing answers better than rapidly bathing the stump with hot water. The temperature of the water should be 120° to 124°, that is, just about as hot as can be borne by the hand.

A troublesome bleeding sometimes occurs, in amputation, from the medullary canal of a bone; this can be stopped by pressing a small piece of beeswax into the spot. Capillary oozing is sometimes kept up by the presence of a clot, and a wound that has been dripping for some time will cease to do so if the coagulated blood be gently sponged away. The free exposure of the bleeding surface to the air is often a valuable resource in arresting general oozing, especially if care be taken that all clot be wiped away. Whether the exposure acts directly on the vessels or on the blood is unimportant; but it is certain that an oozing which has been continuing for a length of time may quickly cease, on exposing the flaps or surface of a wound freely to the air. In the oozing from an abscess-cavity it will frequently happen that, on washing out the collected blood, the bleeding will cease.

Pressure, carefully applied and evenly adjusted, is a form of treatment applicable

to many cases of capillary bleeding, while, in positions where it cannot be applied, syringing with hot water should certainly be tried. Should this prove ineffectual, the wound may be washed out, or the abscess-cavity syringed with a solution of the subsulphate of iron, or, failing this, the wound may be touched with the actual cautery; while, as a last resource, and one that would very rarely have to be applied, the cavity may be plugged with strips of lint dusted with the subsulphate of iron powder.

For treatment of arterial hæmorrhage, *see* ARTERIES, Wounds of.

HARRISON CRIPPS.

HÆMORRHAGIC DIATHESIS. *See* HÆMOPHILIA.

HÆMORRHOIDS.—A varicose condition of the veins of the anus and adjacent part of the rectum. The term is etymologically bad, as it refers to the hæmorrhage, which is only one, although often the chief, of many symptoms which characterise some forms of this disease. Piles, from the Latin *pila*, a ball, is better, as most of these varicosities present, at some time of their existence, a somewhat globular form.

Piles may be classed as external, intermediate, and internal, according to their situation, outside, on the margin of, or inside the anal orifice. This classification is practically useful, for the symptoms and requisite treatment will vary with their situation.

They occur very frequently, and few persons attain to old age without having them in some degree. This is explicable from the anatomy of the part. The anus and rectum being developed from different parts of the embryo, are supplied with blood from separate sources, and return it by separate channels. The rectum is supplied by the superior hæmorrhoidal artery, and the blood is returned by the corresponding vein, a radical of the portal vein. The anus and contiguous part of the rectum are supplied by the middle and inferior hæmorrhoidal arteries, and the blood is returned by the corresponding veins, radicals of the inferior vena cava. There is a free capillary communication between these vessels, so that any obstruction to the flow of blood through the portal vein or the inferior cava tends to produce passive congestion of this part of the bowel. This is further favoured by gravitation, as the veins of the portal system are valveless. Moreover, the submucous tissue of the rectum is very lax, to allow of the adaptation of the mucous membrane to the varying condition of the tube, which is sometimes completely closed, and at other times, during the passage of fæces, more or less considerably distended. The veins, therefore, in this tissue are less capable of resisting increased blood-pressure than in other parts. Thus, constriction of the mitral or tricuspid orifices of the heart, pulmonary emphysema, chronic bronchitis, cirrhosis of the liver, or abdominal tumours, may induce piles. The straining resulting from habitual costiveness, or from stricture of the rectum or of the urethra, or from enlargement of the prostate gland, is a frequent cause. The gravid uterus very frequently produces passive congestion of the rectum, and so causes piles. Active congestion of the part may be induced by constipation, unsuitable purgatives, high living, abuse of alcohol, venereal excess, and, in women, by uterine or ovarian affections. In some cases there appears to be an hereditary tendency to piles; but, as Esmarch well remarks, the tendency to excesses by which piles are produced may also be hereditary in these cases.

The *treatment* of piles must be general as well as local, and unless the exciting cause can be adequately dealt with, the local treatment can only be palliative. As a rule patients with piles may be advised to carry out Falstaff's resolve 'to purge, and leave sack, and live cleanly.' The purgative must not be irritant, and the confection of senna, or Carlsbad water, taken before breakfast, will usually suffice. The rectum should be injected with cold water after each motion. These precautions, with attention to diet and moderation in the use of alcoholic stimulants, will generally check the development of piles, unless there be some persistent obstruction to the return of venous blood, when the treatment must, so far as possible, be directed to the cause as well as to the result.

External piles commence as a dilatation of the subcutaneous network of veins around the anal orifice. As the integument is thin, the dilatations form livid projections, which are soft and easily compressible. If the congestion continue, it produces infiltration and chronic inflammation of the surrounding tissue, which subsequently undergoes cicatricial contraction, and so compresses or even obliterates the dilated veins. Firm incompressible folds of skin remain, which, if uncomplicated, and if due attention be paid to cleanliness, usually cause no trouble. They may produce pruritus or eczema, and sometimes become inflamed and painful. If so, they may be

cut off with scissors curved on the flat. But if they are near the margin of the anus, care should be taken not to remove too much skin, or a troublesome stricture of the orifice may result. Sometimes one vein becomes considerably dilated. Thrombosis usually results, and the nodule, from its size, may cause inconvenience and is liable to irritation. It may become inflamed and suppurate. A longitudinal incision should be made in the pile and the clot be turned out. Some cotton wool should be placed in the wound and the patient should rest for the remainder of the day, for fear of hæmorrhage. The skin need not be removed, as in cicatrising it will contract.

Intermediate piles also result from passive congestion of the veins. If chronic, it induces hypertrophy and thrombosis. From their situation, at the margin of the anus, these piles are exposed to irritation and often becomes inflamed. As they are covered partly with skin and partly with mucous membrane, the latter may ulcerate, and so cause a purulent discharge or hæmorrhage. They often excite tenesmus, and there may be great pain during and after defecation, but this is not so severe or persistent as in so-called fissure of the anus, which, however, sometimes is a complication of this variety of piles. If their removal be contra-indicated, ice will relieve the inflammation, and the dilute nitrate of mercury ointment is a convenient application when they are ulcerated. Otherwise they may be excised with scissors, but, lest stricture of the orifice should result, it is better to remove only two-thirds of each pile, and the remainder will shrivel in cicatrization.

With internal piles there is usually active as well as passive congestion of the mucous membrane. As they are abundantly supplied with arterial blood they are of a bright red colour, and bleed very readily. There is often much mucous discharge. The veins are convoluted as well as dilated, and the hypertrophied sub-mucous tissue around and between them forms tumours which, on microscopic examination, resemble cavernous structures. As a rule internal piles are soft and compressible; but sometimes the hypertrophied sub-mucous tissue may become indurated, and the pile may resemble a fibrous polypus, from which it can be distinguished only by microscopic examination.

Internal piles may be sessile or pedunculated. The latter often protrude through the anal orifice during defecation, and their replacement is painful. It is usually effected by the fingers of the patient, or better by pressure with a soft sponge. In these cases the patient should arrange so that the daily action of the bowels should take place at bedtime, as the piles can be more easily replaced when the patient is in the recumbent posture, and the maintenance of this position during the night, and the dilatation of the cutaneous vessels from the warmth of the bedclothes, relieve the congestion of the bowel. Sometimes the protruded piles are strangulated by the sphincter muscle, and then sloughing and gangrene may result.

Internal piles, in an early stage, cause irritation and a sensation of heat in the fundament, especially after defecation. Sometimes there is mucous catarrh of the rectum. As the piles enlarge, and the mucous membrane atrophies from pressure, there is usually hæmorrhage. This may vary in amount, being sometimes slight, at other times considerable. If it be venous, resulting from congestion of the heart, lungs, or liver, the patient will be relieved. But if it be arterial, from active congestion of the bowel, it is injurious, and, if long continued, in neglected cases will produce symptoms of extreme anæmia.

The *diagnosis* of piles presents no difficulty. Perineal vegetations, condylomata, and cancerous tubercles, can scarcely be confounded with external piles, and the history of the case will prevent the possibility of such a mistake. Protruding internal piles are distinguished, by their irregular outline, from the uniformly annular protuberance of smooth or rugose mucous membrane in prolapse of the rectum. Such piles, however, are often accompanied by genuine prolapse of the rectum. An indurated internal pile, with narrow pedicle, greatly resembles a fibrous polypus, but the distinction is unimportant, as the treatment of both is the same—ligature of the pedicle and abscission of the growth. In fact, most internal piles are genuine new-growths of a nævoid character.

Treatment. — Daily injection of cold water and attention to diet and general health will suffice in many cases. Astringent injections are sometimes of service. They should be small in quantity, and should be administered at bed-time, so as to be longer retained and to act more thoroughly. The tincture of Hamamelis, one drachm to three ounces of cold water, is said to be useful. A suppository of the dilute nitrate of mercury ointment is useful in cases of catarrh. If there be arterial bleeding, it must be checked by operation. For this purpose sessile piles should be painted with nitric acid or the acid nitrate

of mercury solution. The surface of the pile should be dried with cotton wool and the acid applied with a glass brush, but care should be taken to prevent the acid coming in contact with the margin of the anus, as this would cause great pain. The surface of the pile should then be again dried, and some carbolized olive oil (1 in 20) be applied. The patient should maintain the recumbent position for some hours after, and if there be much pain, ice applied to the part will give relief. Sessile piles may also be advantageously treated with the actual cautery.

Pedunculated piles may be removed by ligature or by the actual cautery. An aperient should be administered on the preceding evening, in order that the rectum may be empty, and an injection of warm water, immediately before the operation, will assist in bringing the piles well down. The patient should lie on the left side, with the thighs well flexed, and a strap, passed round the shoulders and under the right thigh, is very useful. The nates should be separated by an assistant. If the ligature be adopted, the pile should be seized with a pair of four-toothed forceps, and a groove cut in the mucous membrane at the lower border of the base of the pile with blunt-pointed scissors. The groove should be perpendicular to the wall of the bowel. The forceps should then be transferred to the assistant, who should make gentle traction on the pile at the moment when the loop of ligature is about to be tied round the base of the pile. The ligature should be of well-waxed hemp, and be tied as tightly as possible. The ends should be cut moderately long. If the base of the pile be broad, a curved needle, armed with the ligature, should be passed through the centre, and, the loop having been cut, the pile should be tied in two parts. If there be more than one pile, the others should be treated in a similar manner. The piles and the ends of the ligatures should then be passed up above the sphincter muscle, and, unless contraindicated, a morphia suppository should be introduced. Any external or intermediate piles should be cut off. Otherwise, however insignificant they may appear, they will almost certainly become inflamed and cause trouble to both patient and surgeon. The patient must remain in bed, and the bowels be kept inactive for some days. The diet should be simple and such as will not leave a bulky residuum. Alcoholic stimulants should be avoided. On the fifth morning some castor-oil or similar aperient should be given, and an injection of olive oil will facilitate the action of the bowels. The ligatures usually come away with the first motion, but if this does not occur, they should not be meddled with, as hæmorrhage might result. If the motion cause much pain, the use of a warm hip-bath will give relief. The patient should maintain the recumbent position until the part has healed, which usually occurs in about three weeks. If the wound be indolent, the compound tincture of benzoin or dilute solution of nitrate of silver (two grains to the ounce), are suitable applications.

If there be much pain after the operation, ice applied locally will usually give relief; but if this fail, then hot fomentations sometimes have the desired effect. If all bleeding has been thoroughly arrested at the time of the operation, there will very rarely be any recurrence if the patient be kept quiet and in the recumbent posture. Should any occur, if outside the bowel, it may be stopped by ligature, or by pressure with a pad of lint and a T-bandage. If it be from within the bowel, the piles should be drawn down by the ligatures, which were left long for this purpose, and the bleeding point touched with a pledget of cotton-wool steeped in the solution of perchloride of iron.

Retention of urine is a frequent complication. It results partly from the sympathetic congestion of the vessels at the neck of the bladder, and partly, perhaps, from the patient's inability to micturate in the recumbent posture. A catheter must, if requisite, be used, and the patient should not be allowed to sit or stand up, as hæmorrhage would most probably result. The difficulty is not experienced in all cases, and rarely persists for more than one or two days.

The inguinal lymphatic glands often become swollen and tender. They very rarely suppurate. If they do, a puncture should be made as soon as fluctuation can be detected, and, the pus having been discharged, the wound heals rapidly.

Pyæmia and tetanus, occasionally, but very rarely, result from this operation. All surgeons, who have had much experience in operating for piles, have probably met with such results; but the fatal cases are very few in comparison with the number of operations. Some surgeons employ antiseptic measures, such as antiseptic ligatures, washing out the rectum with carbolised water, salicylic wool, &c. These can do no harm, but a careful selection of cases to be operated on will probably be more

effectual. If there be evidence of extensive renal disease, operation should, if possible, be avoided, and palliative treatment adopted.

The causes of tetanus are so little known, that the surgeon has no clue as to the cases in which it may be apprehended. Statistics seem to indicate that it may result from some epidemic cause.

The treatment of internal piles by the actual cautery dates at least from the time of Hippocrates, and latterly has been adopted by many surgeons in preference to the ligature, as causing less after-pain and allowing the patient to more speedily resume his ordinary mode of life. The amount of pain, however, seems to depend more on the idiosyncrasy of the patient than on the mode of treatment; and the resumption of active life, before the part has thoroughly healed, always involves the risk of peri-rectal inflammation, and possibly of abscess and fistula. The use of the cautery does not confer any greater immunity from fatal results. The preliminary arrangements are the same as for the treatment by ligature. The base of the pile should be compressed by a suitable clamp, and the pile cut off within a little distance from the clamp. The remainder should then be burnt off down to the clamp with the galvanic, or with Paquelin's, cautery. The clamp should then be cautiously relaxed and, if there be no bleeding, removed. If there be any bleeding, the clamp must be tightened and the cautery re-applied. The after-treatment is the same as when the ligature has been used.

The method of crushing, instead of cauterising, the base of the pile, has recently been advocated, and the method seems to answer well with purely internal piles where it is desirable to avoid the loss of any blood. A very powerful screw-clamp is employed, and it is important to keep up the pressure for fully two minutes, after which the pile may be cut off beyond the clamp and the instrument removed, without risk of hæmorrhage.

Except for the application of nitric acid, which is comparatively painless, an anæsthetic should be administered in all operations for piles, unless contraindicated by the general condition or desire of the patient. The objection that the piles may slip up while anæsthesia is being induced, is groundless, as a good assistant can always, when the patient is unconscious, evert the mucous membrane so as to bring the piles into view. The volitional aid of the patient, desired by some surgical writers, is unnecessary, although sanctioned by Hippocrates, who recommended that the patient should shout loudly during the operation, so as to thrust the piles further down.

Protruded internal piles, sloughing from strangulation by the sphincter muscle, may, if the patient's condition be otherwise good, be at once removed by operation. But if, as is usually the case, there be high fever, it is better to temporise, and with hot fomentations the sloughs speedily separate, and the cure is thus effected by nature.

JEREMIAH MCCARTHY.

HÆMOSTATICS. *See* HÆMORRHAGE.

HÆMOTHORAX. — A collection of blood in the pleural cavity, arising generally from injury, and very rarely from disease. The latter condition is generally due to some morbid condition of the blood, as in purpura hæmorrhagica. In such a condition, the commencement of what would otherwise have been an acute pleurisy may be here ushered in by a violent hæmorrhage into the cavity of the pleura. The course and treatment of this state will be those of the condition primarily causing the morbid state of the blood, and need not be further described here.

Hæmothorax from injury is generally due to injury of the lung or of the intercostal vessels by a penetrating wound. It more frequently takes place when the external wound is a small one than when it is large. In the latter case the blood escapes externally; when it is small, on the other hand, the wound contracts, and the bleeding cannot take place externally; it must then either collect under the skin and fascia, producing a blood-tumour, or, if the pleura be wounded, it is poured into its cavity and constitutes a hæmothorax.

A hæmothorax always causes some dulness on percussion over the affected part. The dulness may occupy the whole of the side, when the amount of blood is sufficiently great to fill the pleural cavity. In such cases there is always more or less collapse of the lung. Or the blood may occupy only a portion of the pleural cavity—generally the part most dependent after the injury has been received. Thus, if the patient has remained propped up it will be towards the base of the lung, and if he has fallen into the recumbent position it will gravitate to the side on which he has fallen. In the severer cases, there is absence of the breath-sounds on auscultation, and deficiency of the vocal fremitus. In the more localised cases, the breath-sounds are not alto-

gether lost, but are distant and deficient in intensity; and in the slightest cases, where only a thin film of blood is effused between the lung and the costal parietes, there may be scarcely any dulness, and the breath-sounds are nearly as loud as usual. In such cases as these, the auscultatory signs are always liable to pass, in process of time, into those of the severer form, from the setting up of an acute pleurisy by the blood-clot. This is especially the case when any foreign putrefactive material has been carried inwards by a small punctured wound. The acute pleurisy thus resulting is very often accompanied by extensive serous effusion (hydrothorax), and the mixture of serum and blood thus resulting gives rise to a condition which, when seen for the first time, is very difficult to distinguish from a pure hæmothorax. The differential diagnosis may partly be made by taking into account the *rapidity* with which the dulness formed. If it came on after three or four days, it will probably be serum only slightly mixed with blood. If it formed within the first twenty-four hours, the chances are that it is blood.

Hæmothorax may be accompanied by the usual signs of a wound of the lung (*see* Lung, Wounds of), or these may be absent if the bleeding has taken place entirely from an intercostal or other large vessel. If the accumulation of blood is very great, the signs of extensive hæmorrhage will be present—viz. great collapse, pallor, thirst, a small thready pulse, and great dyspnœa. The patient sits up in bed with the body bent forwards, the surface of the skin is cold and moist, the pupils become dilated, and there is often vomiting, followed by syncope. In such cases death may take place very speedily, partly from the loss of blood, partly from collapse of the lung due to the pressure of the blood upon it. In such extreme cases measuring the chest may afford some information, the affected side bulging and being less mobile than the sound one. It is, however, a very uncertain test, and cannot be much relied on.

In the less severe cases, air may be extravasated into the chest and become mixed with the blood (pneumo-hæmothorax). In such cases the succussion-sound may be present, and may be audible either to the patient or the surgeon. In the cases which survive for some days, ecchymosis begins to appear in the lower part of the lumbar region of the chest. This is never an early sign, is sometimes not present, and is due to the blood colouring-matter gravitating from the pleura in the direction of the quadratus lumborum muscle. It gives rise to a deep purplish stain of the integuments in this region.

Treatment.—The first consideration is, if possible, to put a stop to the hæmorrhage. Operative measures to this end are too often futile, and the uncertainty where the bleeding comes from will generally render all special exploration with this end in view unadvisable. If, however, it be quite certain that it is the intercostal artery which is the source of the bleeding, an attempt should be made to secure it. On account of the freedom of its anastomoses, this should be done by tying both ends, if possible, at the wound. This is often exceedingly difficult to do, and, where it is found impossible, various special proceedings have been advised to put a stop to the hæmorrhage. Of these it is only necessary to mention one—viz. the introduction into the wound between the ribs of a piece of linen (boracic lint will answer the purpose well), pushing the centre of the piece before the finger into the wound in the form of a cone. The centre of the cone is next filled up with sublimate wool, and the base of the cone is then drawn tight over a small ring and tied. This will make the cone swell out at the sides, becoming more spherical. A slight movement of withdrawal will then cause the part in the chest cavity to press strongly against the thoracic wall, and thus may occlude any bleeding point.

If the hæmorrhage take place from any of the large internal vessels, operative proceedings are useless; but if it be from the internal mammary artery, an attempt should be made to secure it at the wound. In operating on the dead subject this artery is easily secured by opening up the space between the costal cartilages; but in the living patient, where the parts are infiltrated with blood from a bleeding artery, this is often impossible, and it may be best in such a case to cut through and remove a costal cartilage, in order the more certainly to get at the artery.

Practically, in the majority of cases, operative measures for securing the bleeding vessel will be found impossible. Where this is so, when death is impending from the large amount of blood poured out into the chest, it is best to open up the wound and introduce a large drainage-tube into the pleural cavity. The chance of saving the patient in such cases is small; but the pressure upon the lung may be relieved in this way, and the immediate risk tided over. It is

said that this measure is of no use on account of the rapidity with which the blood poured into the pleura coagulates. It is, however, the only possible measure in such extreme cases, and even if fluid blood be not reached and drawn off by the drainage-tube, it is possible that some of the serum, the result of the coagulation of the blood, may be got rid of and the immediate risk from the pressure of the blood-clot be thus removed. In the cases of lesser severity it is very unwise to interfere at all with the wound. Such cases should be kept as quiet as possible, the patient placed on the affected side, the wound (if there be one) closed by some antiseptic dressing, and the effusion of blood checked as far as possible by the administration of ergot (ℳx doses of the tincture every hour at first, and afterwards at increasing intervals), by the application of cold to the surface in the shape of ice-bags to the thoracic parietes, and by almost total abstinence from food. Such cases not infrequently recover, especially where there is no external wound. They may, however, be complicated by the effusion of a large quantity of serum (hydro-hæmothorax), which may call for the operation of paracentesis thoracis (q.v.).

This operation should be done, if there be an external wound, by opening it up, introducing a long drainage-tube of medium size, and allowing the fluid to drain off antiseptically below the surface of carbolic lotion (1–40) placed in a basin. The drainage-tube should never be kept in very long, and when the effusion of serum appears to have ceased, it should be withdrawn, the wound closed, and the rest of the serum and blood-clot allowed to be absorbed by the natural processes. When there is no external wound, the removal of the serum is best accomplished by the use of the aspirating syringe. A puncture should be made through an intercostal space (generally the seventh), not far from the angle of the scapula, with a medium-sized needle, and the fluid be withdrawn with the aspirating syringe. Here again it is wise not to use too much exhaustive force, and, when the fluid begins to flow with difficulty, it is best to withdraw the needle and allow Nature to do the rest. Indeed, it is better to repeat the operation a second time rather than to risk doing too much at first.

To sum up the treatment in these cases; although operative measures should be resorted to, where possible, to put a stop to the hæmorrhage, in practice it will be found that but few cases can be successfully treated in this manner, and more must be expected from the application of cold to the surface, from the internal administration of styptics, and from starving the patient, than from any operation.

H. G. Howse.

HAINSBY'S TRUSS or cheek-compressor roughly resembles a double inguinal truss. It is applied so that the pads fit on to the cheeks, which they compress towards one another; it is used to take off the strain from the sutures after operations for hare-lip.

HAIR, Diseases of the.—These may be divided into four principal groups—(1) atrophic, (2) structural, (3) pigmentary, (4) parasitic. To the first of these belong the different varieties of baldness. The structural and pigmentary changes are also for the most part atrophic, but for convenience are usually considered in separate groups.

Atrophy.—The circumstances under which alopœcia or baldness occurs are very various; in its ordinary form it is only a senile change which is very common in men, and requires no special notice.

Premature baldness may be simply due to an hereditary tendency, in which case it differs but little from senile baldness; more commonly, however, it is the result of some affection of the scalp. Amongst the most common of these is excessive sweating. It is not unusual to find that Europeans, who live in tropical countries, become partially bald owing to this cause. This kind of baldness is by no means confined to men. Various forms of follicular inflammation and seborrhœa give rise to partial baldness. *See* Seborrhœa. Most acute diseases may produce a sudden arrest of the growth and a subsequent rapid shedding of the hair; this is common, for example, after fevers. Syphilis is especially liable to produce temporary partial baldness, which may be generally distinguished from ordinary baldness by the fact that the hair falls off pretty uniformly from all parts of the head, and is by no means limited to the crown and forehead.

Scars of the scalp, from whatever cause they may arise, always produce permanent bald patches; this is the case even with those produced by erythematous lupus, where the scars are of the most superficial kind. For other forms of baldness, *see* Alopecia Areata.

Structural changes in the hair are not very common; one of the best known is called *Trichorexis nodosa* or *Tricho-clasis.*

To the naked eye the hairs affected are marked with two, three, or more white bulging spots, and very slight traction causes the hair to break at these points. Examined under the microscope, the hair presents spindle-shaped swellings of the shaft, which ultimately burst near the middle of the swelling, the cortical portion giving way first, so that the partially divided hair has the appearance of two brushes, the bristles of which are interlocked. The white appearance at the point of fracture is probably due to the same cause that gives rise to the white appearance of the scales of psoriasis—that is, the introduction of air. This form of trichorexis nodosa is chiefly met with on the hair of the face. In another variety of the same disease, first described by Dr. Walter Smith and the writer, spindle-shaped swellings occur in the hairs of the scalp, which usually break with a clean fracture between the swellings, so that the white appearance is not often seen. The growth of hair is generally very poor and feeble in these cases.

Pigmentary changes, like baldness, are often simply the natural result of old age, but premature greyness (canities) is not uncommon. Sometimes it is the result of some hereditary tendency, but more commonly it is due to bad health, anxiety, and worry. As a local cause, neuralgia may be mentioned; a long-continued or recurrent neuralgia of the scalp will often give rise to grey hair, which is distributed over the region of pain. In alopœcia areata the first crop of new hair is generally grey, and, associated with that disease, patches of grey hair are occasionally met with where the scalp has never been bald.

For parasitic diseases of the hair, *see* Tinea Tonsurans; Favus.

Treatment of premature baldness is confined to the use of stimulating lotions to the scalp and the internal administration of suitable tonics. The best stimulating lotions are the different preparations of cantharides; one of the most useful consists of acetum cantharidis f℥ss., glycerine f℥ij., sp. rosmarini ad f℥viij. This lotion is also one of the best in cases of premature greyness; cantharides being the best local stimulant for producing an increase in the pigmentation of the skin and hair.

Robert Liveing.

HAMILTON'S SPLINT for fractures of the femur is a compound of two long splints, which are united at the lower end by a crossbar; it is very useful for children, as it restrains their restlessness and allows of their being turned over without disturbing the fracture.

HAMMER-TOES.—In this affection the toes, especially the second, but occasionally the third and fourth as well, are drawn towards the sole of the foot, usually at the first phalangeal, but sometimes at the metatarso-phalangeal joint.

Causes.—These are:—(1) Crowding of the toes by ill-fitting boots. When these are too short or too small, with pointed toes, the first and fifth toes are driven under the others, which, owing to the scanty room, become displaced into the position of hammer-toes. Boots with heels absurdly high, by throwing the weight on to the front of the foot, will—especially if too small as well—have the same effect. (2) Contraction of the flexor tendons or weakness of the extensors. (3) Contraction of the digital prolongations of the plantar fascia. (4) In some cases the contraction of the toes may be partly reflex, owing to the presence of painful corns; but it is obvious that in these cases direct pressure will probably play an important part. (5) In another group of cases infantile paralysis, as indicated by the wasting, colour, and temperature of the limb, will be found to be at the root of the matter. (6) Occasionally, as in the variety of club-foot which M. Duchenne called hollow 'claw foot,' a hammer-like condition of the toes is produced by wasting of the interossei, the first phalanges being extended, while the last two are flexed upon the first. Whatever be the cause, 'hammer toes' may become a very crippling affection, especially after puberty, when more active life begins. Painful corns and bunions form over the distorted phalanges, or over the exposed heads of the metatarsal bones; and the pressure of the body is no longer evenly distributed over the phalanges, as these, from their distorted and stiffened condition, have lost their natural play.

Treatment.—This consists in first removing any cause, such as ill-fitting boots, remedying, as far as possible, by friction, shampooing, warmth, &c, the deficient action of any weakly muscles. The toes are to be straightened by means of tapes and splints. In early or slight cases these may be of whalebone, but in more advanced cases it is best to make use of a metal sole-plate, with slots cut out at the extremity, by means of which the affected toes are gradually straightened with elastic webbing or broad tapes. Such a sole-

plate may be worn in the day-time within a large boot or slipper; it is always to be worn at night. In advanced cases, straightening will be impossible without the aid of tenotomy. This may be freely, if carefully, made use of in the case of contracted tendons and fascia. The former should not be divided opposite to articulations; the latter is best divided a little above the heads of the metatarsal bones. If the surgeon practise division opposite to the webs of the toes or along the phalanges, great care must be taken of the digital nerves, or troublesome numbness will result. The patient must always be prepared for some stiffness persisting in the toes—a condition of much less moment here than in the fingers. So, too, with regard to amputation, when the straightening of one or two toes proves difficult or very painful, they should be removed; this step will not interfere seriously with locomotion.

W. H. A. Jacobson.

HAMMOND'S SPLINT for fractures of the jaw is a framework of strong wire, which passes both in front of and behind the teeth at the level of their necks. The two pieces of the wire splint are laced together and to the teeth by binding wires passed between the teeth. Silver-plated copper wire does well for the framework, and finer silver wire for the binding wires.

HAMSTRING TENDONS.—*Contraction* of the hamstring muscles may be caused by painful inflammatory swellings in the ham, the pain from which is relieved by flexion of the knee. In painful conditions of the knee-joint, and particularly in 'white swelling,' and when the bones or cartilages are affected, all the muscles about the joint become spasmodically contracted; and as the flexors are more powerful than the extensors, the knee assumes the flexed position. Spasmodic contraction of these muscles is also seen in hysteria, and is occasionally excited by reflex irritation, as in some cases of phimosis. When this contraction is continuous over a long period, the muscles become permanently shortened and unable to relax to their former extent, so as to allow the joint to be fully extended: this condition is distinguished as *Contracture*. This also occurs when the muscles are permanently relaxed with their ends approximated. Thus, when in a case of morbus coxæ, the limb is allowed to remain flexed both at the hip and knee for many months, the hamstring muscles shorten, so that the knee cannot afterwards be extended.

Symptoms and Diagnosis.—These conditions are recognised by noticing that the knee-joint is constantly flexed, and that the attempt to extend it causes the hamstring tendons to start out under the skin as tense resisting cords. When only one tendon is affected, as the biceps in genu valgum, the knee can be extended, but, on attempting to bring the leg into a straight line with the thigh, the outer hamstring tendon becomes very tense. If flexion of the joint again relax the tense muscle, and the attempt at extension be met by a completely unyielding resistance always at the same angle, and if this resistance to extension persist during sleep or full anæsthesia, the condition is contracture and not simple contraction. Contracture is never established under a period of joint-flexion lasting over many months. Sayre states that it can be recognised by the fact that when the affected muscles are put upon the stretch, pressure with the finger along the tense tendons excites spasm in the muscles.

The *treatment* of contraction consists in (*a*) that of the disease causing it, (*b*) extension of the knee by some suitable splint and by weight-extension. Where the tendons are actually shortened they must be divided. *See* Tenotomy.

A. Pearce Gould.

HAND, Dislocations of Bones of the. Carpo-metacarpal Dislocations.— There is no case recorded in which all the metacarpal bones have been dislocated from the carpus. Erichsen gives a drawing of a cast he believes to have been taken from a case of the kind. It appears to be a mid-carpal dislocation forwards, of which there are well-authenticated instances, but which this author fails to describe. Hamilton mentions a case of dislocation backwards of the *four inner metacarpal* bones, caused by a bullet traversing the hand. The *second and third* metacarpal bones have been dislocated *backwards* by blows given with the clenched fist, and the second has been dislocated *forwards* by a hammer. *The metacarpal bone of the thumb* has been more frequently displaced. It may be dislocated *forwards* or *backwards*. The treatment in all these cases is to make extension on the corresponding finger and use pressure over the displaced bone. After reduction, a dorsal splint from the wrist to the end of the finger or fingers should be applied to keep the joints at rest for a fortnight. *See also* Carpal Bones, Dislocation of the.

Dislocations of the Fingers.—*Metacarpo-phalangeal* dislocations are rare, and single joints are more often displaced than the whole together. The writer has seen dislocation backwards of all the fingers at the metacarpo-phalangeal joints, caused by a fall on the fingers, associated with a transverse wound of the palm through which the heads of the four metacarpal bones could be seen. Reduction was easily effected, and the patient recovered with a useful hand. Dislocation of a *single finger* may take place in a *backward* or *forward* direction, of which the former is the more common. Of dislocation backwards there appear to be two forms: in one the phalanx is carried directly backwards and the finger is straight; the other is a dislocation by rotation of the phalanx around the head of the metacarpal bone, so that the articular surface of the former is in contact with the dorsal surface of the head of the latter. The first phalanx is over-extended and the two distal phalanges flexed. The index and little finger are, from their exposed situations, most frequently dislocated. To reduce the bone, extension should be made on the finger at the same time that pressure is put upon the projecting metacarpal head. Should reduction prove difficult, the surgeon may have recourse to the methods of treatment employed for dislocation of the thumb. *Inter-phalangeal dislocations* occur more frequently between the first and second phalanges than between the second and terminal. The phalanges may be dislocated *backwards*, *forwards*, or *laterally*. Backward dislocation is the most common, and may be reduced by simple extension, or by over-extension followed by flexion. The forward dislocation may be reduced by over-flexion followed by extension. Not infrequently dislocations of the fingers are compound, and in these cases the advisability of amputation or excision may have to be considered; but the surgeon should err, if at all, rather on the side of conservatism, as these dislocations are by no means always followed by stiff joints. For mechanical extension, the Indian puzzle, Charrière's forceps, or Levis's noose may be employed.

Dislocation of the Thumb.—The *metacarpo-phalangeal joint* of the thumb is more frequently dislocated than the joint of any other phalanx. The displacement usually occurs in a *backward* direction, but occasionally *forwards*. The dorsal dislocation is of two kinds: in the more common form the phalanx is dislocated by rotation around the metacarpal head, with which it forms nearly a right angle, the terminal phalanx is flexed and the metacarpal head projects towards the palm, so that in shape the thumb resembles a Z; in the other form the phalanx passes behind the metacarpal bone, so that its anterior edge rests against the back of the metacarpal head, and the terminal phalanx is straight.

Great difficulty has often been experienced in reducing these backward dislocations, even under chloroform. Various explanations of the difficulty have been put forward, but that which is generally accepted is that the expanded head of the metacarpal bone slips forward between the two heads of the flexor brevis pollicis, which grasp it and form a *boutonnière musculaire*. This is the view of Ballingall, Malgaigne, Fabbri, Vidal, and Hamilton. Hey and Dupuytren, on the other hand, attributed the difficulty to the lateral ligaments, but experiment on the dead subject almost always causes rupture of one lateral ligament, and this was found to have happened in a dissection by Lawrie of a dislocation caused during life. Pailloux, Michel, Lawrie, Roser, and, more recently, B. Anger, account for the difficulty by the interposition of a portion of the anterior ligament, which has actually been discovered in some cases. Out of three dissections, the long flexor was found on the inner side of the metacarpal head in two, and on the outer side in one. Reduction is most easily effected in the manner recommended by Fabbri. The metacarpal bone is pressed inwards and the phalanx over-extended to relax the flexor brevis. The posterior edge of the base of the phalanx is raised over the metacarpal head, and the thumb being gradually straightened, then flexed, the muscles assist in drawing the phalanx into place. Should this manœuvre fail, increased power of extension may be obtained by employing a clove-hitch of tape, the Indian puzzle, Levis's noose, or Charrière's forceps; but subcutaneous division of the outer head of the flexor brevis and any tight ligamentous band that may cause obstruction will probably be of more service. Humphrey has suggested making a small incision and introducing a blunt hook to draw the head of the flexor brevis and its sesamoid bone forward. Anger states that movements of torsion will sometimes succeed by disengaging the capsule, when all other means have failed. In cases of long standing, when the thumb is useless, excision of the joint may be practised.

Dislocation *forwards* of the thumb may be caused by falls or blows upon the dorsal surface when it is flexed. The head

of the metacarpal bone projects behind, the base of the phalanx in front, and the thumb is shortened and extended. Reduction is much easier than in dorsal dislocation, and may generally be effected by flexion aided by traction upon the phalanges. Should this method fail, over-extension and traction might be employed.

Dislocation of the *terminal phalanx of the thumb* is the most common of phalangeal luxations. It may take place in a *backward* or *forward* direction, of which the former is the most common. Traction and over-extension is the method which succeeds best for reduction of the dorsal dislocation, and traction and over-flexion for the dislocation forwards. Not infrequently the dislocation is compound. If there is not much laceration such cases do not call for amputation. The writer has seen a case of compound dislocation backwards recover with a perfectly movable joint. R. Clement Lucas.

HAND, Fractures of Bones of the.—The Carpus.—Owing to its flexibility and elasticity, the gliding movement that is allowed between the various bones, and the protected position which it occupies in the interval between the larger framework of the forearm and metacarpus, the carpus is little liable to fracture. Several examples, however, of simple fracture—mostly of the scaphoid and semi-lunar bones, combined for the most part with fracture of the lower end of the radius, and produced by falls on the hand—have been recorded. Some have been due to direct violence. Compound fractures, produced by crushing, or by gunshot or other injuries, and associated with lesions of neighbouring parts, are less rare. In simple fracture it is sufficient to keep the hand and forearm at rest in a sling. In compound fractures only such fragments as are completely detached should be removed. Others must be replaced.

Prognosis is generally favourable, and should inflammation not extend to the radio-carpal joint, the movements of the wrist are not likely to be seriously impaired.

The Metacarpal Bones.—From its isolated position and wide range of movement the metacarpal bone of the thumb is especially liable to fracture; next comes the second; the third, strong and supported on either side, most often escapes; the fourth and fifth are occasionally broken. The fracture is usually situated nearer the distal than the proximal end of the bone; and sometimes is multiple, or comminuted. Generally it results from direct violence, but is sometimes produced when a blow is struck with the closed fist, or by a fall on the knuckles. In young subjects 'fracture of the neck' of these bones is usually, in reality, separation of the epiphysis, except in the case of the metacarpal bone of the thumb, which has its epiphysis at the base like a phalanx. For treatment Sir A. Cooper advised that a large ball should be placed in the palm, and that to this the metacarpus should be securely bandaged. If used, the ball must be large enough to keep the phalanges partially extended, so that the head of the fractured bone is prevented from dropping, as it naturally does, towards the palm. Another and better plan is to mould gutta-percha splints to the palmar and dorsal aspects of the metacarpus (the fingers being left free), and to bandage these, carefully padded, to each other. Treatment must be continued for about three weeks.

The Phalanges.—Fracture of these bones is a very common injury, generally due to direct violence—machinery accidents, and the like; but sometimes produced indirectly. The first phalanx, the most fixed and the most exposed, is most likely to suffer. The fracture is generally compound, and associated with laceration of the soft parts of the finger. Mobility and crepitus are easily detected; displacement is seldom very marked. In comminuted fractures, even though extensively stripped of their periosteum, the fragments will generally survive; they should, therefore, not be removed unless they are already completely loose. If a joint is opened, it will not rarely recover, with little remaining stiffness.

The treatment consists of the use of a gutta-percha splint, moulded on the finger, in a slightly flexed position, and prolonged, for the sake of support, into the palm. This may, in simple cases, be removed at about the end of three weeks, when passive motion should be employed. In compound fractures the duration of treatment must vary with the case. Howard Marsh.

HAND, Surgery of the.—In the hand may be seen very early the effects of any general wasting disease, as shown by the falling in of those parts which in health should be full and rounded, so that the bones and joints are rendered more prominent, and the skin more puckered and transparent. A clubbed condition of the finger-ends and of the nails is often found to be associated with some obstruction of the circulation, as in congenital disease of

the heart or in empyema, or as indicative of a phthisical tendency. The hands of idiotic children are often ill-developed.

In the diagnosis of affections in this region, whether resulting from accident or disease, it is of the utmost importance to determine the tissue which is most deeply implicated, and this is in many cases a matter of no little difficulty. Where swelling exists, there must also be ascertained whether any acute or chronic inflammatory process is present, and if not whether any new-growth is in progress. These questions are to be determined by the characteristics by which they are recognised in other parts; but the inflammatory affections of certain tissues of this region are known by special names—e.g. whitlow, ganglion, &c., which will be found described under separate headings, and the new-growths which may be met with are detailed later on.

Atrophy of the hand occurs under many conditions, and may be either partial or complete. In cases of infantile or other forms of paralysis affecting the whole or part of the arm, or even the hand alone, a general wasting of all the component parts ensues. In short, anything which interferes with the full use of the hand will cause a certain amount of atrophy through wasting of the muscular and other tissues which contribute to its roundness and proportions. It follows, therefore, after diseases of or injuries to the bones or arteries, but such atrophic changes as are consequent upon injury to nerves are very characteristic, the glazed and hairless condition of the skin being well marked, and the claw-like deformity of the fingers unmistakable. Atrophy of the interosseous muscles (so that the fingers cannot be divaricated), of the small muscles of the little finger and of the adductor of the thumb, is evidence of loss of power in the ulnar nerve.

Hypertrophy of one hand may ensue from its more constant employment in any severe labour which calls for increased power of its muscular tissue, and an example may be found in the right hand of a racquet or tennis player, which will become considerably larger than its fellow. But the more common form of hypertrophy is a congenital condition, and may affect the whole hand or, as is more frequently seen, one or more of the fingers, the others being of the normal size. This condition is sometimes, though rarely hereditary, and may or may not be symmetrical, or similar conditions may coexist in corresponding parts of the foot. There is a general hypertrophy of all the tissues forming the part, and not of the fat only, although in some cases this is the only tissue which is exaggerated. The elongated member is usually bent to one side, and being very slightly useful, such organs are very greatly in the way.

Gangrene.—Apart from frostbite (q.v.), gangrene very rarely attacks the tissues of the upper extremity. There are, however, certain causes of this affection which should be mentioned here, although the general consideration of the symptoms, &c., will be found under the proper heading. Thus gangrene of the fingers may follow severe injuries, crushes, tight bandaging, or may result from disease or obstruction of arteries. In the museum of the College of Surgeons may be seen a hand and forearm presented by the writer, which he removed from an elderly gentleman on account of gangrene consequent upon an atheromatous condition of the vessels. Injuries to nerves, particularly the ulnar, when followed by loss of sensation and by an ill-regulated state of the blood-supply, may cause gangrene, especially if there is added some slight injury to the part affected or the depressing effect of a low temperature. The absorption of ergot is sometimes the cause of gangrene in the fingers as well as in other parts, and a gangrenous condition of the fingers may result from acute inflammation, as in whitlow or septic poisoning. An affection has been described by Raynaud and others, which occurs in children as well as in adults, in which the parts become livid and in some instances gangrenous, from, as it is suggested, a spasmodic contraction of the arterioles. *See* ARTERIES, Diseases of.

Wounds of the hand and fingers are extremely common, and in proportion to their size are attended with considerable pain and hæmorrhage. It is perhaps owing to their frequency rather than to any other cause, and also to the very extensive supply of nerves to this region, which, especially in lacerated wounds, cannot but be largely implicated, that they are so commonly followed by tetanus. Simple cuts heal readily, and the only treatment required is to carefully clean the parts and extract all foreign bodies, and then, after adapting the divided edges by strapping or other means—stitches should be avoided, if possible, on account of the additional pain—they should be dressed with mild antiseptic lotions or ointments. As a general rule hæmorrhage from the fingers can be restrained without ligature of any vessel,

either by means of compresses or by careful bandaging, or by raising the hand and flexing the elbow.

Lacerated wounds occur from crushes by falling weights or in machinery accidents, and their management calls for the greatest tact and judgment. The parts may be widely torn and the edges of the wound severely contused. The pain is at first dull, but afterwards becomes acute and violently throbbing, and the bleeding may be severe. When no joint is opened and there is no fracture of bone, every effort must be made, by careful strapping or bandaging, to bring the parts closely together, after all hæmorrhage has been arrested by torsion, or ligature if necessary. Lint with some antiseptic lotion, or the complete Listerian apparatus, should be applied, and the hand, bandaged to a splint, must be kept raised over the shoulder or on an inclined pillow. Where, however, fracture of a phalanx is found, or where a joint has been opened, it is necessary, in view of the future usefulness of the part, to amputate, and this should be performed, if sufficient soft tissue can be gained to form the necessary flaps, through the joint next above the seat of injury.

The whole or part of a finger may be torn off by machinery or by being caught when the body is falling, and at the same time a long portion of tendon may be drawn out from the forearm. If it be necessary, the distal end of the remaining bone must be removed, the flaps trimmed and treated as in the case of an amputation.

Of other injuries to which the hand and fingers are liable, fractures of the bones of the phalanges or of the metacarpals are among the most frequent, and the joints are liable to simple or compound dislocation, and to sprains involving, more or less, rupture of the ligamentous tissues. These injuries have no special symptoms, but in their treatment it is important to give attention to the desirability of keeping them fixed with splints, &c., for as short a period as possible, and to the early and frequent passive movement of the joints, which, if this point is neglected, are very liable to become stiff and to be very painful under any voluntary movements.

Foreign bodies are frequently impacted in the tissues of the hand. Among the substances most frequently found are needles, pieces of iron, glass, splinters of wood, &c. The point of entrance may or may not be seen, and the body may be at some distance from it, and will often become embedded, setting up no inflammation, and only giving pain when pressed upon or from the movement of muscles with which it is in contact. Under these circumstances it is very unwise to interfere by any incision, but it is sometimes possible to push the end of a needle through the skin and thus extract it. Grave symptoms are occasionally the result of the pressure of foreign bodies upon a nerve. Thus, patients have been known to fall in a dead faint whenever the foreign body was pressed upon, or the same cause will give rise to fits or symptoms of a tetanic character. Their early removal is then of importance, and Esmarch's bandage is of the greatest possible service, since, by emptying the parts of blood, the foreign body is more easily distinguished and removed.

Inflammation in the subcutaneous tissue of the hand follows wounds of the fingers or of the palm, or may originate spontaneously. When no wound exists through which the products of inflammation can find an issue, the dense nature of the integument of the palm causes tension in this region to be attended with considerable pain. It is evidenced by thick, brawny, red swelling, often exceedingly tender, and very soon œdema, which is often considerable, appears on the dorsal surface of the hand, and upon the anterior and lower part of the forearm above the wrist. When suppuration has occurred, the matter can be seen beneath the skin, but, owing to its thickness, fluctuation is not easily to be detected at an early stage. From the disposition of the palmar fascia pus, situated beneath it, makes its way either upwards into the forearm, or downwards into the fingers, between the openings of that membrane. For the same reasons it will sometimes penetrate the interosseous spaces and present upon the dorsal surface. The lymphatic vessels generally share the inflammation, and their course is marked by red lines running up the forearm, and by swelling and tenderness of the lymphatic glands above the elbow and in the axilla. The constitutional disturbance generally runs high, and the destruction of tissues is frequently very extensive. Should pus find an entrance into the synovial sheaths, it will not only form a large fluctuating mass in the palm, but will bulge above the annular ligament by which it is confined laterally. Such inflammatory swelling can hardly be mistaken for the cold, chronic distension of the sac which constitutes a ganglion, but there is sometimes difficulty in determining the presence of matter. When circumscribed in the palm, mistakes may easily be made

between it and the inflammation surrounding a thorn or other small impacted body, or suppuration of a bursa which often forms beneath the hard cuticle of labourers or artisans. *See* WHITLOW.

Treatment. — So soon as the presence of matter can be definitely ascertained, a deep incision should be made at the most tender point in the palm, where generally some yellow spot indicates the tendency of pus to come forward. If the abscess has presented above the annular ligament, a free incision must also be made parallel and internal to the palmaris longus tendon, and a drainage-tube inserted. The hand must be kept raised, and frequently fomented with hot water to which some carbolic acid has been added, and warm lotions of boracic acid should be constantly renewed, and should embrace not only the hand, but the whole of the forearm. The œdema and inflammation being subdued, no time should be lost in gently exercising the movements of the wrist, hand, and fingers, as the contraction which occurs if this is neglected forms a serious complication of the affection.

Contractions of the fingers or of the hand are found to result from burns, in which case the density of the scar-tissue renders the malady very intractable, and the same condition, in a minor degree, follows deep or extensive wounds, in which the fascia or tendons are involved. Contraction of the fingers is sometimes met with as a congenital affection, and in the subjects of hereditary syphilis. But there is a well-recognised condition in which the fascia only is implicated, and not the tendons, occurring most frequently in men, at or about the middle period of life, sometimes with a history of hereditary gouty tendency. *See* DUPUYTREN'S CONTRACTION.

Caries and Necrosis of the metacarpals or phalanges is not rare, as the result of syphilis or struma, or sometimes of severe injury or inflammation of neighbouring parts.

Dactylitis is a condition in which the medullary canal of a phalanx—generally the distal—becomes distended with inflammatory products. It may be due to scrofula, when occurring in children, and is marked by a thin, red, shiny condition of the skin, which is distended over the subjacent parts. The periosteum is thickened, and the compact tissue of the bone is destroyed; caseation with formation of pus takes place and sinuses form, through which dead bone can be felt and may be discharged. When resulting from syphilis, whether acquired or congenital, there is a gummatous periostitis, which does not always commence in the bone, but may spread from the sheath of the tendons, or from the fibrous tissues of the fingers, and is followed by softening and necrosis.

The *Dislocations* of the phalangeal, or of the metacarpo-phalangeal, articulations can only be confounded with severe sprains, and either form of injury is followed by chronic thickening of the joint. It is advisable, after either, to commence passive movement of the joint as early as possible, in order to avoid the stiffness and pain on movement which result from prolonged rest. These joints are liable to all the diseases which commence in synovial membrane or in articular ends of bone, and are more particularly the seat of the chronic affections of joints which occur as the result of gout or rheumatism, in which, as well as in arthritis deformans, the contour of the articulations is greatly altered and deformed.

Dislocations of the wrist-joint need to be diagnosed from separation of the lower epiphysis of the radius, or Colles' fracture (q.v.), and from acute effusion into the sheaths of the extensor tendons. The diagnosis may be made by noting the position of the styloid processes of the radius and ulna, which in fracture retain their normal relation with the bones of the carpus; while in dislocation the carpus is placed in front of or behind them. Disease of the wrist-joint may commence in the synovial membrane, as a result of injury, rheumatism, syphilis, or septic poisoning, but more commonly results from scrofulous disease of the carpal bones, and, from whatever cause originating, the swelling is most marked upon the dorsal surface, the hand lies semiflexed, and soon shows signs of wasting, and crepitus is detected at an early period from the destruction of the cartilages covering the bones.

Warts very frequently arise upon the hands of persons engaged in dissecting or making post-mortem examinations, but are also often found upon the fingers of children without any apparent cause. *Chilblains* very frequently occur in this region in persons with feeble circulation. The possibility of a *Chancre* must always be remembered in the case of a small obstinate sore with sluggish granulations and spongy surface, situated upon the end of the finger or at the edges of the nail in a medical man or nurse liable to contagion.

Of the affections of the nails *Onychia* needs mention here, and is a form of ulceration commencing in the matrix. The

origin may be due to some slight injury, and the disease is then characterised by redness, heat, and swelling around the edge of the nail; pus soon appears underneath it, and the nail itself becomes altered in colour and is gradually exfoliated. Another form of the disease is due to syphilitic ulceration at the side of the nail, and is characterised by large granulations at the root of the nail, from which a foul sanious pus is discharged. The new nail which follows is badly formed. Treatment consists in removing as much as possible of the diseased nail, and dressing the granulations with iodoform or nitrate of lead. In the syphilitic form black wash or powdered calomel soon reduces the granulations.

The *joints* of the fingers often become enlarged, as a result of former injury, but in old persons such enlargement is more commonly due to rheumatic thickening of the ligaments. It is greatest, however, and is the source of much pain and limitation of movement, when caused by the deposit of urate of soda in the ligaments or around the ends of the bones, as occurs in persons of a gouty habit. Allied to these two conditions is the affection found in these as well as in other joints, termed rheumatoid arthritis, by which also the fingers suffer great deformity. The parts principally enlarged are the ends of the bones entering into the articulation. *See* CHRONIC RHEUMATIC ARTHRITIS.

The favourite site of cartilaginous tumours or enchondromata is found in the fingers, and they are known by their slow growth, their round nodular outline, and by the fact that, though commencing singly, they usually become multiple and affect many of the bones. Of the other tumours which are found to occur about the hand and fingers few need special mention, since the diagnosis must be based on those rules which are laid down for similar new-growths in other parts of the body.

JOHN H. MORGAN.

HANDKERCHIEF BANDAGE. — See *Esmarch's triangular bandage*, under BANDAGES.

HARE-LIP is the term conveniently used for expressing the existence of a congenital cleft in the upper lip. The term is incorrect, since in the hare the cleft occupies the exact median line of the lip, whilst in the human subject the defect is never found in the middle line, but to one side, or on both sides of it. The cause of the defect is a more or less complete arrest in the process of the development of the lip; it seems more than doubtful if the theory of 'maternal impressions' has any direct association with it. In the fifth week of fœtal life the median part of the upper lip is represented by a flap, which is descending from the front of the cranium in connection with the fronto-nasal plate. The lateral parts of the lip are developed from the coverings of the superior maxillary processes, which, extending inwards, are eventually fused with the descending flap at a short distance from the median line. If a unilateral arrest of development take place, a *single* hare-lip will be the result; but if, as less commonly happens, the arrest be symmetrical, the deformity will be *double*. This latter condition is often associated with extreme unsightliness. The cleft of one side or of both sides may extend into the nostril. Sometimes, however, the defect is represented by but a faint notch, or a slight depression on the free border of the lip. Or the apex of a slight triangular gap may be continued upwards as a slender white line, as if Nature herself had been attempting a plastic operation, with only partial success.

Hare-lip sometimes disfigures several members of the same family. Often it is complicated with cleft-palate, and the median piece of the lip, in the case of the single or double defect, may be attached, together with the intermaxillary bone, to the projecting nasal septum. Hare-lip much more frequently affects the male than the female.

The proper age for operating varies with circumstances; the child must be in the most favourable surroundings, and in the best state of health attainable. If the cleft in the lip be slight, and do not materially interfere with the infant's power of sucking, the operation may be conveniently deferred until after the weaning. If it be unassociated with defective palate, the sooner that it is closed the sooner will the infant be enabled to take the breast, and so to flourish. In such cases the operation may be undertaken with advantage and success within even a few hours of birth. Possibly at so tender an age the risks of the patient suffering from shock or hæmorrhage are greater, but for the sake both of the infant and the mother the defect should be dealt with, at any rate, within the first few weeks of cradle-life, provided that the general condition appear favourable. The early closure of the fissure has an important and beneficial influence in bringing together the sides of a palatine cleft.

Certainly it is impossible to over-estimate the importance of providing the infant with the power of feeding at the mother's breast. If the palate be widely cleft, or for any other reason the operation be deferred, unusual care and attention will be required for the infant's proper nourishment. These little patients are often brought to the surgeon in so thin and miserable a condition, that he is compelled still further to delay operation in order that their strength may be improved. When the infant cannot suck, the mother's milk should be drawn by a breast-pump and administered in a warm spoon. Failing this supply, equal parts of fresh cow's milk and water, with a pinch of salt and a little sugar of milk, should be used; and when being fed, the infant should be kept as upright as possible, so that the fluid may run easily into the pharynx. If he be sick after food it should be given in smaller quantities and at shorter intervals, and if cow's milk is being used it may be still further diluted. Condensed milk and the patent foods generally are, in the writer's experience, ill-adapted for the nourishment of these patients. The infant with hare-lip who is being reared by hand should be kept well covered in flannel, and his body and limbs should be rubbed, after the morning and evening warm bath, with cod-liver oil. The nurse who can produce a well-nourished infant, the subject of hare-lip and cleft palate, deserves high praise, many of these infants perishing from sickness, diarrhœa, and exhaustion.

Single Hare-Lip.—In every instance the operation for hare-lip demands the administration of an anæsthetic, fineness of adjustment and expedition being incompatible. Chloroform answers well, and it may be administered on a fold of lint just large enough to cover the mouth and nostrils; the stomach should be empty. The upper part of the infant's body should be wrapped round with a towel, so that the hands and arms may be fixed. In private houses a low chest of drawers forms an excellent operating-table; it should be placed in a good light. The operator will find it convenient to stand at the head of the patient, having the chloroformist on his left hand and the assistant on the right. The first, and a most important step, consists in making a superficial incision in the mucous membrane where it is reflected from the back of the lip on to the gum, and then completing the separation by tearing up the fold with the handle of the scalpel, so as thoroughly to free the lip of its maxillary attachments; this should be done to even far out on each side of the fissure.

The old-fashioned way of operating on an uncomplicated hare-lip consisted in stripping off the mucous membrane from the top of the fissure to the border of the lip on each side, and securely approximating the fresh surfaces; but by this plan the site of the original fissure was generally marked by a permanent and unsightly notch on the free border of the lip. A better plan, one which involves less sacrifice of valuable tissue, is to remove the thin strip of mucous membrane down the poorer side of the fissure, and to continue stripping off a thin layer round the blunt angle of the lip, and for a considerable distance along its free border. Then, from the opposite side of the fissure, a layer is dissected downwards; but, as the edge of the fine-bladed scalpel approaches nearer to the lower border of the lip, it should be turned obliquely, but boldly, outwards through the tissues of the lip. This having been done, a long strip hangs down from the lip, slender at the tip, but connected with the substance of the lip by a wide base. When the edges of the fissure have been brought together, this slip is bridged across the bottom of the vertical wound, and its raw surface attached by sutures of horsehair, or fine silver wire, along the border of the other side of the lip which has been already prepared for it. If this bridge do not come smoothly across the fissure, a slight extension of the oblique cut may be required. When the bridge has been carefully adjusted, all the thin tail of it which is not wanted is to be cut off in a tapering manner, so as to leave a point of mucous membrane to lie along the border of the lip. After the insertion of all necessary sutures the line of incision will look like a widely-spread inverted ⅄, the vertical part of which marks the site of the old cleft, a short limb extends into the conservative side of the lip, whilst the other and almost horizontal limb stretches along the opposite side of the lip, along the line of the transposed mucous membrane. In planning these incisions, care must be taken that the lines of the mucous membrane be evenly arranged. If the red flap be left deeper on one side of the lip than on the other, an unavoidable and permanent disfigurement results. For arresting bleeding from the coronary arteries during the operation, the finger and thumb of a dexterous assistant are better than any mechanical compress; the chloroformist will take charge of the left side of the lip. Blood is to be

kept from getting into the mouth by the use of fragments torn from a clean sponge.

As quickly as possible a fine harelip pin is passed well through the substance of the lip, at about a third of an inch from the sides of the fissure, and reaching to the mucous membrane, so that the coronary arteries may be secured by a twisted suture of worsted or silk, not too tightly applied. A second pin is inserted higher up the lip. For a simple and narrow cleft the pins may not be absolutely necessary, but the writer invariably uses the lower one, leaving it in for twenty-four hours. If it be left in longer, a permanent scar may indicate its site. Many fine sutures are to be used, and it is important that some be inserted on the posterior aspect, the lip being gently everted for the purpose; these last sutures keep the saliva and food out of the wound. As the sutures are being inserted, the lower pin may be found to require readjustment.

The pins having been cut short with wire nippers, and the skin having been washed with a perfectly clean scrap of sponge, a morsel of lint is tucked under the ends of the pins to keep them from pricking the lip. Then a small piece of dry lint is placed over all, and secured by a piece of Seabury and Johnson's adhesive rubber plaster, cut like an hour-glass, and long enough to reach almost from ear to ear. There is much art in applying this piece of strapping. A broad end is to be firmly attached to one cheek, so that the narrow part of the strap falls over the middle of the lip; with the finger and thumb the two cheeks are to be drawn together, so that all the slack of cheeks and lip seems gathered below the nostrils, and then the other end of the strap is to be fixed in the hollow of the other cheek. In this way all strain is taken from the sutures. The cheeks being grasped in this way by the finger and thumb each time the strapping is removed, or the wound inspected, there is little risk of the parts being disturbed. Collodion is not required; it may be that its application causes unnecessary irritation.

For removing the pins it is not necessary to disturb the dressing, which by this time is forming a firm scab over the lip; the end of the pin should have been left uncovered by the strapping, so that it can easily be caught by a pair of sequestrum-forceps, and loosened by being gently twisted round, in order that it may the more easily be withdrawn. During this manœuvre the lip should be steadied by the finger and thumb. With a small piece of sponge, and a pair of dressing-forceps, the nostrils may be cleaned out from time to time. Three or four days after the plastic operation, the incrusted dressings may be cautiously detached, and one or two of the sutures removed if they have done their work. If the transplanted paring of red membrane appear loose and unsatisfactory, it must be left uninterfered with; it may require some trimming and adjustment on a future occasion. To allow the infant to suck before the fourth or fifth day would be likely to disturb the union of the paring. The invention of trustworthy and waterproof strapping has rendered unnecessary the use of Hainsby's truss for keeping together the sides of the lip.

Double Hare-Lip.—The treatment of double hare-lip is conducted on the same principles as those just enunciated. The rounded or oblong flap of skin, which descends from the nasal septum, must have its red mucous borders carefully pared off; and the outer borders of the cleft should be treated on the conservative principle, the paring being dissected downwards and left attached to the lower borders of the lip by a wide base. These two dependent flaps will afterwards be trimmed as short as may be necessary, their raw surfaces being brought together along the lower border of the median flap, to fill up the gap, and even to form a prolabium. Both sides of the fissure should be dealt with at the one operation, and two hare-lip pins will be used with advantage, but they should be withdrawn at the end of the first twenty-four hours.

Complicated Hare-Lip.—When either single or double hare-lip is complicated with a cleft palate and a projection of the intermaxillary bone, there is no urgency for the performance of an operation, as the closure of the labial cleft alone would be of little advantage in the feeding; but even in this case the lip should be operated on, the child being well, long before the end of the first year. Often the intermaxillary bone, firmly connected with one side of the hard-palate, is so much twisted forwards and outwards that it offers a serious impediment to the success of the operation upon the lip. In these circumstances the projection must be forced back into the intermaxillary gap some days, at least, before the lip is dealt with. The twist may be given to the bone by a strong pair of sequestrum-forceps, the blades of which have been carefully surrounded with lint, so that their pressure may not injure the bone or the mucous membrane. During the subsequent day or two a piece of adhesive plaster secured along the lip will

suffice to steady the repressed bone. If the intermaxillary projection be associated with a bilateral fissure of the front of the palate, it may be far advanced upon the nasal septum, to which it is attached posteriorly. It will then be advisable to remove a triangular segment from the septum, by means of strong scissors or cutting pliers, before the repression of the mass is proceeded with. Sometimes one is greatly tempted to remove the intermaxillary bone altogether; but as it will prove very useful in filling the front of the palatine cleft, every effort should be made to get it back. Its removal would certainly be followed by a falling back of the upper lip. Moreover, in it are the germs of the central incisor teeth, and perhaps, also, of one of the lateral incisors in addition. When all local disturbance has quieted down, after the thrusting back of the mass, the lip may be dealt with on the principles described above.

If the intermaxillary bone be found eventually to be useless, or possibly an impediment to the closure of the cleft, it can at any time be taken away; but it should always have every chance given it. If the incisor teeth come through horizontally or obliquely, and the dental surgeon do not succeed in imparting to them a right direction, they must be extracted. When, as sometimes, though rarely, happens, the intermaxillary bone is advanced to the utmost, and attached to the tip of the nose, it must, probably, be sacrificed; but even then the median piece of the lip which partially covers it should be turned down to form a greatly-wanted columna for the nostrils.

If, after even the most careful operation, the promises of a satisfactory result end in suppuration and disappointment, all hope need not be laid aside. Attention must be given to the child's health, and still stricter inquiries be made into the condition of drains, sinks, and closets; the raw surfaces must still be brought and kept together by adhesive plaster, and, later on, feeble granulations stimulated and improved by judicious scraping. Thus it may be possible to secure an excellent result after all; and a year or two later any unnecessary and unsightly scarring may perhaps be lessened by operation.

EDMUND OWEN.

HEAD-INJURIES, Diagnosis of.—However trifling an injury to the head may appear, it ought never to be lightly regarded. The importance attached to such lesions is not so much due to the mere implication of the scalp and skull, as to the degree in which the brain and its membranes are involved. They ought to be estimated primarily according to the amount of extracranial injury, and, secondarily, as to the probability of the brain and its membranes becoming affected. Without any primary or secondary implication of the brain or its membranes, a fracture of the skull, even when compound, is of much less importance than a simple cerebral contusion or laceration. Owing to the intimate anatomical relations existing between the external and internal parts of the head, amounting in some parts to direct continuity of structure, inflammatory action is apt to spread from the former to the latter. So, a small scalp wound becoming affected with inflammation may lead to a fatal issue. Primary symptoms cannot be relied on as a sure sign of the amount of cerebral injury, as in many cases ultimately proving fatal the primary indications are extremely slight, or completely absent. In other instances, the symptoms may be very alarming at the outset and may yet pass rapidly away, the patient remaining in good health afterwards. A case which came under the writer's observation aptly illustrates the former of these statements. A man received a blow on the head while at his employment. He considered it a trifle, and continued at his work for three days without complaint or reference to his injury. But on the fourth day he was rather suddenly seized with symptoms of compression, from which he died. The post-mortem examination showed a large clot of blood over the posterior aspect of the left hemisphere. There were no inflammatory products.

Although, as a rule, the probable amount of injury sustained may be estimated by the degree and kind of violence used—and information on this point is of great value—still it cannot be too implicitly relied on, as comparatively slight violence has at times produced serious lesions. A blow on the head with the naked fist would not be expected to produce a fracture of the skull accompanied by a serious brain-lesion; but such a thing has occurred. A man received a blow on the eye from a comrade. He neither fell, nor was his head driven against any object whereby the effect of the blow might have been increased. Yet that man sustained a fracture of the orbital plate of the frontal bone, with laceration and extravasation of blood into the corresponding frontal lobe, from which he died. The history of the accident may

serve to indicate whether the lesion produced is likely to be diffuse or local. A fall upon the head or a blow from a heavy weight is likely to be followed by a widespread injury; while a local lesion is most likely to be produced by a blow from a pointed instrument. It must not be overlooked that the presence of constitutional disease will materially affect the prognosis in any traumatic lesion of the skull or its contents. Thus such an injury to the head as might be readily recovered from by one in good health, would not improbably induce serious or fatal results in one suffering from Bright's disease, through the occurrence of secondary inflammation or its consequences. In certain cases of cerebral tumours, the first indication of their presence has followed upon slight injuries of the head, and the symptoms of the disease have been mistaken for those of the injury.

Though the brain is spoken of as a single organ, it is made up of a series of centres, each with definite functions. Physiologically it may be divided into motor and non-motor areas, the latter including the portions of the cerebrum situated in front of, below, and behind the motor area.

All are agreed in regarding the ascending frontal and parietal convolutions along with the paracentral lobule as the chief motor centres. Some are inclined to limit the motor area to these, since they are the parts which have been most clearly demonstrated in man as regulating the motor functions. Those who argue from physiological investigations on the lower animals include, along with the above-mentioned areas, the bases of the three frontal convolutions and the postero-parietal lobule. There is still considerable diversity of opinion as to the particular spots in those areas to which the special motor functions ought to be relegated. To some extent this may be accounted for by the fact that the data have been derived from different sources—in man from clinical and pathological observations, in the lower animals from direct physiological experiment. As might be expected, the conclusions of the latter are the more advanced and more minute. But even from the side of experimental physiology all observers are not quite at one. A few of the main points may be here briefly alluded to.

Charcot and Pitres place the centre for the motor power of the arm in the middle of the ascending convolutions, and especially in the middle third of the ascending frontal. Hitzig and Ferrier concur in placing the centre for these movements in the upper part of the ascending frontal.

The centre for the motor power of the lower limbs, according to Charcot and Pitres, is in the paracentral lobule. Ferrier places it in the postero-parietal lobule; while Hitzig locates it in the ascending frontal, immediately below the centre for the movements of the arm. Charcot in this localisation agrees more nearly with Ferrier than with Hitzig.

Among the associated monoplegias, Charcot and Pitres attribute those of the arm and face to lesions of the inferior half of the ascending convolutions; those of the face and tongue to very limited lesions of the inferior extremities of the ascending convolutions, especially that of the frontal; and those of the arm and leg to lesions in the superior half of the ascending convolutions. Ferrier goes further and localises other centres of movement as follows—of the hand and wrist, in the ascending parietal; of the facial muscles, in the middle third of the ascending frontal (Hitzig agreeing in this) and in the base of the second frontal; of the mouth and tongue, in the lower third of the ascending frontal and in the base of the third frontal (the former portion agreeing with the conclusions of Charcot and Pitres); of the lateral movements of the head and eyes, in the posterior third of the first frontal and the corresponding part of the second frontal.

Ferrier defines the sensory zone in monkeys as that portion of the cerebrum which lies posterior to the motor zone. In man it may be said to lie below as well as behind the motor zone. In it the centres of sight, hearing, touch, smell, and taste are situated. He particularises as follows. The sight centre is located in the angular gyrus, and embraces also the adjoining part of the occipital lobe. The centre for hearing is seated in the superior temporo-sphenoidal convolution. The tactile centre is in the hippocampal region; while the centres for smell and taste are situated together at the lower part of the temporo-sphenoidal lobe.

If the lesion of any of these centres in the sensory area be unilateral, its fellow in the opposite hemisphere appears to take on the whole function. As far as being aids to the localisation of lesions, it is unfortunate that it is only when there is an identical bilateral lesion that the special sensation involved becomes completely and permanently impaired; therefore unilateral lesions in these areas cannot be recognised by loss of function, and on this account they

are apt to remain latent. In destructive lesions of the posterior third of the internal capsule, external to the optic thalamus, hemianæsthesia of the opposite side of the body results.

The portions of the brain in front of the motor area, including the orbital lobe, are not known to be connected with any definite function, except it be that of ideation; and as the one side of the brain is capable of continuing this function after the other side has been destroyed, it is difficult to find any definite symptom indicative of a unilateral destructive lesion in this region.

Lesions of the posterior portion of the third frontal convolution, Broca's region, cause defect in articulate language; when these lesions are destructive they usually produce a distinct psychological disorder, and when they are left-sided aphasia almost always results. When they are unilateral, there is no paralysis of the muscles concerned in articulation, but when destructive lesions in this area are bilateral there is both aphasia and paralysis of the tongue and mouth.

According to Charcot, all paralyses arising from destructive lesions of the motor cortex are permanent, and after a certain time are accompanied by secondary contractions of the paralysed muscles and descending degenerations of the motor tracts. The loss of motion is most marked in those movements which are most independent, the arm being more paralysed than the leg. If a unilateral destructive lesion of the brain involve the whole motor cortex, complete permanent hemiplegia of the opposite side of the body would result. Permanent monoplegia is produced by limited lesions of the cortex of this area. Cortical hemiplegia is not accompanied by defective sensation; whereas hemiplegia due to lesion in or near the corpus striatum is generally associated with a degree of anæsthesia, which, however, is of short duration. As distinguishing features of paralysis arising from intra-cranial lesions, the nutrition and the electrical contractility of the muscles are not affected. They may, however, suffer from disuse, and they may become rigid and contracted through secondary changes or extension of the disease to the spinal cord.

In a case of hemiplegia, the surgeon should first make out if it arises from a cerebral lesion. In the early stage, paralysis of cranial nerves and the presence of mental disturbance will in most cases point to this conclusion. Somewhat later, in the possible absence of these indications, assistance may be derived by noting if the nutrition of the muscles is fairly well preserved, and if they contract to electricity. Secondly, let him ascertain whether the paralysis is permanent, by the muscles tending to assume secondary contractions—from descending degeneration of motor strands—if so, if it be cortical, the lesion will be situated in the motor area of the opposite hemisphere. If the paralysis is confined to certain groups of muscles, the seat of the lesion in a particular motor area can be diagnosed. When right-sided hemiplegia is associated with aphasia, the lesion will include the posterior part of the third frontal convolution.

Irritative cortical motor lesions may give rise to epileptiform convulsions, which begin with a motor aura, and are either general or confined to one half of the body (hemispasm), or to a single muscular group (monospasm). If the lesion is in the motor zone, paralysis of the affected muscles is apt to ensue, and this may be also a guide to the area affected. In general, the lesions capable of provoking epileptiform convulsions are seated in the vicinity of the cortex, and the parts convulsed at the beginning of the attack (protospasm) may be taken as a guide to the lesion. There are, however, instances in which limited convulsions have been present during a considerable period prior to death, and where, judging from these, cortical lesions were expected to be found in the motor area and yet none were discovered; so that it must be admitted that there are a few cases, where functional disorder may induce symptoms similar to those of organic disease.

It will thus be seen that in morbid states of the brain there are two problems to solve, the locality and extent of the part affected, and the nature of the lesion, or, in other words, regional and pathological diagnosis. Regarding the former, the symptoms of cortical lesions, whether they be the result of injury or disease, depend on their situation and on whether they are unilateral or bilateral; so that a knowledge of the physiology of the cerebrum, and especially of the motor centres, becomes a necessity; and if the surgeon is to profit by this, he must know the exact relation in which the various parts of the brain stand to the outside of the head.

Whatever form the pathological lesions assume, they may be divided broadly into two classes, irritative and destructive. The former, among other causes, may be induced by depressed fractures, spicula of bone driven into the brain or its membranes, thickening of the membranes, &c. These

may cause twitchings and convulsions of groups of muscles or of one limb, without loss of consciousness; or of the whole of one side, which is usually accompanied by loss of consciousness. Primary paralysis generally indicates a destructive lesion, such as laceration of the brain or infiltration of blood into the brain-tissue.

A few indications may here be given of the relations of the external parts of the head to the convolutions and sulci of the cerebrum. The base of the brain is on a higher level in front than behind. The base of the anterior lobes corresponds to a line drawn across the forehead at the level of the eyebrows. At the side, the base may be roughly indicated by a line drawn from a point (in the adult) half an inch above the external angular process of the frontal bone to the upper part of the external auditory meatus, and from that to the occipital protuberance, the cerebellum lying below that line. To find the fissure of Sylvius (in the adult), draw a line from a point one inch and a quarter behind the external angular process of the frontal to a point three quarters of an inch below the most prominent part of the parietal eminence. The main fissure is seated in the first three-quarters of an inch of this line; the remainder of the line indicates the horizontal limb; while the ascending limb runs vertically upwards from a point two inches behind and slightly above the external angular process. To find the fissure of Rolando, draw two perpendicular lines parallel to one another from the longitudinal fissure—the first to the depression in front of the external auditory meatus, the second to the posterior border of the mastoid process. These lines will give approximately the anterior and posterior limits of the fissure of Rolando, its lower extremity being bounded by the fissure of Sylvius. The point where the anterior line crosses the fissure of Sylvius will be about the anterior inferior extremity; while the posterior superior extremity will correspond to the part where the posterior line meets the longitudinal fissure. The ascending frontal and parietal convolutions bound this fissure.

Scalp wounds are not in themselves dangerous. They heal with ordinary care quite as well as wounds do in any other part of the body, and the reason why they ought to be more carefully examined and treated is, as has been above indicated, on account of their relation to the cranial contents. Such wounds permit of an accurate examination being made of the state of the skull after injury. In all scalp wounds, when the existence of fracture is suspected, a digital examination should be made; if at all possible it is much preferable to the probe. When the wound is large the eye may enable one to diagnose with more precision. When, however, the fracture is not compound, other signs are required for the determination of its existence. There are three external phenomena which are of diagnostic value in cases of supposed fracture of the skull. These are: 1st, infiltration of blood into the tissues in certain directions and places; 2nd, the escape of the cranial contents—blood, cerebro-spinal fluid, and brain-matter; 3rd, symptoms and appearances of brain-lesions complicating the fracture.

A *hæmatoma* may form over a depressed fracture, and prevent its recognition by masking its external physical signs. Again, consequent upon a blow, there may be a rupture of the tissues and an infiltration of them with blood, and, as this condition occasionally assumes the form of an elevated ridge with a hollow in the centre, it might be mistaken for depressed bone. In the former, if there were reason to suspect the existence of a fracture from the symptoms, an antiseptic incision would reveal the true state of affairs. In the latter, firm pressure with the finger on a portion of the elevated border would dispel the swelling at that point, and reduce it to the level of the surrounding scalp.

With *infiltration of blood* into the eyelids, causing discoloration, a differentiation requires to be made between fracture of the base in the frontal region and the ordinary 'black eye.' A pathognomonic distinction cannot be made, as is sometimes stated, by the shade of colour, as the colours in the two cases are sometimes identical. In 'black eye' the eyelids swell first, and the conjunctiva is only afterwards affected, and often not at all. When the blow has been very severe there is great difficulty in separating the eyelids, and often in such cases, as seen a few hours after the injury, there may be no conjunctival ecchymosis. In infiltration from fracture of the orbital plate of the frontal, the eyeball becomes more or less prominent and fixed. The conjunctiva is generally first affected, or it may become so synchronously with the lower eyelid, which assumes a baggy appearance, much like what is seen in œdema, with the additional discoloration. The infiltration may go no further than the lower eyelid, or it may involve the upper eyelid to a slight degree. In cases of wounds of the brow, a dis-

coloured infiltration into the eyelids is very apt to ensue. This always affects the upper eyelids first, then spreads to the lower. Seldom is the conjunctiva infiltrated in such cases, and only so when the pericranium has been separated. But when the fracture runs through the orbital ridge, then the appearances very closely resemble those of 'black eye.' Ecchymosis frequently shows itself behind the ears and extends down the neck in fractures of the base, and when it appears twenty-four or more hours after the injury it is all the more likely to be indicative of this form of fracture. In the pharynx infiltration of blood is likewise occasionally seen in fracture of the base.

Bleeding from the ears, the nose, or the mouth, after an injury to the head, is a common accompaniment of fracture of the base; and when one or other of these follows an injury to the head alone, the source of the bleeding ought to be closely investigated. After an injury to the head, when bleeding takes place from a previously healthy ear in a continuous flow, lasting for an hour or more, in all probability there is fracture of the middle fossa, with rupture of the membrane of the tympanum. If this be followed by a more or less continuous stream of clear fluid, the probability of fractured base is increased; and if these be closely succeeded or accompanied by facial paralysis on the same side, the diagnosis of basal fracture of the middle fossa is positive. Bleeding from the mouth may occur from a fractured base in one of three ways—through the Eustachian tube, through the posterior portion of the roof of the nose, and through a ruptured pharynx, communicating with the fracture—a very uncommon occurrence. The blood in such instances might be swallowed, and escape observation until afterwards vomited. Bleeding from the mouth is by no means such a common accompaniment of fracture of the base as bleeding from the ear, and unless when clearly traceable to one of the above-mentioned sources, it is of no value as a diagnostic sign. When it is suspected that it proceeds from a fracture of the base, the pharynx ought to be closely examined. If the hæmorrhage proceeds from a rupture of the mucous membrane of the pharynx, the result of indirect violence, the probability is that there is a fracture of the base of the skull. If there be no rupture of the mucous membrane of the pharynx, then the channel for the blood is limited to the Eustachian tube or the roof of the nose. When the blood comes by way of the Eustachian tube, an examination of the ear on the injured side will reveal a dark, distended, tympanic membrane from the presence of blood within. Blood will likewise trickle through the Eustachian catheter when introduced into the tube.

Hæmorrhage passing into the mouth, from the upper and back part of the nostril, may be considered along with bleeding from the nose. In some cases of fracture of the nasal bones severe bleeding from the nose comes on; but, as a rule, firm pressure exercised by the fingers on the part for five consecutive minutes will arrest it. When the nasal bones have been driven through the cribriform plate of the ethmoid, or when this plate has been otherwise shattered and driven in, and the anterior extremity of the longitudinal sinus has been opened, the bleeding from the nose is venous and much more profuse. On one occasion the writer saw such a case, where the bleeding was not at first very profuse, but this stage was followed by a sudden burst—probably on the removal of a clot—when the venous blood rushed like a torrent from both nostrils for nearly a minute. This is a rare occurrence. The bleeding, however, in shattering of the ethmoid is generally copious, and continues for a considerable period.

Cerebro-spinal fluid may escape through any openings by which blood finds its way from the interior of the skull to the outside. Its escape shows that not only is there a fracture of the skull itself, but also that there is laceration of the brain-membranes. The most frequent point at which this laceration takes place is the tubular prolongation of the membranes surrounding the seventh pair of nerves. It escapes in lesions of the vertex, as well as in those of the base, though in the former the amount is small if the head be kept elevated and the patient at rest. If, on the other hand, the patient be permitted to toss about, to depress the head, or to make violent expiratory efforts, the fluid wells freely away. After an injury to the head, when a clear fluid flows continuously from the ear, especially after a preliminary bleeding, it is almost certain to be cerebro-spinal. The same may be said of the clear fluid that escapes from compound fractures of the skull. When a clear liquid proceeds from the nose or mouth it cannot be satisfactorily traced to a fracture of the skull except by chemical examination, which can be easily carried out. The cerebro-spinal fluid is limpid, contains little or no albumen, and a large quantity of chloride of sodium.

The escape of brain-matter from any of the cavities leaves no doubt as to the nature of the injury—fracture of the skull, with laceration of the brain tissue. Brain-matter frequently escapes from compound fractures in which portions of the bone have been driven into its substance. It has in a few cases escaped from the ear, and also from the nose.

The effects of severe injuries to the head, with or without fracture of the skull, on the *mental condition* is very diverse; the patient may be in a state of profound coma, or in one of complete consciousness, in which a careful examination detects nothing wrong mentally. Though this be true, it is uncommon to find no mental peculiarity in severe head-injuries; and even in cases in which replies are given rightly enough, there is often a cloud hanging over the intelligence, as indicated by the expression of the face, and the tardiness of the answers to the simplest questions. The mental derangement, though at first indicating but slight disturbance, generally increases after the lapse of an interval varying from a few hours to as many days.

There are some cases of fracture of the skull in which no external physical signs exist, but which may be detected from the symptoms to which they give rise. There are, no doubt, many instances of fissured fracture which are free from either symptoms or appearances which would enable the surgeon to pronounce a definite opinion as to their presence. In fracture of the base, besides what has already been mentioned, reliance must be placed upon a careful study of the appearances and phenomena exhibited, all of which are fully entered into under the heading of Skull, Fracture of the.

Patients are brought under the surgeon's notice who are absolutely insensible, and in such cases it is necessary to make at least a proximate diagnosis between pressure on the brain and insensibility induced by drugs or alcohol. No doubt the history in many instances of this kind is amply sufficient to point to a definite cause for the condition; but in many others it is misleading, and in not a few there are—at least in that stage when it is most important that a diagnosis should be made—no items of previous history obtainable. Under such circumstances one requires to rely on the symptoms. In opium-poisoning, as well as in certain cases of traumatic or idiopathic pressure on the brain, the pupils are contracted and fixed; and if reliance were placed on the condition of the pupils alone, the one state might be mistaken for the other. In opium-poisoning, one is almost sure to obtain probable evidence that opium has been taken from the laudanum phial or pill-box found in possession of the individual or in his immediate vicinity. When the patient has taken solid opium there is seldom any distinctive odour from the breath. When laudanum has been drunk, its peculiar odour is usually perceived at an early period in the case, though after the first few hours it is frequently absent. In any case, its absence must not count for much in a diagnostic point of view. When the coma of opium-poisoning has set in, it is accompanied by a slow, irregular, intermitting cardiac and respiratory action, which are not readily mistaken by those who have had experience of them. In such cases there is seldom any injury to the head, as would most likely be the case were the symptoms due to traumatic compression.

Alcoholic coma may be, and very frequently is, accompanied by wounds or bruises on the head. The coma (not mere drunkenness) arising from alcohol may be distinguished from that due to other affections by the fact that, when the patient is left undisturbed for twenty minutes, the pupils are contracted to the size of a pin's head. If an attempt be made to rouse him, by shaking him or pulling his hair, though he still remains quite comatose, his pupils will slowly dilate, until, if the physical stimulation be continued, they become fully dilated. If the patient be then left undisturbed, the pupils remain dilated for a period of variable duration, after which they begin to contract, though at a very slow rate, until they reach their former dimensions. The time taken for the transition from the fully-dilated stage to that of pin-head contraction is from ten to twenty minutes, varying according to the intensity of the coma. In rare cases, where the coma is very intense, the change has been completed in five minutes. In instances in which the patient is not deeply comatose, the dilatation continues for ten minutes, and then the contraction sets in at a very sluggish rate. In persons in whom the alcoholic coma is passing off, and who can be temporarily roused, the dilatation, once effected, continues, or the pupil may become smaller, though it does not attain the same degree of contraction as it formerly did. In some uncommon cases of cerebral compression the contracted pupil will slightly enlarge on stimulation (not fully dilate, as in alcohol),

and almost immediately thereafter contract to its former condition. On very rare occasions, when the alcoholic coma is about to have a fatal issue, shortly before death the pupils become widely dilated.

Some have supposed that the state of the patient's temperature yielded a means of diagnosis, but it is not of the slightest value in practice, and, if trusted to, would be sure to mislead. WILLIAM MACEWEN.

HEARING, Disorders of. *See* DEAFNESS, Diagnosis of.

HEART, Rupture and Wounds of the.—Rupture of the heart is generally caused by severe compression of the thorax from some heavy body passing over it. It is not infrequently accompanied by rupture of the valves. Death takes place nearly always directly after such an accident, either from the shock to the system, or from blood entering the pericardium freely, and thus interfering with the heart's action.

Wounds of the heart may result either from an external penetrating agent, or from a fractured rib or sternum. The latter, however, does not take place so frequently as the similar accident in the case of the lung, owing to the better protection of the pericardiac cavity in the chest. Its consequences, on the other hand, are much more serious, and for all practical purposes wounds of the heart, whether produced by an external penetrating agent or by fractured bone, may be considered together.

These wounds are generally regarded as necessarily fatal, and though a large proportion of them are no doubt so, yet recovery takes place in about 15 per cent. As in rupture of the heart, death takes place either *immediately* from shock or from blood entering the pericardium and so impeding the contraction of the muscular fibres, or *secondarily* from the after-consequences of the wound. Thus death may take place from continued hæmorrhage either externally or into the surrounding tissue. Or it may take place as a result of the acute pericarditis and myocarditis set up by the injury.

The nature of the wound does not appear materially to affect the mortality, nor does the part of the heart wounded. Thus the average of fatality remains nearly equally distributed amongst punctured, incised, and lacerated wounds, and the same is true whether the right or left ventricle or the right or left auricle be wounded.

The *signs* of a wound of the heart are the fact of a wound existing in its immediate neighbourhood, the occurrence of external hæmorrhage taking place from it, and the signs of internal hæmorrhage, which may take place either into the pericardium or into one of the mediastina. The pulse is small, intermittent, and irregular. There is often considerable pain over the sternum, and much dyspnœa, though these are not constant. The dyspnœa does not come on immediately, but is generally a later sign in those who live sufficiently long. Auscultation may reveal a friction sound if the amount of blood in the pericardium be small, but more frequently nothing is audible, the heart-sounds being muffled by the surrounding blood.

Treatment.—Rest to the injured part, so far as Nature herself permits it, is the most important element in the treatment of these cases. This is necessary for the prevention of hæmorrhage, both internal and external. The patient should lie absolutely still in the position most easy to him, no food or stimulant be allowed for the first twenty-four hours, and after that only the very smallest quantity of fluid nourishment. Half a pint of milk, with a very small allowance of ice to suck, is generally all that is required for three or four days after the injury. Small venesections may be employed with advantage, during the first few days, to diminish the tendency to hæmorrhage and to increase the coagulability of the blood, if they can be done without too much disturbing the patient. Cold may be usefully applied to the part, and it is said that belladonna and digitalis administered internally have also a certain value. Much trust, however, cannot be given to these drugs, and it is probable that rest, starvation, and small bleedings have a much more powerful influence for good than any drug. H. G. HOWSE.

HECTIC FEVER is the systemic expression of a continuous wasting or exhausting process, which in surgical experience is so frequently suppurative that the common term 'suppurative fever,' though too restrictive, is hardly a misnomer.

Pathology. — Unlike traumatic and many other fevers, hectic is not produced by absorption into the blood of any morbid matters. It may be due to a pre-existent state of over-action and excitement, sufficiently intense and prolonged to have greatly depressed the vital powers; to defect of the nutrient powers, preventing due repair of the blood; or to continued

subtraction from that blood of its protein elements, through some disordered excretion, or by means of suppuration. Thus, acute exhaustion, as from nervous shock or hæmorrhage, is expressed by prostration, chronic exhaustion by hectic. Therefore the names of all the diseases that frequently give rise to this fever may be omitted here, if it be taken that all subacute or chronic maladies, attended by pain, sleeplessness, inedia, impairment of the assimilative functions, loss by the kidneys of albumen or sugar, &c., are generally accompanied or closely followed by hectic. But the most frequent and common cause is prolonged suppuration; therefore, as strumous and tuberculous diseases are those which most frequently induce such discharges, and as persons of such diatheses are usually feeble—in other words have little recuperative power—so do we find hectic very surely developed in strumous and tuberculous affections accompanied by pus-formation.

Symptoms.—Since the morbid action which induces hectic operates little by little throughout a considerable period, so must the advent of that fever be very gradual, its first onset very slightly marked. Probably a sense of fatigue and weakness on first waking, a distaste for the morning meal, a rather rapid and small pulse, are the first signs. Afterwards, a slight loss of flesh will be noticeable, and the pulse becomes irritable; that is to say, while the patient is at rest its rapidity is normal or nearly so, but any excitement or exertion raises it by ten or twenty beats. The skin is somewhat dry and hot; this is at first only observed in the evening. Afterwards it is dry throughout the day, the evening, however, still keeping its pre-eminence. Many patients are at that time chilly, uncomfortable, and often thirsty; the tongue is either white, slightly furred, and feels sticky in the mouth, or else is unnaturally red and irritable-looking. The rest, at all events during the early part of the night, is unbroken; but awakening takes place early, and the patient finds his night-dress and the bed-clothes wet with perspiration.

By this time the febrile state is fairly established; the emaciation has become pretty strongly marked; the face, frequently pale and transparent-looking, flushes very easily, or there is a permanent, sharply-defined flush about the cheeks, the rest being pallid; the redness of the lips is often strongly marked, the eyes are bright, the sclerotic brilliantly white. Morning fatigue and languor, with evening irritability and excitement, correspond with the thermograph, which shows a normal, or even subnormal, temperature in the early hours, and a rapid rise after 2 p.m. Such is the usual and general course, but occasionally variations occur, probably produced by some condition of the digestive system. At this time the tongue is usually very clean, presenting a lighter or more pink-like red than is normal. The appetite is very variable and capricious; sometimes the patient eats well, at other times but little; requires much tempting, and often, after selecting certain viands for his next meal, turns from them, when set before him, with disgust. The action of the bowels is likewise irregular, the stools often loose, though not large in amount; at other times constipated. The urine is pale, rather abundant, and deposits much lithate of ammonia; there is, too, some excess of sulphuric acid and chloride of sodium.

If the exhaustive process and, therefore, the fever still continues, the last stages are marked by obstinate diarrhœa and violent night-sweating, called 'colliquative,' while in the day the excessive dryness of the skin renders it rough and furfuraceous. Emaciation is extreme. The joints of the limbs come to be larger than the mid part of each segment. On the trunk the bony processes become sharp and prominent; the skin over them, tightly stretched, is especially liable to develop bed-sores. The pulse is very small and quick, from 120 upwards; the temperature, while still subject to periodic elevations, has a tendency in the intervals to fall below normal. In this stage certain viscera may enlarge—the liver more particularly, and the spleen—while the urine exhibits casts called hyaline. If these conditions arise, the skin assumes an earthy hue, hardly icteroid, even though the liver be much involved. These symptoms mark lardaceous disease, which is chiefly, if not entirely, associated with prolonged suppuration. Throughout, the mind remains clear, and, until death is very near, free from delirium, which is often absent altogether; although in all stages, save the earliest, the patient is not infrequently troubled by unpleasant, even frightful, dreams, from which he awakes somewhat confused.

Treatment.—The chief, most certain and rapid cure of hectic is removal of its cause, either by healing a discharging sore or cavity, or by ablation of diseased parts. The surgeon, though he may often have witnessed such an effect, is always charmed to see how, after a successful

operation, his patient rallies from even severe hectic. The writer has more than once witnessed this result when lardaceous disease was already somewhat advanced.

The draining, and if possible, healing of an abscess, the removal of sequestra, though perhaps large and deep, should never be neglected. More important operations, especially such as mutilate to a greater or smaller extent, viz. excision of a joint or amputation, though never to be inconsiderately undertaken, must not be evaded until too late. In many cases the position of the disease permits of no such measures, and of these there are two sorts: such as may get well if life can be prolonged and strength maintained, and such as must prove, in an uncertain period, fatal. The treatment, though the same in both, is evidently more important in the former case. The surgeon's object must be to maintain strength, and so lessen fever. Food should be of the most nutritious forms, administered frequently and in small quantities, nor should it be at any time intermitted for any long period. Stimulants, in moderate quantities, are generally necessary. To diminish the fever, quinine in doses of from 3 to 10 grains, may be given an hour before the periodic rise. Kairine is in many cases useful. Sulphuric acid and iron are also valuable. If these check the fever they will also diminish the night-sweats, and for this latter purpose belladonna or its alkaloid is often effectual, as also is sponging the surface with hot vinegar and water. When diarrhœa supervenes, such astringents as kino or sulphuric acid, with spirits of chloroform, cardamoms, and tincture of opium, may be administered. The latter drug may only be used in small doses, as it augments perspiration. By such means we may, in the former class of case above-mentioned, prolong life until the local disease heals, or at all events we can carry out our duty of maintaining existence as long as possible.

R. Barwell.

HEMERALOPIA.—This term, like nyctalopia, has been, and still is, used in two opposite and contradictory senses. Some writers employ it to denote *day*-blindness, and others *night*-blindness. Most modern authors use it in the latter sense; all older writers in the former sense, and in contradistinction to nyctalopia. As Galen, in his Hippocratic lexicon, defines 'nyctalopes' to be those who are blind at night, it is certain that the original meaning of the word hemeralopia was day-*blindness*, and, so far as the term is admissible into modern nomenclature, it should continue to be used in this sense. Day-blindness usually assumes the form of photophobia, or dread of light, and is commonly dependent upon inflammation of the cornea, sclerotic, or iris. See *Nyctalopia*, under Amblyopia. J. Tweedy.

HEMIANOPSIA denotes an absence of one-half of the visual field. It is also called hemiopia. *See* Amblyopia; Perimetry.

HEMIOPIA. *See* Hemianopsia.

HERNIA of the BLADDER. *See* Cystocele.

HERNIA CEREBRI. *See* Brain, Hernia of the.

HERNIA, Inflamed.—In the form of rupture so named, there is acute or subacute inflammation of the interior of the hernial sac, and of its contents. The condition, indeed, is essentially that of acute peritonitis, limited to the parts concerned in the protrusion. The following are among the chief causes of this condition:—The pressure of an ill-fitting truss, blows upon the part, violent exercise, the arrest of a foreign body in the herniated loop, severe diarrhœa. The condition is much more common in irreducible than in reducible herniæ, and in small ruptures than in large. It is especially apt to occur in herniæ containing omentum. Omentum appears to be more readily inflamed than gut, and its lack of elasticity renders it less able to withstand the effects of violence.

The commonest seat of an inflamed hernia is a small irreducible femoral epiplocele. On examination, the inflamed parts are found to be red and œdematous. The sac will probably contain no fluid, but on the surface of the inflamed serous membrane will be many flakes of lymph. In some cases, however, there is much serous fluid in the sac, and but little lymph upon the surface of the membrane. The condition may pass on to suppuration, and the sac may be converted into an abscess-cavity. As a rule the mischief ends in resolution, and the involved gut or omentum, if not already irreducible, is found to have become fixed to the sac by unyielding adhesions.

The *symptoms* in this form of hernia are tolerably pronounced. The tumour is irreducible, is tense, hard, and firm, is the seat of much pain, and is extremely tender. If situated in the groin, the pain is increased by movement of the limb. The skin over

the swelling is hot, red, and œdematous. The tumour is most probably dull on percussion, but still retains an impulse on coughing. There is some malaise, and a varying degree of fever. There will probably be nausea and possibly vomiting, but in any case the latter symptom will be slight. There may be constipation, but it will, if present, not be absolute. There is no marked abdominal pain, and no constitutional depression.

As a rule, the case ends favourably in three or four days, but in exceptional instances the inflammation may spread to the general peritoneal membrane, or the gut may become acutely inflamed and even gangrenous, and extensive suppuration may appear in the sac.

In the *treatment* of the case, absolute rest in bed must first be insisted on. The parts should be so adjusted by posture as to relax as far as possible the tissues about the hernia. An ice-bag should be applied to the part, or a proper degree of cold may be maintained by Leiter's tubes. Opium should be given, and the patient placed upon a scanty diet of fluid nourishment only.

If any of the complications arise to which reference has been made, they must be treated in the usual way.

FREDERICK TREVES.

HERNIA, Irreducible, is a morbid condition of a hernia in which the contents of the sac cannot be completely replaced within the abdomen. This form may include intestine or omentum, alone or both together. This condition does not give rise to symptoms of strangulation or of obstruction, although it frequently causes increased dyspeptic flatulence. It is due occasionally to non-recognition of the lesion, more frequently to neglect on the patient's part to procure a well-fitting truss.

Irreducibility may depend upon causes situated—(*a*) outside the sac, due to the fibrous structures of the abdominal walls; (*b*) in the sac itself, as seen in cases where the neck is much narrowed or unduly thickened; or (*c*) in the very large majority of instances it is referable to altered conditions of the sac-contents. These are the presence of fluid, more or less in amount, in the sac, so that no well-directed pressure by taxis can be exerted upon the solid contents; adhesions between the omentum or the intestine and the sac; fibrous adhesions uniting contiguous portions of the omentum, so that it cannot be unravelled; adhesion of a coil of intestine; adhesions between omentum and intestine; accumulation of fat, or fibroid changes taking place in the omentum; hypertrophy of the mesentery; sudden descent of a large amount of intestine or omentum, or both together; fibrous bands passing across the sac; and, lastly, the anatomical peculiarities of the extruded viscera, which either have no sac at all, or only an incomplete one, as in hernia of the cæcum, sigmoid flexure, bladder, &c.

Irreducible herniæ are most commonly met with in the inguinal, femoral, and umbilical varieties.

In the inguinal variety of hernia, 2·8 per cent. are irreducible in males, and in females 3·1 per cent. In the femoral variety, the protrusion is irreducible in males to the extent of 15·5 per cent., and in females to that of 25·2 per cent. In both varieties of hernia, the right side is that on which it is most commonly irreducible. In females, this holds good positively and relatively; in males, hernia of the left side shows, in later life, a slightly increased tendency to become irreducible.

The contents of irreducible herniæ are usually omentum, the intestine being rarely irreducible; so that irreducible intestine amounts in inguinal herniæ to only 1·6 per cent., and in femoral herniæ to ·3 per cent. of all cases of irreducible hernia. This condition of hernia is liable to become inflamed, incarcerated, or strangulated; and cases have also been described in which the irreducible intestine has been ruptured by blows and falls.

The *symptoms* of irreducible hernia are those referable to ruptures generally, only largely increased. Beyond these symptoms are those of colic, constipation, and inconvenience from the size and weight of the hernia. There is no limit to the size which irreducible herniæ may attain, varying as they do from that of a small walnut to one involving a large part of the intestines and omentum.

As irreducible hernia leads, apart from local inconvenience and dyspepsia, to more serious morbid conditions, its treatment should be carefully watched. In all cases instrumental support must be given, not only to procure reduction of the mass if possible, but also to prevent increase of the hernia and its consequent dangers. In the majority of cases, complete reduction may be looked for by the application of well-fitting trusses, assisted by the cordial co-operation of the patients. By the constant pressure of hollow-padded trusses, gradual absorption of the omental fat and adhesions is effected, so that after wearing instruments for a longer or shorter time the mass be-

comes so diminished in bulk that it can be easily reduced. This reduction may take place gradually or suddenly.

If the presence of fluid in the sac be the cause of irreducibility, this may be evacuated by tapping, when the contents are in some cases capable of reduction.

Irreducible omentum may be removed by operation, and at the same time the sac should be excised. This operation is not without danger, for several fatal results have been recorded.

Irreducible intestine should be treated by suspensory bags, or by hollow-padded trusses having rim plates, the interval being filled in with chamois leather, so as to increase their depth without increasing their weight.

Herniæ of the bladder or large intestine, which, by the nature of their anatomical relations, are frequently irreducible, must be treated by palliative measures of support, by strong suspensory bags, or hollow-padded trusses with rim plates. *See* Trusses.

The plan of attempting reduction of old irreducible hernia by long confinement to bed and restricted diet, so as to lessen the amount of fat in the omentum or mesentery, has been recommended. The application of ice is sometimes followed by reduction, the result as much of the steady, persistent pressure of the ice as of the physiological effects of cold.

John Langton.

HERNIA, Obstructed or Incarcerated. In this form of rupture there is a hindrance to the return of the bowel into the abdomen, and an obstacle to the passage of its contents. The loop of intestine in the hernia becomes blocked up with fæcal matter, and a certain amount of obstruction is thus produced. This blocking is brought about either by a slight increase in the degree of constriction to which the loop is subjected, or by a sluggish movement of the intestinal contents, or by an increase in the quantity of those contents and in their consistence. The condition is most usually seen in cases where a part of the colon is involved in the rupture, and is comparatively rare in forms of hernia other than the umbilical. A loop of small intestine can scarcely be the seat of obstruction in the present sense of the term. The contents of that bowel are fluid, and it is hardly intelligible how a loop of small intestine can become blocked by gas or fluid. The contents of the lower ileum have often the consistence of soft fæces, and a hernia containing a portion of this segment of the bowel may be the seat of an incarceration. The so-called obstructed herniæ of small intestine would be more properly classed as herniæ the seat of a slight degree of strangulation.

The tumour, in cases of obstructed or incarcerated hernia, is increased in size, is tense, is tympanitic in some cases, and dull and doughy to the touch in others. It is seldom markedly tender, although it may be the seat of much pain. Often the swelling can be partially emptied by pressure, or its outline may be altered by the same means. Unlike the tumour in strangulation, there is an impulse on coughing, and although the mass is irreducible, it is not so hard and unyielding as it is in the more serious condition.

The constitutional symptoms are those of severe constipation. There is nausea, and possibly vomiting. The vomiting is never alarming, is never feculent, and is often quite insignificant. There is constipation, but it is not usually absolute, and flatus is often passed. There is some distension of the abdomen, but no grave abdominal pain. The tongue is coated, the appetite is lost; the pulse may be enfeebled. There is, however, no marked constitutional depression, as in strangulation, and indeed the condition present could only be confused with strangulation in the old and cachectic.

It will generally be found that the patient is liable to constipation; that he has been constipated for some time before the hernia has become obstructed; or that he has been the subject of flatulent dyspepsia, or of some kindred intestinal disturbance.

The *treatment* is simple. The patient must lie in bed. An ice-bag may be applied to the tumour, or the swelling may be emptied as far as possible by manipulation. If there be much pain, opium may be given in small doses. The diet should be scanty, and composed of small quantities of fluid nourishment only. An enema should be at once administered, and repeated several times if necessary. As soon as the local and general symptoms are less urgently marked, a dose of castor oil may be given.

Frederick Treves.

HERNIA, The Radical Cure of.—In the Jacksonian prize essay of the Royal College of Surgeons of 1862, the writer was the first to demonstrate by the results of sixty cases of inguinal hernia the necessity, in the operation for radical cure, of closing up not only the neck and cavity of

the sac, but also the deep ring, the sides of the inguinal canal, and the pillars of the superficial ring; and he accomplished these objects, in cases of reducible hernia, by the use of one common ligature applied in a peculiar way. Since that date he has used in 240 cases a stout silvered wire ligature, applied subcutaneously as described in the following pages, with the results of about 20 per cent. of failures and only two deaths. Two hundred of these cases were operated upon successively without a single death.

Since the introduction of the more complete application of the antiseptic method, rendering the dangers of operation less and the success more certain, the author has applied his operation, modified as required, to cases of irreducible hernia, and also to strangulated herniæ after herniotomy. In such cases the sac must necessarily be opened to obtain access to its contents, the removal of a portion of omentum is frequently required, and the risks of the operation are considerably increased.

In his address on Surgery to the British Medical Association at King's College in 1873, the writer advocated the ligature of the deep hernial aperture and the sac at and during the operation for strangulated hernia, after the bowel (not too much damaged) had been returned and a portion of the omentum (if necessary) entirely removed. On that occasion a patient was exhibited upon whom this proceeding had been successfully adopted. Since that time he has operated under spray in thirty cases of inguinal hernia with three deaths, and in eleven cases of strangulated inguinal hernia with one death. In some of these the sac was tied, twisted, and wired or tied across in several places, but in the majority the sac was entirely removed after ligature of its neck. In many, a stout piece of carbolised kangaroo- or ox-tendon has been employed instead of wire, but applied in the same way as had been done in his earlier attempts at the radical cure with ligature-thread and compress.

A similar operation has been performed by him in twenty cases of crural hernia, fourteen of which were cases of strangulation and three of irreducible hernia, with one death and one failure.

Some of the modern operators for the radical cure of inguinal hernia have devoted their attention chiefly to the closure of the pillars of the superficial ring, either by applying subcutaneously catgut, gold, or silver sutures, closing the skin over them, and leaving them in permanently, or for as long a period as the tissues will retain them. Some have, to all appearance, fancied that thereby they have effected an improvement and an important modification in the direction of simplicity upon the writer's method.

Mr. Spanton has proposed and practised a method of closing the canal in reducible cases, which is in its way very ingenious—viz. by the use of an instrument like a corkscrew, applied upon the pillars over and around the fore-finger invaginated into the canal, and left there until union has taken place. Others have, with greater effect, directed attention chiefly to securing the neck of the sac at the internal ring by what is called the *open method*. For this purpose an incision along the whole length of the canal down to the sac is practised, usually under the carbolic spray. Then the sac is opened and its neck is carefully separated from the spermatic cord and tied with catgut. At the same time some surgeons remove the sac altogether; others are content with twisting and stitching it up. In irreducible cases the sac is opened, the adhesions separated, and the omentum, if necessary, removed. The remaining steps of the operation vary with the individual operator, nor would it be within the scope of this article to do more than mention the names of the surgeons who have lately been working for the improvement of this department of surgery.

Professor Annandale of Edinburgh, Professor Stokes of Dublin, and Mr. Mitchell Banks of Liverpool have done good work in this direction. These surgeons stitch up the pillars of the superficial opening either with catgut, wire, or silk cord. In some of his later cases Mr. Banks has included the conjoined tendon, thereby approaching nearer to what the author considers to be an essential step towards the production of a radical closure of the canal. A similar plan has been followed by Sir William MacCormac. This kind of operation has been done abroad, according to Tillanus of Amsterdam, in numerous cases, and also by M. Reverdin of Geneva.

It is very difficult, from the nature of the case, to obtain reliable statistics of the deaths following the open method of operation. Still more difficult is it to get at the real results as to a radical cure. M. Tillanus gives 11 per cent. of deaths as the result in the numerous cases he has collected. The death-results of the recent operations by the open method are very difficult to obtain. Some of the cases operated on by the writer have been very large, and so have some published by An-

nandale, Banks, and others. The size of the rupture does not seem to influence the mortality as much as might be supposed.

We may conclude, however, that 11 to 12 per cent. of deaths even is too great a mortality to render the open method attractive. No doubt, in correspondence with all analogy, the mortality will decrease as surgeons become more skilful and dexterous in manipulation, and the number of cases multiplies. We may also conclude, from ample experience, that too much reliance cannot safely be placed upon ensuring the complete effect of any kind of antiseptic dressings. The region to which they are applied is a very difficult one upon which to fix and retain the dressings free from septic infection, and a limited size of the wound is of considerable importance from this point of view.

Selection of Cases and Modes of Operation.—The experience of nearly 400 cases of operation for hernia (from April 1858 to February 1885) has shown the writer that hernial cases differ so much from each other—even those classed necessarily under the same names—that modifications and variations of the operations for the radical cure are absolutely necessary to accomplish fully the purposes of the surgeon. Thus: 1. For simple *reducible inguinal hernia*, which resists the curative effects of careful and continued truss-pressure, the subcutaneous method of applying a thick silver wire to the sides of the canal, rings, and sac is most suitable, both because of its successful results—viz. 240 selected cases of operation, 9 of which were double, and 11 second operations, with (as far as could be followed) 40 failures (18 to 20 per cent.); and because of its safety, only 2 deaths having occurred, 1 from tetanus and 1 from peritonitis, set up independently of the operation. Two hundred consecutive operations by this method, without special antiseptic precautions, were performed by the author without a single death. A modification of this (used in young children), consisting in the employment of two pins instead of wire, has been used in 48 cases more, with 7 failures and 2 deaths, 1 from erysipelas and 1 from peritonitis. For some years these were exclusively the hernia operations practised by the writer, and no cases were operated on except those of reducible and uncomplicated hernia.

2. Cases of *reducible inguinal hernia* in which the omentum was troublesome, slipping down under the truss and dilating the canal progressively. In these the omentum and sac have been altogether removed under spray and antiseptic precautions, and wire, tendon, or catgut has been used for ligature. This operation has been performed in 16 cases, of which 1 died, all the rest being successful.

3. Cases of *irreducible inguinal hernia* incarcerated by adhesions or changes in the omentum, in which catgut or tendon has been used for ligature, the adhesions detached, and the sac and omentum removed. Of these there have been 14 cases, with 2 deaths, but no failures.

4. Cases of *strangulated inguinal hernia* resisting taxis under anæsthetics, in which, under spray, and after the ordinary operation for strangulation, the sac has been tied close up to the deep ring and removed, with or without a portion of omentum, and the inguinal canal closed with wire, catgut, or tendon. Of these there have been 11 cases operated on by the writer, with 1 failure and 1 death from peritonitis, the latter resulting from the injury inflicted on the bowel by the strangulation and not from the operation.

In reviewing the foregoing it will be seen that the mortality increases clearly with the severity of the case, and, therefore, of the operation; and that the result has depended, to a considerable degree, upon the extent of interference with the integrity of the parts concerned in the operation. The nature of the means adopted in the operation, the method of it, and the careful selection of cases fit for the operation, are shown to have some influence by the result of seventeen reducible, but otherwise unselected cases, operated on by the writer's earlier and abandoned method with common ligature-twine and boxwood compress, in the course of which suppuration, as a rule, occurred—viz. 17 cases with 8 failures and 1 death; and also in the pin method, now rarely used, 48 cases (1 double) with 7 failures and 2 deaths. Something considerable, too, must be allowed for improved manipulation and dexterity in operating in the later cases, and for matured judgment and experience—as in all other operations.

Writer's Percentage of Successful Cases. It comes out clearly that, in this operation, the greater number of failures declare themselves during the first two years after the operation. If the operation is not properly done, or from some other cause, the return is evident when the patient removes his truss or ceases to wear it. Consequently, in estimating results, the writer has left out all cases which have not been cured for two years. He has been able to follow (out of

a total of 339 cases of the variously modified subcutaneous operation) 96 cases, all of *more than two years'* duration after operation. The longest was twenty-five years after operation, and this was a case of very large rupture, with no truss worn after. Twenty have been examined more than ten years afterwards, and the rest at various periods above two years. In 59 cases there has been a return of the rupture to a greater or less extent, usually before the end of two years. In 152 other cases the patients are known to be cured up to and below two years after operation. The proportion of successful cases in 339 instances of the subcutaneous operation is calculated at from 73 to 82 per cent.

The number of deaths in the 339 cases was five, one of which was from tetanus, and one from causes quite unconnected with the operation. The other deaths were from erysipelas, peritonitis, and pyæmia. Two hundred and twenty subcutaneous wire operations were consecutively performed without a *single* death, and in 240 wire operations there were only two deaths.

Operations for the Radical Cure of Inguinal Hernia.—The instruments used by the writer for these operations are a small scalpel or tenotomy knife, and a stout curved semicircular needle on a strong handle. The concave surface of the needle should be flat, the other rounded. The point must be sharp, but the tapering shoulders of it not sharp enough to cut, but only to split the tissues. Both should be steeped in carbolic lotion (1-20) and plentifully oiled with carbolic oil (1-5). In most of the writer's operations thick copper-wire, silvered, one foot and a half long, has been used to close the canal and rings—wire thick enough not to cut through the compressed structures too quickly, and not so thick as to be inflexible; each end should be bent into a well-made hook. Latterly, however, he has used a stout piece of kangaroo- or ox-tendon, well soaked in carbolic oil for a month at least before. It is applied exactly in the same manner as the wire, but tied in a surgeon's knot instead of the twist of the wire. He cannot yet speak positively as to the respective advantages of these two methods. The tendon is better than catgut, as it is more pliable and does not untwist. It possesses the undoubted advantage, like prepared catgut, of not requiring removal subsequently, and of maintaining its hold of the closed structures until the adhesions and fibrinous effusion set up to replace it are permanent and resisting. The wire sets up more solid effusion and granulation in the track of its passage, and keeps open a straight drain for the escape of any fluid effusion, but it necessitates removal after a week or ten days, and frequently a second administration of anæsthetics.

The patient being anæsthetised and laid on his back, with the shoulders raised and knees drawn up to relax the groin structures, and the pubes and genitals shaved and well washed with a 1-20 carbolic solution, a vertical incision about three-fourths of an inch long is made through all the integumentary structures about one inch below the pubic spine. Sometimes, in old cases which have worn a truss, the superficial external pudic vessels require ligatures at both ends after being divided. The edges of the cut are then detached from the deeper tissues with the handle of the knife; the forefinger purified and dipped in carbolised oil, is passed through the cut, and made to invaginate the deeper coverings and the sac (if scrotal) as far up the canal as the deep ring or hernial opening. Then, by hooking forward the finger, the thickish muscular border of the internal oblique muscle is raised, and the finger is pressed inwards so as to pass behind the edge of the conjoined tendon, raising it well forward. The curved needle is then passed along the concavity of the hand till its point is felt at the tip of the finger, when it is pushed through the resisting structures until its point is seen to raise the yielding skin of the groin at the level of the deep ring. This skin is now drawn inwards towards the median line, and the needle pushed through it. Then the hook of the wire (if wire be used), or the end of the ligature (if tendon or catgut be used), is passed through the eye of the needle and drawn down through both the groin and the scrotal punctures and detached. The invaginating forefinger is then shifted outwards and placed behind the centre of Poupart's ligament, pushing inwards the cord, so as to feel distinctly the groove formed by Poupart's ligament. The latter is then lifted well forwards and kept away from the iliac vessels, which lie directly behind it. The needle is again passed along the concavity of the finger to its point and through Poupart's ligament. When seen to raise the skin, the latter is drawn outwards until the needle-point can be passed through the same aperture as in the previous stage. The needle is then withdrawn, carrying the other end of the ligature or wire through the scrotal puncture. If wire be used, a loop must be left protruding through the groin puncture.

The deep coverings of the cord below the superficial ring are next pinched up by the finger and thumb—and with them the sac of the hernia, if present—at the scrotal opening. The spermatic duct is to be here carefully felt and distinguished, and the needle passed in front of it at one side of the scrotal puncture and out at the other; one end of the ligature or wire is then passed through its eye, drawn back with it, and detached. If wire is used there will now be a loop above at the groin puncture, and two loose ends below at the scrotal incision. The wire must then be pulled upon so as to be straightened out between the loop and the ends, where two twists are to be made and the loop drawn up so as to invaginate and compress all the tissues; the wire is then finally twisted down at the loop end into the groin puncture. With the tendon ligature all that is needed is to tie firmly together the two ends protruding through the scrotal incision in a true surgeon's knot, and to cut off the ends within the incision, stitch up the upper part of the incision if it gapes, and put a few horse-hairs for drainage into the lower part. If wire is used, the ends are bent upwards to the loop, passed through it, and fastened by a single bend, the ends being cut off short. The patient is then put to bed in the sitting posture, with the knees drawn up over a bolster, and fed on milk and beef-tea for a few days.

It will be observed that the steps of the operation are essentially the same whether wire or tendon be used as the retaining medium, the nature of the material employed requiring a little modification of the process. The wire may be withdrawn after a week, ten days, or a fortnight, according to the amount of action set up. Usually there is very little discharge, and the wire comes away with little trouble. The two ends are untwisted and stretched straight, and the loop pulled upon. The two parts of the wire lie usually in the same track, having slowly ulcerated through the tissues and left granulations behind them, which close up firmly by a deep cicatrix the compressed and twisted tissues. The tendon remains in the tissues, and holds them together until the solid effusion which ensues absorbs and replaces the ligature. Upon the perfection of this process depends the permanency of the cure.

By this operation the valvular arrangement of the sides of the normal inguinal canal is restored by the union of the conjoined tendon with the edge of the deep ring, the internal pillar of the superficial ring, and with the fascia transversalis and deeper fibres of Poupart's ligament. This union occurs, if the operation be well managed, close up to the deep ring, and involves its structures also. The obliquely placed ligature embraces both the invaginated sac, the deep ring, the canal, and the superficial ring. The inner limit of the ligature is the edge of the sheath of the rectus, the outer limit is Poupart's ligament. In the numerous operations now performed no trouble has ever been experienced with the epigastric artery. It yields easily to pressure, and cannot be punctured. If included in the ligature, it becomes obliterated without further trouble. The iliac vessels are avoided by lifting up Poupart's ligament well on the finger, and by keeping the needle well in front of the finger. The writer has never had trouble of any kind from this source in all his experience, now very considerable.

Modifications of the Operation.— In cases in which it is thought desirable to open and remove the sac, with or without removal of the omentum, the scrotal incision is carried upwards as far as the superficial abdominal ring, and through all the intervening structures down to the sac itself. The sac is carefully looked for and drawn out of the wound, great care being taken in detaching it from the spermatic duct, which is closely connected with and often totally invested by it. The fingers, forceps, and the handle of the knife are the safest instruments to employ. If it be necessary to use the point of the knife, the incision should be always vertical—i.e. in the direction of the duct, which it is desirable to avoid, and never across it. The sac should be gradually enucleated, and its fundus detached from the tunica vaginalis and drawn out. An opening to admit the finger should then be made, and any omentum which may lie in the sac is thus brought into view. The fundus of the sac is then lifted up and held at right angles to the trunk, while the finger of the surgeon feels carefully for the deep abdominal opening. The sac is then isolated as far up as this point, which is easily done through the dilated superficial ring. If difficulty be experienced, the upper fibres of this ring—i.e. the *intercolumnar*—are to be cut to a limited, but sufficient extent, to allow of a complete investment of the neck of the sac with the ligature. If there be a process of the omentum which it is desirable to remove, this should be first dealt with. All adhesions to the sac, whether of omentum or bowel, which can be easily separated, should be first detached; then the omentum, held

firmly by the assistant, should be spread out and examined. A small curved suture-needle, armed with the thinnest catgut, should be passed under the vessels which are seen in the omentum separately, and these should be tied, the ends of the catgut being cut close. Then, the deeper part of the omentum being still held firmly, the portion of it which is beyond the ligatures should be cut off with the scissors. Any oozing points should be tied carefully with the catgut, and the part exposed to the air to see if there be more oozing. The omentum is then allowed to return into the abdominal cavity.

The sac is next dealt with. The fore-finger being passed through it to the deep ring, the neck of the sac is twisted round firmly for two complete turns. The handled hernia-needle before described is armed with thick, stout, prepared catgut or tendon, and is passed across the twisted neck of the sac at the point of the finger, close up to the deep ring, a double ligature being left on the withdrawal of the needle. The loop is cut and the four ends tied, two and two, in a firm surgeon's knot, and cut off close. Care must be taken here that the spermatic duct behind the sac is not included in the ligature or injured in any way.

Lastly, the tendinous sides of the inguinal canal are to be secured by wire or tendon in the way before described—viz. through the conjoined tendon close to the edge of the rectus muscle on the inner side, and through the centre of Poupart's ligament on the outer side, the two ends of the ligature, tendon, or wire being brought down into and through the scrotal puncture. There being no sac left in the scrotum, the needle must now be carried across in front of the spermatic cord and closely embracing it, through the fibres implanted into the pubic spine on the one hand and the internal pillar of the superficial ring close to the pubic crest on the other, and the end of the ligature or wire be drawn across, leaving the cord easily movable behind the ligature. If tendon or thick catgut is used for ligature, it must be tied firmly, so as to be quite tight. A surgeon's double knot should always be used. If wire is used, its ends must be twisted as before described, and the loop above drawn upon so as to close up all the tissues involved, and secured as already mentioned. Finally, a drainage-tube should be placed along the cord close up to the ligature, and the scrotal wound closed by sutures.

For the better safeguarding of the patient, the writer is strongly of opinion that the strictest form of antiseptic dressing and treatment should be followed out. He employs Lister's spray method as the most sure and convenient.

In this operation the ends of the wires or ligature are crossed like a bootlace. The superficial ring and canal are thus secured along their whole extent, together with the deep hernial opening. The sac is tied close up to the deep ring, and the possibility of its becoming patulous and again admitting bowel or omentum is removed by its adhesion to the oblique muscles and aponeurosis. The ligature and removal of the omentum, in the cases requiring it, add a still further impediment to a return of the rupture by the stump becoming adherent to the deep hernial opening. There is thus formed, in large and severe cases, a triple barrier against a return of the rupture.

In cases of direct hernia this laced arrangement of the ligature must be carefully carried out, the needle being carried through the tissues close to the border of the rectus muscle, so as to include the margins of the opening in the conjoined tendon. In such cases, there is found not uncommonly an awkward position of the spermatic cord in relation to the sac. It may be found in front of the sac instead of being outside it. It has also been in several cases found to be separated into two parts, one containing the spermatic duct and the other the spermatic vessels and nerves. In all these cases it should be carefully looked for and isolated before lifting out the sac.

In congenital hernia, the fundus of the sac may be left attached to the testicle, and sewn up with fine catgut to form a *tunica vaginalis*, the intermediate portion up to the deep ring being removed.

The writer considers it advisable, in all cases where an elongated piece of omentum is habitually in the sac, to open the latter and to remove the omentum and sac. Nothing is more calculated to dilate the openings than a piece of omentum forced down by abdominal muscular pressure. Experience has shown that in such cases, uncomplicated and in healthy subjects, the ligature and removal of the sac and process of omentum under the spray is a safe enough proceeding; while the result is a more resisting impediment to the return of the hernia.

A still more difficult complication is found in an *imperfect* or *non-descent of the testicle*. This is usually associated with, or followed by, a hernia of the congenital kind, with an open funicular process. The hernial contents are in close

contact with the testicle, often passing in front of and below that gland, so as to resemble a hydrocele. This resemblance may be further increased by the presence of fluid from the peritoneal cavity in the sac of the hernia. In these cases the process of peritoneum is usually drawn down by the gubernacular fibres which are attached to it, so as to *precede* the testicle, which is kept back by adhesions in the inguinal canal or abdominal cavity. If, under such circumstances, strangulation takes place or the testicle becomes inflamed, the case is obscured and complicated in a very dangerous manner. In several cases of this kind in young adults the writer has successfully dealt, by one operation, with both the undescended testicle and the hernia also.

By a modification of the operation before described for removal of the sac, the testicle is cut down upon and detached from its connections with the canal and rings. The sac is then tied close up to the deep ring and cut off short. It is again stitched up below with fine catgut, and cut close to the testis, leaving the fundus for a *tunica vaginalis*. The spermatic duct, with its vessels and nerves, is then stretched gently, but firmly, by laying hold of the testis and drawing forwards and downwards. In this way an inch to 1½ inches will usually be gained in length, and the gland may be drawn down and placed in the scrotum so as to lie below the level of the symphysis pubis. It is held in the scrotum by a stout catgut ligature passed with the handled needle through the scrotal tissues below the testis and serous tunic, which are probably the remains of the gubernaculum. The two ends of the ligature are passed separately through the skin of the scrotum and tied over a small pad of carbolised gauze. In some cases, where the cord or spermatic duct did not yield sufficiently to traction, the duct was cautiously separated from the epididymis in the lines of cleavage of the connective tissue, from the globus major down to the globus minor. The gland was then turned upside down, so as to gain the length of its long diameter, and fixed in the scrotum as before described.

The extremely convoluted arrangement of the spermatic duct, and its elasticity within its fibrous envelopes, permit of this stretching without damage to its structure by using too much force. To prevent as far as possible the elastic retraction which follows to some extent, a stout silver wire or tendon suture should be carried deeply through the scrotum directly above the testicle, and this has also been supplemented by elastic traction upon the pad and ligature at the bottom of the scrotum.

In most cases the testicle has become adherent to the scrotum where placed. In some, a certain amount of subsequent retraction has drawn the testicle into the angle between the adductor muscles and the penis. It was, however, in this retired position sufficiently protected from violence or pressure, and was not by any means so liable to be crushed or injured as in its original position in the groin. In one case there has been suppuration in the new tunica vaginalis formed from the fundus of the sac of the hernia. No atrophy of a testicle which was well developed before the operation has occurred. In one case, a child eight years old, in which the testicle was transplanted to enable a truss to be applied to the hernia which followed it, the testis, which was originally wasted somewhat, finally disappeared, either from the operation, or by the truss-pressure subsequently kept up upon the newly formed cicatrix resulting from the operation.

Radical Cure after Herniotomy for Strangulation in Inguinal Hernia.—Since the writer published the first case of this operation in the Address on Surgery at the British Medical Association meeting in August 1873, he has operated in eight cases of *strangulated inguinal hernia* after relief of the strangulation, the intestine being in a comparatively healthy condition—i.e. not sphacelated or ulcerated, but only chocolate-coloured from congestion. The operation was completed by the ligature and removal of the sac, and ablation of diseased omentum; then the sides and rings of the inguinal canal were drawn together by either wire, catgut, or tendon, and the wound stitched up over a drainage-tube. In one case of *reduction en masse* he has done this with complete success. The same operation was done in eight cases of strangulated *crural hernia*. Two deaths resulted, from the damage done by the strangulation and not by the operation.

Operation for the Radical Cure of Crural Hernia.—For this operation the same instruments and appliances as in that for inguinal hernia are used by the writer. The parts, the instruments, and the hands of the operator being carefully purified, the skin closely shaved, and the hernia, if possible, reduced, a vertical incision, 1½ to 2 inches long, is made over the centre of the hernia, and layer after layer of tissue divided with a small scalpel or tenotomy knife until the sac is reached. This is opened

on a director, or by the careful use of the scalpel and forceps, and any omentum which may be present is drawn out gently and spread out, so that the vessels which supply it can be recognised. These are to be taken up with the point of the forceps, and tied with the finest catgut, wherever needed. The omentum is then to be held steady by the assistant, and cut off with a pair of blunt bent scissors, or torn carefully with the fingers and forceps.

All the bleeding vessels are to be tied carefully and kept exposed to the air and spray for a while, to make sure that bleeding will not recur. The omentum may then be suffered to retract into the abdomen. The sac is then drawn firmly downwards and forwards. A piece of strong catgut or prepared tendon, doubled, is then to be passed through the neck of the sac, and tied on each side, as high up as possible. The ligature and the sac are cut off close, and allowed to retract into the abdomen. Then the needle is passed through the pubic portion of fascia lata, just internally to the femoral vein, which is to be carefully protected with the forefinger. The point of the needle is carried upwards and forwards, through Poupart's ligament, and brought out at the upper end of the skin wound. A stout piece of prepared tendon is threaded through the eye of the needle and drawn back through the tissues. The needle is then cleared, and passed through the same structures—viz. the pubic fascia lata and Poupart's ligament close to Gimbernat's ligament, the surface and border of which is closely skirted. The other end of the ligature is then threaded through the eye of the needle, drawn down into the wound, and released. If the rupture be a large one, a third ligature may be placed through the same parts, between the other two; or the end of the ligature may be carried across, through, and behind the fascia lata, close to the pectineal line, to obtain a firm hold of those tissues. The ends of the ligature are then tied firmly in a surgeon's knot and cut off short. It will be found, if rightly applied, to close up entirely the femoral hernial opening. A few horse-hairs or a small india-rubber tube, for drainage, should be applied in the lower part of the wound, the upper part of which should be closely sutured with silk and dressed. The patient should be placed in bed sitting, with the knees drawn up. This operation may be performed in favourable cases without taking away either sac or omentum.

Operation for the Radical Cure of Umbilical Hernia.—The operation originated and employed by the writer is performed by the aid of a stout needle, cockspur or semicircular in shape, and with or without handle, carrying a flexible silver wire or thick, stout, aseptic tendon or catgut about 12 or 14 inches long. The instrument and ligature should be steeped for a quarter of an hour in a 1-20 carbolic solution, the patient's navel be well cleaned out, and the neighbouring parts, as well as the operator's hands, be washed with a 1-30 solution.

Then, under an anæsthetic carried far enough to prevent all struggling, the point of the forefinger or, in small cases, the little finger, should press in the protrusion and invaginate the sac so as to make sure that all the parts round the navel are free from bowel and omentum. The needle—unarmed if a handled one be used, but armed with the ligature if an ordinary cockspur or semicircular one be employed—is passed along the front of the finger and made to pierce, from behind, the fibrous structures and skin, about half an inch from the margin of the aperture, leaving a loop at the puncture thus made. The needle and one end of the ligature are then carried round under the skin, close upon the tendinous aponeurosis, just one quadrant of the circle of the hernial aperture, and brought out again to the surface, as in tying a nævus subcutaneously. The needle, if a handled one, is then freed from the ligature. The invaginating finger is again placed on the deep surface of the edge of the hernial opening opposite to this point (or, if preferred, in small cases, the spoon end of a common director can be substituted for it), and upon this the needle is to be again passed through the aponeurosis and skin-aperture occupied already by the ligature, and the end of the latter threaded through its eye and drawn through. These steps are to be repeated for each of the remaining quadrants of the circular hernial opening, carrying the same end of the ligature all round the margins of the aperture and neck of the hernial sac. By traction upon both ends of the ligature (wire, catgut, or tendon) the neck of the hernial sac is closed up firmly, the fundus being gathered up by a pair of hooked forceps and puckered like a sack's mouth when tied. The ligature may be secured by tying or twisting in two separate halves if the case be a large one. By these means the deep surfaces of the peritoneal sac are closely applied to each other in the grip of the ligature. In children's cases stout prepared catgut or tendon should be used. In larger adult cases the writer prefers the use of moderately stout silver wire. The latter

ulcerates gradually through the tissues enclosed in its grip, and may, at the end of a week or ten days, be removed with ease on account of the ulcerative action enlarging the track in which it lies. Antiseptic treatment and dressing may be used in both ways of operating. When catgut or tendon is employed it is the more necessary to prevent septic changes, which will cause the ligature to set up suppuration and become discharged, with some delay—perhaps considerable—in the course of the after-treatment.

Two cases of this operation of which notes were kept were in healthy young men. One was afterwards admitted into the army, after having been refused before the operation by the medical examiners. There were no bad symptoms whatever in any of the cases in which the writer has operated, and convalescence was speedy, especially in children.

In the great majority of cases, children can be cured by the maintenance of efficient truss or belt-pressure, carefully applied and sedulously kept up. The writer is of opinion that the pad should be hard, firm, and flat, and should present no boss or projection to be forced into the hernial aperture. If such projection be effective, it delays or prevents contraction of the hernial opening. If not effective, it lies anywhere but opposite to the hernia, and hinders really efficient support to the hernial weakness.

A flat circular disc of lead the sixth of an inch thick and four times the diameter of the hernial opening, slightly bent into a ridge to fit the median abdominal groove when this is deep, covered with wash-leather and held on by a jean or rubber belt, has been found to be the best for children, and seldom fails to cure the rupture in a year or two. When this is borne with difficulty, an air-pad may be fitted to the surface of the metal disc to make it more comfortable and easier to be worn.

In children, the hernia should be cured by pressure before the age of ten years, or be submitted to an operation. Each year after that diminishes the chances of a radical cure.

There are but few adult cases, comparatively, which are good subjects for operation upon this kind of hernia. They are commonly stout, with protuberant abdomens and a large accumulation of intra-peritoneal and surface fat. Often the liver and stomach are troublesome, and sometimes the kidneys are not sound. These patients should be made as comfortable as possible by air-pads, bags, and belts.

In exceptional cases, the radical cure of umbilical or ventral hernia may be attempted after the operative relief of strangulation and division of the point of stricture, by a method of closure of the aponeurotic opening similar to that just described. The sac may previously be tied at the neck with stout catgut or tendon and removed. All should be done with careful antiseptic precautions, and not upon flabby subjects with protuberant and tense abdomens.

With respect to the numerous attempts at the radical cure of hernia by various operators, the conclusion of the author, after a study of the numerous published cases of other surgeons, and the practical experience of his own 409 operations, is that the *mortality* of the operation depends chiefly upon the proper selection of cases, partly upon care and skill in the steps of the operation, and partly upon various accidental risks from other sources; while the *successful issue* depends chiefly upon the skill and experience of the operator, and partly upon due care in the selection of cases and the method of operation.

JOHN WOOD.

HERNIA, Reducible.—In this condition the hernia can be completely returned into the abdominal cavity. Herniæ are, in the large majority of cases, slow in their increase; occasionally, however, they suddenly acquire large proportions. In these, which are usually of the inguinal variety, the protrusion descends into a sac already existing, and thus constitutes one of the forms of congenital hernia.

The earliest symptoms of reducible hernia are the presence of a swelling, associated with dyspepsia, lumbar pain, and a sense of weakness in the region through which the hernia is protruding. Whilst the hernia is advancing through the abdominal walls its progress is slow, taking often many months before it becomes complete. After it has once passed beyond the limits of the retention-action of the abdominal muscles, its progress is usually rapid.

Herniæ increase from ill-health, excessive muscular action, and from carelessness, sometimes attaining enormous proportions. If small, the protrusion returns spontaneously when the patient assumes the recumbent position; but if large, some portion of the hernia usually remains down. The hernia is always more easily reduced whilst the patient lies down, but can be returned with varying difficulty even in the erect position. If the protrusion consists of

an entero-epiplocele, the intestine is usually the first part to be returned, followed by the omentum. Should the hernia be composed entirely of intestine, the tumour is soft, more or less resonant on percussion, with a distinct impulse on coughing, and yielding frequently a gurgling sound on the taxis being applied; if the hernia consists of omentum, the swelling is soft, doughy, dull on percussion, lobulated, with no distensile impulse on coughing. In adults the intestine is usually returned gradually; in early infancy, owing to its being more tense, the intestine is frequently returned suddenly. Omentum is nearly always replaced gradually, and often with much difficulty.

In the very early stages of a hernia the sac may be reduced, but it soon acquires adhesions to the surrounding connective tissue, and thus becomes irreducible.

The treatment of a rupture consists either in the palliative method of wearing a truss, or in the adoption of the radical cure, which aims at closing the aperture through which the hernia protrudes by operation. *See* HERNIA, Radical Cure of.

The palliative means are those usually adopted. In infancy the truss should be applied as soon as the hernia is discovered, and should be worn day and night, only being removed three or four times in the course of the day for the sake of cleanliness and readjustment. In adults it must be worn in the day-time, and should be applied before rising from bed, and removed after retiring to rest. If the hernia does not descend at night the truss need not be worn, but if any portion should descend, then the instrument should be worn day and night. *See* TRUSSES.

If a patient who is the subject of a hernia begins to wear a truss before the age of ten, a permanent cure may, in the very large majority of cases, be confidently anticipated after wearing a truss for a few years; after the age of puberty the likelihood of recovery is much lessened; while if the hernia appear after twenty years of age, the patient should be advised to wear a truss for the remainder of life, even if there is no descent of the bowel.

JOHN LANGTON.

HERNIA, Strangulated.—*Definition.* A strangulated rupture may be defined as one in which there is (1) an obstacle to the passage of the gut back into the abdomen; (2) an obstacle to the passage of the intestinal contents; and (3) an obstacle to the passage of blood through the involved loop. These three factors must all be present to constitute a strangulated hernia. If one alone or two alone be present, the rupture is other than strangulated. Thus if there be only an obstacle to the passage of the gut back into the abdomen, the hernia is simply 'irreducible,' while, if there be an obstacle to reduction, as well as an obstacle to the passage of the intestinal contents, the hernia is classed as 'obstructed' or 'incarcerated.'

METHODS OF STRANGULATION. — A knuckle of gut is thrust through a narrow strait or aperture, and, being unable to return, becomes strangulated. When once the bowel has been snared, all further evils which befall it depend indirectly upon the blood-vessels. The vessels are compressed; the blood is unable to return to the great veins; the part swells; the strangulation is thereby rendered more pronounced, and the lack of a supply of fresh blood soon imperils the life of the captured loop. It is obvious that were the intestine non-vascular it could not become strangulated in the usual sense of that term. The gut is thrust through the hernial orifice by a pressure acting from the abdominal cavity. As it is being forced through the narrow aperture, its shape is altered in such a way that its long axis is more or less at right angles to the plane of the hernial orifice. When, however, it has passed through that orifice, it tends to assume its natural outline, and its long axis becomes parallel to the plane of the said opening. Its return, however, is soon rendered still more difficult by reason of the swelling which it undergoes.

The constricting agent is sometimes the neck of the hernial sac itself, sometimes the dense tissues which form the margin of the hernial orifice, and which have indeed moulded the neck of the sac. In recent herniæ, and in congenital herniæ that are of not too long standing, the neck of the sac cannot form the constricting agent. In such ruptures it has indeed no independent existence. If all the tissues about it be cut away, the neck can be drawn out as a part of a perfectly flat piece of peritoneum. If a square bag be pushed through a small ring, it will appear to have a neck where it is encircled by the ring, but if the latter be broken the neck ceases to exist. After a hernia has existed for some time, the plaits and folds into which the peritoneum is thrown at the neck of the sac become matted together; the tissue immediately external to the neck becomes condensed, and the neck acquires an independent exist-

ence. In such a case, if all the structures about it be divided, it still exists; and even if the hernial sac be separated from the body, it will still appear as a bag with a definite and rigid constriction for a neck. In certain old ruptures of large size, the neck of the sac may become almost as tough as a ring of cartilage.

In some instances the gut in a rupture has been strangulated by bands of adhesions which pass from one wall of the sac to another, or it has been so compressed beneath a strip of adherent omentum as to be occluded, or it has been closed by being thrust through a slit in a portion of adherent omentum.

There are instances where an occlusion of the bowel, leading to symptoms of acute strangulation, has been brought about by a twisting upon itself of a loop of gut within the hernial sac. Here the strangulation is due to two distinct causes acting in concert, viz. the volvulus of the bowel, and the rigid neck of the sac, or the adhesion within that sac, which has rendered the volvulus possible and has maintained it when once it has formed.

Strangulation commonly follows the protrusion of an unusual amount of intestine. It is thus often ascribed to sudden exertion, to violent expulsive efforts, to injuries causing compression of the abdomen, and the like. In many instances, however, there has been no such feature in the etiology. The rupture has become strangulated while the individual was at rest, and even while asleep. In certain of these cases the patient has been for some time out of health; his tissues are relaxed, or he has been troubled with colic, with severe indigestion, with constipation, with diarrhœa, or some such intestinal trouble. Some authors lay great stress upon the intestinal disturbances that are certainly often to be noted in cases where a rupture has become strangulated without conspicuous cause. They maintain that such disturbances have a paramount influence in the production of the strangulation.

A hernia may become strangulated on its very first appearance, as is not infrequently the case in some congenital inguinal ruptures. On the other hand strangulation may appear for the first time in a hernia that has existed for many years, that has always been reducible, and has never given serious trouble. It may appear in a hernia that is in whole or in part irreducible. When it involves a rupture that has been for a long time wholly irreducible, the symptoms probably depend upon the snaring of a new and recently descended knuckle of gut.

Strangulation is most commonly met with in the herniæ of adults. It is comparatively rare in children and in old age. It is somewhat more often met with in males than in females. Reducible herniæ are more often strangulated than irreducible, small herniæ than large, and congenital herniæ than acquired.

Symptoms.—A typical case.—A labouring man has a common inguinal hernia. Apart from the rupture, he enjoys perfect health. He has had the hernia for several years; it has always been reducible, and he has worn a truss. On several occasions, probably, the gut has come down, and he has had much difficulty in forcing it back again, and, during his efforts to effect this end, the rupture has pained him a good deal, he has felt uncomfortable in his abdomen, and a little sick and faint. On a certain day he goes to his work, and, during some unusual exertion, the rupture suddenly descends behind the truss. He at once removes the truss, and endeavours to reduce the hernia as on previous occasions, but fails. He has a good deal of pain about the neck of the sac, and feels sick and faint. Possibly a cold perspiration breaks out over his forehead. He makes his way home with difficulty and lies down. By this time the sensation of sickness has increased, and he has vomited. The vomiting becomes more marked with each hour that the strangulation exists. He first brings up simply the contents of the stomach, then a yellowish fluid deeply stained with bile. As the case advances, the vomit becomes of a deeper colour, a dullish green, and ultimately a watery fluid that is brown and ill-smelling. It may in time become feculent.

The bowels may act once or even twice after the strangulation has set in. Probably, however, they do not act at all. When sufficient time has elapsed, the patient finds that he is constipated, and that the constipation remains absolute. Not even does flatus pass the bowel. One most conspicuous symptom is the great constitutional depression. The man, who a few hours ago was in vigorous health, is now utterly prostrate. His pulse has become rapid and feeble, and may rise to 120 or 140. His temperature is below normal and remains so; his skin is cold; his face looks pinched; his eyes begin to appear sunken. He looks prematurely old, and such expression as his face may wear is indicative of great anxiety and distress. The tongue

becomes coated, is at first white, but soon becomes dry and brown. As the case advances he becomes troubled with intense thirst. Whatever he drinks he vomits again, and the more copious the vomiting the more marked the thirst. The amount of urine that he passes is diminished, and often conspicuously so. If the abdomen be examined, it presents a normal appearance. When the case has lasted for some time, it may become swollen, but the distension will never be great. Besides the pain about the hernia, the patient has severe abdominal pain—pain of the nature of colic, it may be, or a more constant pain that is situate about the region of the umbilicus. The abdomen is not at first tender on pressure, but it becomes so in time, and manipulation of the belly, or examination of the rectum, probably causes increased suffering and an attack of vomiting.

On examining the hernial tumour, it is found to be larger than usual, very tense and even hard, dull on percussion, tender, absolutely irreducible and without impulse on coughing. On percussing the abdomen in the immediate vicinity of the neck of the sac, there may be some dulness due, to the presence of a distended coil above the rupture. If left alone the patient becomes worse hour by hour. The collapse deepens; the vomit may now come up in great gushes, or it may somewhat abate. He does not appear to suffer very acute pain. He lies in bed, restless, yet utterly prostrated, and in a state of faint and desperate misery. The collapse may be such as to resemble that of the algid stage of cholera. The urine may be suppressed. There may be some delirium. In all probability, however, the collapse deepens, and the patient simply dies of exhaustion.

A patient, with an unrelieved strangulated hernia, may die in forty-eight hours, while, on the other hand, he may live a fortnight or even longer. The prognosis in such a case depends upon many factors—upon the age and state of the patient, the nature of the hernia, and the degree and position of the strangulation. Probably the average duration of a case of unrelieved strangulated hernia would be as long as seven days.

Analysis of the Symptoms.—The first symptoms of strangulation are evidently due to the impression conveyed to the abdominal nervous centres by the damage to the bowel; the later symptoms are due in part to this cause and in part to the actual obstruction of the intestine. The small intestine is usually the part of the bowel involved in a hernia. It is supplied by the superior mesenteric plexus of nerves—a plexus of considerable extent, which comes off almost directly from the great solar centre. The faintness, the collapse, the failing pulse, the early vomiting, can all be ascribed to disturbance of the great abdominal nerve-plexuses.

It is obvious that the vomiting, which may appear almost immediately after the strangulation, cannot be directly due to an obstruction in the bowel as far down as—let us say—the lower ileum. The more severe and abrupt the strangulation, the more marked are the symptoms of general constitutional depression and the more pronounced the vomiting. Later on active peristalsis is excited in the gut, above the obstruction, and by means of this movement the vomiting is kept up so long as the obstruction exists. Feculent vomiting may occur when the lower ileum is involved. It would rarely appear before the fourth or fifth day. In any case where the symptoms have lasted many days, the vomited matters possess an offensive smell —'an intestinal odour;' but it is doubtful if they can become really stercoraceous unless the strangulation be low down in the ileum.

The constipation is to be ascribed, in the first instance to the sudden shock given to the abdominal nerve-plexuses, whereby the bowel is paralysed, and in the second to the obstruction. In the majority of cases no motion is passed after the snaring of the bowel, and it cannot be presumed that in all these cases the whole of the intestine below the obstruction is empty. Yet although the colon may be filled with fæces at the time of the accident, those fæces are not evacuated. All the excitement and tumult within the abdomen is taking place in the part of the intestine above the occlusion; the part below remains quiet, inert, and functionless.

The pain experienced depends (1) upon the direct damage to the bowel; (2) upon painful impressions referred to the great solar plexus; and (3) to violent and irregular peristaltic movements in the bowel above the herniated segment. Pain due to the first cause is mostly felt at the neck of the sac, and an examination of that part reveals some tenderness. The fixed pain which patients so often complain of, about and especially above the umbilicus, is, the writer thinks, due to an impression made upon the central nerve-plexuses, to pain referred to the solar centre. Peristalsis of the bowel, above the hernia, causes the colicky, wander-

ing pains which are felt more or less all over the abdomen, and which assume a paroxysmal, although not an intermittent, character. Extreme tenderness of the abdomen is not usually met with in hernia. When present, it probably indicates peritonitis, and is associated with great tension of the abdominal parietes, and increasing meteorism.

The diminished excretion of urine depends partly upon the large amount of fluid lost by vomiting, but to a much greater extent upon the abrupt disturbance in the abdominal nerve-centres. The renal plexuses, it may be observed, are directly derived from the solar plexus and its semilunar ganglia. The diminution in the urinary secretion is most marked in cases attended by severe constitutional symptoms. It has no direct connection with the seat of the strangulation. It is, undoubtedly, usually more marked the nearer the obstruction is to the stomach; but it must be borne in mind that the higher the site of the strangulation, the more severe are the symptoms apt to be, and the more marked and profuse the vomiting. The jejunum, with its muscular walls, its copious blood-supply, its well-developed nerve-plexuses, and its vigorous functional activity, would resent an injury more energetically than would the lower ileum, where the muscular tissue is so much scantier, the blood-supply less free, and functional activity less pronounced.

The local changes in the hernial tumour are all intelligible enough. The most important feature is the loss of all impulse on coughing. The tension of the swelling depends in part upon the increased amount of gut in the sac, in part upon the swelling of the bowel, and in part upon the collection of serum in the sac. The dulness on percussion depends in most cases upon the presence of the serum. It may be due to omentum between the bowel and the anterior wall of the sac. The amount of gas within the herniated loop is often so small, and the swelling of its coats so extreme, that even when the bowel is pressed close to the sac-wall, the percussion note is still dull. From the condition of the gut, the tumour may be expected to be tender on handling, but pronounced tenderness probably indicates hernial peritonitis, i.e. inflammation of the serous lining of the sac and serous covering of the bowel.

Variations in the Symptoms.—The symptoms vary in different cases. The main bases for such variations are the age of the patient, the state of the health, the nature of the hernia, the portion and amount of gut involved, and the treatment adopted. In general terms it may be said that recent herniæ cause more severe symptoms, when strangulated, than do old herniæ; that small strangulated herniæ are more acute than large, and that strangulation of a reducible rupture is usually more serious than that involving an irreducible one. When congenital herniæ are involved, the symptoms are, as a rule, more urgent than when corresponding acquired ruptures are implicated.

It would appear that the symptoms are often less severe when omentum is involved with the bowel, the omentum possibly offering some protection to the intestine. Strangulation is commonly attended with graver manifestations in the young than in the old, and much of the future course of a case depends upon the abruptness and vigour of the strangulation.

It is often seen that strangulated herniæ are attended with urgent symptoms in those who are in vigorous health—in individuals whose processes are active, whose vessels are well filled with blood, and whose nerves respond readily to stimulation; while, on the other hand, in the delicate, the anæmic, the individual whose muscular system is flabby and inert, the course of a strangled rupture is often attended by disturbances of a much more moderate character.

In some of the most acute cases the collapse is very pronounced. There is rapid prostration, the skin is cold, the limbs are cyanotic, the voice is lost, the urine is suppressed, and cramps seize upon the extremities. During epidemics of cholera, this ultra-acute form has actually been mistaken for that disease, and French authors have indeed named it 'cholera herniaire.' On the other hand, in some of the least acute forms, the symptoms develop gradually. There is some colic, some pain in the hernia, some tenderness about it; the bowels do not act, and the patient vomits occasionally, and only, most probably, after food. Three or four days may thus be passed before the characteristic symptoms of strangulated hernia set in. Symptoms of this nature are most commonly met with in ruptures of large size.

Among some of the least usual phenomena met with may be mentioned severe and extensive congestion of the lungs (Verneuil), cramps in the limbs, delirium, and, in children, convulsions.

The three most important and constant symptoms are the constitutional depression, the vomiting, and the constipation. The

last-named symptom may, however, be replaced by an evacuation of the bowel below the obstruction.

The local manifestations are liable to variation, and, in the diagnosis of strangulated hernia, must assume a somewhat subordinate position.

When the hernial tumour presents all the characters which have been mentioned in describing a typical case, the evidences of strangulation are very powerfully confirmed; but it must not, on the other hand, be assumed that the absence of one or more of those characters is inconsistent with strangulation, or any evidence that it is not present. The local symptoms may be quite insignificant. In many instances the patient has been quite unconscious of having a rupture, and the swelling has been discovered for the first time by the surgeon. The tumour, moreover, may be of such small dimensions, and so deeply placed, that it can hardly be subjected to examination, and presents characters that are negative or questionable. In some herniæ, such as the obturator and sciatic, it may not be possible to distinguish any tumour after careful examination.

In small herniæ the absence of an impulse on coughing is often difficult to clearly establish. Tumours which are of small or moderate size will probably be dull, hard, and tense. The same characters may be noted in even large swellings. But a patient may present a tumour that is apparently, in all parts, soft, fluctuating, and perhaps resonant on percussion. Yet such a swelling may be the seat of a strangulation. The tumour in such a case will be large, and will contain mainly certain unstrangulated loops, while probably, deep at the neck of the sac, is a little knuckle of strangled intestine which is beyond the reach of the surgeon's touch. Such tumours are usually met with in cases where a large irreducible hernia becomes the seat of a strangulation. On the other hand, a hernial tumour may present the principal characters which are associated with strangulation, and yet not be the seat of the affection. This is seen in connection with small inflamed and irreducible epiploceles, especially when situated in the femoral region. In such a case the little tumour is irreducible, is hard, tense, and dull on percussion, and either presents no impulse on coughing or only equivocal evidence of that symptom. The swelling, moreover, is tender on pressure and painful.

Conspicuous alterations may be noticed in the hernial tumour as the result of certain gross changes in the ensnared bowel or its sac. Thus, when a high grade of inflammation attacks these parts, the tumour becomes more tense and dull upon percussion, more painful and tender, while the skin over it will probably be found red and œdematous.

When gangrene attacks the entrapped intestine, and perforation follows, the tumour may be found to have become soft, and to feel doughy to the touch. It may have ceased to be painful, and may be resonant on percussion from the presence of gas in the sac. When suppuration follows as the result of such a change, the swelling presents the ordinary characters of an abscess (fæcal abscess).

It may now be convenient to consider whether symptoms, similar to those which attend strangulation of the bowel, may attend strangulation of the omentum, and whether the strangulated epiplocele is to be admitted into the clinical conception of a strangulated rupture. That omentum may become strangulated must be admitted, although its physical conditions are such as to render that occurrence much more unlikely to happen than in the case of the bowel. There are surgeons who, while they are compelled to admit the anatomical possibility that omentum may become strangulated in a rupture, yet will not allow that that accident is attended by symptoms in any way allied to, or apt to be confused with, the symptoms of strangulated enterocele. As to the precise symptoms—if any—which attend the strangulation of omentum, they are either silent or at variance with one another, and are thus disposed to ignore the clinical existence of a condition whose anatomical status they readily recognise. They agree in asserting that a strangulated epiplocele cannot give rise to the ordinary symptoms of a strangulated hernia, and the solitary argument upon which this assertion is based, may be expressed in the words of the surgeon who asks, 'If the ligature of omentum, by the surgeon's hands, produce no symptoms of strangulation, how comes it that the comparatively slack constriction of a hernial neck can be supposed to do so?' This question may be at once answered. There is an immense pathological difference between a lesion which merely irritates nerve-filaments and disturbs function, and a lesion which at once destroys nerves and totally annihilates function. The constriction of the hernial neck acts as a severe irritant to the nerves of the part, and greatly disturbs its circulatory

conditions; the surgeon's ligature, on the other hand, is so tight that all tissues within its grasp are killed; the parts on the distal side of the thread are at once practically destroyed, and cease to share in the activity of the body.

Strangulated epiplocele may produce symptoms which resemble, and may not always be distinguishable from, those attending a strangulation of the bowel, and into the clinical conception of a strangulated hernia, this form of rupture must be admitted. The special features that may mark the strangulated omental hernia, as compared with the rupture containing bowel, are well described by Mr. Bryant: 'It is characterised by less severe and acute symptoms. They are the same in nature, but different in degree. The pain is less severe, the vomiting not so marked, constipation is less complete and insuperable; the constitutional symptoms are milder; the local distress is also inconsiderable, the tumour permitting manipulation more freely than when it contains intestine. It will also feel harder and more nodular.'

It is quite possible that many instances of hernia, classed as strangulated omental, have been instances of error in diagnosis. For example, symptoms of such severity may attend the inflammation of an irreducible epiplocele that they may be confused with the evidences of strangulation; and, on the other hand, in herniæ containing much omentum, a little strangulated knuckle of gut may be overlooked when kelotomy comes to be performed for the relief of obstructive symptoms.

Littre's Hernia.—This name has been given to a form of strangulated hernia, where only a part of the circumference of the bowel is strangulated by the margin of the hernial orifice. The part of the intestine involved is that most distant from the attachments of the mesentery. When the condition has been relieved, the portion of the wall of the gut which has been strangulated will appear as a sharply-defined, rounded swelling, projecting from the surface of the intestine. It may look, indeed, like a nipple-shaped diverticulum, and, as a matter of fact, in the earliest cases described a small Meckel's diverticulum had found its way into a hernial sac and had become strangulated. The nature of these cases was not recognised, and the diverticulum was supposed to have been produced by the strangulation. In a genuine Littre's hernia normal small intestine is involved, and the little saccular swelling pinched up on the surface of the bowel is produced solely by the constriction. In this form of hernia the intestine may be very firmly held, and a part of its wall so rigorously constricted that it becomes gangrenous, while all the time the lumen of the tube is not obliterated. This form of strangulation is rarely met with, except in femoral herniæ. It occurs usually in quite recent herniæ in young adults, and for the most part in individuals who have no suspicion that they are the subjects of rupture. The symptoms resemble those which are associated with an ordinary strangulated enterocele. They are, on the whole, somewhat less acute, the vomiting is less marked and persistent, and the bowels may continue to act during the whole progress of the case. In many instances the intestine becomes acutely bent or kinked at the seat of the strangulation, and, under such circumstances, the bowel is entirely occluded, and the symptoms differ in no way from those of an ordinary strangulated rupture. In Littre's hernia the tumour is very small, and is often overlooked. When the patient is stout, and the portion of gut occupies the femoral ring, the presence of a tumour may not be detected, even after careful examination. In such instances there will merely be pain and tenderness about the part, in addition to the ordinary signs of strangulated bowel. If the strangulation be not speedily relieved, the ensnared portion of intestine will rapidly become gangrenous.

Diagnosis of Strangulated Hernia. The special points which serve to distinguish a strangulated rupture from one that is merely inflamed or obstructed will be considered when dealing with the two last-named forms of hernia. The symptoms attending an acutely strangulated hernia may resemble those arising from acute peritonitis. In examples of hernia, with ill-marked or misleading local evidences of rupture, the two affections have been confused with one another. The chief points in the differential diagnosis will be found described in the table of diagnosis of intestinal obstruction. *See* Intestinal Obstruction.

A strangulated hernia is readily diagnosed from an internal acute obstruction by the presence and condition of the hernial tumour. Should all local evidences of rupture be absent in any instance, the diagnosis of the two conditions would be obviously impossible. In several cases the abdomen has been opened to relieve a supposed internal strangulation, and the cause of the symptoms found to depend upon a hernia.

In other instances where obstruction-symptoms existed, a hernial tumour has been cut down upon, the gut within it found unimpaired, and the patient's death, or a further operation, has revealed an obstruction deep in the abdominal cavity.

In a child an undescended testicle, which is retained in the inguinal canal and has become inflamed, may, as already stated, give rise to symptoms like those of strangulation. In the diagnosis, the absence of one testicle from the scrotum will be noticed. The surgeon will probably be able to feel and define the upper limits of the tumour. The tumour will be harder than is usual in hernia; it will also be much more painful and more tender. The constitutional symptoms, and the vomiting and constipation, will be all much less marked. Indeed, the local symptoms will usually quite outweigh the constitutional.

The certain diagnosis of the contents of a strangulated rupture is not usually possible. The sac is tense, and distended with fluid. It is uniformly dull, and in all parts equally resisting. There is, indeed, a singular sameness in hernial tumours of like size and position, when they have been for a little while the seat of a strangulation.

The Morbid Anatomy may be considered under three headings:—1. The tissues outside the sac. 2. The sac. 3. The contents of the sac.

1. The tissues outside the sac. These will vary in thickness and character according to the anatomical situation of the rupture. They may be found quite normal as the parts are displayed when cutting down upon the sac, or may be the seat of inflammatory œdema, or, when rough taxis has been applied, of some extravasation of blood. In cases of suppuration of the sac, or of the formation of a fæcal abscess, the tissues outside the sac may simply appear as the wall of an abscess. In some instances a well-localised collection of fat has been found between the layers of tissue covering the sac, or has appeared in the connective-tissue layer immediately external to that structure. To such collections the French have given the name 'Lipome herniaire.'

2. The sac. The sac may be entirely absent, as is usual in hernia containing part of the urinary bladder, or it may be incomplete, as is commonly the case when the cæcum is herniated. The adhesion of the sac to the tissues immediately external to it is usually slight, especially in recent and in congenital ruptures. In old herniæ, and particularly in such as are irreducible or have been inflamed, the sac is often closely blended with the parts around it. In any case the neck will be more adherent than the fundus. In recent, and in congenital herniæ, the wall of the sac is thin, but when the rupture is of long standing, and especially after it has been inflamed or the seat of obstruction, it may become thick and dense. The pressure of a truss undoubtedly tends to promote this thickening. The sac-wall may be thick at one part and thin at others. In these latter situations it may have become distended, so as to appear lobed.

In some cases two sacs may be found in the same tumour, as when an external and an internal inguinal hernia have formed on the same side, and the necks of the two sacs are separated only by the epigastric artery. Or, again, there may be two necks to the same sac (hour-glass sac). When this condition exists, a distinct and peculiar hour-glass outline may be given to the rupture. It is supposed that in these cases the original sac of a hernia has been displaced downwards by a fresh protrusion; the original neck then forms the lower constriction or the waist of the hour-glass, while the new sac forms the upper part of the bilobed swelling.

3. The contents. The gut in a strangulated hernia may be found to be free, or the parts of a knuckle may be matted together by old adhesions, or similar adhesions may attach the bowel to the sac-wall. The changes which take place in the snared intestine are as follows:—It becomes congested, the vessels that are at first most conspicuously involved being the veins. The gut becomes a deep purple. It may show arborescent vessels upon its surface, or appear mottled, or display extravasations beneath its serous coat. In the next place it becomes swollen and œdematous. It feels thick, fleshy, and leathery, and is of a deep purple hue. As a further change its surface ceases to be smooth and glistening and becomes dull and sticky, and flakes of lymph may appear upon it. The bowel now loses its elasticity, it feels doughy, and offers no resistance to the finger. It is, in fact, gangrenous. It may present an ash-coloured slough, or may be the seat of a perforation. Where the bowel is constricted, a deep, ring-like groove is formed, which may persist for many days after successful reduction. The perforation, when such exists, may be at the fundus of the loop, and will then probably be small; or a more extensive rupture of the gut from gangrene may be found at the line of the constriction, especially in the upper limb of

the involved loop. The bowel immediately above the strangulated hernia may be perforated, and the escape of the contents into the abdomen be prevented by a number of recent adhesions. In any case the gangrenous change appears to commence in the mucous membrane, and the change is always most advanced in that tunic. The ends of the bowel immediately above the obstruction-line are often fixed to the abdominal parietes about the hernial orifice by recent adhesions. In the interior of the ensnared loop are found flatus, fluid fæcal matter, much mucus, and often a considerable quantity of blood. The mesentery of the strangulated coil is greatly thickened, is œdematous, and often the seat of extravasation.

Any omentum in the sac may be found congested, inflamed, or gangrenous. It may be free or adherent. Its tissue may show none but recent changes, or it may, on the other hand, be found to be dense, tough, and fibrous. Sometimes the gut is entirely enveloped and concealed by omentum. This omentum is adherent to the walls of the sac, and forms the condition known as an omental sac.

The serum in the sac varies in appearance according to the state of the gut. It is at first of a pale yellow colour, clear and bright. As the gut becomes more congested, the serum becomes of a dark brown or purple tint, but remains clear. At a later period it becomes turbid, and is mixed with flakes of lymph. When the gut is gangrenous it has a feculent smell, is opaque and of a dull, brownish colour. The serum may possess a distinct feculent odour without the gut being actually perforated, just as an abscess in close connection with the bowel may contain most offensive pus, without communicating in any way with the interior of the intestine.

Treatment of Strangulated Hernia. The treatment of strangulated hernia consists practically of two measures only—the taxis and herniotomy. If the case be seen almost directly after the rupture has become strangulated, there is no doubt that the best treatment consists in placing the patient in the recumbent position, and at once applying the taxis. This is frequently done by the patient himself, and with perfect success. The writer does not think it desirable to administer an anæsthetic in this early attempt at reduction. If the patient recovers from the anæsthetic with the hernia still unreduced, his symptoms will be found to be aggravated, especially as regards the vomiting. Chloroform or ether should not be administered unless the surgeon has resolved to perform kelotomy in the event of the failure of the taxis. If the gut cannot be reduced on the first attempt, and if the symptoms have only just set in, and there is no vomiting, it is well to try for a while the local application of ice. Some surgeons advise, in the place of ice, a long-continued emersion of the body in a hot bath. This measure, however, is usually very exhausting, and entails an undesirable amount of exertion on the patient's part. What effect the ice will have upon the tumour it will exercise within four or five hours; and if at the end of that time no benefit follows, the prolonged application of the ice-bag is not to be advised. After the ice-bag has been applied for some five hours, or for a longer period, if the symptoms be not urgent, taxis may be once more attempted, and if it again fails, the operation of herniotomy must be perfumed.

Taxis *versus* Herniotomy.—It is usual to consider that of these two procedures the latter is the more serious. The common advice is—'If the taxis fails, resort to herniotomy.' This latter operation is regarded in the light of a *dernier ressort*—a desperate final measure. Comparing, however, these two measures simply as operations, and without regard to their individual merits in any one special case, the writer would urge that the taxis is certainly the more serious and hazardous operation of the two. In the taxis an attempt is made to push the ensnared bowel into the abdomen by main force. There is no question of 'manipulation,' as that term is ordinarily used in surgery. There is no manœuvre of a kind similar to that by means of which the head of the humerus is coaxed into the glenoid cavity after a dislocation. It is merely a question of which is the stronger, the constricting ring or the surgeon's hand. The object upon which this force is expended is a bladder-like knuckle of intestine, whose walls are engorged with blood, are œdematous and softened, and possibly on the verge of gangrene. It is true that the force applied by the surgeon is modified and more evenly distributed by the fluid within the hernial sac, but that fluid is not a protection against all degrees of pressure. The measure, moreover, is an operation performed more or less in the dark. The surgeon may actually be in the anomalous position of endeavouring to introduce into the abdomen a loop of gangrenous intestine. He may readily bring about a perforation, and

the only decided effect of energetic taxis may be the introduction of fæcal matter into the peritoneal cavity.

In herniotomy, on the other hand, the parts are not roughly handled; no violence is applied to the delicate and damaged gut. There is a simple incised wound, and a gentle reduction of the ensnared loop, and, in many cases, that is all. It is unnecessary to refer to the opening of the sac, because that is not a *sine quâ non* in kelotomy. It must be remembered that the evil results of improper taxis are commonly placed to the credit of herniotomy. The gut has been seriously damaged by unsuccessful attempts at reduction, herniotomy is performed as a last resort, the patient dies, and another contribution is made to the mortality of the operation. It is impossible to compare the taxis, on the one hand, with herniotomy after taxis on the other. The comparison should be made between taxis and herniotomy without previous attempts at reduction. Of the two operations it must, in strict justice, be owned that taxis is the more fatal, and has been followed by the larger series of lamentable results. A herniotomy is often little more than a clean incision; and the recent vast improvements in the treatment of wounds have certainly helped to make that incision a less serious thing than the crushing of a loop of intestine lying in a state between life and death. The death of the patient can very often be distinctly and directly traced to the operation of taxis, but it is comparatively rare to trace death to the immediate effects of the incision made in kelotomy.

Taxis. — In applying taxis, the parts about the hernial orifice are relaxed as far as possible by the means named in the descriptions of the different anatomical varieties of hernia. The neck of the sac is steadied by the forefinger and thumb of the left hand, while pressure is applied to the fundus by means of the thumb and fingers of the right hand, which should be spread out over the tumour. The nature of the force is a mixture of squeezing and pushing. The pressure should be slowly, evenly, and cautiously applied. The degree of force used must depend upon the judgment of the manipulator. He should keep before his mind the picture of a knuckle of gut, engorged and swollen, protruded through a sharp-edged opening, and possessed of a precarious vitality. Under no circumstances should much force be employed. Violent taxis causes extravasation into the subcutaneous cellular tissue, or into the wall or the cavity of the sac. It may lead to certain displacements of the sac, and to spurious reductions. It may cause rupture of the gut, greatly encourage the development of gangrene and inflammation, and at once render complete a threatening perforation. Violent attempts at reduction always seriously compromise any further measures of treatment. The possible success of the taxis will depend upon data that are both numerous and complicated. Briefly, it may be said that an umbilical hernia is more readily reduced than an inguinal, and an inguinal than a femoral, other things being equal. Upon the same grounds reduction is more likely to be effected in a rupture of moderate dimensions than in one that is either very small or very large. Congenital inguinal herniæ are more difficult to replace when strangulated than are the corresponding acquired forms. The larger a recently-descended hernia has become, the less chance is there of its being reduced, and the same may be said of it the harder and more tense it is.

When the reduction of a knuckle of intestine is successful, the gut passes into the abdomen with a characteristic slip, and often with a gurgling noise; and after its return the sac is found to be empty, and the hernial orifice clear. Omentum, on the other hand, returns slowly and gradually; it does not slip back, nor is its return, of course, attended by any gurgling. Relief of all the symptoms of strangulation follows more or less immediately after the reduction.

There are certain *fallacies* in connection with reduction by taxis which demand close attention. 1. *A successful reduction of strangulated intestine may be erroneously considered incomplete.* This fallacy may arise under these circumstances: there is much omentum in the sac, but only a small knuckle of gut, which is deeply placed. The reduction of the latter may very readily be quite unobserved. In another case there is an irreducible hernia which has existed for years without causing symptoms. Into it descends a small knuckle of fresh intestine, which becomes strangulated. The reduction of this little loop may also escape observation. Or, again, the sac may have an unusually thick or uneven wall, or there may be a localised deposit of fat over it, and after successful taxis it may be thought that something still remains in the sac.

2. *The taxis is considered to be successful, but is attended by no relief to the symptoms.* This may depend upon the following conditions:—1. Reduction *en*

masse. 2. Reduction through a rent near the neck of the sac. 3. Incomplete reduction. 4. Reduction of the gut still strangulated.

1. In the reduction *en masse*, the sac, together with its contents, is pushed forcibly into the abdomen, and as the bowel will still be strangulated by the neck of the sac, the symptoms are in no way relieved. In this event the rupture is made to disappear slowly; there is no slipping back and no characteristic gurgle. After the reduction, a dull, painful tumour may possibly be made out on the abdominal aspect of the hernial orifice. This accident is met with in small and in recent herniæ, and especially in those where the neck is large. It is met with almost exclusively in external inguinal ruptures. In 112 cases of reduction *en masse*, collected by Follin and Duplay, 101 occurred in the subjects of external inguinal hernia, 2 in direct inguinal ruptures, and 9 in the subjects of femoral hernia. A considerable amount of force is required to effect the reduction of the entire sac, and the accident has been frequently brought about by the patient's own attempts at taxis. As soon as the accident is discovered, the canal through which the rupture has escaped should be opened up, the fundus of the sac drawn down and opened, and the ensnared loop liberated.

2. In this variety of pseudo-reduction, the pressure applied to the part causes the sac to rupture. The rent is usually close to the neck, and commonly on the posterior aspect of the sac. By a continuance of the attempts at reduction, the strangled loop is thrust through this rent, and is forced into the subperitoneal connective tissue. In such cases the return of the bowel is effected slowly, and with continued effort. It does not return with a slip, and there is no gurgle. The hernial orifice is found to be still occupied after the supposed replacement, and the symptoms persist. The presence of the strangulated loop in the subperitoneal tissue may be made evident by a dull and tender swelling about the abdominal aspect of the hernial orifice. This accident is met with only in inguinal herniæ, and usually in such as are of the congenital variety. The treatment is the same as for the previous condition.

3. Under certain conditions—as in the very obese—a small, inguinal hernia may be so far returned into the inguinal canal as to be no longer perceived externally, although it remains still strangulated and still unreduced.

4. A loop of bowel lying in a hernial sac may be strangulated by adhesions which pass between the two limbs of the loop, or it may be ensnared by having passed through a slit in the omentum, or between adhesions formed by herniated omentum. Such a loop may be reduced without any relief being afforded to the strangulation. When the reduction is complete, the treatment of the case will demand an opening of the abdomen either in the linea alba, or in the parietes about the hernial orifice.

The consideration of the circumstances under which attempts at reduction by taxis are most to be advised, may be conveniently introduced by pointing out *the conditions in which the taxis is inadmissible*. 1. Attempts at taxis are inadmissible when the parts show evidence of inflammation, when the swelling is extremely tender, and the skin over it is red, hot, and œdematous. 2. In the case of strangulation, involving a rupture which has long been quite irreducible, the prospects of relief by taxis are very remote. 3. The longer the symptoms have lasted in any case, the less marked are the indications for taxis. Every hour renders the possibility of reduction by taxis more distant, and renders the bowel more susceptible to grave damage if roughly handled. It is needless to say that the tumour should not be subjected to manipulation if any suspicion exist that the gut is gangrenous. 4. In recently strangulated herniæ, where the symptoms have not existed for many hours, but have, in spite of their short duration, attained a degree of extreme severity, the taxis had better not be applied. The patient's condition indicates a vigorous strangulation, and the possibility that such strangulation may be overcome by pressure is overbalanced by the still greater probability that the bowel will be seriously damaged by the manipulation. Thus, in the case of very acute strangulation, involving a congenital inguinal rupture in a young lad, an anæsthetic should be at once administered, and if the gut be not reduced by a brief and gentle attempt at taxis, kelotomy should be performed without delay.

Taxis may be tried in cases that come under the surgeon's notice within a short time of the appearance of the symptoms, and in instances of longer standing where the local and general manifestations are but slightly marked. It should never be forcible nor long persisted in, and it would appear that the tendency of modern surgery is to regard this mode of treatment with considerable caution and some little doubt. In all cases, except where the hernia is seen immediately after it has become strangu-

lated, the taxis should be applied under an anæsthetic. Anæsthesia places the patient in a condition most favourable for successful taxis, and reduces to a minimum the amount of force required to effect a reduction.

In any instance where taxis fails, or where it is considered inadmissible, kelotomy must be performed without delay.

Herniotomy or Kelotomy.—The precise incisions required in this operation are detailed in the accounts of the various anatomical forms of hernia. The tissues between the skin and the sac are divided layer by layer, and the outer wall of the sac is exposed. The recognition of the sac is often a matter of difficulty. In recent and uncomplicated strangulated herniæ, the sac is covered by a thin layer of loose cellular tissue devoid of fat. It has a bluish appearance, and all the characters of a thin-walled cyst, containing a darkish fluid. In ruptures of long standing, and in such as have been inflamed or have been unduly compressed by an ill-adjusted truss, or have been subjected to violent taxis, the sac-wall may present a very different aspect. It may be thick, pale, dense, and fibrous; or thick in one part and thinned in another. Its surface may be irregular, of a dark red colour, and so thickened that it may be readily mistaken for strangulated omentum. It may be closely bound down to the surrounding tissues, so that the finger cannot be passed about it. If the sac is to be opened, a part of its wall should be pinched up with the finger and thumb so as to insure its freedom at that spot from adhesions to its contents, and a small portion of the wall so examined being then seized with dissecting-forceps, the sac is opened. The opening of the sac is indicated by an escape of fluid.

There are certain fallacies which may occur, however, in connection with the opening of the sac. In the first place there may be no sac at all, or but a partial one. As a very rare condition there may be no fluid in the sac, or so little that its escape is not noticed. On the other hand a cyst may be found in front of the sac which, on being opened, may allow of the escape of fluid. Such cysts are usually bursal, and are developed in the connective tissue of the part as the result of the pressure of the truss. Cysts of the spermatic cord, when associated with hernia, are found behind the sac. In certain instances the sac-wall may be so closely adherent to the contents—especially to omentum—that the cavity of the sac cannot be demonstrated, and on continuing the dissection under such circumstances, the bowel has been opened.

If, when the sac is exposed, the tissues immediately outside its neck, which form indeed the hernial ring, be divided in part, the gut may often be reduced without the sac having been opened. Much has been written as to the question whether the sac should or should not be opened. The question is of little moment at the present day. The serious objection urged against the opening of the sac has been that it implied an opening of the peritoneal cavity. Since, however, the application of antiseptic principles to the dressing of wounds, this objection has ceased to have weight. If the sac be not opened, there is risk that the bowel may be reduced into the abdomen still strangulated, or in a condition of gangrene, or in a state of actual rupture or perforation. It must be confessed that these risks outweigh the risks which may be considered to attend the opening of the great serous cavity. It is by no means needful, however, that the sac should be opened as a matter of routine. If the rupture be still irreducible when the parts about the hernial ring have been divided, the sac must of course be opened. It should also be opened in any case when the rupture has been long strangulated, when the strangulation has been very acute, when violent taxis has been employed, and when the parts show evidence of inflammation. In any case of doubt, also, the sac should be opened. If the surgeon has resolved upon opening the sac, then it should be done before dividing the stricturing tissues outside the neck. If the stricture be divided, a piece of ruptured or perforated bowel may slip back into the abdomen before the sac has been opened. In any case where the hernia is very small—as in Littre's hernia and small femoral ruptures—the sac should be opened before the stricture is divided. If this precaution be not taken, the loop—which may be perforated—may slip out of reach into the abdomen. In ruptures that have always been readily reduced, or that are recent and are attended by strangulation-symptoms of slight degree and moderate duration, the reduction may be effected without opening the sac. In very large scrotal herniæ, the opening of the sac involves a special element of danger, in that it exposes a large amount of intestine to the ill-effects of cold, the irritation of sponging, &c., and much manipulation.

When the sac has been opened, and the fluid it contains allowed to escape, the

contents must be carefully examined. Their treatment involves much consideration. If the gut be not too seriously damaged, the constrictions which retain it in position must be divided, and the piece of intestine returned into the abdomen. The constriction may either exist in the tissues outside the neck of the sac, or may be found in the neck itself; and in some cases a division of the narrowed parts, in both of these situations, may be needed to insure reduction. The stricture must be divided upon a hernia director by means of a hernia knife, or a suitable, protected bistoury. Care must be taken when the stricture is being divided, that no part of the distended bowel overlaps the edge of the director, and comes in contact with the edge of the knife. When the stricture has been partially divided, it is better to use the forefinger in place of the director. A forcible dilatation of the stricture, with the finger, is inadvisable and likely to cause damage to the bowel.

The state of the bowel can be better judged from its consistence than its colour. So long as the gut appears sound externally, and feels firm and resilient to the touch, it may be safely reduced. When it yields to the finger, and feels soft and flabby, it will most probably be too seriously damaged to be reduced. The colour of the loop alone is no true test of its condition. The surface of the gut is often dull and sticky from peritonitis. This condition is in itself no bar to reduction, but it should be noted that such a loop, after reduction, will probably acquire adhesions to some part of the serous lining of the abdomen. Flakes of lymph, upon the surface of the gut, should not be disturbed if the gut seems generally in fair condition, since they often hide minute perforations. If the bowel be gangrenous or ruptured, the whole portion involved should be well exposed and then resected; the part removed should include a little more of the intestine than the part actually gangrenous. An account of the methods of performing this operation is given under ENTERECTOMY.

When a pinhole perforation exists, it has been advised that the little aperture be closed by a ligature applied as one would apply it to the mouth of a bag, and that the loop be then reduced. Such a procedure is extremely hazardous. The gut about the perforation is possibly gangrenous, or, at least, not in a condition for repair; and the probability of sloughing of the ligatured part, after reduction, is not inconsiderable. In such a case, if the gut be gangrenous about the perforation, the dead segment should be excised. If its condition be doubtful, the loop should be fixed *in situ* by means of sutures that penetrate no deeper than the muscular coat. All constriction having been relieved, an artificial anus is established, which may be dealt with subsequently. If in any case the gut about the perforation appear really sound, then a minute elliptical portion of the bowel-wall may be excised, so as to include the fistulous aperture. The long axis of the ellipse should be parallel to the circular fibres. The margins of the wound should then be united by a deep and superficial set of sutures, and the loop returned into the abdomen.

When omentum is concerned, it should be reduced if its condition permits. If it be gangrenous or very difficult to reduce, or adherent, it should be removed. Its removal should be effected by clamping it just beyond the line of constriction, then excising it with scissors, and securing separately, by means of fine catgut sutures, such vessels as are divided. The cut end is then returned into the abdomen. The practice of including a mass of omentum in one ligature is strongly to be condemned. Equally to be condemned is the practice of leaving the divided or ligatured end of the omentum in the hernial orifice, so that it may form a plug. Omentum, thus rendered adherent, may form an 'omental band,' which may readily become, at some future time, a cause of internal strangulation.

Recent adhesions may be gently broken down with the finger. Old adhesions may be divided with scissors or torn across between two pairs of forceps. Bleeding from the divided ends may usually be arrested by forcible momentary compression of the part with a strong clamp, or, in the failure of this measure, by a touch with the thermo-cautery. In some cases, where large irreducible herniæ are concerned, the adhesions may be too numerous and extensive to be so treated. Under such circumstances, all constriction having been relieved, the gut must be left *in situ*, and protected—after the healing of the operation wound—by a suitable truss.

When the hernia has been reduced, the abdominal orifice of the sac should be closed. To effect this the attachments of the sac at and about its neck must be freed, so that the neck itself can be pulled down into the wound. It must then be encircled with a stout catgut ligature, which is tied in a firm knot. The ends of the ligature

are cut off close to the knot. The treatment of the sac below the ligature permits of much difference of opinion. Some surgeons advise that it be left; others simply cut it across below the ligature, while others excise it entirely. In certain instances, as a species of compromise, a portion only of the sac below the ligature has been removed. In small and recent herniæ, and in herniæ that have not been the seat of inflammation of the sac, the separation of the sac, from the surrounding parts, is not difficult, the only obstacle indeed being the extreme thinness and delicacy of the membrane in recent ruptures. In femoral herniæ, the separation is, as a rule, readily effected. In inguinal ruptures there will be some difficulty in separating the sac from the cord, and this will be especially observed in the congenital forms. In dealing with sacs that have been the seat of inflammation in past times, the toughness of the walls, and the close adhesions that attach themselves to the surrounding tissues, may render the placing of a ligature about the neck of the sac or the excision of the membrane a matter of much difficulty.

As a general rule, it may be said, that when the hernia is of small or moderate size, the entire sac should be excised. In very large ruptures, however, such excision would involve an extensive wound and a tedious dissection; and in these cases, after the neck has been ligatured, the sac should be cut across below the ligature and its cavity well drained.

By the obliteration of the sac, the peritoneal cavity is closed; any bleeding that may occur after the operation cannot take place into that cavity, there is no trickling of serous fluid into the wound, and the hernia is kept up during the healing of the parts. In the case of small ruptures, the procedure may cause the hernia to be permanently retained, and in other cases it has led to such great improvement that the rupture has ceased to give the patient trouble, and has been supported by the lightest truss. From Leisrink's statistics, it would appear, that the rupture recurs in one-third of the cases so treated, while, according to Nussbaum, the hernia re-appears in nearly one half of the cases. Finally, the margins of the hernial orifice should be approximated, whenever practicable, by means of one or two sutures. The sutures may be of catgut or of silver, but the latter are to be preferred. In many cases these sutures are permanently retained. *See* Hernia, Radical Cure of.

The superficial incision may now be closed. A drainage-tube should be inserted, which, in cases where an antiseptic dressing is used, may be removed at the end of twenty-four or thirty-six hours. Firm pressure, by means of pads and bandages, must be applied to the part during the healing of the wound. After the operation, the patient must retain the recumbent position; and in cases where the hernia has occupied any of the orifices about the groin, the thighs should be slightly flexed by means of a pillow placed beneath the knees. No food of any kind should be given by the mouth for twenty-four hours, nor until all sickness, due to the anæsthetic, has ceased. Ice to allay thirst should alone be given. Food excites peristaltic movements, and such movements are undesirable in a segment of intestine that has just been reduced from a hernia. Indeed, for twenty-four or forty-eight hours after the operation, all peristaltic movements should be checked by means of small hypodermic injections of morphia, or, if the patient be not sick, by opium or chlorodyne taken by the mouth. By the use of opium the parts are placed in a condition of perfect rest. The roughly handled or harshly strangled loop of gut can lie quiet and still within the abdomen, and can recover itself at its leisure. The bowels may be allowed to act spontaneously; but if they have not been opened for seven days after the operation, and the patient be in other respects well, an enema should be administered, followed by a dose of castor-oil.

Sequelæ of the Operation.—There are cases where, after successful taxis or successful reduction by kelotomy, the symptoms of obstruction in the bowel persist and lead to death. In such instances the following conditions have been found:—(1) A strangulation of the bowel exists elsewhere, either at a hernial orifice or within the abdomen. (2) The reduced gut lies within the abdomen *hors de combat* and paralysed, and, in such instances, death has followed without the gut having become gangrenous, and without peritonitis having followed. If such a condition be suspected upon fairly good grounds, laparotomy should be performed, and an artificial anus formed in the damaged loop. (3) The gut, which was in a critical state when reduced, has become gangrenous, or it has become so twisted upon itself as to be occluded. (4) Acute peritonitis has set in. In such a case the constipation persists, the vomiting continues, although it may be less frequent and less severe; the pain in-

creases, and is more constant and more diffused; there is general and extreme tenderness; all peristaltic movements cease; the paralysed bowel is distended, and meteorism appears; the temperature usually rises, and the pulse becomes more rapid and more thready. The peritonitis may be due to extension of the mischief from the damaged loop, or may be due to perforation of the bowel, or to the entrance of septic matter into the peritoneal cavity during the operation. FREDERICK TREVES.

HERNIA TESTIS.—By this term is signified a protrusion of the testicle through an opening in the scrotum, due to inflammation of the gland. It is also known as benign 'fungus testis,' and 'granular disease' of the testicle. It has nothing in common with malignant fungus of the testicle, or 'fungus hæmatodes,' which is a protrusion of a malignant tumour of the organ.

1. *Causes.*—The most common causes are syphilitic and tubercular orchitis. Injuries and malaria may lead to chronic orchitis, ending in hernia testis, and very occasionally an acute orchitis leads to suppuration of the testicle and a hernial protrusion. Another form of hernia testis, due to a growth of granulations from the outer surface of the organ, is met with as a sequel of hydrocele, hæmatocele, or pyocele treated by incision of the tunica vaginalis.

2. *Pathology.*—For the pathology of the diseases terminating in hernia testis, *see* TESTIS, Diseases of the; HYDROCELE. It is usually the gummatous form of syphilitic orchitis that leads to hernia. One or more of the gummatous masses in the gland undergoes disintegration, the two layers of the tunica vaginalis over the gumma become adherent, and the superficial tissues of the scrotum inflame and ulcerate, discharging a certain amount of purulent débris and the detritus of the disintegrated gumma. The peripheral part of the gumma then protrudes from the opening in the skin. This may be sloughy in appearance and gradually soften down, or may consist of small pink nodules of seminal tubules with intervening masses of granulation-tissue; as the process subsides, the whole surface may be covered with granulations. The protrusion may consist of a great portion, or even the whole, of the testicle, and the tunica albuginea may be itself everted through the opening in the skin. In some rare instances the affection begins as a syphilitic tubercle in the skin, which gradually enlarges towards the testicle, and then involves that organ, and at last softens down; this is just the reverse of the usual course of events, so far as the order in which the tissues are affected is concerned.

The tubercular disease occurs in the epididymis alone, or in that and the posterior part of the body of the testicle. The exuded material undergoes caseation, and the caseous masses soften down into abscesses. Over these abscesses the superficial tissues become adherent, inflamed, and ulcerated, and the abscesses discharge externally; the caseous or infiltrated walls of these abscesses may then protrude through the orifice in the skin. Where acute orchitis terminates in hernia testis, it is by the formation of an abscess in the gland, which gradually enlarges towards the surface, and bursts externally; the infiltrated tissue forming the wall of the abscess then fungates through the sinus.

In cases of incision into the tunica vaginalis for the cure of hydrocele, hæmatocele, or pyocele, a growth of granulation-tissue from the visceral layer of this serous membrane may take place, and the granulations may at length project beyond the skin-wound. This form is known as *superficial hernia testis.* Where the wound in the scrotum is large, the contraction of the dartos favours the production of this form of hernia.

3. *Symptoms and Diagnosis.*—The symptoms common to all varieties are an ulcer in the scrotum, to the floor of which the testicle is felt to be adherent, and from which a pinkish grey or dull-grey soft fungus projects. The hernia varies greatly in size, and may be so large that but little, if indeed any, of the testicle can be felt within the scrotum. The edge of the ulcer is often thickened, everted, and puckered in, and it is more or less firmly adherent to the subjacent testicle. If the hernia be large, it overlaps the edge of skin, being shaped like a mushroom. The discharge from the sore is pus or sero-pus, and in some cases contains spermatozoa; hæmorrhage is rare, and only slight in amount. The protrusion is soft and yielding to pressure, which may elicit the peculiar testicular sensation. By these signs this disease is readily distinguished from a mere fungating ulcer of the scrotum on the one hand, and a malignant fungus of the testicle on the other. The latter is characterised by the presence of a large, rapidly growing, tumour of the testicle, by an entire loss of the testicular sense, by the livid colour of the protruding mass, and by the frequent profuse hæmor-

rhages from the fungus; also by the enlargement of the cord and the implication of the inguinal or iliac glands. To distinguish between the varieties of benign fungus, the following points must be carefully noted: the history, the part of the testicle affected, the condition of the cord, prostate, and seminal vesicles, and the character of the discharge.

Syphilitic fungus testis is a chronic affection occurring in the tertiary period of the disease; it may be met with in young children. The body of the testicle is alone or chiefly affected; the cord is slightly, if at all, enlarged, and the prostate and seminal vesicles are not enlarged; the discharge may contain spermatozoa. Tubercular fungus testis is also a chronic disease, in which the epididymis is alone or chiefly affected, and the sore is at the back or outer side of the scrotum. The discharge is stated never to contain spermatozoa. The cord is enlarged, and there is very often nodular enlargement of the prostate and seminal vesicle, and signs of tubercular disease of the lungs, kidneys, or bladder; there may or may not be an entire absence of all history of syphilis. The history of the acute onset and rapid progress of the disease distinguishes the rare cases arising from acute suppuration in the testicle. The discharge may contain spermatozoa. The superficial form of hernia testis is recognised by the history of a previous incision into the tunica vaginalis, by the slight amount of fungous protrusion, by the normal or, more usually, enlarged size of the testicle within the scrotum, and oftentimes by the appearance of the granulating surface. The discharge never contains spermatozoa.

4. *Treatment.*—Hernia testis is a curable affection, and the aim of the surgeon is to close up the superficial wound over the protruding mass as quickly as possible. At the same time, the disease which has led to the fungus must be energetically treated. When due to syphilis, the system should be brought under the influence of mercury or iodide of potassium. Where the patient has already been subjected to a thorough course of mercury, iodide of potassium may be given; but where this is not the case, mercury should be given, alone or combined with the iodide. The fungus may be dressed with powdered iodoform, or iodide of starch paste, or unguentum hydrargyri; and then careful compression should be exerted upon the fungus by means of a dossil of lint placed over it, and fixed by strapping brought round the scrotum and crossed over the lint. If the edges of the skin are very adherent and indurated, they may be carefully detached from the subjacent parts, and the above treatment continued. Syme's operation of dissecting up the skin on each side and uniting it over the hernia is usually unsuccessful. When the whole testicle is evidently entirely disorganised, it should be excised; but this operation should not be hastily done, as with patience and perseverance in the treatment recommended, even severe cases may recover, with a more or less useful organ. Where the disease is tubercular, the same local treatment should be carried out, iodoform being the best application to the sore. Internally, cod-liver oil, iron and quinine, combined with good food and residence by the sea, will be indicated. In some cases, where the whole testicle is disorganised, and the disease is still limited to the one organ, castration is clearly indicated. Even where other organs are diseased this may be the best treatment, as causing less drain upon the feeble powers of the patient than discharging sinuses. When the result of acute orchitis, the patient should be kept at rest, and the part should be carefully cleansed and dressed with iodoform or some other unirritating antiseptic agent, and compression applied as in the other cases. The same treatment is applicable to the cases of superficial hernia testis; castration should not be performed.

A. Pearce Gould.

HERNIA, Varieties of. *See* Femoral, Inguinal Hernia, &c.

HERPES.—An acute inflammatory affection of the skin, characterised by one or more groups of vesicles running a definite course.

Herpes Facialis (*Synon.* H. labialis, H. catarrhalis) may accompany slight indisposition of a febrile character (catarrh), or it may occur in the course of severe febrile diseases, pleurisy, pneumonia, typhoid, ague.

Symptoms.—The lips, alæ of nose, more rarely the cheeks, chin, or ears are at first affected by hot œdematous patches of skin, accompanied by a burning or smarting sensation. Soon a crop of pin-head or pea-sized vesicles appear, which, if not interfered with, dry up and fall off at the end of about a week, no scars remaining. When the affection occurs on the lips, the mucous membrane of the inside of the mouth is liable to be affected; here, in consequence of the maceration of the saliva, the epithelium is soon shed from the vesicles, leaving red excoriations. Herpes facialis is prone to recur, especially in certain individuals.

Herpes Progenitalis (*Synon.* H. preputii).

Cause.—The disease differs little from Herpes facialis, and is said to occur in individuals who have been previously attacked by gonorrhœa or syphilis. In some individuals it occasionally follows coitus, in others it invariably does.

Symptoms.—In the male, the prepuce, inner or outer surface, glans, and balano-preputial sulcus are the parts affected; in the female, the labia minora, majora, and adjacent skin. The eruption is similar to that described under H. facialis; only three or four vesicles are usually present; it may be preceded by itching or neuralgic pain. It has been supposed that these neuralgic cases are more allied to H. zoster.

Diagnosis.—When occurring on a mucous surface (inner prepuce, labia minora) the lesions are soon converted into superficial excoriations, covered with a pus-secreting membrane. In this state they may be confounded with a soft sore. The lapse of a few days is sufficient to settle doubt, herpes running a definite short course.

Exposure to infection during an attack of herpes suggests a guarded prognosis, as the lesions may eventually become the seat of an indurated sore and lead to constitutional syphilis.

Treatment.—This need only be local. See *Herpes Zoster* treatment.

Herpes Circinatus, an old term for ringworm.

Herpes Iris (*Synon.* Hydroa), *see* Erythema.

Herpes Zoster (*Synon.* Zona, Zoster, Shingles).

Cause.—An inflammation of the nerve-trunks or ganglia. In some instances this has been shown to be due to traumatic influences, wounds, surgical operations, strain, &c., or to the spread of inflammation from neighbouring growths, &c. In the vast majority of idiopathic cases the cause of this inflammation is obscure. Malaria, cold, damp, have been suggested. Lately it has been shown that patients taking arsenic are peculiarly liable to herpes zoster. Considering the number of individuals who must be exposed to the causes of herpes zoster, and its comparatively rare occurrence, it seems probable that the disease depends upon some personal peculiarity or idiosyncrasy. The affection very rarely recurs.

Pathology.—The inflammatory changes which have been found in the ganglia and nerve-trunks are hyperæmia, cell-infiltration, extravasation of blood, with softening and destruction of the nerve-fibres. The irritation of the inflamed sensory nerve is determined to its peripheral distribution, setting up the peculiar eruption on the skin which has been conjectured to be caused by inflammation of the special nerve-endings (bulbs, &c.) of the cutaneous nerves. The cutaneous lesions early affect the deeper cells of the Malpighian layer—the inflammatory exudation, serum or pus, finally elevating the more superficial layers of the epidermis, and giving rise to the formation of vesicles.

The proximity of the inflammation to the papillæ cutis accounts for the frequent destruction of the latter and the resulting loss of substance.

Symptoms.—The eruption manifests itself at first as hot, erythematous patches, distributed in the course of the cutaneous branches of some cerebral or spinal nerve. Within a few hours papules or minute vesicles are recognisable on the patches. The vesicles rapidly attain their full development; and at the end of four or five days the patch has assumed the typical appearance about to be described. During the first few days fresh patches may continue to crop up, prolonging the climax of the disease to about a week or ten days. At this stage the disease takes the form of clusters of vesicles situated on inflamed patches of skin. The vesicles are mostly lentil or pea-sized, tense, somewhat flat, overhanging their bases; they are filled with a serous or sero-purulent fluid, according to their stage of maturation; not infrequently their contents are purplish from admixture with blood. The vesicles are thickly scattered towards the centre of the patches, where they are liable to coalesce into flat, irregularly-shaped blisters or bullæ. This central group of vesicles is often surrounded by other outlying and similar groups, giving to the whole patch a clustered, or, as it has been termed, corymbose appearance. Having attained its full development, the eruption rapidly declines, the redness subsides, the pus desiccates into yellowish-brown scabs which fall off in a few days; so that usually by the end of a fortnight or three weeks all that remains of the eruption are a few discolorations of the skin, with or without accompanying scars.

The eruption is liable to certain modifications. (*a*) It may abort; the redness may appear, but rapidly subside again, leaving a few scattered pin-head vesicles, which rapidly desiccate. This is specially liable to occur in the remote distribution of the

nerve, so that in a case of zoster pectoralis, while typical patches are seen near the spinal groove, the patch corresponding to the anterior branch of the nerve may be abortive. (*b*) Sometimes spontaneously, more often as a result of friction (clothing, &c.), the vesicles are ruptured. Crusts form, and if the irritation is continued the vesicles become the seat of sloughy sores, with more or less infiltrated bases, leading to extensive loss of substance. Names are encountered indicating the region attacked—e.g. Zoster frontalis, Z. nuchæ, Z. brachialis, Z. femoralis, &c. The disease is almost always unilateral, but a few cases of bilateral herpes are recorded. This unilateral distribution of the disease assists the diagnosis, the eruption stopping almost abruptly at the middle line.

Pain is almost a constant symptom of herpes. It may precede, accompany, or succeed the eruption; it may be trifling or severe, and quite out of proportion to the severity of the eruption. Children scarcely complain of it, but in adults it may be of a persistent, gnawing, neuralgic character, destroying rest. In old people it is liable to persist for months, seriously undermining the health.

Besides this essential neuralgic pain, the eruption itself gives rise to smarting and burning during its development.

Certain complications may arise in herpes. (*a*) Trophic disturbances. One of the most serious is the liability for the deeper structures of the eye to become involved in destructive inflammation in cases where the conjunctiva is affected in zoster frontalis. The teeth have been known to fall out in cases where the second division of the fifth has been affected. (*b*) Paralyses (temporary) have been known to precede or accompany the eruption. (*c*) Numbness of the part affected, more or less persistent, may follow the eruption.

Diagnosis.—H. Zoster is to be distinguished from (1) catarrhal herpes, an affection liable to occur about the orifices of the body, mouth, nose, genitals, &c.; not accompanied by neuralgia nor following any nervous distribution, and recurring frequently in the same individual. Anatomically the two eruptions are similar.

(2) From eczema, an itching, not painful affection, characterised in its vesicular stage by small miliary vesicles, evenly and closely set, not running a definite course.

(3) From some vesico-pustular forms of secondary syphilitic eruptions, the grouped arrangement of which may give a superficial resemblance, but which can be recognised by their chance distribution, mode of evolution, and the presence of concomitant symptoms of syphilis.

The early neuralgia, preceding the eruption in zoster pectoralis, with the accompanying difficulty of breathing, has led to the mistaken diagnosis of incipient pleurisy.

Treatment. — Simple, uncomplicated cases of herpes zoster require little treatment; all that is necessary being to warn the patient not to rupture or irritate the vesicles. The clothing should be loosened, and the eruption thoroughly dusted with a dusting powder—*e.g.*: ℞ Pulv. camph. ʒss.; zinci oxidi, ʒiij.; amyli ad ʒj. Absorbent cotton wool should be lightly bound over the part.

It may be necessary to relieve pain during the acute stage by opiates given internally, or by morphia injected subcutaneously; the after-pain may require tonic treatment by quinine, iron, or arsenic. Phosphide of zinc (gr. ¼ every three hours), given at the commencement of the attack, is said to control the pain and abort the eruption (Bulkley).

A good plan for protecting the vesicles and relieving the pain locally is to paint on flexile collodion with morphia (gr. x.–fʒj). Glycerine and carbolic acid (1–8), painted on, relieves the smarting, especially if the vesicles be ruptured. In the early stages soothing lotions may be applied to relieve the burning sensations—e.g. lotio plumbi or linimentum calcis.

Duhring says the disease may be most advantageously treated by the constant current, applied directly to the seat of eruption and over the course of the nerves by sponge electrodes (five to ten cells), for fifteen to twenty minutes once or twice a day; the pain and eruption are often arrested thereby. ALFRED SANGSTER.

HERPES FRONTALIS vel OPHTHALMICUS, from the frequency with which it is attended by inflammation of the conjunctiva, cornea, and iris, calls for the surgeon's special notice. It occurs in two forms, the simple and the neuralgic. In the latter, which is in all other respects also the graver, pain, more or less severe, may be felt in the area about to be attacked for days, or even for weeks, before the eruption appears. The parts commonly concerned are the supra-orbital region, the root and side of the nose, the brow, and the scalp —those parts, in fact, which are supplied by the ophthalmic division of the fifth nerve. The precise areas involved are those inner-

vated by the supra-orbital, the infra- and the supra-trochlear, and the nasal branches, and, more rarely, that supplied by the lacrymal branch. In all respects the skin-eruption resembles that of herpes zoster (q.v.). About the time that the crusts of the dried vesicles are falling, inflammation of the conjunctiva and cornea may occur. The keratitis may go on to ulceration and, finally, perforation of the cornea. See *Neuropathic Keratitis* under CORNEA.

With or without the corneal complication, a chronic and obstinate form of serous iritis may occur, accompanied by increase of intra-ocular tension (pseudo-glaucoma), or true glaucoma itself may supervene. The eye is especially liable to be implicated if the nasal nerve have been involved (Hutchinson).

The *pathology* of herpes ophthalmicus is the same as that of herpes zoster. *See* HERPES. The pain and the skin-manifestation are neuropathic, and dependent upon irritative lesions in the Gasserian ganglion and other portions of the fifth nerve.

Diagnosis.—The disease is often mistaken for erysipelas. It may, however, be discriminated by observing its precise unilateral distribution, and the character, site, and mode of grouping of the vesicles, which are situated along the course of the affected nerves, or about their terminations.

Treatment must be local and general. *Local* treatment consists in protecting the skin, and applying soothing and absorbent powders, as oxide of zinc, calamine, starch, &c. If the conjunctiva, cornea, or iris be implicated, a drop of a solution of atropine should be applied once or twice a day, and the eyelids must be kept closed and scrupulously clean. The conjunctival sac may be gently washed once or twice a day with a solution of boracic acid (gr. iv. ad f℥j.), or sulphate of quinine (gr. iv. ad f℥j.). In addition, the lids should be covered by means of a well-fitting compress, on which a layer of boracic acid ointment (gr. xx. ad ℥j.) has been spread, so as effectually to exclude both air and light. The compress should be kept gently but firmly applied by means of a light bandage. In very severe cases, immediate and permanent relief may be obtained by paring the edges of the lids and stitching them together. Not only does the pain at once abate, but the ulcerative process is checked, and repair takes place. The lids should be kept closed, and protected from dust, air, and wind, until pain and all other signs of inflammation have entirely disappeared. This may not take place for two, three, or four weeks, or even longer. When repair is complete the lids may be separated, and the eye gradually accustomed to exposure. At first tinted or other protecting glasses should be worn out of doors or in a bright light.

For the *general* treatment see *Herpes Zoster* under HERPES. J. TWEEDY.

HEY'S AMPUTATION. *See* FOOT, Amputations in the.

HIP, Diagnosis of Diseases and Injuries about the.—The hip-joint lies everywhere under muscular cover, and is in consequence but little open to direct examination. The position of the great trochanter, which can be readily felt, thus becomes of importance as indicating, when displaced with the shaft, an alteration in the normal position of the head of the bone or a separation of the neck of the femur. There are two positions, however, where, by firm pressure, some indication is obtained of the condition of the hip-joint. The first of these is a little below Poupart's ligament, where the joint is crossed by the psoas, iliacus, and pectineus muscles. By extension and rotation outwards, the head of the bone may be thrown up beneath these muscles, and on flexion a slight hollow appears over the position of the joint. The other spot is the hollow behind the great trochanter. Tenderness and fulness may be often detected in these situations when there is inflammation of the joint.

If a healthy person be placed in the prone position, with his legs extended and parallel, the gluteal folds between the buttocks and thighs form a right-angled cross with the vertical interval between the thighs, and its continuation upwards between the buttocks. In hip-disease, the fold of the affected side becomes lowered in position and lessened in depth. This change is brought about by semi-flexion of the thigh and wasting of the gluteal muscles.

Rigidity of the muscles about the hip is an important sign of disease of the joint, especially in children. Normally, the knee may be so flexed as to touch the abdomen without pain, but in hip-disease the motion of the thigh becomes arrested long before this position is reached. On the other hand, if the leg and thigh be straightened so as to lie flat on a couch, the lumbar spine will rise in a curve, indicating that the hip-joint will not admit of full extension. In addition to flexion some adduction takes

place, and the writer has pointed out in the Clinical Society's Transactions for 1881 that, as a result of double hip-joint disease, a peculiar deformity may result, whereby one leg is fixed across the other, and the patient walks from his knees instead of from his hips. This he described under the name 'cross-legged progression,' or 'scissor-leg deformity.'

Muscular rigidity will enable the surgeon to distinguish *hip-disease* from *neuralgia* or *sciatica*; but, should he trust too much to this sign, he may overlook disease of the spine and treat it as of the hip-joint, for an abscess, burrowing in the psoas or passing through the sciatic notch, will cause pain and consequent limitation of the movements of the hip. Rigidity, tenderness, and prominence of some part of the spine would tend to clear up the case; but *spinal disease* and hip-disease may co-exist. Semiflexion and limitation of movement may be also caused by *cellulitis in the iliac fossa*, resulting from perityphlitis or spreading from the uterus. In this case resistance above Poupart's ligament will be detected on pressure, and in gentle rotatory movements the hip-joint will be felt to move smoothly.

Osteo-arthritis, affecting the hip-joint, may be generally distinguished by its occurring in the middle or late period of life, its chronicity without tendency to suppuration, the creaking movements, and the occurrence of outgrowths about the trochanter, neck, and acetabulum, which in the later stages may be felt. *Charcot's joint-disease*, which is associated with locomotor ataxy, may cause rapid destruction of the hip, resulting in dislocation without suppuration. Its onset is usually sudden, though little painful, and it is often associated with much swelling of the soft parts, so that it has been mistaken for malignant growth. In its late stages its tendency is towards atrophy of bone and looseness of capsule, whereas the tendency in osteo-arthritis is towards hypertrophic outgrowths, and consequent fixation of the joint. *See* CHARCOT'S DISEASE.

Lameness due to *sacro-iliac disease* may be distinguished from that due to morbus coxæ by proving the movements of the hip to be free, by the pain excited on pressing together the iliac crests, and by the swelling and tenderness usually evident over the affected joint. *Inflammation of the bursa* between the gluteus maximus and great trochanter may obscure the outline of this process. The bursa may be evident in three forms—(1) as a fluctuating swelling due to serous effusion; (2) as a firm tumour due to fibrous deposit in its interior; (3) in a state of suppuration, when there will be tenderness, enlargement of the superficial veins, and a tendency to œdema of the cellular tissue over it. *Sciatic hernia* or an *abscess passing through the sciatic foramen* may cause a tumour at the lower margin of the gluteus maximus, and either may yield impulse on coughing; but the latter will be found associated with disease of the pelvis or spine, and the signs of inflammation will be gradually developed. Hernia, if reducible, passes back suddenly, and often with a gurgle.

If loss of movement and deformity about the hip result from *injury*, a fracture or dislocation is to be suspected. It is thus of great importance to compare accurately one limb with the other. Skilled hands will determine sufficiently the relative positions of the trochanters and iliac crests on the two sides, by placing the thumbs on the anterior superior spines and the fingers over the trochanters. For more exact observation, 'Nélaton's line' is of great assistance. This is a line drawn by a tape or string from the anterior superior spine to the most prominent part of the ischial tuberosity, and its value rests on the fact that it just skirts the upper edge of the great trochanter; consequently, any alteration in the normal position of this process is readily detected. The trochanter is raised above this line in cases of fracture of the neck of the femur, and in three out of the four regular dislocations of the hip-joint. Another way of measuring the elevation of the trochanter has been suggested by Bryant. When the patient is on his back he drops a perpendicular from the anterior superior spine of the ilium, and measures the distance between the trochanter and this vertical line. Shortening of the limb may also be determined by comparing the measurements between the anterior superior spine and the inner malleolus on either side. Forcible extension should not be made when taking this measurement, as, owing to tilting of the pelvis, the limb may thereby be actually shortened instead of being lengthened.

An injury resulting in shortening of the limb, with *eversion* of the foot and elevation of the trochanter, is probably a *fracture of the neck of the femur*. The only dislocation which causes well-marked eversion is the *superpubic*; in this case the head of the bone is felt in its abnormal position. If the injury were caused by a direct fall upon the trochanter, the fracture is probably *extra-capsular* and *impacted*.

The trochanter is widened, there is no crepitus, and the axis of rotation is through a shortened neck. If caused by abduction of the limb in an aged person, it is probably *intra-capsular* and *unimpacted*: the trochanter is normal, the axis of rotation is through the shaft, and crepitus may be elicited by extension and rotation.

When the injury results in shortening of the limb and fixation, with *inversion* of the foot and elevation of the trochanter, one of the two backward dislocations is present. In *superiliac* dislocation, the head of the bone may be felt on the dorsum, the trochanter is prominent, and the shortening considerable. In *supersciatic* dislocation, the shortening is slight, the inversion less marked, and the head of the bone not readily to be found from the outside, though sometimes to be felt in the sciatic notch by the finger passed into the rectum or vagina. In rare cases an extracapsular fracture of the neck is associated with inversion. The movements of the joint are then freer than in dislocation.

If the limb is apparently lengthened, and the trochanter lowered and buried, there is a *superthyroid* dislocation; the foot is then carried forwards and outwards, the body is bent over the thigh, and the adductors are tense.

Pathological and *congenital* dislocations usually take place on the dorsum ilii. A pathological dislocation is apt to become ankylosed in a flexed position, in consequence of which great bending forward of the lumbar spine, or *lordosis*, takes place when the foot is brought to the ground. Congenital dislocations also give rise to lordosis, and a waddling gait is usually noticed as soon as the child begins to walk.

R. Clement Lucas.

HIP, Excision of the. *See* Hip-disease.

HIP-DISEASE.—This term is applied to a chronic and often very insidious inflammation of the hip-joint, which, beginning either in the bones or in the synovial membrane, tends to pass on to suppuration and the production of deformity, and in many instances even to a fatal issue; but which, if efficiently treated in its early stage, may in most cases be repaired with little injury to the functions of the limb, and with no impairment of the general health.

By many authorities this affection is considered to be the result merely of neglected local injury, and to be unassociated with any constitutional defect, while by others it is looked upon as strumous or scrofulous. This question can be treated only very briefly in the present article, but it cannot be entirely passed over. The terms struma and scrofula are here taken to be synonymous, and are used to express a defective condition of the general health, with a tendency to various obstinate local inflammations tending to suppuration and caseation—as of lymphatic glands, cancellous bone, mucous and synovial membranes, and the skin. Although in many examples of struma as thus defined tubercle is present, in others no histological elements beyond those of mere chronic inflammation can be detected; and it is only when certain points in their natural history and clinical features are taken into account, that the ground for placing these affections in a distinct group becomes apparent. These points are their common association, in respect of inheritance, with tubercular phthisis; their occurrence in different members of the same family; the development, as we frequently see, of several of them in the same patient; their strong tendency to advance and relapse and to lead to suppuration; and their presence in cases from which the occurrence of local injury can be excluded—for instance, when disease of one of the large joints comes on in a patient who has been in bed for several months for the treatment of spinal caries. These characteristics are so well-marked in a large number of instances of hip-disease that, while many cases may be fairly attributed to mere local injury in patients who are otherwise healthy, the affection, even though originating in an injury, must, speaking generally, be regarded as owing its subsequent progressive tendency to the strumous diathesis. This question, however, is not of so much clinical importance as at first sight it appears to be; for the strumous and the non-strumous cases alike must be treated—in the manner described below—by absolute rest of the joint itself, combined of course with all the means that are calculated to improve the general health. The mistake formerly committed lay in maintaining that, as the disease is often strumous, or, in other words, constitutional, the chief point in treatment must be to provide exercise in the open air, and to regard local measures as of merely secondary importance. It is to this fundamental error in the treatment of this affection that the disastrous results which were formerly so common must be attributed.

Hip-disease, like other affections of the strumous group, although it may be met

with at any age up to puberty, or even later, is much more prevalent in early childhood, and commences in a large proportion of cases between the ages of three and seven years. The affection most commonly begins in the bones—either in the head or neck of the femur, or in the acetabulum. It may, however, take its origin in the synovial membrane. The view formerly entertained, that it commenced in the ligamentum teres, or in the cartilage, has been discarded. In the upper end of the femur its starting point is the cancellous tissue just beneath the cartilage, or the line of junction of the epiphysis with the shaft. It may also commence, in more rare instances, in the neighbourhood of the ossific nucleus of the head, or in some part of the neck within the capsular ligament. In the acetabulum, the inflammatory process commonly attacks the line of junction between the three segments of bone which meet in the floor of this cavity. The synovial form may be so acute as to lead to early suppuration, tending to run on to disorganisation of the joint; or it may be chronic and persistent, and attended with the slow formation of matter, or the effusion of plastic lymph, leading to fibrous or bony ankylosis.

In whichever way it commences, the disease, unless it is arrested by treatment, soon involves all the soft structures of the joint, and frequently also both the upper end of the femur and the acetabulum, so that a general arthritis, attended in the great majority of instances with suppuration, is established. As the bones forming the joint are cancellous in structure, the inflammatory process commonly ends in caries rather than in necrosis. Even when necrosis has taken place the sequestra are seldom large enough to be important, and consist of soft fragments, easily broken down and carried away in the discharge. Sometimes, however, in consequence of acute inflammation in the line of junction of the head with the neck of the femur, the whole head, or what remains of it, may become separated from the rest of the bone and form a large loose sequestrum. In the later stages of the disease, the bones, including the upper border of the acetabulum, are extensively absorbed, and the upper end of the femur—though generally remaining in the eroded and enlarged acetabular cavity—is drawn, by the muscles inserted into it, upwards and backwards towards the dorsum ilii. In cases in which the strumous diathesis is very pronounced, chronic inflammation may spread widely in the medullary tissue of the femur, or may lead to the destruction of the whole floor of the acetabulum and the adjacent parts of the pelvis.

Diagnosis.—The recognition of hip-disease in its advanced stage is generally a very simple matter; but this is by no means the case when the affection is still incipient, for the various symptoms are then often but very slightly marked, and, moreover, nearly all the signs of early hip-disease are also the signs of other affections either of the lower limb or of the spinal column. A diagnosis, therefore, can often be arrived at only by a careful study of many slight symptoms, any one of which, taken alone, would be either deceptive or altogether inconclusive. These symptoms, to take them in the order in which they may be most conveniently observed in the examination of a patient, are—

(*a*) *Lameness.*—This condition is always present, though it is often so slight that it may easily escape notice. It may depend either on pain, or on a fixed or distorted position of the limb; but as the sensitiveness of the joint varies in different cases, and as the position of the limb varies in different instances, there is no form of lameness that is at all characteristic of hip-disease, and the symptom is valuable only so far as showing that the patient is unsound, and as calling for further investigation of the case.

(*b*) *Pain.*—The degree to which pain is developed is very variable. In some instances it is so slight, or even so entirely absent, that the disease is not suspected. In others it is from the first very severe. It may be limited to the joint itself, but very often it is referred to those situations lower in the limb to which the peripheries of the obturator and anterior crural nerves, which send offsets to the joint, are distributed—that is, to the knee, or in rarer instances to the middle of the inner part of the thigh or the inner side of the leg. It must, however, be borne in mind that pain is referred to these situations, not only in hip-disease, but also in such widely different affections as disease of the lumbar spine and of the sacro-iliac joint, cancer of the rectum as related by Mr. Hilton, and abscess and aneurism in Scarpa's triangle; every case must, therefore, be thoroughly investigated, so that the real source of the pain thus referred may be ascertained.

(*c*) *Altered Position of the Limb.*—In the early stage of the disease the joint, in a typical case, becomes flexed, abducted, and rotated outwards. The explanation of this position of the limb has been much discussed; it is, however, very simple. The

posture is merely that of 'greatest ease,' and is the same as that into which the joint is unconsciously brought when a person sits down with the limbs flexed on the trunk, the knees slightly apart, and the heels touching. It secures the relaxation of all the ligamentous structures of the joint: flexion relaxing the front of the capsule, abduction relaxing the ligamentum teres and the strong outer (ilio-trochanteric) band of the ilio-femoral ligament, and rotation outwards relaxing the inner band of the same ligament and also the back of the capsule. At a later stage the adductors, the most powerful group of muscles around the joint, stimulated to contraction by reflex irritation, gradually draw the limb inwards, so that, instead of being flexed and abducted it now becomes flexed and adducted. Shortening due to absorption of bone commonly takes place at this period, and is indicated by the shifting of the trochanter upwards, or upwards and backwards, in the acetabulum enlarged by the absorption of its upper border. This displacement may be detected by observing that the apex of the trochanter lies above Nélaton's line, drawn from the anterior superior iliac spine to the most prominent part of the tuber ischii. In advanced cases real shortening is often in part due to arrested growth of the limb. Real lengthening, if it ever occurs, is certainly in the highest degree rare. The writer has never seen it demonstrated. Apparent lengthening arises when, the limb being abducted and fixed, the patient wheels it inwards till it is parallel with its fellow, by drawing up the opposite side of the pelvis; while apparent shortening results when, the limb being adducted, the patient wheels it outwards by drawing up the pelvis on the affected side.

(*d*) *Loss of Movement in the Joint.*— This is the most constant and the most conclusive symptom. Cases of hip-disease in which movement is absolutely unimpaired are so rare, that the presence of completely free movement may in itself be taken as all but absolute proof that the joint is sound. It should be remembered, however, that the loss of flexion and extension of the thigh on the trunk is a symptom by no means limited to hip-disease; in psoas and iliac abscess the thigh generally cannot be fully extended; in abscess under the glutei it cannot be fully flexed; it is, therefore, necessary not only to test flexion and extension, but to see whether the ball-and-socket movement, or rotation of the femur in the acetabulum, is interfered with. If rotation is free, it may be concluded that the loss of either flexion or extension depends on some condition external to the joint; if, however, rotation is deficient, this fact will tend to show that the joint itself is affected. This test as to the various movements of the thigh on the trunk must be very gently carried out. If the examination is roughly made, all the muscles will be contracted to protect the joint, and this contraction will be mistaken for rigidity resulting from disease.

(*e*) *Muscular wasting* is a very constant symptom. It is most marked as flattening of the glutei and obliteration of the fold between the nates and the thigh; but it can also be detected, with less annoyance to the patient, by comparing the measurement around the middle of the thigh with that at the same level of the opposite limb. Muscular wasting is often ascribed to non-use of the limb; it is, however, in great part dependent on reflex atrophy, and has its counterpart in the muscular wasting which accompanies disease of all the principal joints.

(*f*) *Swelling.* — This is often absent during the earlier stages of the disease. At later periods it may make its appearance either in front of the joint in Scarpa's triangle, or behind the trochanter, or on the outer aspect of the limb beneath the tensor fasciæ femoris, or in the form of general brawny thickening around the articulation.

During examination, a patient suspected of having hip-disease should be undressed and placed, not on a soft bed, but on a firm mattress or couch, so that the outline of the spine and limb may be clearly ascertained. It must be noticed whether, while the ham touches the couch, the lumbar spine is free from anterior curvature (lordosis); whether the heels correspond; and whether the anterior iliac spines occupy corresponding positions. If, when the limb is down upon the couch, the spine is arched forwards, this is evidence that the thigh is flexed upon the pelvis. The extent of this flexion can be defined by raising the limb till the spinal curvature is removed. If the iliac spine on the suspected side is lower than that on the opposite side, it shows that the limb is abducted—to what extent may be ascertained by moving the limb outwards till the two spines are again level; while if the iliac spine on the suspected side is, on the contrary, drawn up, it indicates adduction, the amount of which may be determined by moving the limb inwards across its fellow till the pelvis is again square. In this manner the real position of the limb on the trunk will be ascertained. Motion should now be tested by carrying the thigh slowly and gently in a direction first of

flexion and then of extension, the hand being placed under the loin to see that the lumbar spine remains at rest. Next, the thigh should be carefully rotated to ascertain whether the femur turns freely in the acetabulum. These several movements must be carried to their full natural range; for, in slight cases, it is only when the extreme limits are approached that any stiffness can be detected. Muscular wasting should be investigated, either by observing whether or not there is any flattening of the gluteal region, or by comparing the circumference of the two thighs at the same level. If swelling is present it may be detected by comparing the two sides, or by passing the hand over the surface. Tenderness on pressure, either in front of the capsule or behind the trochanter, is sometimes noticed in cases in which other signs are but little marked; but, unless care is used, the pain of rough handling may be mistaken for the evidence of disease. Jarring of the heel or knee is not to be relied on; it is a test very likely to make a timid child flinch, although the joint is quite sound; while, on the other hand, there are many cases of hip-disease in which the jar produces no complaint of pain.

When these various symptoms have been investigated, the evidence obtained must be carefully weighed. As a rule it is easy to arrive at a definite conclusion; but in some cases the diagnosis can be formed only by combining a number of minor signs. Thus, in one case there is, together with an appreciable limitation of movement —which is, as has already been said, almost invariably present—some slight muscular wasting of the limb; in another, to slight stiffness are added slight apparent lengthening, pain on movement, and rigidity of the adductor longus or some of the other muscles around the joint. In another, with some loss of motion, there may be detected slight flexion, pain in the knee, and fulness in the groin. Negative evidence is sometimes of great value; for if, notwithstanding that the child is lame, has pain in his knee, and keeps his thigh constantly flexed on the pelvis, it is found that there is no stiffness at the joint, but that the head of the femur still moves freely in the acetabulum, it may be strongly suspected that the symptoms depend, not on disease of the hip, but on caries of the spine, or some other affection of the neighbouring parts, and a more extended examination must be made. The affections most likely to be mistaken for hip-disease are caries of the spine, attended with iliac or psoas abscess, or abscess burrowing down under the glutei; infantile paralysis; congenital dislocation of the hip-joint—a more common condition than is usually supposed; and, in young children, the lordosis of rickets, accompanied, as it may be, by a painful condition of the limbs, often present when rickets is acute.

When the disease is allowed to make progress, various complications are developed.

Deformity.—The limb, under the influence of the surrounding muscles, assumes positions which undergo some remarkable changes as the disease advances. At first the thigh becomes more flexed and more abducted—the latter posture being itself the cause of any apparent lengthening; but at a later stage, owing to the preponderating action of the adductors—the most powerful group of muscles around the joint—the limb becomes adducted, or, when the compensatory has been substituted for the real position, apparently shortened, by the drawing up of the pelvis on the affected side. By degrees also, and as the effect of constant intra-articular pressure resulting from muscular action, the joint surfaces are absorbed, and the trochanter travels upwards and backwards upon the ilium, and so considerable real shortening is produced.

Abscess.—In neglected cases suppuration is almost constantly met with, while, even when treatment has been resorted to in an early stage of the disease, abscess in a large number of instances sooner or later is developed. Matter usually forms slowly, so that the abscess is of the cold variety. But in some cases the suppurative process is acute, and attended with a high temperature, night screams, and pain on movement. The abscess is generally formed within the capsule, and subsequently makes its way outwards, either through the cotyloid notch, to reach the surface in Scarpa's triangle, or through the thin posterior part of the capsule, to appear beneath the glutei; or it may pass into the bursa under the tendon of the ilio-psoas (which frequently communicates with the joint), and present itself in the immediate neighbourhood of the femoral vessels. In some cases, however, the abscess is from the first external to the joint, and arises from suppuration among the inflammatory products with which the soft parts have been infiltrated. Such abscesses may appear at any aspect of the joint, though they are most commonly seated beneath the tensor fasciæ femoris, or further down on the outer side of the thigh. A formidable variety of abscess is that which is developed within the pelvis as

the result of disease of the acetabulum, and which makes its way to the surface above Poupart's ligament. Suppuration within the pelvis may often be detected by a finger passed into the rectum—a method of examination which it is often useful to adopt in the diagnosis of hip-disease in childhood. The writer has met with four instances in which intra-pelvic abscesses have burst into the rectum, and fæcal material has passed from the bowel through the hip-joint, so as to reach the surface through sinuses opening behind the trochanter. All these were fatal—one after amputation at the hip-joint had been performed.

Amyloid Degeneration.—Should suppuration be copious and of long standing, amyloid degeneration of the internal organs, indicated by enlargement of the liver or spleen and the presence of albumen in the urine, may take place. The period at which this condition is developed varies, however, very much in different instances. In some it is present soon after suppuration has commenced, while in others it makes its appearance only when the discharge of matter has been going on for many months, or even for two or three years.

Tubercular Meningitis. — Formerly, when hip-disease was so frequently allowed to advance to the chronic suppurative stage, tubercular meningitis was by no means a rare complication; but at the present day, when suppuration is so largely diminished by treatment in which rest is combined with the early antiseptic opening of abscesses, it is much less often seen. It may, however, be developed at any period of the disease: in some instances it has occurred when no suppuration had taken place; in others after the joint-affection had long been cured. It always terminates fatally.

It is remarkable that pulmonary phthisis is rarely met with in patients suffering from hip-disease.

Treatment.—In its early stage hip-disease must be treated by absolute rest, combined with the means by which any abnormal posture of the limb may be gradually corrected. The best method for carrying out these indications is that of extension by the weight and pulley. The patient is placed on a firm mattress, with a board beneath it to keep its surface flat. The pillow should be wedge-shaped, so as to support the head in a raised position at a convenient angle; but it should be large enough only to correspond to the head. If it is of the ordinary size the patient raises his shoulders upon it, so that his trunk is no longer in a horizontal position. The weight is connected with the limb by means of the ordinary 'stirrup.' This consists of a piece of stout strapping, from two to four inches wide, which is doubled upon itself at its middle so as to form a long loop, the sides of which are placed one on the inner and the other on the outer aspect of the limb, from the foot to the middle of the thigh, a loop of about four inches in length being formed below the sole. The strapping is kept in place by circular strips, over which a bandage is applied. A thin piece of wood of the shape of a visiting card is placed transversely in the lower end of the stirrup, to prevent the side pieces from pressing on, and excoriating the malleoli. Through the centre of this piece of wood, and through the strapping at a corresponding point, a strong piece of cord is passed, and carried down to the foot of the bed, where it passes over the pulley and supports the weight. The amount of the weight must vary with the case, but in children under twelve years of age from three to five pounds should be used; in young adults as much as six to ten, or even more, may occasionally be required. It is, however, not to its large amount, but to its continuous action, that the weight owes its efficacy in these cases. Very heavy weights put a mischievous strain upon the ligaments of the knee, and often produce œdema of the foot. A cradle should be used to keep the weight of the bed-clothes off the feet.

In the case of a child, the mattress should be protected with a piece of macintosh, covered with a draw-sheet. It is absolutely necessary that, for a time, the patient should be confined to the horizontal posture. To ensure this a long splint should be placed on the opposite, or sound side, and a chest-band will also be useful. This consists of a piece of webbing, an inch or two wide, passing across the upper part of the chest between the two armpits, and ending in two loops through which the arms are passed, and through which, also, another piece of webbing is threaded, which runs transversely across the surface of the bed under the patient's shoulders, and is securely tied at its two ends to the sides of the bedstead. When this contrivance—which ought not, however, to be tightly applied—is worn, the patient can neither sit up nor turn on his side.

In adjusting the limb, the first step is to exchange the compensatory position which it has assumed for its real position. Thus, if there is lordosis, this must be removed by flexing the limb to the necessary extent on the trunk. If the pelvis is oblique, so

that the anterior iliac spine on the affected side is lower than that on the sound side, the limb must be moved outwards till the two spines are again at the same level. If, on the contrary, the iliac spine of the diseased side is higher than that on the sound side, the limb must be adducted till the spines are again horizontal. Secondly, in whatever position the limb has now been brought, it must be maintained by pillows, or by some equivalent support, and the pulley must be adjusted in a line with the long axis of the thigh, so that extension is made exactly in this line. In instances in which deformity is extreme, the adjustment of the limb is a matter requiring some ingenuity, and a light wooden framework, covered with pillows, may be necessary to support it. But for ordinary cases sloping or wedge-shaped pillows will be sufficient. The reason for arranging the limb in the manner now described, and making traction in the long axis of the thigh, is that when this is done the weight has a direct tendency to remove intra-articular pressure, while if extension is not thus made in the axis of the deformity, the femur is converted into a lever, whose fulcrum is at the acetabulum, so that the articular surfaces are pressed still more firmly together. As the contraction yields, it is necessary to alter the position of the pulley and the height of the pillows, so that extension shall still correspond with the axis of the thigh. It is often surprising to see how quickly weight-extension thus applied will remove deformity. In recent cases the limb may be restored to its natural position in ten days or a fortnight; while, even in cases of long standing, its position may be corrected in from three or four weeks to two months.

It must be noticed that, although it removes flexion, the action of the weight has little effect on either adduction or abduction, so that when the limb has been restored to a position of extension on the trunk, abduction, showing itself as apparent lengthening, or adduction, taking the form of apparent shortening, will still remain.

Abduction calls for no interference, for it will gradually disappear spontaneously if movement in the joint is preserved; while, should ankylosis result, the presence of abduction, assuming the form of apparent lengthening, will be a distinct gain, for it will tend to compensate for any real shortening that may have taken place. Instances are not rare in which a limb, which has become permanently fixed in a position of abduction, has the appearance of being of the same length as its fellow, though it is in reality shortened to the extent perhaps of an inch or an inch and a half. Adduction is of greater moment, for it has the effect of making the limb practically shorter than its fellow. It is therefore necessary if possible to correct it. This may be done in the following manner. A weight somewhat heavier than that which would ordinarily be used—for a child of five or six years six pounds may, for the present purpose, be employed—is attached to the affected limb in the ordinary way. A long splint is then applied to the sound side, unless this has already been done, and at its lower end is fastened a cord which runs along its outer side upwards to the head of the bed, where it is made to turn over a pulley and sustain a weight of five or six pounds. By this means, while the affected limb is drawn down, the opposite limb is carried in a contrary direction. There are few cases in which, unless firm ankylosis has taken place, this method will not in the course of two or three months completely remove apparent shortening dependent on adduction. Should the limb, in consequence of the absorption of the head of the femur, tend to be everted, this posture may be corrected by the following plan:—An outside splint, long enough to extend from the level of the sole to the knee, and furnished with a cross-piece so that it is T-shaped at its lower end, is applied to the outer side of the limb, and is at first tilted with sand-bags (one of which is placed upon the outer, and the other beneath the inner end of the cross-piece), so that it is rotated outwards to the same extent as the foot and leg. It is then gradually rotated inwards by changing the slant of the cross-piece and altering the sand-bags until, carrying the limb with it, it has brought the latter into its natural position.

Formerly it was the custom, in cases of considerable deformity, to place the patient under the influence of chloroform, and to forcibly straighten the limb. This was a violent proceeding, which often inflicted much injury. It is now very generally, and very properly, discarded. In those instances, however, in which the limb is so firmly held by adhesions that no improvement is obtained by weight-extension, the following plan may be adopted. While the patient is under an anæsthetic, the limb may be straightened by manipulation through two or three degrees, and may then be left again to the action of the weight. It will be very generally found that, after extension has once been thus commenced, the weight will do

the rest, and the limb will gradually come down into its normal posture. This proceeding must always be very carefully carried out, and only very slight force ought to be employed.

Mr. Thomas, of Liverpool, has introduced an excellent splint for hip-disease, which has become very popular in England. Made entirely of iron, it consists essentially of a well-padded bar, running along the posterior aspect of the limb from the inferior angle of the scapula to just above the ankle. This bar is easily bent with wrenches to the outline of the trunk and limb, but it is strong enough to maintain its shape when once applied to the patient. At its upper end is a chest-piece, made of iron behind, and ending in a strap and buckle in front, for fastening round the thorax. The splint is kept in place at its lower end by a semi-circlet made of sheet iron behind, and fastening with a strap and buckle round the leg in front. A similar fastening is added at the middle of the thigh. In the lumbar region of the spine the splint is fixed by a wide flannel bandage, surrounding it and the trunk. In acute cases this splint is applied to fix the limb as the patient lies in bed; and if deformity is present, it is fitted to the shape of the limb, and is gradually straightened, so that the position of the limb is corrected. In the later stages of treatment the patient is allowed to be upon crutches and to wear a high boot on the opposite foot, so that the affected limb does not touch the ground.

This splint is very useful, both for the purpose of maintaining the limb, when disease is acute, completely at rest (and for this purpose it may advantageously be combined with weight-extension), and in the convalescent stage, in order to prevent the return of flexion. Children who are wearing this splint can also be lifted without disturbance of the limb. The principal objection to it is that if long-continued it leads to considerable atrophy of the muscles of the thigh. Moreover, as it effects no extension, it does not prevent, when bone-absorption is taking place, the sliding of the upper end of the femur towards the dorsum ilii—in other words, the gradual shortening of the limb. Nor does it exert any direct influence to remove adduction. Thomas's splint, in short, is chiefly useful for the purposes of fixing a limb in acute disease, and for preventing the return of flexion when the patient is up and using crutches. Its simplicity and durability, and the ease with which it can be managed, are strong recommendations of this appliance. While it is in use the patient must be placed on a soft bed, instead of on the firm mattress necessary for weight-extension. A common fault in this splint, as supplied by the instrument-makers, is that it is much too sharply bent where it corresponds with the junction of the nates with the thigh, with the result that it may lead to pressure on the great sciatic nerve to a degree which seriously interferes with the nutrition of the limb. This curvature ought to be modified before the splint is applied.

Mr. Bryant has invented an appliance consisting of two outside long splints, one for each limb, extending from the sole to the axilla, and fastened together at their lower ends by a cross-piece, and at their upper end by an iron rod arched over the chest, so that they are maintained in a parallel position. The object of this double splint is to keep the patient at complete rest, and to prevent abduction or adduction. The various forms of shield splints made of leather or gutta-percha, and the more recently introduced plaster of Paris splint, are all rendered very nearly useless by the fact that as they have very little power to prevent flexion they entirely fail to keep the joint at rest. They are in every respect inferior to Thomas's splint, which ought to be regarded as having completely superseded them.

In America, Taylor's and Sayre's splints, or some of their numerous modifications, are much in use. These appliances, which are described in all American works on surgery, are intended to maintain extension while the patient is allowed to move about in the open air. The defect, however, in all of them is, that it is impossible, except by constant readjustment, to maintain extension, or even to secure adequate rest of the limb. Hence this form of apparatus has never become popular with English surgeons.

It is difficult to say how long treatment in any particular case should be continued. It must be remembered, however, that recovery takes place very slowly, and that relapses are very prone to occur, so that the danger is that time enough will not be allowed. Very few cases, even among those that are treated efficiently from their very commencement, are cured by less than six months of absolute rest, and even eighteen months or two years may be necessary. When weight-extension is the method employed, it should be maintained for at least three months after all pain and tenderness have completely disappeared. Then the weight should be very

gradually reduced, and the patient should not be allowed to be up for a month after all extension has ceased. He may then get about with crutches, with a high boot on the sound side, and with a Thomas's splint applied to the affected limb; and this form of treatment must be persisted in for at least another six months, or even a year, at the end of which period Thomas's splint may be left off during the day, although it should still be worn for some months longer during the night, in order to guard against any recontraction of the limb.

It is very important that the formation of matter in hip-disease should not be overlooked, yet large collections sometimes escape notice. If an abscess is detected, it is best to evacuate the collection at once by some means by which septic changes may be prevented. The writer has largely employed Lister's method. A free incision is made, and matter is gently pressed out, so that the abscess-cavity is emptied. A drainage-tube just long enough to enter the abscess is introduced, and the ordinary carbolic dressings are applied. The results have been extremely satisfactory. There is, in the great majority of cases, no rise of temperature, nor any constitutional disturbance. Where suppuration is acute, and connected with inflamed bone, discharge necessarily continues for a time, but the matter quietly escapes through the small sinus which is soon all that is left of the incision, so that no injury is caused to the soft structures of the limb. When the bone-disease, under the influence of rest, comes to an end, suppuration ceases, and the wound quickly heals. In instances in which pus has formed late in the case, and where active disease has come to an end, the abscess has frequently been soundly healed within a month or six weeks, while not a few have been completely closed within three weeks.

The safety with which matter can be evacuated by Lister's method enables us entirely to change the old form of practice in the management of these abscesses, and the early withdrawal of matter may be confidently recommended. When this rule is followed, the wide burrowing of pus in the limb, and the formation of numerous sinuses —hitherto so common an occurrence—is avoided, except in the very few instances in which acute scrofulous bone-disease becomes very extensive, and is attended with wide infiltration of the limb by inflammatory products.

Excision.—Very different opinions are still held as to the value of excision as a means of treating hip-disease. In the view of the majority of surgeons the operation is one that should be employed only in otherwise hopeless cases; for experience, the force of which is daily increasing, shows that if the treatment by rest and the evacuation of matter is efficiently carried out before the disease has reached an advanced stage, recovery, with a much more useful limb than that which is left after excision, will usually take place. The result, however, of excision in cases in which the operation has been performed only after all other means have failed, and in which the general health has suffered considerably, is very unsatisfactory; suppuration often continues to be as free after as it was before the operation, the wound never heals, and the patient dies of exhaustion or visceral disease; or if healing is at last effected, this is only after so long a delay that very little has been gained by the operation. In view of these failures, some authorities have advised that the operation should be performed at a much earlier date—as soon, in fact, as suppuration is detected. If this is done, it is maintained that the wound quickly heals; the local nidus of tubercular disease is removed, so that the danger of systemic infection is averted; and the patient escapes the suffering and dangers which are incidental to the later stages of the affection. The argument, however, which is widely accepted as conclusive against early excision, is the same as that which applies to the case of the removal of a strumous testis in the early stage—namely, that if proper treatment is adopted repair will take place, and the organ may be saved. Other objections to early excision are that the operation is one that cannot be spoken of as free from considerable risk; and that the limb, after even successful excision, is generally much shorter, and much less strong and useful than that which is left when a cure has been obtained without operative interference. Nor is there much force in the proposition that the operation diminishes the risk of systemic infection, for it is impossible to be certain that all infective material (the presence of which, however, is, in the earlier period of the disease, a mere matter of assumption) will be removed, or that other centres of infection do not already exist. Moreover, systemic infection is, after all, so rare, that the possibility of its occurrence is no justification for the sacrifice of such an important joint as the hip.

Although, however, excision generally fails when employed in the later stages of the disease, and although an early resort to it is not warrantable, there are

certain conditions in which the operation ought to be performed. These are—(*a*) when the whole or a considerable portion of the head of the femur has become detached, and is lying, as a sequestrum, in the acetabulum or in the cavity of an abscess. This occurrence, which is not very rare, may be suspected when suppuration continues to be copious, and when it is found that the upper end of the femur is abnormally movable, so that it can be pushed upward on the dorsum ilii, and then be drawn down again, especially if grating between the bony surfaces is felt. In these cases—in which, however, what is done is rather an operation for the removal of dead bone than a systematic excision—recovery generally quickly takes place, and a very satisfactory result is obtained. (*b*) When suppuration continues to be copious after three or four months, and the patient is losing flesh and strength in spite of rest and the provision for the free drainage of matter, and when careful examination discloses no evidence of extensive disease in either the femur or the pelvis. If the femur is extensively diseased, it is usually found that sinuses lead to bare bone in the upper end of the shaft; the bone is felt to be enlarged when grasped between the fingers in a direction from before backwards, and there is general brawny thickening of the soft parts, accompanied by burrowing of matter for some distance in the thigh. The formation of sinuses about the ilium, and the fact that a probe, introduced into any openings that may have formed, runs towards the pelvis, will point to the existence of disease of the acetabulum. Important information may also be obtained by exploring the pelvic aspect of the acetabulum with the finger passed into the rectum, when swelling, indicating the presence of an abscess, may sometimes be felt. When the femur is extensively diseased (chronic myelitis sometimes affects the upper third or even more of its shaft) amputation is the only operative proceeding that will suffice. When the pelvis is widely involved, excision will generally be useless, though in some cases it does good by securing free drainage. (*c*) Excision may also be advisable when long-continued and very free suppuration is associated with displacement of the upper end of the femur, attended with deformity which cannot be removed without operative interference. Should albumen appear in the urine, or enlargement of the liver be detected (evidences that amyloid degeneration of the viscera has commenced), the question of excision ought to be carefully discussed, for, if the operation can check suppuration, complete recovery of the internal organs may, and indeed very probably will, take place. It must, however, be remembered that amyloid disease often passes off as the disease subsides under rest and drainage of the joint, so that the mere presence of albumen or of an enlarged liver or spleen does not call for active interference, unless the discharge is very profuse and shows no tendency to decrease. The operation should, therefore, be performed only when it is evident that no improvement is to be expected from further delay.

It is sometimes better not to perform a complete excision, but to operate with the purpose of removing any sequestra that may be present, and of laying open any deep sinuses through which pus may have a difficulty in escaping. Great improvement, or even sound healing, may follow this method of treatment.

The Operation of Excision.—In cases suitable for the proceeding, the operation of excision is limited to the removal of the head and neck of the femur or what remains of these parts. The trochanter should not be taken away, and the soft structures around the bone, including the attachments of the muscles, should be as little disturbed as possible. The method formerly adopted, by which the upper end of the femur was stripped and forced out of the wound, has been superseded by the following proceeding:—A deep incision, four or five inches in length, is made from the base of the trochanter upwards in the direction of the fibres of the glutei; the edges of the wound are retracted, and the capsule, if it remains, is divided, so that the joint is opened from behind. The finger is then introduced to ascertain the condition of the bones and the position of the neck of the femur. A narrow saw is now passed along the finger, the neck is cut through, and the detached portion of bone is removed with sequestrum-forceps with as little violence to the neighbouring parts as possible. If the trochanter or the upper end of the shaft is extensively diseased, they must be removed; but it must be borne in mind that this step seriously interferes with the future usefulness of the limb, and should not be resorted to unless on the ground of clear necessity. The acetabulum must now be explored, and search made for sequestra. If any pieces of bone are found detached, they should be removed; but should the bone be found merely inflamed and bare, it should be left for subsequent healing by granulation. If perforation of the acetabulum has occurred, and abscess has formed in the pelvis, suffi-

cient bone must be removed, with a gouge, to provide for the free escape of pus, and a drainage-tube should be introduced. The wound may be conveniently dressed with carbolic gauze. After the operation, the limb should be placed on a long splint, interrupted at the hip, or it may be supported between sand-bags, a light weight being suspended from the foot to prevent retraction.

Amputation.—Many circumstances have conspired, during the last few years, to induce surgeons to recommend a more frequent resort than formerly to amputation, as a means of treating certain cases of hip-disease. The introduction of the various forms of elastic tourniquet, and of Davy's lever, having provided the means whereby hæmorrhage can be, to a great extent, prevented, the operation has been found much less fatal than was anticipated. It is now known that amyloid degeneration is no bar to operative interference, and that patients often completely recover from this condition when the copious suppuration which has produced it is arrested; while the fact has become more and more clear that, in many cases of advanced disease, it is useless to hope for recovery by the expectant treatment, and futile to resort to excision. It is needless to say that amputation at the hip-joint ought only to be performed when there is good reason to believe that the patient has no other prospect of recovery. The cases in which the proceeding should be adopted are:—(*a*) Those in which there is extensive disease of the femur attended with copious and long-continued suppuration, persisting in spite of rest and free drainage; and in which the patient is steadily losing flesh and strength, and especially when albuminuria or enlargement of the liver is present, to show that amyloid degeneration of the internal organs is in progress. (*b*) When excision has been performed but has failed to arrest suppuration, and the patient's strength is becoming exhausted. An additional ground for resorting to amputation in these cases is that the operation is much more easily and quickly carried out when excision has been already practised. (*c*) When, in spite of careful treatment by rest and drainage, the disease continues to advance, and the patient's strength is not sufficient to enable him to effect repair after excision. (*d*) The operation may, sometimes, be performed in cases of free suppuration connected with extensive disease of the pelvis. The result of these cases must generally be doubtful; but recovery, otherwise hopeless, may perhaps be secured by the provision of such free drainage as is provided by the removal of the limb. Possibly, also, when the limb is removed, diseased bone, not previously within reach, may be got at and extracted.

As the patient is already in a condition of great prostration, care must be taken both to prevent hæmorrhage and to complete the operation with as little delay as is compatible with its careful performance. The bleeding which is most difficult to prevent is that which is derived from the vessels of the posterior flap. This may be guarded against by—1, Davy's lever, or 2, pads may be placed on the external iliac artery, just above the groin and over the posterior vessels as they leave the great sciatic notch; and an elastic tourniquet, made of tubular india-rubber, may be applied firmly, in a circular manner, over these pads.

The method of performing the amputation is a matter of importance. The old plan of transfixion may be rapidly carried out; but it has the disadvantage that the stump is so short that the patient will have little or no power to use an artificial limb in walking. When, however, the muscles are saved, so that a long stump is provided, the patient will be able to use an apparatus with which he can walk in a satisfactory manner; many surgeons, therefore, remove the limb by Furneaux Jordan's method. *See* Hip-Joint, Amputations at the. The choice between this method of amputation and that by transfixion must be carefully made, and must depend upon circumstances. If the patient is fairly strong, so that it is thought he can bear a somewhat prolonged operation, it will be right to endeavour to secure for him the advantage of a stump which will enable him to wear an artificial limb; and Furneaux Jordan's operation should be selected. In cases, however, in which great exhaustion is present, the main question is, not what form of stump will be most useful, but how the patient's life can be saved; and in these instances the much more expeditious method of transfixion—when bleeding has been provided against by the use of Davy's lever or a carefully adjusted tourniquet—had better be selected.

Howard Marsh.

HIP-JOINT, Amputations at the.—Amputation at the hip-joint is an operation which, under any circumstances, and no matter what precautions may be adopted to avoid the traumatic accidents liable to occur from the necessarily great size of the

wound, must be regarded as one of the most serious in the whole range of practical surgery. The rate of mortality that has hitherto attended it is exceptionally high. Dr. J. Bryant states that in military practice the 'immediate' amputation is attended with a mortality of 93 per cent., in civil practice 60 per cent., and in both combined 80 per cent; in non-traumatic cases it is under 41 per cent., and in the two classes taken together it is a little over 64 per cent. The conditions necessitating the operation, the shock, and the dangers of hæmorrhage and septicæmia, all contribute to make the prognosis in such cases one of the utmost gravity. 'Death,' observes M. Verneuil, 'is sometimes immediate, on the operating table itself; sometimes rapid in the first five hours, sometimes within two hours; at other times it occurs after the first seven days or later. Early deaths are by much the most frequent, ordinarily caused by the hæmorrhage which precedes, accompanies, or follows the operation, and which proceeds not only from the femoral artery, but also from the branches of the gluteal and the sciatic arteries. Later deaths are most frequently the result of blood-poisoning.' The four main factors, therefore, which have hitherto played so important a part in raising the mortality of this operation are:—

1. The serious conditions which necessitate the operation.
2. Shock.
3. Blood-poisoning.
4. Hæmorrhage.

Over the first of these the surgeon has obviously no control; with the second he is almost equally powerless, although there is the authority of Von Langenbeck for maintaining that hæmorrhage intensifies it, but with septicæmia and hæmorrhage he is in most instances able to grapple, and with good prospect of success. As regards the third factor, the absence of surgical fever in the cases the writer has operated upon, in all of which rigid Listerian antiseptic precautions were adopted previously, during, and subsequent to the operation, is evidence of the powerful means that are now at our disposal for striking at those septic influences which have hitherto proved so fatal.

The arrest of hæmorrhage during amputation at the hip-joint can best be effected by one of three methods—(1) the abdominal clamp of Sir J. Lister; (2) Davy's rectal lever; and (3) elastic pressure. In the first of these the defects are threefold—(1) the difficulty of adjustment, especially in cases in which there is any deviation from the normal course of the aorta; (2) the danger to the intestines resulting from overpressure of the instrument; and (3) the interference with the respiratory movements from pressure on the abdominal muscles. The first two of these defects are acknowledged by Sir J. Lister, while the rectal lever introduced by Mr. Davy effectually gets rid of the third, but has itself special dangers, viz. unreliability in checking hæmorrhage where an unusual course of the aorta or common iliac artery exists; besides the necessarily fatal accident of perforation of the bowel resulting from an undue amount of force used in the introduction of the lever. The writer has tested the method in three cases of amputation at the hip-joint. In the first two the lever acted perfectly, the operations being practically bloodless; in the third it was not so satisfactory, the hæmorrhage being such as to give rise to anxiety. Elastic pressure as suggested by Esmarch appears to be the most effectual method, and the one attended with the minimum of danger. A simple mode of making such pressure has been recommended by Mr. Jordan Lloyd. Having first produced anæmia of the limb by an Esmarch bandage, he takes a strip, about two yards in length, of a Martin rubber bandage, and passes it doubled round the thigh at the groin. An ordinary roller bandage is then placed on the external iliac artery, and 'the ends of the rubber are firmly and steadily drawn by an assistant upwards and outwards, one in front and the other behind, to a point above the centre of the iliac crest of the same side.' The portion of the bandage crossing the groin obliquely presses on the roller, which in its turn presses on and occludes the external iliac artery, and the other portion, passing behind, closes the gluteal vessels, bleeding from which gives as a rule in this operation most trouble and anxiety.

The following are the methods by which amputation at the hip-joint may be performed:—

I. Single flap (anterior or internal).
II. Double flap (antero-posterior or lateral).
III. Oval.
IV. Circular.
V. Modified circular.

The first of these procedures may be thus described:—

The parts about to be operated on having been rendered aseptic, anæsthesia induced, and some of the measures already mentioned taken to prevent hæmorrhage,

the patient should be so placed on the table that the pelvis should project beyond its edge. The scrotum should be drawn aside by an assistant with a broad bandage or cloth; another assistant should stand beside the operator to take charge of the anterior flap and, if necessary, make pressure on the femoral artery; a third should support the condemned limb and thoroughly understand when to flex, extend, abduct, and adduct the limb during the performance of the operation. The thigh being slightly flexed on the pelvis the operator takes a long narrow-bladed catlin (Liston's), the cutting portion of which should be at least twelve inches in length, and should enter it at a point midway between the anterior superior spine of the ilium and the great trochanter, and carry it inwards and backwards to a point an inch below and in front of the tuber ischii. This step of the operation, if done skilfully, should open the capsule of the joint. The operator then with a rapid sawing movement carries the knife longitudinally downwards and forwards, during which manœuvre the assistant passes his fingers behind the flap, as soon as room is afforded him, in order to make, if necessary, pressure on the femoral artery. The termination of the flap should correspond to the junction of the upper and middle thirds of the thigh. The anterior flap having been formed, reflected, and compressed by an assistant, the limb should be extended and abducted, and the capsule, thus made tense, freely opened. The head of the bone will now protrude, and the round ligament and posterior portion of the capsule should then be divided. The limb should then be rotated inwards, and the attachments to the great trochanter divided. The knife is then placed behind the bone, and the posterior tissues divided obliquely downwards and forwards.

In performing the *antero-posterior* or double-flap operation, the long anterior flap having been formed in the manner described, the knife is carried round and under the thigh and a lunated incision involving the integument and fascia made, connecting the two extremities of the anterior flap. The deeper tissues are then obliquely divided, following the edge of the retracted skin, and a short posterior flap thus made, one-third in length of the anterior flap. This method the writer has always adopted.

In the *oval method*, recommended by Verneuil, the operator makes a vertical incision about two inches in length, involving only skin and fascia, commencing an inch below Poupart's ligament. This incision is then carried downwards, outwards, and backwards, then transversely along the gluteal fold, and finally obliquely upwards and inwards to the termination of the vertical incision. The femoral vessels having been exposed, and the artery ligatured above and below the origin of the profunda, the latter vessel in its turn is also secured. Ligature of the femoral vein is likewise recommended. The deeper incisions through the muscles following the line of the integumentary incision are then made, every divided vessel being ligatured. The capsule is then opened and the trochanteric muscular attachments divided, the thigh having been depressed, and the head of the bone protruded. On the removal of the limb a large gaping wound will result, which cannot be closed. This M. Verneuil considers an advantage, as no accumulation of fluids liable to undergo putrefactive changes occurs. The wound is dressed on the 'open' principle with pledgets of lint or charpie soaked in some antiseptic solution. The writer does not recognise the alleged merit of this procedure.

The *circular method* of amputation is performed by making an incision, involving primarily only skin and fascia, at a distance of from six to eight inches below the anterior superior spine of the ilium. The skin is then retracted, and the superficial and deep layers of muscles successively divided. The bone is then reached, the capsule freely divided close to the cotyloid cavity, the muscular trochanteric attachments divided, and the head of the bone made to protrude by depressing and abducting the thigh. This method is preferable to that which immediately precedes it.

Mr. Furneaux Jordan (*Lancet*, March 22, 1879) has proposed a mode of amputating at the hip-joint for which he claims many advantages. The principle of the operation is a primary enucleation of the bone and a subsequent division of the soft structures of the thigh at any desired spot, 'the middle of the thigh, or below, or even near the knee.' A straight incision is first made, the trochanters and upper part of the shaft are freed from their muscular attachments and the capsule opened. The shaft is then cleared downwards from all its attachments for a considerable distance and lastly 'a few free sawing movements with a long-bladed knife through the thigh from which the bone had been removed' complete the operation. The advantages claimed for this operation over that usually performed are—the wound being less severe,

the cut surfaces less extensive, less shock, less hæmorrhage, and less opportunity for septic infection. The absence of the bone enables the operator to cut the muscles on, or nearly on, a level with the skin, their retraction under these circumstances being so great that the skin readily covers them.

The operation would clearly not be indicated in cases where the soft tissues were much engaged or in cases of malignant disease, and it leaves necessarily a large pendulous, boneless mass. These defects may, not altogether without reason, be advanced as arguments against the operation.

WILLIAM STOKES.

HIP-JOINT, Dislocations of the.—These injuries are rare, and few surgeons can claim a very large experience of the various displacements, whilst the opportunities for making recent dissections are very limited. Consequently, much that has been written concerning the pathology of dislocations at the hip has been founded on experiments made upon the dead subject. This method of inquiry, though useful, is scarcely reliable; and the results require to be checked by more careful dissections of recent cases. Fabbri, who made a series of elaborate experiments, and laid down rules for the artificial production of the various dislocations, has been followed on the same lines by Tillaux and H. Morris. The general result of these observations is to the effect that, the lower part of the capsule being the weakest, and the lower edge of the acetabulum the least elevated, in all dislocations of the hip the head of the bone escapes primarily through this region, and arrives secondarily at its characteristic position. Further, according to Morris, abduction is the position in which all dislocations of the thigh happen. This scarcely accords with clinical experience. Thus, a case of dislocation on to the dorsum ilii, which came under the writer's notice, was caused by the squeezing and rolling of a man's thighs and hips between a moving omnibus and a wall, in which position abduction could scarcely have occurred; and Hamilton mentions a case caused by a fall from a height on to the outer side of the knee, where a contusion existed to verify the patient's statement. Tillaux, indeed, avers that adduction, with flexion and internal rotation, will send the head of the bone out below the tendon of the obturator internus, and his belief is that all dorsal dislocations are primarily incomplete ischiatic. In curious contrast to these views are those of R. A. Vance, who asserts that if the acetabulum be divided into 360 degrees, it can be truly said that dislocations occur at every degree. Eve, also, has collected several cases of direct dorsal dislocation; and there is a specimen in St. Thomas's Hospital, in which the head of the femur is seen to have perforated the capsule above the obturator internus tendon.

Since the days of Astley Cooper, who, perhaps more than any other observer, made clear the signs by which the various displacements might be recognised, all surgeons have admitted four distinct forms of dislocation at the hip-joint. These are generally spoken of as—(1) dislocation upwards, or upwards and backwards, on to the dorsum ilii; (2) dislocation backwards, or upwards and backwards, into the ischiatic notch; (3) dislocation downwards, or downwards and forwards, into the foramen ovale; (4) dislocation forwards, or forwards and upwards, upon the pubes.

It is time perhaps that some less cumbersome and lengthy nomenclature was adopted for these injuries, similar to what has now been generally accepted for dislocations at the shoulder-joint; and the writer suggests the terms *superiliac*, *supersciatic*, *superthyroid*, and *superpubic*, to indicate respectively these several displacements. If philologists take exception to these terms, their convenience must be their apology, and they are not more barbarous than those in use for the homologous joint of the upper extremity. These four are usually regarded as the *regular* dislocations of the hip-joint; but others are met with in which the head of the femur occupies various intervening points on the circumference of the acetabulum, and the latter are regarded as *irregular* or *anomalous*. Bigelow has laid great stress on the importance of the ilio-femoral or inverted Y-shaped ligament in determining the character of the dislocation, and he would regard all cases as *regular* except those in which this ligament is 'wholly ruptured.' He also follows Malgaigne in regarding the position of the tendon of the obturator internus as the distinctive feature separating the superiliac from the supersciatic dislocation. In the former, according to these authors, the head of the femur escapes above the obturator internus tendon; whilst in the latter, which Bigelow terms 'dorsal below the tendon,' it escapes below the obturator, and then turns up behind it.

As regards the relative frequency of the four regular dislocations, rather more than half are superiliac, and about a fourth

supersciatic; the superthyroid come next in order, and the superpubic are the rarest. The hip is most liable to dislocation between the ages of fifteen and forty-five, and the injury is very much more frequent in males than in females. Several cases have been reported at the age of four years, and one even as early as six months; whilst at the other extreme of life they have been known to occur after the age of eighty.

The Superiliac Dislocation (dislocation upwards and backwards on to the dorsum ilii) may be caused by a fall on the outer side of the knee and thigh, by a wheel passing over the hip, or by a weight falling on the back when the patient is stooping. Malgaigne mentions two cases caused merely by a twist of the limb inwards and forwards.

The *symptoms* are shortening of the limb from one to three inches, adduction, inversion, and fixation. If the patient be examined when standing, the dislocated limb is seen to be semi-flexed and rotated inwards, so that the knee lies above and in front of the other knee, and the ball of the great toe rests on the instep of the other foot. The trochanter is above Nélaton's line, nearer the anterior superior spine of the ilium, and so rotated that its posterior angle projects. The buttock is flattened and the gluteal fold raised. In thin persons the head of the femur may be easily felt, and sometimes be seen, resting in its new position. By increasing the adduction it may be made to project, and during flexion it may be felt to descend. The natural motions of the joint are lost, and the movements are limited to slight flexion, adduction, and rotation inwards.

The ligamentum teres is ruptured, and the capsule often extensively torn, so that sometimes only the upper and anterior part remains unsevered. The untorn portion, nevertheless, has a powerful influence in retaining the bone in its new position; and the maintenance of the inversion is due, according to Bigelow, to the tension of the external fasciculus of the ilio-femoral ligament. Gunn, however, differs from Bigelow on this point, holding that the ilio-femoral ligament is relaxed in superiliac dislocation, and that the continuance of the position is due to the tension of the anterior inferior portion of the capsule and the fascia lata externally. The small external rotators are generally considerably damaged by the dislocation. In one case the head of the bone was found to have escaped between the pyriformis and gluteus medius; in another, between the obturator internus and pyriformis; whilst, in a case related by Cooper, the pyriformis, obturatores, gemelli, and quadratus were all completely torn across. The lower margins of the gluteus medius and minimus may be damaged, and sometimes the psoas and iliacus are partially torn.

If force sufficient to cause dislocation is applied to the limb when extended, the margin of the acetabulum is liable to be split off; but this is not a frequent accident. When it has occurred there has been a tendency to reluxation after reduction.

Reduction of the superiliac dislocation may be effected by *rotation* or *traction*. To reduce the bone by *rotation* the surgeon stands on the injured side, and placing one hand on the knee, grasps with his other hand the leg at the ankle. The limb is then flexed in the adducted position, by which means the ilio-femoral ligament is relaxed and the head of the bone is brought down towards the acetabulum; next, the limb is abducted, then rotated outwards, and finally carried down into the extended position. During this manœuvre the bone usually enters the socket with a sudden snap; but should flexion or abduction be carried too far, the head of the femur may glide round the acetabulum and become lodged in one of the other characteristic situations. Rupture of the outer branch of the Y-ligament, by lengthening the arc, may be another cause of the rotation method failing. An old formula in use at Guy's for many years, was, 'lift up, bend out, and roll out,' which is equivalent to flexion, abduction, and circumduction outwards. Hamilton, in advocating gentleness during reduction by rotation, says 'the limb should follow constantly its own inclination.'

Traction may be made in the extended position by placing the foot on the perineum for counter-extension, and pulling on the dislocated limb, as practised by Morgan and Cock. Traction can also be made, when the thigh is flexed at a right angle to the body, by raising the limb vertically, the surgeon's foot being placed over the anterior superior spine or on the pubes, to make counter-extension. Traction by means of pulleys, as practised by Astley Cooper, is now seldom employed, but, if required, may be applied as follows:—A jack-towel is passed between the thighs and secured to a staple in the floor near the head of the bed, to fix the pelvis and make counter-extension. A leather girth is buckled round the lower part of the thigh, and connected by the cords of the pulleys to a staple in the wall. Extension is then made, by tightening the pulleys, in

a direction downwards and across the other thigh.

The Supersciatic Dislocation (dislocation upwards and backwards into the ischiatic notch, or dorsal below the tendon) resembles in many respects the superiliac. On this account some surgeons have grouped these two forms together as dorsal. According to Malgaigne, and, more recently, Bigelow, the distinction between them rests on the anatomical fact that, in the supersciatic, the head of the femur escapes below the tendon of the obturator internus, and then ascends behind it, so as to lie on this muscle or the pyriformis, the obturator tendon serving to hold down the neck and prevent the bone rising to the position of the superiliac. If the patient is examined in the erect position, the limb will be found adducted and inverted as in the superiliac dislocation, but shortened only to the extent of half an inch, or an inch at most. Allis has shown, however, that if both thighs be brought to a right angle with the body, the knee of the affected side will appear much lower. In the erect posture the great toe rests on the ball of the great toe of the other foot, and the knee is in front of the other knee. The trochanter projects less than in the superiliac, and the head of the bone is less evident behind; but in thin subjects it may sometimes be felt a little above the ischial tuberosity. Squires and Hamilton have detected the head of the bone in the sciatic notch by the finger passed into the rectum or vagina. Syme laid great stress on the lordosis which occurs when the limb is straightened; but this is merely the result of the joint being fixed in a state of semiflexion, and occurs whether the joint is fixed by contraction of the psoas and iliacus, by hip-joint disease, or by dislocation. Passive movement is limited to slight flexion and adduction. Flexion is believed to be essential for the production of this dislocation, and, if seen immediately after the accident, the limb may be found in this position strongly adducted across the other; but the weight of the limb in the erect posture causes the head of the bone to rise behind the obturator to the position of the great sciatic notch. Bigelow, contrary to most observers, maintains that inversion is greater in this dislocation than in the superiliac. Reduction has been found difficult and even impossible in some cases. This Sir A. Cooper accounted for by supposing the head of the femur to have become impacted in the sciatic notch; Bigelow attributes the difficulty to the hooking of the head on the tendon of the obturator internus; whilst Tillaux holds that it is due to the untorn portion of the capsule. The head of the bone is not always found resting on the pyriformis and margin of the greater foramen; sometimes it has been found on the spine of the ischium, or even lower. Fabbri attempted to distinguish between these forms, terming the higher 'sacrosciatic,' and the lower 'ischio-sciatic.' As the head of the bone escapes between the gemellus inferior and the quadratus femoris, the latter muscle is the one more constantly ruptured than any other. Next to it, the gemelli and obturator externus are apt to be lacerated. The capsule is usually torn from the femur at the lower and back part. If the obturator internus gives way, the dislocation may become consecutively superiliac.

Reduction of the supersciatic dislocation by rotation differs but little from that of the superiliac variety; but to disengage the head it may be well to commence by over-adducting and rotating a little inwards, then to flex, abduct, rotate outwards, and extend. Flexion should not be carried to the same extent as in the superiliac, or the head will be brought round into the thyroid foramen. Sometimes, when rotation has failed, by placing the hands under the knee and lifting up the thigh, whilst repeating the manœuvre, the head may be drawn into its socket. If traction is employed by means of pulleys, the direction of the force should be across the middle of the sound thigh, the patient being on his side.

The Superthyroid Dislocation (dislocation downwards, or downwards and forwards, into the foramen ovale) may be caused by a fall with the limb in an abducted position, or by a weight striking the pelvis when the back is bent and the thighs are separated. Abduction is essential for its production. The lower part of the capsule is torn through, the ligamentum teres ruptured, and the head lies on the obturator externus muscle over the thyroid foramen. The pectineus, adductor brevis, and obturator externus are the muscles which suffer most, whilst the psoas and iliacus are put forcibly on the stretch.

The chief *symptoms* are abduction and semiflexion, with apparent lengthening of the limb. When the patient stands on the sound limb, the foot on the dislocated side is carried in advance and usually pointed nearly directly forwards. The body is bent forwards and towards the affected side, either to relieve the tension of the psoas and iliacus, or, as Bigelow would explain, to reduce the flexion of the thigh consequent

upon the trochanters being held up by the ilio-femoral ligament after the head has descended. The heel is raised, and the knee separated from the other knee. On the outer side the prominence of the trochanter is lost, and there exists a hollow, bounded anteriorly by the line of the tensor vaginæ femoris; whilst on the inner side the adductor muscles are rendered tense, and by deep pressure the head of the bone may sometimes be felt beneath them. Anteriorly, where normally the soft tissues are supported by the head and neck of the femur, a lack of resistance is felt with the hand; and, behind, the buttock will be noticed to be flattened and the gluteal fold lowered. Pain is felt along the course of the obturator nerve, and the movements of adduction and extension cannot be effected even with external force. Astley Cooper stated the lengthening of the limb to be two inches, but this is mainly due to the oblique direction of the pelvis. The limb being semi-flexed and abducted, and the trochanter tending to drop into the acetabulum, measurement from the anterior superior spine of the ilium to the inner malleolus usually shows a distinct shortening. Thus Malgaigne found a shortening of two centimètres, Rivington half to three-quarters of an inch, and Morris an inch and a quarter.

To *reduce* a superthyroid dislocation by rotation, the limb is first flexed nearly to a right angle with the trunk, then adducted, rotated inwards, and brought into a state of extension. Over-flexion may convert it into a supersciatic or superiliac dislocation, in which case outward rotation may be necessary for its reduction. Traction may be sometimes effectually applied, in the flexed position, by the surgeon carrying the leg over his shoulder, grasping and raising the thigh, whilst the pelvis is held down and the head of the bone is drawn outwards by a band passed between the thighs. Another way, formerly much in vogue, was to place the patient astride a bedpost and draw the dislocated limb inwards. To employ traction by means of pulleys, it is necessary first to fix the pelvis by a broad band around both ilia; a girth is then passed round the inner side of the dislocated thigh and through the loop of the pelvic band. The pulleys are connected to the girth around the thigh, and whilst extension is being made in a direction upwards and outwards, the surgeon passes his hand under the sound leg, grasps the ankle of the dislocated extremity, and draws the limb inwards.

The Superpubic Dislocation (dislocation upwards and forwards on to the pubes) is caused by violence which forces the limb into a position of abduction and over-extension, such as may happen when a person stepping unexpectedly into a hole falls backwards. The ligamentum teres is ruptured, and the head of the femur, tearing through the capsule on its antero-internal aspect, ascends upon the body of the pubes beneath or internal to the psoas and iliacus. Usually the head lies external to the femoral vessels, but in one case related by Astley Cooper it lay upon the vessels, stopping pulsation in the artery; and in a case observed by Bransby Cooper, and in another by Gosselin, it lay internal to the vessels. The pectineus and adductor brevis muscles suffer most, and the small fleshy muscles behind the joint —the quadratus and gemelli—are usually torn, and the psoas and iliacus may be lacerated.

The *symptoms* are shortening to the extent of about an inch, abduction of the limb, and eversion of the foot generally to a right angle with the other. The trochanter lies in a hollow on the outer aspect of the hip, and is nearer the anterior superior spine of the ilium, the buttock is flattened, and the head of the femur is to be felt as a hard round ball resting upon the pubes. The movements are limited to slight flexion and abduction. Pain and numbness are felt along the course of the anterior crural nerve, and retention of urine more frequently follows this dislocation than any other, owing probably to an inhibitory action excited by irritation of the genito-crural nerve.

Reduction may be accompanied by rotation in a manner similar to that employed for the superthyroid dislocation, but flexion should be carried further. One hand seizing the ankle and the other resting on the knee, the limb is flexed in the abducted position till the knee nearly touches the abdomen; adduction, rotation inwards, and extension of the limb are the movements then successively employed. Reduction by manual extension has been successfully employed by Morgan and Cock with the foot on the perineum for counter-extension. In one of Morgan's cases, whilst assistants made extension on the limb and he made counter-extension with his foot on the perineum, the patient was told to sit up, the surgeon at the same time rotating the limb inwards, when reduction immediately followed. Thus, flexion and rotation inwards were associated with manual extension and perineal counter-extension. Larrey suc-

ceeded in one case by carrying the patient's knee over his shoulder, then clasping his hands over the dislocated bone, and pressing it down into its socket. In Astley Cooper's method by pulleys, extension was made from above the knee in a direction downwards, outwards, and backwards, and counter-extension by means of a band between the thigh and perineum; a towel was then passed round the upper part of the thigh, by which means the head was lifted over the edge of the acetabulum.

Irregular or Anomalous Dislocations.—A certain number of dislocations of the hip cannot be strictly classed under the four regular forms described, but it will be found convenient to arrange them for study according as their clinical signs bring them into near relation with the superpubic, superiliac, supersciatic, or superthyroid forms.

Irregular Dislocations allied to the Superpubic.—In some instances, when the general appearance of the dislocated limb resembles that present in the superpubic form, the head of the bone, instead of passing forwards and upwards so as to lie on the body of the pubes or near its junction with the ilium, is found to pass more directly upwards. These dislocations have been classed as *supracotyloid*, and there are several varieties. In some instances (adspinous) the head of the bone lies just internal to the anterior inferior spine of the ilium, as in cases reported by Morgan, Olknow, and Agnew. In others (abspinous) the head lies on the ilium just external to the anterior inferior spine. In several (supraspinous) the head has been found lodged above the inferior spine, between it and the superior, as in cases reported by Cummins, Lente, and Travers. Lastly, there are cases (infraspinous) where the head rests on the edge of the acetabulum between it and the anterior inferior spine, as in cases reported by Gerdy, Wormald, and Cruveilhier. In all these cases the limb was in a state of eversion similar to what is met with in superpubic dislocation, but carried, in some instances, to an extreme degree, so that the toes pointed outwards and backwards. There was, in addition, a variable amount of shortening and abduction or slight adduction. Reduction should be accomplished by the same manœuvres as recommended for superpubic dislocations.

Irregular Dislocations allied to Superiliac.—There is no irregular dislocation whose clinical signs would lead to its being classed near or among the superiliac; but experimenters on the dead have supplied us with new forms, which, so far as one can judge from clinical records, have never yet occurred among the living. The 'anterior oblique' of Bigelow is to be made from a dorsal by forcibly adducting and everting the flexed thigh across its fellow. Oldnow's case already referred to, which Bigelow places here, the writer, with the original case before him, cannot but regard as an irregular superpubic. The same will be said of the majority of the so-called 'everted dorsal' cases by those who can free themselves from theoretical considerations of the influence of ligaments and tendons. The marked eversion of the limb is the most important symptom in all these cases, and, what is perhaps even more to the point, in the cases successfully reduced by manipulation, rotation of the flexed thigh inwards was the manœuvre followed by success.

Irregular Dislocations allied to the Supersciatic.—These have been included under the general term *infracotyloid*, of which there appear to be several varieties, some being allied to the superthyroid. The head of the bone has most frequently been detected in a direction downwards and backwards from the acetabulum, lying between the spine of the ischium and the tuberosity. In this position one would expect the dislocation to be associated with much flexion of the thigh and inversion of the limb. This was the case with Wormald's patient, whose thigh was inverted, forming an angle of about 45° with the body, the shaft of the femur crossing the symphysis pubis and being immovably fixed. The head was found on dissection to rest opposite the upper part of the ischial tuberosity above the quadratus, and the obturator internus was torn through. In Kirkbridge's case the symptoms were almost exactly similar, and in both the head could be felt beneath the gluteus maximus. A case reported by Warren, and two dissected by Travers, in which there was inversion of the limb, the writer would include in this category. Reduction should be attempted by abduction and rotation outwards, followed by extension. Van Buren's case, in which there was shortening of an inch and slight eversion, whilst the head was 'obscurely felt in the back part of the sciatic notch,' must be regarded as an irregular supersciatic. It was reduced by extension in the flexed position.

Irregular Dislocations allied to the Superthyroid.—In this category the writer places

all those infracotyloid dislocations in which there is abduction, eversion, and lengthening of the limb, whether the head of the bone be found to have taken a downward and forward, directly downward, or downward and backward direction. Those in which the head is found to have passed downwards, or downwards and slightly forwards, may be regarded as incomplete superthyroid, whilst those in which the head is found to have passed downwards and backwards are to be regarded as secondary, though by the term 'secondary' in this instance it may not be necessary to regard the original dislocation as having always been complete. Keate's case may be taken as typical of this latter class. A horse fell back on his rider in a deep narrow ditch, in which position they lay struggling for a quarter of an hour. The thigh was much flexed, much abducted, everted, and elongated, whilst the trochanter was depressed. The head was felt close to, and on a level with, the tuber ischii. A first attempt at reduction threw the head into the thyroid foramen, which the patient recognised as the position in which it was first dislocated; it was afterwards returned to the acetabulum. In Bouisson's case the symptoms were almost exactly the same, and the head was felt in a similar position. In others, with the same symptoms, the head could not be felt. In Roux's case, the limb was lengthened, slightly flexed, and abducted, and the head was felt during flexion above and a little internal to the tuber ischii. In Luke's case, where there was abduction and lengthening without eversion, dissection showed that the head had passed directly downwards.

Dislocation *into the perineum* is a rare form allied to the superthyroid. It has usually been caused by a weight falling on the back when the thigh was abducted. The thigh is fixed at a right angle to the body, and the head of the bone can be felt near the raphè of the perineum, where it lies about opposite the junction of the ramus of the ischium with that of the pubes, and is apt to cause retention of urine by pressure on the urethra. There is a deep hollow in the usual situation of the trochanter, and the toes are sometimes everted and sometimes inverted. Reduction is best effected by vertical traction, when the patient is on his back, at the same time that the head is pushed outwards. In this way the head is usually first carried into the thyroid foramen, whence it may be reduced to its proper cav ty.

R. Clement Lucas.

HODGEN'S SPLINT.—The suspension splint, devised by Dr. J. S. Hodgen, of St. Louis, United States, for the treatment of fracture of the femur, consists of a wire framework of such a length as to extend from the hip to a point just beyond the foot. From this framework hang in loops broad strips of cotton-sacking. The injured limb is suspended in this form of cradle, the foot being fixed by a strip of strapping to the cross-bar at the end of the wire-splint. The apparatus, together with the limb, is suspended by means of cords and pulleys, either to a long upright board at the foot of the bed, or to a bar extending high above the patient from one end of the bed to the other. Extension of the limb may be regulated by varying the obliquity of the extending cords, whilst counter-extension is kept up by the weight of the patient's body. This suspending apparatus is far more comfortable than the long, outside splint, as it allows some freedom in the movements of the body. It requires much attention, however, and care has to be often taken to prevent eversion of the foot.

HODGKIN'S DISEASE. *See* Lymphadenoma.

HORDEOLUS. *See* Eyelids, Diseases of the.

HORNS (*Synon.* Cornua cutanea).—Cutaneous horns are far from common; they are usually solitary, but several cases have been recorded in which they were numerous. They may occur on any part of the body, but the face, scalp, and penis appear to be the regions in which they are most commonly met with. They grow slowly, and are unattended with pain unless there is some inflammation at the base, which is marked by the appearance of a red areola; this is sometimes followed by a shedding of the horn, which leaves a superficial ulcer. Under these circumstances the horn is gradually reproduced. Horns vary from half an inch to several inches in length, and are larger at the base than at the distal extremity; they are apt to become dry and twisted, so that they often bear a close resemblance to the horns of some of the lower animals. They grow from the deeper layers of the epidermis, and are made up almost entirely of altered epidermic cells, which have a laminated arrangement. After the horn has been removed, it is a necessary part of the treatment to destroy the base from which it grows by means of caustic.

Robert Liveing.

HOSPITAL GANGRENE is a highly contagious form of acute inflammatory gangrene, of which, in its true form, owing to the improved hygienic and sanitary conditions of our hospitals, we rarely or never get an instance in this country. It is a rapidly spreading disease, accompanied by great constitutional disturbance, which almost invariably proves fatal and is of a most contagious nature, so much so, indeed, that it is occasionally denominated 'Gangræna contagiosa.' There is, nevertheless, a modified form of the disease which occasionally occurs, and sometimes assumes an epidemic form, to which the term 'hospital gangrene' is applied, but which should more properly be termed 'phagedæna,' since it differs in many essential particulars from the true hospital gangrene. It is accompanied by much less constitutional disturbance, is not of so distinctly contagious a nature, and involves little danger to life. It may be regarded as an intermediate condition between ulceration on the one hand, and true hospital gangrene on the other.

The views which have been held as to the *cause* of hospital gangrene are various, but there seems to be no reason to doubt that it is due to some specific virus, introduced into the wound. The experiments of Koch seem to prove that the gangrene is due to the presence of minute micrococci, which, when brought into contact with a wound, induce rapid death and destruction of tissue, by a process of multiplication and excretion of a soluble substance, which has a deleterious action on the cells of the part. These minute organisms do not exist in the blood of the patient, since blood-inoculation from a patient suffering from hospital gangrene produces no effect. It would appear that the growth and multiplication of these minute organisms may be favoured by certain atmospheric conditions, which are set up by overcrowding, deficient ventilation, and a want of proper cleanliness, and in this manner an epidemic outbreak of the disease is brought about.

On account of the resemblance of wounds attacked by hospital gangrene to 'diphtheria of wounds,' many authors have regarded the two conditions as identical; but they appear to differ in many essential particulars. There are not in diphtheria the same swelling and pulpy degeneration of the edges of the wound as are found in hospital gangrene; the disease in the former case spreads by the formation of vesicles at the margin of the sore, which run together and form excoriations, which subsequently become covered with a fibrinous infiltration resembling an eschar. Nor is hospital gangrene known to be followed by paralysis, which is so frequent a sequel of diphtheria. *See* DIPHTHERIA OF WOUNDS.

The exciting cause of hospital gangrene is, no doubt, in very many instances, direct contagion. This has been abundantly proved, not only by the experiments of Koch on the lower animals, but by undoubted instances in which the disease has spread by direct contact from one patient to another, and also where the attendant has inoculated himself from an infected patient by accidentally pricking his finger or otherwise. It seems probable, also, that the flies, which usually abound where a number of sick are congregated together, may be a source of contagion, carrying the poison from one wound to another.

Symptoms.—When a wound is invaded by 'hospital gangrene,' it becomes covered with a thick, ashy-grey, or black pulp. At the same time the sore increases rapidly in extent, and has a tendency to assume a circular form. The edges are sharp-cut, and the tissues become swollen and reddened, and in their turn become converted into a black or grey pulpy material, and in this way the wound increases with enormous rapidity. The discharge is thin, dirty yellowish-green, or blood-stained. The limb becomes swollen and hard. The sloughing mass remains adherent to the parts beneath, though at the same time it shows a tendency to separate at the margins, so that it can be moved to and fro when an attempt is made to separate it. At other times the disease appears to assume more the character of an ulcerative process. There is a rapid liquefaction of the tissues, so that the wound soon presents an excavated appearance, and spreads rapidly. The skin around is swollen and red, and would seem to melt away. There is a discharge of a fetid, blood-stained, seropurulent fluid. Generally the disease, whichever form it assumes, is at first confined to superficial structures, the deep fascia appearing to offer considerable resistance to the spread of the disease to the deeper structures. But after a time this tissue may be perforated, and extensive ravages result; muscles may be implicated, blood-vessels exposed and finally perforated, joints opened, and bones denuded of their periosteum and necrosed.

The constitutional symptoms are usually very severe. The expression betokens great anxiety; the body is bedewed with a cold and clammy sweat; there is a small, quick, and rapidly failing pulse. Pain of a burn-

ing, stinging character in the part, and frontal headache, are complained of. The respirations become short and hurried, the heart's action becomes weaker and weaker, and the patient sinks in a few hours. *See* PHAGEDÆNA.

Treatment.—There can be no doubt that when this disease attacks a patient he should be immediately isolated from all his surroundings, with special attendants who should be forbidden to mix with the other patients; and be furnished with special appliances and dressings. Should the disease invade a hospital or ward, it should be evacuated at once.

Abundance of fresh air is essential, and this may perhaps be best accomplished—especially in military surgery—by placing the patients under canvas in the open air. The strictest cleanliness is to be rigorously enjoined, and every precaution taken to prevent the spread of the disease from one patient to another. No sponges should ever be employed, but every material with which the wounds are touched should be burned at once.

An endeavour should be made to prevent the extension of the sloughing by the free application of fuming nitric acid to the wound. It should be carefully cleansed with lint or wool, and the whole surface of the sore, and the edges for some distance around, be freely swabbed with the acid, which should be allowed to remain in contact with the tissues for some minutes, so as thoroughly to soak into them. Opium should be given, and the patient's strength supported by the administration of liberal supplies of stimulants and nourishment. Some surgeons recommend, instead of the application of nitric acid, that the tissues should be freely destroyed with the actual cautery.

Dr. Goldsmith, of the United States, speaks highly of bromine as a local application to arrest the sloughing; and others have recommended carbolic acid, iodine, oil of turpentine, and strong chlorine water with the same object. It frequently happens that more than one application will be required should the patient survive, and the operation should be performed under the influence of an anæsthetic in order to do it thoroughly. T. PICKERING PICK.

HOSPITALISM and HOSPITAL MORTALITY.—For a long time surgeons had been convinced, each one from his individual experience, that the mortality among cases in hospital was excessive as compared with that among patients treated in private. Up to 1870, indeed, many hospitals were almost plague-stricken, especially those of cities; the mortality after all major amputations being 1 in 2–3, and due chiefly to septic disease. The experience of lying-in wards, and of ovariotomies in general hospitals, showed the existence in these of some very fatal influence, for the detection of which the puerperal uterus and the peritoneum seemed to be the most delicate instruments. No attempt, however, was made to reduce to figures the difference in mortality after operations within and without hospital walls until Sir J. Simpson published papers on the subject in 1869.

Before going further, attention should be drawn to the fact that in 1869 small country and cottage hospitals were rare. The frightful mortality above-mentioned was calculated from the statistics of hospitals in the large towns of Great Britain and the Continent, and existed in them only at that time; fortunately such a state of matters is now a thing of the past, and young practitioners know nothing of it.

As the standard of comparison Simpson selected amputations through bones (those through joints being excluded for the sake of simplicity), because their frequent occurrence rendered possible the collection of large numbers of cases both in and out of hospital; the amount of operative skill required put country practitioners and hospital surgeons more on a level in this respect, and the similarity of the causes for which those operations are performed, and of the condition of the subjects of them in hospitals and in the country, justified the comparison of the two series of cases.

From eleven large hospitals in London, Edinburgh, and Glasgow, Simpson collected 2,089 cases of amputation through the bones of the thigh, leg, arm, or forearm; of these, 855 died, giving a mortality of 1 in 2·4 (in each case the statistics included those for 1868 and the preceding years).

Simpson also sent schedules to a large number of practitioners resident in districts where accidents were common, requesting each to record *all* his amputations under headings of 'injury' and 'disease,' in each case noting the number of deaths. The results obtained showed that of 2,098 cases of all kinds, 226 died, or 1 in 9·2.

At least 23 of the cases were double, and of these only 7 died, in 3 of which one thigh, and in 3 both thighs were removed. The mortality even in these cases was only 1 in 3·03. It appeared, further, that of 22 amputations between 70 and 84 years, 8

died, or 1 in 2·7, the mortality being less than that for amputations at all ages in general hospitals. There is every reason to believe that had the operations been done by men of experience, the results would have been better still, for the results of each practitioner improved with the number of amputations performed.

It was evident from the numbers of amputations at different heights, and from remarks appended, that there was no material difference in the severity of cases in the two classes: thus, among the country cases were 313 primary amputations of the thigh, with 80 deaths, or 1 in 3·91; whilst in the hospital list were 304 cases, with 196 deaths, or 1 in 1·57. It is probable, indeed, that the conveyance of these severe injuries to hospitals told considerably against the patients. The remarks showed that many cases included in the country list, and which ultimately did well, were not sent to hospital simply because they appeared so bad that to carry them any distance would have been fatal. Lastly, very few of the amputations in private were done among the upper class of society—8 to 10 per cent. of the whole were done among the middle class, and the vast majority upon artisans, miners, labourers, &c.; so, as regards social position, the two classes are strictly comparable. Much has been made of the probability that the country patients were in ruder health at the time of operation than those admitted into great hospitals; but no inconsiderable proportion of amputations done in London, even, comes from country districts, and feeble constitutions, debauchery, and inattention to domestic hygiene are not unknown in the country. Even in this respect, therefore, the two series of cases do not differ much.

It should be noted that, in the country statistics, Simpson seems to have made all doubtful cases tell against them; e.g. an amputation was said to have done well, but the patient died of phthisis three months later—it was counted as a fatal case.

It may therefore be taken as approximately true that, at the period of which we are speaking, the mortality after amputations for all causes was almost four times as great in large hospitals as in the country. Though no similar comparison of the results of other operations has been made, there is no reason to doubt the truth of the conviction which was widely held, viz. that every patient with an open wound was safer out of hospital than in it, even though he should be placed under circumstances immeasurably inferior as regards surgical skill, nursing, housing, and feeding.

This difference in results led to the belief that certain conditions in hospitals engendered disease, and the word '*hospitalism*' was invented by Simpson to express those peculiarities of hospitals which produced such fatal results. The exact meaning of 'hospitalism' will, however, be found, by comparing the *causes of death* in the two classes, and seeing which produce the excessive mortality in hospitals.

The cause of death was stated in 160 of the 227 fatal private cases; these, at a mortality of 10·8 per cent. among 2,098 patients, correspond to 1,478 patients. In the following table the number of deaths per cent. (calculated upon this number), produced by the chief causes are shown; and, side by side with them, similar results from a series of 200 amputations through bones, with 49 deaths (24·5 per cent.), performed at University College Hospital from 1871 to 1881 inclusive:—

PRIVATE—1,478 cases.

Cause	No. of cases	Per cent.
Shock	63	4·05
Internal injuries	13	0·87
Exhaustion	28	1·89
Pyæmia	8	·54
Septicæmia	0	·00
Tetanus	11	·74
Gangrene of stump	18	1·20
Secondary hæmorrhage	9	·60

UNIVERSITY COLLEGE HOSPITAL—200 cases.

Cause	No. of cases	Per cent.
Shock	10	5·00
Internal injuries	1	0·50
Exhaustion	4	2·00
Pyæmia	12	6·00
Septicæmia	9	4·50
Tetanus	0	0·00
Gangrene of stump	3	1·50
Secondary hæmorrhage	0	·00

Other causes in each series produced 1–2 deaths each.

Erichsen states that the amputation-mortality at University College Hospital has been pretty constantly a little above 25 per cent, and although of late years the mortality from septic disease has been much diminished, from the successful employment of antiseptics, other causes have kept up the mortality almost to the same point. Whilst yielding the same total mortality then, the statistics of University College up to 1868 (could they have been obtained) would have brought out

still more strongly the chief difference between the above tables, viz. the difference in mortality from septic disease. The best way to arrive at this is probably to add together the mortalities from pyæmia, septicæmia, and exhaustion; for under the latter heading were formerly placed many cases of acute and chronic septic disease. The cases which may fairly be entered under the head of exhaustion will balance each other. We thus find that the mortality from septic disease in private is 2·40 per cent., in hospital 12·5; in other words, the mortality from septic disease in University College Hospital during the last 11 years has been 5·14 times greater than it was among private cases 15 to 20 years ago. And this is not putting the case as strongly as it might be put by any means. The general result of the discussion at the Clinical Society in 1874 on 'pyæmia in private practice,' pointed to a similar conclusion; though it is right to state that a few surgeons, and especially Sir J. Paget (who had seen 3 cases of hospital gangrene in private, at different times and apparently not due to infection from hospital cases), expressed their belief that septic disease was not specially common in hospitals.

Causes of Hospitalism. — Why were septic diseases so much commoner in hospitals than in country cottages? What were the differences in the conditions of the two classes of patients? The first is that private patients were treated apart from each other, in cottages which probably never before contained a surgical case, and by men who may not have had another case with an open wound under their care at the time—certainly not a case of infective wound disease, unless it were erysipelas. Next, the almost constant remark concerning the dwellings in which the patients lived was that the ventilation was of the freest, through broken windows, &c.; they were either one- or two-roomed, and by no means remarkable for cleanliness. The conditions were therefore strongly opposed to infection from any case of wound-disease. But simple putrefaction of the discharges probably occurred in every case, and it is more than likely that, in spite of the draughts, many patients suffered at night from simple overcrowding.

On the other hand large hospitals had for generations contained numbers of septic wounds, and many of the sufferers had died of septic disease, so that any virus which such cases could leave behind them would certainly have been left. The wards were often 'close' from simple overcrowding; and at dressing time, if at no other, an odour of putrefaction arose from the wounds. Isolation of existing cases of septic disease, even erysipelas, was not uniformly practised; and disinfection after the death or recovery of such a case was by no means perfect, if attempted. The same surgeons, dressers, and nurses tended the patients, and in passing from one to the other the hands were not cleansed, unless distinctly soiled. Sponges used promiscuously among the patients were ready carriers of infection. Lastly, when septic disease started in hospitals, the conditions giving rise to it often went long undisturbed and unchanged; thus certain beds maintained bad reputations and added considerably more than their share to the general mortality.

Now, assuming that erysipelas, hospital gangrene, septic infection, and many, if not all, cases of pyæmia are mildly infectious, and certainly contagious or inoculable, no conditions can well be imagined more favourable than the above either to the spread or to the preservation of their seeds. Infection and contagion doubtless explain a great deal of the excessive mortality of hospitals; as is shown by the immediate diminution of mortality in lying-in hospitals after insisting that the nurses should wash their hands in carbolic-water after attending to each patient, or upon causing each patient to attend to herself and to use clean wool (which is immediately burnt) instead of sponges.

It is impossible to say exactly how much of the excessive mortality of hospitals is due to simple infection; but it is held by the majority of surgeons that pyæmia, septic infection, and hospital gangrene actually arose with special frequency in hospitals. *The* condition which chiefly favours them is overcrowding of septic wounds. In civil hospitals again and again the best surgeons have noticed that when the amount of suppuration in their wards rose above a certain point, septic disease broke out. Again, the common experience in times of war is that cases admitted into the hospital at first do well; but ten to fourteen days after a battle, when the hospitals have become crowded with wounded, septic disease appears and empties many a bed; and this in churches, barns, and similar buildings which never held a septic case before. As a rider to this, it must be added that where overcrowding is almost impossible—as in the open, in tents or lightly constructed huts—septic disease is slight or absent.

Thus, overcrowding of wounds does seem to exercise a powerful influence in the pro-

duction of septic disease. But wounds are not essential, for overcrowding of typhus patients may cause pyæmia to appear among them. Overcrowding first prevents a free supply of air from acting upon the virus of these diseases, pure air diluting and being apparently destructive of such contagia. Next, it greatly lowers the health of patients, by causing them to breathe air containing excess of carbonic acid, and of organic bodies leaving the body by the respiratory and other channels; and it thus acts as a predisposing cause of septic disease, like all weakening influences. Finally, overcrowding would seem to have its effect upon the development of the viruses of these diseases, by means of something arising from the septic wounds in surgical hospitals.

All recent research tends to show that these diseases are due to the action of locally or generally infective organisms. Koch was able to obtain from putrid fluids organisms which produced in mice diseases similar to the pyæmia, septic infection, and hospital gangrene of man; and, as he worked in Wollstein, where it was impossible to obtain material from septic diseases to experiment with, this would mean that the organisms of these diseases exist almost everywhere, and that they find putrid fluids a suitable nidus. But, as the discharges of all wounds in former times became septic, each wound would have contained the poisons of perhaps all three hospital scourges; nothing but conditions preventing their entry from the wound, or their development after entry in the system, would save the patients from dying of them; and the effect of overcrowding would be limited to destroying these barriers by enfeebling the patient. But this is certainly not its sole effect. It seems most probable, indeed, that the causes of pyæmia, septic infection, and hospital gangrene are more numerous—as are all organisms—in great centres of human activity; but that they have to undergo some change, some increase of virulence perhaps, before they can invade the body and produce these diseases. The aggregation of septic wounds tends strongly in some unknown way to favour this development; but it is not essential to it, the development taking place apparently under other circumstances, though much less commonly. It is, however, impossible to speak with any certainty on this matter until the poisons of the diseases have been isolated and their life-history ascertained.

Prevention of Hospitalism.—Until the etiology of septic disease is cleared up, action must be taken on the hypothesis that, in at least 99 cases out of every 100, disease of this type is due to the invasion of the body by micro-organisms from a septic wound.

The first point to attend to is the prevention of overcrowding. The amount of carbonic acid in the air is taken as the index of impurity, the deleterious organic matter from the lungs varying directly with it. Normally air contains about ·4 of carbonic acid per 1,000 cubic feet. If the quantity rises above ·6 the room gets 'close.' To prevent this, it is calculated — from the average quantity of carbonic acid given off by an adult in an hour—that at least 3,000 feet of air should be supplied per hour for each adult; 3,500 to 4,000 feet will therefore be required for a case with a septic wound. This amount must be supplied without draughts, which can be effected only by giving each bed a cubic space of 1,800 to 2,000 cubic feet, the height being about, but not more than, 12 feet. As much space as possible between the beds should be given. Provision must be made for the removal of stale and the supply of fresh air at the stated rate, open windows and cross ventilation being used as much as possible.

Whenever it can be managed, a ward should be emptied and thoroughly cleaned and ventilated for a week after three months' use.

The clothes of patients should not be placed, in their frequently filthy condition, beneath the beds.

Secondly, with regard to wounds, these should be rendered and kept aseptic wherever possible. When this is impossible, no discharge should be allowed to accumulate and decompose in the wound, but it should be drained off and immediately disinfected by the dressing. No one should pass from one case to another without purifying his hands with an antiseptic solution—mercuric chloride, 1 per 1,000, being the best.

Foul cases—e.g. large ulcers, moist gangrene, incontinence of urine or fæces—should not be admitted to the general surgical wards.

Thirdly, should a case of septic disease occur, it should be isolated as soon as recognised, together with bed, bedding, and all belongings; and the ward round about well washed with bichloride of mercury solution (1 in 500) or carbolic lotion. This is especially necessary with erysipelas and hospital gangrene. No communication should take place between the attendants

upon ordinary and upon septic cases. The freest ventilation should be provided in the infectious ward.

Upon the recovery or death of the patient, the straw of the mattress should be burnt and the rest of the bedding disinfected thoroughly. The iron bedstead should be taken to pieces and well washed with carbolic or mercuric lotion. If the patient returns to the ward he should first have a bath containing carbolic acid (1 in 40), or bichloride of mercury (1 in 1,000).

None of these precautions should be neglected, but least of all the prevention of putrefaction in wounds, this being so favourable to the development of the organisms of septic disease. Every hospital now-a-days shows the results of antiseptics, though 'Listerism' may not be practised. No more striking example can be given than that offered by Lister himself when introducing the subject. The male accident wards of the Glasgow Infirmary were decimated by septic disease, the surroundings of the hospital being truly awful (*Lancet*, Jan. 1, 1870, p. 6). The mortality among Lister's own amputations was 1 in 2·2; after the introduction of antiseptics it fell to 1 in 6·6 (3 years' experience.) During this time two died of pyæmia, in one of which the disease was contracted before amputation, and in the other the dressing became septic. Here there was absolutely no other change, and the cases were treated by the same hand. Other hospitals, especially some German ones, tell the same story; so that now we have much less use for the word 'hospitalism.'

STANLEY BOYD.

HOUSEMAID'S KNEE. *See* BURSÆ, Affections of.

HOWSE'S SPLINT for excision of the knee is a metal splint roughly resembling McIntyre's splint, but the thigh and leg pieces do not reach so near to the knee, and instead of the hinge behind the joint there is a rigid metal bar about two inches wide. At the distal extremity of the splint there is a pulley which revolves transversely; the limb is suspended from this pulley, which allows rotation of the limb when the patient shifts his position, and so protects the knee from jarring. The limb is fixed to the splint by waxed bandages, and the intervals between the limb and the splint are packed with cotton wool soaked in melted wax and paraffin, which prevents the discharges trickling between the limb and the splint.

BILTON POLLARD.

HUMERUS, Dislocations of the. *See* SHOULDER, Dislocations of the.

HUMERUS, Fractures of the.—Fractures of this bone fall into three groups—(*a*) those of the upper end, (*b*) of the shaft, (*c*) of the lower end. In group (*a*) are fracture through the anatomical neck: splitting off of the greater tuberosity: separation of the epiphysis (a block including the head and the two tuberosities): and, a little lower down, fracture through the surgical neck. These injuries are generally the result of a fall on the shoulder or other direct violence, though they are occasionally produced by falls on the elbow or hand.

Fracture exactly in the line of *the anatomical neck*, if complete, would isolate the head, and might be expected to lead to its necrosis. Such a result, however, in simple fracture, has not been observed, either because separation has not been absolute, or because some of the capsule has remained attached to the upper fragment, and has sufficed to maintain its nutrition. This fracture is often impacted. In some cases the upper fragment is more or less rotated, and has even been found turned round, so that its cartilaginous surface presented towards the shaft, in the cancellous tissue of which it was firmly embedded; or the head may even be driven out through the capsule into the axilla. Exact diagnosis, especially if swelling is great, may be impossible. There may be crepitus, with absence of the signs of fracture in other parts, and loss of free movement between the smooth surfaces of the joint. Occasionally the head is felt not moving with the shaft when the arm is rotated, or the upper end of the bone feels abnormally wide. In impacted fracture there is slight shortening, slight flattening of the shoulder; the smooth movements of the head in the glenoid cavity are not felt; the upper end of the shaft is slightly drawn up towards the acromion.

Fracture of the greater tuberosity has several times been verified by dissection; but the injury is almost invariably associated with dislocation of the humerus beneath the coracoid process. Some, however, maintain that it occurs alone, either from direct violence or from the sudden action of the muscles inserted into this process. For its treatment (after reduction of the dislocation of the head, should this be present), nothing would be required beyond keeping the arm at rest by the side.

Separation of the epiphysis is not met with after the age of about twenty. When it

occurs, the head is felt in the glenoid cavity, but it does not rotate with the rest of the bone. The upper end of the shaft is drawn inwards and upwards beneath the coracoid, where its smooth outline, contrasting with the jagged shape of an ordinary fracture, can be felt. The elbow is slightly withdrawn from the side, and pointed slightly backward.

Fracture of the surgical neck is much more frequent than the injuries already mentioned. Its seat may be at any point between the tuberosities and the insertion of the teres major, a space of about two inches. It is generally transverse, and not rarely impacted, the shaft being driven into the upper fragment. The upper fragment is often rotated through a quarter of a circle, or more, by the muscles inserted into and acting with great leverage upon it; the shaft is drawn, by the muscles attached to it, inwards towards the axilla, where its small irregular end, quite unlike the head, may be detected. There may be shortening, but this is seldom marked; there is flattening of the shoulder; the head does not rotate with the shaft unless there is impaction; and crepitus is detected when the ends are brought into contact.

Treatment.—If there is impaction, care should be taken not to break the connection between the fragments. A pad must be placed in the axilla, and the arm, hanging down, must be bandaged to the side, the forearm lying across the chest. When there is no impaction there is great difficulty alike in adjusting the fragments and in maintaining them in position, the more so because swelling is often considerable. Reduction here, as in separation of the epiphysis, may sometimes be effected by carrying the limb perpendicularly over the head, and manipulating the fragments in this position, and then bringing down the arm while extension is steadily continued. After reduction a pad is placed in the armpit, and a splint of leather or gutta-percha is moulded over the shoulder and arm; towards this splint the upper end of the lower fragment is drawn—that is, outwards—by a carefully applied bandage. The elbow is then bandaged closely to the side, so as to throw the upper end of the lower fragment still further outward. Or, as Erichsen suggests, a piece of leather, two feet long and six inches broad, may be bent at its middle and applied, the one half to the chest, the other to the inner aspect of the arm; the rounded bend, which must be carefully padded, being well pressed up into the axilla. The elbow is then bandaged to the side.

Fracture of the surgical neck is sometimes associated with *dislocation of the head* of the bone into the axilla, or forwards under the coracoid process. This injury is easily mistaken for ordinary dislocation. But on careful examination the following symptoms will be detected:—The shoulder is flattened, and a hollow beneath the acromion shows that the head has left the glenoid cavity; the head is felt in its abnormal situation; no movement, however, is communicated to it when the shaft is rotated; the width of the shoulder from before backwards is increased; the arm is shortened, and the upper end of the shaft may sometimes be felt as a rough projection beneath the deltoid. Crepitus may perhaps be detected when the arm is extended and rotated.

Treatment.—An anæsthetic should be given, and, if possible, the head should be replaced in the glenoid cavity by extension and manipulation. The fracture should then be put up in the manner described above. In several recorded cases reduction has been easily effected. Should the attempt, however, fail, the shaft may be pushed up into the glenoid cavity to form a false joint. Or the fracture may be put up with the head unreduced, and when union has taken place an attempt at reduction may be made. This, however, is very little likely to succeed, and all that is possible will be to break down adhesions, and restore some degree of movement, as in an ordinary case of unreduced dislocation. In such instances it is best to give the patient a written statement of the nature of his injury, so that his case may not subsequently be mistaken for an uncomplicated dislocation, and be treated from that point of view.

Fracture of the shaft is more frequent in the lower than the upper half. It is due either to direct violence; to falls on the hand or elbow; or (and this more often than in any other bone except the patella) to muscular violence. The fracture is generally oblique, in a direction downwards and outwards, but not rarely it is transverse. The *symptoms* are plain: loss of power, mobility when the two fragments are separately grasped, and crepitus. In oblique fractures overlapping may be considerable. The deltoid, in fractures below its insertion, may cause troublesome displacement by tilting the upper fragment outwards. Ununited fracture is much more common in the shaft of the humerus than in any other of the long bones.

Treatment.—After adjustment has been effected, four splints of appropriate length,

and wide enough in the aggregate to exactly enclose the limb, are applied so as to surround it, and are fixed by broad pieces of strapping and a bandage. The forearm, placed at a right angle, should be securely bandaged across the chest. Some surgeons use a rectangular splint, extending along the inner aspect of the arm and forearm, with three short accessory splints for the purpose of defending the fracture from disturbance by movements of the forearm, which they regard as the chief cause of non-union. Extension (in order to prevent shortening) has been attempted in various ways, among others by applying weight-extension (in the usual manner), but with no very satisfactory result. Union should be firm in from thirty days in the young, to forty or forty-five in older persons, and it must be carefully tested before the splints are discarded. The arm is useful even where union takes place with considerable deformity. The large vessels generally, but not always, escape injury. Paralysis may occur from pressure on the nerves, especially the musculo-spiral, resulting from exuberant callus. *See* NERVES, Injuries of.

Fractures of the lower end are divided into those which are external to, and those which involve the joint—an important distinction in respect to the future utility of the limb. The first group comprises transverse fracture just above the condyles; separation of the epiphysial block; and detachment of either of the condyles. The second group includes T-fracture, consisting of a transverse break just above the condyles, accompanied by a vertical fissure separating the two condyles from each other; and an oblique fracture, detaching a fragment of variable size, composed of one or other of the condyles, and a corresponding portion of the articular surface. All these injuries are much more common in the young than in adults, while separation of the epiphysis does not occur after about the eighteenth year. They are apt, particularly those which directly involve the joint, to be followed by impairment of movement in the limb, a fact of which it is best that parents, at the outset, should be informed. They are usually produced by falls on the elbow, or, more rarely, on the hand.

Fracture across the bone, just above the condyles, may be directly transverse; but it is generally oblique, the line passing upwards and backwards. Occasionally it runs upwards and forwards. The appearances caused by this injury are very similar at first sight to those of dislocation of the bones of the forearm backwards, and the likeness is still more deceptive when the latter accident is combined with fracture of the coronoid process of the ulna. The olecranon projects backwards under the action of the triceps, and the tendon of this muscle stands out in strong relief; the forearm looks shortened, and the lower end of the humerus is prominent anteriorly. A correct diagnosis, however, is easily arrived at. In dislocation the humerus is found to be entire, the two condyles lying, as they should, in the long axis of the shaft, while the olecranon has been separated from them and carried backwards. In fracture of the humerus the condyles are parted from the shaft, and have followed the olecranon backwards. In dislocation there is limitation of mobility, the soft structures are tense, and some force is required to effect reduction, but when this has once been effected it is permanent; while in fracture of the humerus the parts are less fixed and less tense, and reduction is very easily effected, but deformity returns when extension is withdrawn. The same recurrence of deformity is observed when the coronoid process is detached, but the condyles of the humerus are found in their normal relation to the shaft.

Treatment. — In transverse fracture above the condyles reduction is easily effected by drawing the radius and ulna forwards, while the shaft of the humerus is steadied by an assistant. A firm gutta-percha or leather splint, bent to a right angle, is then moulded to the whole length of the posterior aspect of the arm, elbow, and forearm as far as the wrist; and a well-padded short splint is applied to the front of the arm to prevent projection of the upper fragment forward. These are secured by wide pieces of strapping and a bandage. When, as is often the case, there is considerable swelling, the limb must be placed in an elevated position on a pillow, and evaporating lotion used until the appliance referred to can be borne; in the meantime, if there is any marked tendency to displacement, the limb should be secured by light bandaging on an inside rectangular splint. In three weeks, the lower end of the humerus being firmly held, gentle passive movement of the elbow should be employed. The splints may be discarded in from three weeks to a month in young subjects; in adults they should be continued for five weeks.

Separation of the epiphysis must be treated in a similar manner. Displacement

is usually slight, and the fragments are easily kept in place by the splints mentioned above. Gentle passive movement should be practised at the end of a fortnight. The tip of the internal condyle is sometimes knocked off by a fall on the elbow, or detached by the action of the muscles arising from it. The fragment can generally be felt to be displaced, and can be moved when grasped. Crepitus may sometimes be detected, and there is pain when the patient attempts to flex the forearm. The separated piece may, in some cases, be maintained in place with strapping and a pad; but even if this cannot be done, ligamentous union occurs, and no impairment of the arm is likely to remain.

Fractures of the lower end of the humerus, entering the elbow-joint, are always serious. It is difficult alike to adjust the fragments and to keep them in position. The contour of the articular surfaces is apt to be permanently changed; and the inflammation which follows the injury leads not only to the formation of articular adhesions, but to the production of a large amount of callus, by which the movements of the joint are in great part or entirely prevented. Usually considerable swelling follows quickly on the accident, and interferes both with exact diagnosis and with the necessary treatment.

In T fracture all these drawbacks present themselves. Not only is there displacement backwards, but the olecranon is apt to be wedged up into the line of fracture between the two condyles, with the result of spreading them from each other and increasing the transverse diameter of the joint. This relation of the fragments to each other it may not be possible to correct, while, especially in young subjects, the callus thrown out from the broken surfaces and the surrounding soft parts converts the lower end of the humerus into a shapeless mass, against which the radius and ulna become firmly locked. At once, or as soon as swelling has sufficiently subsided under the influence of position, rest, and cold lotions, adjustment must, as far as is possible, be accomplished, an anæsthetic being, if necessary, used. To facilitate reduction, the forearm, bent at a right angle with the arm, should be pressed downwards for the purpose of disengaging the ulna from between the fragments, which must then be manipulated in whatever direction is indicated by their displacement. The joint should be placed at a right angle, not only to relieve tension, but in view of the stiffness which is likely to ensue. The most convenient splints are those recommended above for transverse fractures above the condyle; but a rectangular inside splint for the arm and forearm may be used. Any improvement in the position of the fragments that may be possible must be secured by further modelling; but little in this direction can be done after about the twelfth day. Passive movements should be commenced, in children, not later than the twentieth, in adults not later than the thirtieth day, and be regularly continued as long as they are found to increase the range of motion in the joint; but the condition of the fragments, as to their firm union, must first be carefully observed. In some cases movement may be improved at a later period, and when some of the callus has been absorbed, by breaking down adhesions under an anæsthetic; but no great force ought to be employed. Should the joint have become fixed at an inconveniently obtuse angle, there is no objection, if it can be done without much violence, to bending it up to within a right angle. For the diagnosis and treatment of oblique fracture of either of the condyles extending into the joint, the rules, modified according to particular cases, are the same as those just stated for T fractures. Howard Marsh.

HYDATIDS.—In considering this subject from a surgical point of view, attention will be chiefly directed to symptoms, diagnosis, and treatment. It may, however, be well at the onset to briefly recall to mind some of the main features of the pathology.

The formation of an hydatid results from the ingestion of the eggs of the tænia echinococcus—a tape-worm found in the upper small intestine of the dog. The embryo, when liberated in the human stomach by the disintegration of its egg-shell, bores into or through the gastric walls. In the majority of cases it then enters the blood-vessels and is carried by the blood-stream to the various organs and vascular tissues of the body, not one of which is exempt from its invasion. The organ most frequently attacked is the liver; possibly, as Dr. Thomas suggests, because the hepatic capillaries are the first to arrest the onward progress of the embryo. Should it run the gauntlet of these, the pulmonary capillaries act as the obstruction, and consequently the next most frequent seat of the disease is in the lungs. In a fully-formed hydatid three layers may be described as composing the cyst-wall. The outermost layer, called the adventitia, is tough, fibroid, and very vascular. It is not, however, a part of the true hydatid, but is

formed of the tissue in which the parasite lies. The minute embryo acts as an irritant, and induces proliferation of the cells of the surrounding connective tissue; as it enlarges, the cells are subjected to pressure, and become arranged round it as a capsule. Blood-vessels from the adjoining healthy tissues enter this capsule, which is thus gradually organised into a fibrous membrane. This adventitious layer varies in thickness according to the amount of initial irritation and the position of the hydatid; in some structures it would appear never to be formed at all. Thus, Professor Allen, of Melbourne, has reported several cases of hydatids in serous cavities perfectly devoid of adventitia. It is, however, usually present, and is always very vascular. The vessels on its smooth, inner surface are dilated and varicose—a fact to be constantly borne in mind by the surgeon.

Within the adventitia, and in close contact with it, is the true hydatid sac. It has a greyish, gelatinous appearance; it is translucent and highly elastic. When punctured, the contained fluid is evacuated under considerable pressure, and the cyst collapses, falling in folds from the adventitia with a peculiar tremulous movement.

The outermost layer of the *true cyst* (ectocyst of Huxley) is tough, thick, highly elastic, and laminated. The inner layer (endocyst or germinal membrane) is thin, delicate, and cellular. The contained fluid, when healthy, is limpid and transparent, and has a peculiar faint and earthy odour. It is neutral or alkaline in reaction, and of low specific gravity, 1005–1013; it contains an excess of chloride of sodium, but no albumen. Some small hydatids consist merely of the cyst filled with this fluid; such are called acephalocysts. In most cysts, however, and certainly in large ones, echinococcus heads or scolices are to be found. Small cysts, termed 'daughter cysts,' are sometimes formed within the main cyst, and these in turn may contain 'granddaughter cysts,' resulting in what is known as the 'pill-box' hydatid.

Symptoms and Diagnosis.—When an hydatid is sufficiently near the surface of the body to be recognised, it appears as a painless swelling, slowly increasing in size, but giving rise to no inconvenience except by reason of its bulk. Occasionally, as a result of pressure on neighbouring structures, or of changes in the cyst, certain symptoms may arise. Thus severe gastralgia, attended with attacks of syncope, has been noticed in cases where a large cyst projected from the under surface of the left lobe of the liver, and possibly pressed on some neighbouring sympathetic plexus. Vomiting and other dyspeptic symptoms may be the result of direct pressure on the stomach. The cyst may be even so large as to encroach upon the thorax and impede respiration. Jaundice, ascites, and anasarca may be induced by pressure on the hepatic duct, vena portæ, and vena cava respectively. When in the lung the presence of the cyst may excite cough, dyspnœa, and hæmoptysis. Again, a cyst may inflame and suppurate, and so become practically an abscess, and be attended by constitutional symptoms. Finally, a cyst may be ruptured by external violence. Such a rupture into the peritoneal cavity is attended with agonising pain and intense collapse; the case probably ending fatally. In the lung the rupture is less dangerous, the cyst or cysts being coughed up, although suffocation is not uncommon from the glottis being firmly plugged in the patient's effort to expel the cyst. Even in cases where the cysts have been successfully expectorated, recovery is often slow, as a more or less severe broncho-pneumonia is apt to supervene.

Physical Signs.—The sensation imparted to the fingers of an expert manipulator by palpation of an hydatid tumour is characteristic, and is often an infallible guide to diagnosis. The tumour presents a smooth, uniform, rounded contour; it is elastic and tense, and not at all tender. Fluctuation may generally be obtained. Percussion elicits a clearly defined area of absolute dulness, and in some cases also the peculiar and characteristic thrill known as hydatid fremitus. This is felt in large cysts filled with daughter-cysts, and is probably produced by the concussion of these with each other.

With regard to the differential diagnosis of hydatids, so much depends upon the situation of the tumour that it would be impossible here to enter into special details. Hydatids in the abdominal cavity may be confounded with hepatic abscess, a dilated gall-bladder, malignant growths, renal cysts, uterine and omental tumours, or aneurism. With all these conditions there is either constitutional disturbance or some special symptom which is never present in hydatids. Hypertrophy of the spleen and hydatid of that organ are sometimes mistaken for each other; but the tough, unyielding feel, and the detection of the splenic notch, especially if the condition be associated with anæmia and dropsy, will help to distinguish the former from the tense, elastic, and even hydatid cyst. From an ovarian monocyst the diagnosis of a very large, thin-walled

hydatid is not always easy, as there are many characters in common. Attention to the mode of growth—the ovarian from the flank displacing the intestines upwards, whilst the hydatid generally pushes its way from above downwards—may be of service. The careful examination of the fluid obtained by exploratory puncture should be decisive. Hydatids in the lungs may be confounded with phthisis, pleuritic effusion, localised empyæma, and malignant growths. These, again, are usually distinguished by constitutional symptoms. Dr. Bird, in his work on *Hydatids in the Lung*, enters fully into this matter.

Treatment.—Various drugs, such as iodide of potassium, tincture of kamala, and turpentine, have from time to time been recommended as capable of arresting the progress of an hydatid growth or of killing the parasite; electrolysis, also, has been much lauded. The success of these remedies, however, appears to be equivocal; the curative treatment of hydatids is to be regarded as a purely surgical matter.

The disease sometimes undergoes natural cure. The hydatid itself is non-vascular, and derives its nourishment by a process of imbibition from the vessels of the adventitia; this may undergo contraction, and the calibre of its blood-vessels is diminished to such an extent that the hydatid dies from gradual starvation. The adventitia goes on contracting, and sometimes becomes cartilaginous, or even calcareous in places.

Occasionally the daughter-cysts proliferate to such an extent, and become so tightly packed inside the parent cyst, that they are, so to speak, crushed to death. They then degenerate, become opaque, and fuse into a solid mass, which may caseate. These processes, however, are so slow that the life of the hydatid is as a rule longer than that of the patient. The treatment of an ordinary hydatid of moderate size, when possessed of an adventitia, and situated in the substance of an organ such as the liver, spleen, or lung, consists in tapping the tumour with a long, fine syphon-trocar; the fluid is drawn off, and the canula is removed when the cyst is nearly emptied. The result of this procedure is that the hydatid cyst collapses and falls away from the adventitia, and serum exudes from vessels to fill the space thus formed. This fluid is usually absorbed in a few days, and the adventitia then gradually contracts. The cyst may or may not undergo degeneration. The writer, when examining the bodies of persons who had died from other causes, years after being tapped for hydatids, has found cysts almost unchanged, lying simply folded up inside a cavity, and still remaining within the adventitia.

The simple operation described above is, as a rule, free from danger; now and then, however, alarming symptoms supervene. A few precautions are necessary to diminish the risk of their occurrence:—the trocar used should always be a clean and long one, with an accurately-fitting canula; the cyst may be much deeper than the surgeon thinks, and, if the trocar be long enough only just to reach the sac, it may push the adventitia away from surrounding tissue, and so entail an extravasation of hydatid fluid and blood. Some surgeons prefer to use the aspirator; but this involves the risk of exhausting the receiver to such an extent that the dilated vessels of the adventitia may be ruptured, and a dangerous and even fatal hæmorrhage may follow. In tapping a pulmonary hydatid the course of the large bronchi should, as far as possible, be avoided; this is best done by introducing the trocar at the side of the thorax midway between the sternum and spine, and keeping it as nearly as possible parallel with the direction of the main bronchi. The simple introduction of a trocar deeply in the epigastrium has at times been followed by intense shock and collapse lasting for days, probably from some injury to the solar plexus. Slight febrile disturbance occasionally follows the tapping; and, when the operation is performed on an abdominal hydatid, a mild attack of urticaria, known as the 'hydatid rash,' may supervene. This is the result of the extravasation of a little fluid into the large serous cavity; the rash generally subsides on the second day. Occasionally it is necessary to tap two or three times before the parasite succumbs. Inflammation and suppuration of the cyst may follow the operation; they must be met by active treatment. Cases of hydatids in the pleural cavity require careful watching after tapping. Should the temperature rise and the area of dulness suddenly increase, a free incision must be made into the cavity, and thorough drainage established until all cysts and débris are evacuated.

When a cyst has very thin walls, and is freely movable in the abdominal cavity, tapping may prove a dangerous procedure. In these cases there is a probability of the adventitia not being properly formed, and when tapped the fluid is not only liable to be extravasated into the peritoneal cavity, but the collapsed cyst itself may die from malnutrition, and determine a fatal peritonitis.

The plan of treatment the writer has found most successful in these cases is to secure adhesion between the visceral and parietal layers of the peritoneum prior to tapping. This is accomplished by inserting about a dozen harelip pins, with flat heads, through the abdominal parietes into the tumour in a circle round the site of puncture, and then carefully supporting the abdominal walls with strapping or a bandage. At the expiration of from eight to ten hours these pins are removed, the tumour tapped with a fine syphon-trocar and canula, the patient being kept at rest in bed for some days subsequently.

When the cyst is very large adhesions may exist, and the tumour can then be tapped in the ordinary way. But this simple treatment will seldom be successful in such cases, especially if daughter-cysts be present; the sac will require free incision and drainage. This is best performed as follows:—A suitable site for tapping having been selected, adhesion is obtained between the opposed serous surfaces by the use of harelip pins in the manner already described. Then an incision of an inch or more in length is made through the skin, and a full-sized trocar, such as is used in veterinary surgery, is plunged into the tumour, the canula being left in and secured with tapes. The fluid, cysts, and débris are allowed to flow away, and the cavity is washed out twice a day with a tepid antiseptic solution. On the third day the canula is removed and a large india-rubber tube is inserted in its place.

The opening thus made is gradually dilated until the finger—which is by far the best kind of probe—can be easily introduced into the cavity. By this method daughter-cysts, and in some instances even the mother-cyst, may be removed. A very convenient aid is a light steel hook attached by a spring to the pulp of the index finger. These cases are often tedious, the suppuration being sometimes profuse before the mother-cyst and débris have entirely come away. The patient's strength requires support by nourishing and easily-digested food and by fresh air. In the end these cases usually do well.

When a cyst is very large, and movable in the abdominal cavity, possessing but few adhesions and appearing to contain many daughter-cysts, the safest mode of treatment consists in the entire removal of the whole tumour by abdominal section. This operation is generally a complete success. A suppurating hydatid must be treated like an ordinary abscess. Adhesions will generally exist, but if not they must be established, and then the cavity may be freely opened and drained.

When an hydatid in the substance of the liver has been treated by drainage, a biliary fistula is occasionally established which it is difficult to close. The writer in such cases has had good results from the use of the galvanic cautery, a coil of platinum wire, properly insulated, being introduced into the fistulous track.

To sum up, the surgical operations required for the cure of hydatids are four in number, and may be classified thus:—

I. For moderate-sized cysts in solid organs, the minor operation of simple tapping with a fine syphon-trocar.

II. For movable cysts with thin walls, the medium operation of establishing adhesions, drawing off the fluid, and removing the canula.

III. For very large adherent cysts filled with daughter-cysts, the major operation of establishing adhesions at the site of tapping, using a large trocar, washing out the cavity and draining it.

IV. In large movable cysts with partially solid contents—i.e. containing daughter-cysts, and with but few adhesions—the operation of abdominal section and removal of the cyst or cysts entire.

T. Naghten FitzGerald.

HYDRARTHROSIS.—An effusion of fluid into the synovial cavity of a joint, unattended by symptoms of inflammation.

This condition, met with chiefly in the knee, may either result from a previous subacute inflammation, or may from the first be of a passive and indolent character. Usually at the commencement of even the most chronic cases there is slight increase of the temperature of the affected joint; but there is no pyrexia, and pain is absent or very slight. The joint is distended to a degree which makes manifest the reflexions of the synovial membrane; fluctuation can be felt across its cavity, the ligaments are stretched, and there is a feeling of weakness and instability. The contained fluid is of pale yellow colour, slightly turbid, and highly albuminous.

This affection is sometimes the commencement of the joint-disease associated with locomotor ataxy. *See* Charcot's Disease.

The *treatment* will consist of immobilisation, counter-irritation, and pressure.

The limb being placed upon a splint, the joint should be repeatedly blistered. When the fluid has been thus considerably reduced,

a layer of cotton-wool should be placed over the joint and an elastic bandage applied; or the joint may be strapped over lint spread with camphorated mercurial ointment.

If, in spite of such measures, the effusion persists, the joint is to be emptied by aspiration, with antiseptic precautions, after which elastic pressure is to be maintained; and, should this fail, the aspiration must be repeated, with the addition of an intra-articular injection. The fluid injected must be aseptic and mildly stimulant. A 1 per cent. watery solution of carbolic acid, or a mixture of tincture of iodine and water (1 in 10), are appropriate injections, though stronger solutions than these are sometimes necessary. The injected fluid having been brought into contact with every part of the synovial cavity, is then withdrawn, the puncture closed, and the joint covered with a layer of cotton-wool and a bandage. The injection is usually followed by a slight inflammation and swelling of the joint, which subsides without treatment, and leaves the synovial membrane with less tendency to excessive secretion.

This treatment is, however, not unattended with danger, from the too great acuteness of the resulting inflammation, and should only be used in otherwise healthy persons. When the use of the joint is resumed support must be given by an elastic bandage.

J. Warrington Haward.

HYDROCELE.—It will be convenient to consider the varieties of hydrocele in accordance with the following classification, and in the following order:—

(1) Acute vaginal hydrocele; (2) Chronic vaginal hydrocele; (3) Congenital hydrocele; (4) Infantile hydrocele; (5) Encysted hydrocele of the testis; (6) Encysted hydrocele of the cord; (7) Diffuse hydrocele of the cord; (8) Inguinal hydrocele; (9) Hydrocele of a hernial sac.

1. Acute Vaginal Hydrocele or acute inflammation of the tunica vaginalis with effusion.

Causes.—The most frequent cause is acute epididymitis, for, owing to the absence of any tough fibrous or other membrane between the epididymis and the subserous tissue of the tunica vaginalis, inflammation very readily and frequently extends from the one to the other. It may be excited by direct injury to the part by blows, squeezes, &c.; by injection of irritating solutions thrown into the serous sac for the cure of a chronic hydrocele; and the use of a dirty trocar and canula in tapping a hydrocele may be followed by acute hydrocele.

Pathology.—The pathological changes resemble those in acute inflammation of other serous membranes. There is considerable engorgement of the veins in the subserous connective tissue, with œdema, which may extend to the superficial structures of the scrotum. The surface epithelium proliferates rapidly, and parts of it become shed in the form of shreddy flakes, and lymph may coat its surface in flakes or in soft, yellow, butter-like masses. The fluid effused into the sac is turbid and very richly albuminous; it is generally in small quantity only. The effusion may become chronic, or, on the other hand, when the inflammation is very acute and not speedily allayed, it may become purulent. Slight or extensive adhesions between the two serous surfaces may be left behind.

Symptoms and Diagnosis.—As most often met with, it causes a moderate, elastic, and fluctuating swelling of the scrotum in front of the inflamed epididymis. The skin over this swelling is reddened and often œdematous. When occurring primarily, there is a moderate globular enlargement of the scrotum, with redness and œdema of the skin and deep fluctuation; the pain and tenderness are not so severe as in inflammation of the testicle, and the cord is not thickened. As, however, the inflammation tends to spread to and affect the epididymis, these distinctions are not often to be observed. The diagnosis rests, therefore, upon detecting an acute inflammatory and fluctuating swelling over the front of the testicle. Should the superficial œdema increase, the swelling 'point,' and the patient experience a rigor or rigors with increased fever, the diagnosis of suppuration in the tunica vaginalis, or pyocele, may be made.

Treatment.—When it is secondary to epididymitis, the treatment of the latter meets the indications. *See* Testis, Diseases of the. When primary, the patient should be confined to bed, with the scrotum raised upon a cushion between the thighs, or a broad strip of plaster stretched across between the thighs; and hot belladonna fomentations should be applied. The bowels, if necessary, are to be cleared by a purge, and the diet should be light and mainly fluid. Tapping should not be performed. Should suppuration occur, the surgeon must at once lay the tunica vaginalis freely open and wash out the cavity with some antiseptic lotion, allowing the wound to heal by granulation.

2. Chronic Vaginal Hydrocele.—*Causes.*—Chronic hydrocele is sometimes secondary to inflammatory and other enlargements of the testicle, such a condition being known as hydro-sarcocele. If we exclude these cases, little is known of the causes of this very common affection. Its frequency in infancy and about middle life suggests that it may be connected with the structural and functional changes occurring at these periods; and when, as sometimes happens, it is seen in several members of one family, an hereditary influence may be inferred. In some cases repeated strains and local injuries appear to occasion the disease, and it has been alleged that hydrocele is especially common in those who are, or have been, the subjects of diseases of the urethra or prostate. In rare instances small loose bodies are found in the tunica vaginalis and are believed to be the cause of hydrocele. The great frequency of the disease in tropical climates supports the view of a malarial origin, and its common association with elephantiasis scroti, when this disease is met with, suggests some etiological factor common to the two. An enfeebled circulation, chronic visceral disease, the dependent position of the scrotum, and relaxation of the dartos, are other alleged causes of hydrocele.

Pathology.—Two views are held as to the nature of chronic hydrocele; by some it is regarded as a 'dropsy,' and by others as an 'inflammatory effusion.' In the author's opinion the evidence appears to support the latter view. The disease occurs about equally on the two sides, and is as often double as single. When double, the effusion is generally later and also less in amount on one side than the other. In children, hydrocele is most common on the right side. The common case is for the tunica vaginalis to be distended into a pyriform or ovoid sac, across which slender adhesions may occasionally be found stretching. But the cavity may be sacculated, and of this three varieties have been noticed. Broad bands of adhesions may divide the cavity into closed or intercommunicating cavities. A pouch is sometimes found extending between the epididymis and the body of the testicle, opening into the general sac on the outer side; this may be regarded as a deepening of the normal digital fossa. The rarest form is that in which a hernial protrusion is found extending outwards into the dartos, this variety being caused by a distension of one of the very delicate, finger-like processes which normally project from the parietal layer of the tunica vaginalis. The serous membrane may remain unaltered in structure even in large and old hydroceles, but more generally its deeper layers are thickened by the addition of newly-formed fibrous tissue, and in some long-standing cases this tissue may attain a cartilaginous consistence, or may become calcified, the lime-salts being deposited in plates or thicker masses. This thickening of the membrane is found to extend over the epididymis, but to a much smaller extent, if at all, over the body of the testicle.

The fluid varies in quantity up to several pints, as much as six quarts having been withdrawn from the historian Gibbon. In adults the average quantity is from six to sixteen ounces. The fluid is of a bright straw colour, sometimes deeper in tint, at others having a greenish hue, and from the admixture of blood (hydro-hæmatocele) it may be rendered opaque and dark. Its specific gravity is about 1024; in reaction it is slightly alkaline. It contains a large amount of fibrinogen, but no fibrin-ferment, and does not coagulate spontaneously unless blood or some other source of the ferment is added to it. A small amount of fatty matter is normally present, and also cholesterine in larger quantity than in any dropsical effusion. Succinic acid is also stated to be present. Fine flakes of lymph, cholesterine crystals, and epithelial cells or shreds may be found under the microscope; and very rarely, larger solid bodies or thick-walled cysts may be found loose in the vaginal sac, these probably being detached hydatids of Morgagni. The fluid may be altered in appearance by the presence of an unusual quantity of cholesterine in the form of sparkling crystals, and, in some cases, the tunica vaginalis has been found filled with a soft solid mass of this substance.

A much rarer condition is the admixture of finely-divided fat, in such quantity as to impart a milky look to the fluid, which retains its turbidity on standing. Where there is a combination of encysted hydrocele of the testis with vaginal hydrocele, the former may rupture into the latter, and, in that case, the fluid may have an opalescent or milky appearance from the admixture of semen; on standing, an opalescent sediment falls, leaving the supernatant fluid clear. The testicle is usually found at the lower and back part of the sac, but when that organ is inverted, it lies at the lower and anterior part; the testicle may be fixed in some unusual position by adhesions. When the

quantity of fluid is large the organ is flattened out, and, in old cases, may scarcely project at all into the cavity. As a rule its function is not interfered with, but occasionally the organ is found anæmic and atrophied, and then it probably fails to secrete spermatozoa. The constituents of the spermatic cord are sometimes separated and spread out by the pressure of the fluid in the vaginal sac. The tissues of the scrotum over a hydrocele in time become more or less matted together, and the muscular bundles of the cremaster are hypertrophied, with hyperplasia of the connective tissue making up the cremasteric fascia. In very large tumours of long standing this muscle is apt to atrophy.

Symptoms and Diagnosis.—The main symptom of chronic vaginal hydrocele is the scrotal swelling which it occasions; this leads to a sense of weight in the groin which the patient endeavours to relieve by wearing some form of suspensory bandage; when of large size the swelling impedes free motion, and forms an unsightly prominence difficult or impossible to conceal. A more serious effect is that it renders the part liable to injury, and, owing to the distension of the vaginal sac, the force of contusions is transmitted directly to the testicle, and in this way hæmatocele may be superadded. As the scrotum becomes distended, the skin of the penis is gradually drawn over the swelling, and the penis proper is lost in the scrotum, the glans being at the bottom of an umbilicus-like depression. This is generally a source of much annoyance to the patient, and the trickling of urine over the scrotum may excoriate the part. It is often noticed that the swelling is larger at night than in the morning. When the effusion accumulates with unusual rapidity, or the sac is very tense, or when the part has been contused, or the testicle is inflamed, or blood has been effused into the vaginal sac, the patient may experience acute pain. All the symptoms of hydrocele are much exaggerated when the affection is double.

The tumour, which grows from below, is limited to the scrotum, and the cord can be felt quite free above it. Usually pyriform in shape, it may be ovoid, globular, or may present a circular constriction about its centre. Its surface is smooth, and the tension of the swelling is uniform, but variable in degree in different cases. Fluctuation is to be detected quite across the tumour, which is also translucent. There is no impulse on coughing, and the swelling is entirely irreducible into the belly; the skin over it is not adherent to the deeper parts. The position of the testicle should always be made out; it can be determined by noticing an increased resistance to pressure at one part, by the patient experiencing the peculiar 'testicular pain' when the organ is manipulated, and by observing that at this part too the tumour is opaque to transmitted light. Where all these signs are present the diagnosis is quite easy and certain, but when the sac or its coverings are greatly thickened and opaque, or the contents are opaque or reduced to a solid mass of cholesterine, or a hernia or some other swelling is superadded, the diagnosis may be very difficult or even impossible without an exploratory operation.

From hernia, hydrocele is to be distinguished by its growth from below instead of from above, by its irreducibility, fluctuation, and translucency, and also by the fact that the cord and the inguinal canal are free. When there is a hernia with hydrocele, the distensile impulse on coughing may be transmitted from the hernia to the hydrocele; after reduction of the hernia the hydrocele-swelling will present all its usual characters. Should the hernia be irreducible, the diagnosis becomes more difficult, but the history will probably throw light upon the case; the difference in outline, tension, and consistence of the upper and lower parts of the swelling, the absence of fluctuation and translucency in the upper part, which may be tympanitic on percussion or present the lobulated feel of omentum, and lastly, the extension of the swelling up to but not beyond the internal abdominal ring, are the signs by which this condition is to be recognised. (For hydrocele extending up to or beyond the internal abdominal ring, see *Infantile Hydrocele*.) The chronic character of the swelling, its uniformity, fluctuation, and translucency, together with the detection of the testicle at one part of it, will distinguish hydrocele from malignant tumours of the testicle. From hæmatocele the diagnosis of hydrocele is made by the difference in the mode of origin of the tumours, and usually by the translucency of hydrocele. When a doubt exists, an exploratory puncture will usually clear up the case, but a better plan is to make an incision with antiseptic precautions carefully down into the tumour; this affords more information, and also is the best means of curing the cases which present this difficulty in diagnosis.

Fluctuation and translucency are thus seen to be two very important signs of hydrocele. Fluctuation in scrotal tumours

is best detected by grasping the mass with the fingers and thumb of each hand, and then, when compression is made with one hand, the part of the tumour grasped by the other will be felt to become more tense. To test for translucency it is necessary to have a good light, to grasp the tumour properly, and to carefully shut off the rays of light passing over the scrotum. The light should be held on the outer side; the swelling should be seized from behind and made tense in front, and neither the surgeon's fingers nor the patient's penis should be allowed to intercept the rays of light; a stethoscope or some larger tube may be used to look at the part, or the external rays of light may be shut off by the surgeon's other hand. When translucent, a more or less intense reddish glare is seen, the testicle appearing as a dark shadow.

Treatment.—In infants spontaneous cure is not very rare, and the surgeon may fairly wait for a time to see whether it will occur; it is generally thought that the use of an absorbent lotion containing acetate of ammonia and iodide of potassium, or painting the scrotum with diluted tincture of iodine—1 to 3 of spirit—may aid this process. Should it not occur, acupuncture is generally sufficient to bring about a cure, and in the rare cases which resist this measure, injection of the sac must be resorted to. In adults spontaneous cure does, very rarely, take place as a result of injury, but the surgeon should never expect it, and if the swelling is of such a size as to cause annoyance to the patient or is increasing, he must adopt some treatment. Tapping the hydrocele should be first performed, which affords immediate relief; in some few cases it results in cure, but in the great majority it is followed by more or less rapid re-secretion of the fluid. When the fluid accumulates very slowly and causes only trifling inconvenience, or when the patient is aged or the subject of serious visceral disease, the repetition of this trifling operation is the proper treatment. But in other cases when tapping fails to cure, and the inconvenience caused by the affection is marked, and the state of the patient does not afford any sufficient contraindication, a radical cure must be attempted. Many methods have been suggested, but two only—injection of a stimulating fluid and incision of the serous sac—are now practised; the use of setons and caustics has been rightly abandoned. Of the two methods, that by injection is more generally employed; it has the advantage of simplicity and, when carefully done, of safety; but it is liable to failure or to be followed by recurrence of the disease. Incision requires to be done with careful antiseptic precautions; but it is then a safe operation and certain in its results. It should undoubtedly be resorted to when injection has failed, when the sac is considerably thickened or contains loose bodies, when the hydrocele is compound or sacculated or combined with encysted hydrocele, when there is doubt as to the diagnosis, and in the case of aged persons in whom the operation of injection presents special danger.

(1) *Acupuncture.*—The object of this procedure is to allow the serous fluid to leak out into the cellular tissue of the scrotum, whence it is very readily absorbed. An ordinary sewing needle may be employed, but a harelip pin is the best instrument. The swelling being made tense, the needle is thrust obliquely into the sac, and then, without withdrawing it through the skin, the needle is made to puncture the tunica vaginalis in three or four places—not by its point but by the edge of its lance-shaped end. A little fluid generally trickles from the skin-puncture.

(2) *Tapping a Hydrocele.*—For this purpose the common hydrocele trocar and canula is much the best instrument. The surgeon should be careful to have the trocar sharp, the canula well-fitting, and the whole scrupulously clean. The patient may stand with his back against a wall; but should he be nervous, very old, weakly, and liable to faint, or when the hydrocele is very large, he should lie on his side at the edge of a couch. Care must be taken to enter the serous sac without pushing it before the instrument, and not to allow the sac to slip over the end of the canula when it retracts as the fluid escapes; and the surgeon must guard against wounding the testicle, cord, or one of the scrotal veins. Having accurately determined the position of the testicle, a spot is chosen on the opposite side of the scrotum, towards the lower part of the swelling and where the skin is free from visible vessels. With the left hand the scrotum is grasped so as to make the skin and the swelling as tense as possible at this part, and then with the right hand the well-oiled trocar is thrust into the sac; as soon as the instrument is free in the cavity, its point should be directed upwards parallel with the cord, and the canula alone should be pushed in for its whole length. Some surgeons prefer to insert the instrument by steady continuous pressure, while others resort to a quick thrust; each method has its advantages and defects.

The slower method is said to be less painful, and free from risk of injuring the testicle or cord, but the danger of displacing the tunica vaginalis is greater, and therefore this plan should only be adopted when the sac is tense. The more rapid method is free from this danger, but exposes the patient to some risk of puncture of the testicle or of a spermatic vein, unless skilfully performed. The best safeguard is to hold the instrument with the forefinger placed half an inch from its extremity, so that it cannot be plunged in too deeply, and if at the same time the thumb-nail is held behind the broad flange of the canula, it can slip this on over the end of the trocar as soon as the sac is pierced, and while the whole hand is depressed, so as to direct the point of the instrument up along the cord. All the fluid should be removed, the last few drops being gently pressed out; the testicle will be found tender in recent cases. On withdrawing the canula a dossil of iodoform wool should be placed over the skin-puncture, and the scrotum supported in a suspender; the patient should be directed to keep quiet in his room for the remainder of the day.

(3) *Injection of a Hydrocele.*—A favourable time should be chosen when the patient is in good health, and the tumour contains about six ounces of fluid, and the testicle is not tender. It should then be tapped in the usual way, care being taken to push the whole length of the canula into the tunica vaginalis. By means of a well-fitting syringe a stimulating fluid is thrown into the vaginal sac, and the canula is then carefully withdrawn so as not to allow any of this fluid to escape into the superficial tissues of the scrotum. The best form of syringe is one with a long metal nozzle which fits the canula, and when passed in to its full length just projects beyond the end of the canula; by using this syringe the surgeon may be sure of injecting all the fluid into the tunica vaginalis. Many fluids have been used. The most popular, and one which rarely fails, is a solution of 40 grs. of iodine and 30 grs. of iodide of potassium in an ounce of water, of which from 1 to 2 drachms are to be injected. In children the fluid should be diluted one half. Some surgeons prefer the tincture of iodine, B.P., or that diluted with an equal bulk of water; after injection and thorough manipulation of the part, some operators prefer to allow some of the fluid to escape before withdrawing the canula. The operation may cause little or no pain, or be attended with severe pain and great tendency to syncope. Similar differences are seen in the subsequent course of the cases. Generally the injection is quickly followed by a moderate effusion of fluid, with slight redness and tenderness of the scrotum and trifling pyrexia; these symptoms gradually subside, and the fluid is absorbed. But in some cases the inflammation assumes a severer grade, and it is necessary to keep the patient at absolute rest, on spoon diet, and with hot belladonna fomentations to allay the local inflammation. In yet other cases the injection fails to excite sufficient inflammation, and then the surgeon has to manipulate the part freely and let the patient walk about, to try by these means to supplement the irritant action of the iodine. If the fluid at first poured out is not afterwards absorbed, the scrotum should be strapped. The injection sets up a subacute or acute hydrocele, and when the products are absorbed the cavity of the tunica vaginalis, as a rule, is not obliterated, although limited adhesions may form. Iodine may fail to excite sufficient inflammation, or the fluid poured out may not be reabsorbed, and in some cases the sac may be too dense to collapse. On the other hand, if used too strong, it may set up suppuration.

Recently, injection of pure carbolic acid, with just sufficient water added to liquefy the crystals, has been practised. From ɱv–x. is the amount required. The operation is almost if not entirely devoid of pain, and the subsequent inflammation appears to be more uniform in degree than when iodine is used. The author has used carbolic acid in many cases, and with some success; it is certainly less painful than iodine, and he has found it quite unnecessary to confine his patients to bed afterwards; often they are able to go about their work as usual. The acid should always be injected with the long-nozzled syringe. Port wine, chloride of zinc solution, and many other fluids have been recommended and used, but they none of them are equal in value to iodine or carbolic acid. Latterly, finely-powdered iodoform has been introduced into the cavity of the tunica vaginalis, and this practice is highly spoken of; the writer has had no experience of it.

(4) *Incision of a Hydrocele.*—For this the scrotum and pubes should be shaved and thoroughly cleansed, and, using all the usual antiseptic precautions, the surgeon should make a vertical incision two inches long over the front of the swelling. After arresting all hæmorrhage from superficial vessels, the tunica vaginalis is to be opened

for the same length and the fluid allowed to escape. The cut edge of the serous sac is to be united to the skin by one or two chromic catgut stitches on each side, and a drainage-tube is to be passed in to the bottom of the cavity. Outside, the usual carbolic gauze dressing is to be applied. The dressing will need to be changed every third or fourth day, and the tube is to be shortened from time to time, and removed altogether as soon as the discharge is reduced to a few drops. The patient may generally be allowed to get up at the end of the second week. The operation is followed by very slight pyrexia, and slight orchitis for the first two or three days. As the serous cavity is obliterated by this treatment, the cure of the hydrocele is certain and permanent.

3. Congenital Hydrocele.—*Etiology.* The cause of this variety of hydrocele is a congenital malformation; the processus vaginalis is not obliterated, the tunica vaginalis being therefore continuous with the general peritoneal cavity. Nothing definite is known of the cause of this malformation; it is said to be more common in weakly children and in those born prematurely.

Pathology.—The communication between the tunica vaginalis and the peritoneal cavity may be very free, or it may be valvular or reduced in size until it only admits fluid to flow along it drop by drop; and this constriction may be at one point only—either at the internal abdominal ring or just above the testicle—or involve some length of the serous tube. Congenital inguinal hernia is often associated with it. It may be unilateral or bilateral.

Symptoms and Diagnosis.—The swelling, which is most often noticed in early infancy, has the general characters of hydrocele, being fluctuating, translucent, and surrounding the testicle. In addition, it exhibits a distinct expansile impulse on coughing or crying, and is wholly reducible into the belly without occasioning any intra-abdominal tumour. This reduction is never accompanied with a 'slip' or 'gurgle'; when the communication is free, it is rapid, but when narrow, it is very slow and easily overlooked unless great care be taken and the attempt to reduce it be continued for some few minutes; and this precaution must be observed in every case of hydrocele in infants and young children. When the serous tube is irregularly constricted for some distance, the flow of fluid along it may be attended with a fine fremitus. Should the upper part of the swelling be opaque, or tympanitic on percussion, or yield a gurgle on manipulation, or recede with a sudden slip during taxis, a congenital inguinal hernia is present; a combination of two or more of these signs will render this diagnosis more obvious. Whenever the swelling can be seen or felt to extend along the inguinal canal, or is found to yield a very marked impulse on coughing, hernia is to be suspected.

Treatment.—A well-fitting truss should be applied, to prevent the descent of a hernia, and to induce obliteration of the vaginal process of peritoneum. When this is obtained, the remaining hydrocele can be treated like an ordinary chronic hydrocele. Should obliteration not result—a rare event—and further treatment be necessary, the sac may be injected with the iodine solution, or, better, incised and drained antiseptically. When hernia is combined with the hydrocele, the treatment must be directed to secure the radical cure of this condition, by ligature of the neck of the sac and suture of the inguinal ring if it be dilated.

4. Infantile Hydrocele.—Under this name are known cases of vaginal hydrocele which involve more or less of the process of peritoneum in front of the cord, but are shut off from the peritoneal cavity by obliteration of the tube at or near the internal abdominal ring. The majority of cases of hydrocele in infants are of this nature, and it is rare to find this affection in adults. In men, however, the upper part of the sac may be distended and even form a tumour of large size behind the belly-wall but outside the peritoneal cavity.

Symptoms and Diagnosis.—If the swelling extend up to, but not through, the external abdominal ring, its shape and extent are the only features peculiar to it. Should the sac reach up along the cord in the inguinal canal, there will be an expansile impulse on coughing, but the tumour will be entirely irreducible. In the rare cases in which a sac or pouch is formed within the belly, this internal tumour will be felt, and fluctuation will be detected between it and the scrotal swelling, the one becoming more tense as the other yields under pressure. This simulates reducibility of the scrotal swelling, but the detection of the internal tumour and its increased tension as the scrotum is emptied, will distinguish the case from congenital hydrocele: in such cases there is, of course, a well-marked impulse on coughing.

Treatment.—The application of absorbent lotions or of weak iodine paint to the scrotum should first be tried, and if these fail, acupuncture will usually succeed.

Should a case resist this means, injection with iodine or incision should be practised. Care in the diet and general hygiene of the child may aid in the cure, and, where indicated, tonics should be given.

5. Encysted Hydrocele of the Testicle.—*Pathology.*—Three varieties of hydrocele in connection with the testicle, in which the fluid is not contained in the tunica vaginalis are met with. The most important are cysts in connection with the epididymis — generally the upper part— globular or lobed in outline, and rarely attaining a large size. They consist of a delicate fibrous membrane, lined with tesselated epithelium. The fluid is transparent and colourless, containing a small trace of albumen, chloride of sodium, and alkaline carbonates which give effervescence on the addition of acetic acid. In a certain number of cases the fluid is opalescent or milky in colour, and on standing yields an opaque sediment, consisting of spermatozoa, which may be found moving actively, motionless, or broken up. As the cyst enlarges the vasa efferentia are spread out over it, and it is by the rupture of one or more of these tubes into the cyst—sometimes from injury—that the semen finds entrance to the hydrocele. Such cysts are usually single, they may be multilocular, but are very rarely more than two or three in number. A very unusual condition is for such a cyst to extend up along the cord even to the groin. These cysts have been supposed to arise from dilatations or ruptures of the vasa efferentia, but it is more probable that they are dilatations of the remnants of fœtal structures, particularly of the organ of Giraldès, and the duct of Müller, possibly also of the vas aberrans of Haller. The second and very rare variety is a cyst beneath the tunica albuginea testis, pressing the seminal tubes aside. This condition probably ensues upon parenchymatous hæmatocele. *See* Hæmatocele. The third variety consists in the development of small subserous cysts, the size of peas or currants, in connection with the head of the epididymis; they are common after forty years of age, very rare before that, never contain spermatozoa, and are of no clinical importance.

Symptoms and Diagnosis.—Only the first of the three varieties named above will be considered. The cyst forms a tense globular or lobed tumour attached to the epididymis, and generally situated above and behind the testicle. This tumour is translucent, fluctuating, very movable in the scrotum, without impulse on coughing, and quite irreducible by pressure. The growth is slow, and the tumour is usually painless, and may remain stationary. When of small size the fluid is clear; when larger, it is very frequently mixed with semen. An enlargement occurring suddenly, or following upon an injury, may be assumed to indicate a rupture into the cyst of a seminal tubule. The affection is most common in boys and young adults. Encysted hydrocele may be associated with vaginal hydrocele, and the cyst may rupture into the tunica vaginalis. The diagnosis of hydrocele will rest upon the fluctuation in and translucency of the tumour; the variety of hydrocele will be recognised from the tumour being fixed to but not surrounding or obscuring the testicle, by the small size and globular shape of the cyst, together with its slow growth and the character of the fluid.

Treatment.—When the cyst attains any size or gives rise to annoyance, it should be tapped, the trocar being introduced from the outer side. Should this fail to cure, the surgeon may attempt the radical cure—either by injection of iodine, by a seton of threads soaked in tincture of iodine, or by antiseptic incision. Injection often fails. Incision is readily performed and very certain in its results, and is therefore the best treatment for the cases in which tapping is insufficient.

6. Encysted Hydrocele of the Spermatic Cord.—This is a circumscribed collection of serous fluid in connection with the cord. The cyst is generally developed by distension of an unobliterated part of the vaginal process of peritoneum. Some cysts may be of new formation or dilatations of the organ of Giraldès.

Symptoms and Diagnosis.—The affection is relatively frequent in boys and young men. The tumour is of small or moderate size, ovoid in shape, and attached to the cord; it fluctuates, is translucent and irreducible, but very movable up and down with the cord; its outline is always well defined. If situated in the inguinal canal it is impossible to test for translucency, and the swelling will expand on coughing. By making traction upon the testicle the mobility of the tumour is greatly lessened.

Treatment.—This is the same as for chronic vaginal hydrocele. In the first place absorbents may be tried, and, should they fail, acupuncture, tapping with a trocar, injection with iodine and antiseptic incision may be relied upon in order of merit and safety. Before applying any means of radical cure, great care must be taken to determine that the sac does not communicate with the peritoneal cavity by

a narrow channel; such a condition has been called the *water-bottle hydrocele*.

7. Diffuse Hydrocele of the Cord, or œdema of the areolar tissue of the spermatic cord, is a rare condition, the causes of which are not understood. The writer has seen it follow wearing an ill-fitting truss. The spermatic cord is uniformly enlarged, the swelling being elastic, yielding to pressure, with impulse on coughing, but neither fluctuating nor translucent. The tumour may attain a very large size. It is to be distinguished from a hernia by the less clear definition of the swelling, its dulness on percussion, irreducibility into the belly, absence of gurgling, the less clear impulse on coughing, and its smooth contour. Where there is doubt in the diagnosis, a careful incision should be made into the part.

Treatment. — Acupuncture, or tapping with a trocar, may first be tried, and if the fluid reaccumulate, an incision with antiseptic precautions is the best means of obtaining a radical cure.

8. Inguinal Hydrocele. — This is a very rare condition, caused by the accumulation of fluid in a closed serous sac around a testicle retained in the inguinal canal. The cause of the effusion is the injury to which the organ is exposed in its abnormal position. Part of the swelling may escape through the external ring and extend transversely along the groin in the superficial structures.

Symptoms and Diagnosis.—There is a fluctuating, translucent, irreducible tumour in the groin, and the scrotum on the same side is found undeveloped and not containing a testicle. In the recorded cases there is stated to have been no impulse on coughing.

The *treatment* consists in a free incision into the tumour, the removal of the testicle and the careful dissection out of the serous sac. By this means the hydrocele is radically cured, and the patient is freed from the annoyance and risk attending imperfect descent of the testicle.

9. Hydrocele of a Hernial Sac.—By this is meant an effusion of serous fluid into the sac of a hernia, which has become shut off from the peritoneal cavity by plugging of its neck with omentum, or its obliteration as the result of wearing a truss. The disease is more common, and attains greater magnitude, in inguinal than in femoral hernia. The fluid resembles in character that of chronic vaginal hydrocele.

The *symptoms* will be those of a fluctuating, translucent, irreducible swelling, occurring at the site of an old hernia for which, usually, a truss has long been worn. If scrotal, the swelling will reach up to or even into the inguinal canal, and in the latter case will have a faint impulse on coughing. The testicle will not be lost in the swelling as in vaginal hydrocele, nor attached to the cyst as in encysted hydrocele.

The *treatment* consists first in tapping the tumour, and, if this fail to give permanent relief, an incision with antiseptic precautions will be the best means of obliterating the sac. A. Pearce Gould.

HYDROCELE OF THE NECK is the name given to a peculiar form of cystic growth which is generally found to lie in the line of the sterno-mastoid on one or sometimes on both sides, and which is, in the majority of cases, of congenital origin, and therefore noticed at or soon after birth; but, in rare instances, develops much later and even at an advanced age, one having been described in a patient over seventy. The congenital form is identical with the condition which goes by the name of 'cystic hygroma,' and which occurs also in the axilla, on the back, and around the kidney; but when developing in later life, the disease bears a resemblance to the single blood-cysts which are found in other parts of the body.

The growth is composed of cysts which push forward the healthy skin covering them, and render it tense, so that their conformation, lobulated form, and even their contents, may be seen through it. They may present at any part of the neck between the mastoid process and the clavicle, but the favourite situation is below the jaw, or springing from the posterior triangle of the neck. In size they show great variety, sometimes being quite small, at others attaining enormous proportions. Their progress is remarkably capricious, at one time remaining at a standstill, and at others increasing with great rapidity, and this even after many years of quiescence. The whole, or a portion, will sometimes diminish in size, or altogether disappear. Nor are all the parts found to increase in the same ratio, and thus they will occasionally cause symptoms of pressure without any evident increase in bulk. It is to their pressure-effects that their fatality in early life is to be ascribed, since they are often continued down into the thorax, surrounding the trachea, and extending into the mediastina.

Cause and Pathology.—On dissection, the tumour appears to be an aggregation of cysts, often in great numbers, the components

of which are nothing but an exaggeration or hypertrophy of the cellular tissue of the part. Although presenting superficially, they generally originate beneath the deep cervical fascia, and protrude in all the parts with which that structure is connected. Thus, they sometimes are situated beneath the tongue, and cause one of the forms of ranula, or they may pass across the median line and present upon both sides of the neck, and, as already stated, may extend into the thorax or axilla. The fluid contents are enclosed in a wall of areolar tissue, smooth, glistening, and finely fibrous, though differing greatly as to consistence, even in various parts of the same tumour, so that the larger cysts will be found enclosed by a thin covering, and the smaller by a dense wall of similar structure. The size of the cysts varies from that of a pea to that of an orange, and their contents are equally prone to vary as to colour and consistence. The fluid in one will be found to be clear and watery, while that of its adjoining neighbour may be composed of blood-stained serum, in which may float white, flocculent particles of lymph-coagulum; and whilst one cyst may give the sensation of a bag of fluid, the adjoining ones may be so tense as to appear solid. Occasionally fleshy masses are seen in the growth, but, as a rule, the only solid elements consist of hypertrophied connective tissue. Lymphatic glands are not affected, but are often surrounded and enclosed, as are also the vessels and nerves. The size to which, in some cases, these tumours have attained is enormous, and they are prone to inflame under very slight provocations, as from blows, &c., or will often do so spontaneously.

The *symptoms* and *diagnosis* of this affection are so obvious, that little need be said as to any distinction which must be drawn between it and other tumours which may occur in this region. Large venous nævi are the only swellings with which it is likely to be confounded; but in these the dilated walls of the numerous veins show through the thin coverings of the skin, and, as opposed to what occurs in a cystic growth, their bulk can be diminished by firm pressure, and their size is immediately re-established when it is relaxed. To fatty tumours these growths may bear some resemblance; but whilst the one is seldom, the other is nearly always congenital, and can, when rendered tense, be made in some part translucent with a strong light.

Treatment.—When it seems fairly probable that the tumour is only a single cyst, it is justifiable to try the effect of tapping, with or without the subsequent injection of tincture of iodine, or Morton's solution, composed of iodine, iodide of potassium, and glycerine. After injection, the trocar should remain for a few seconds, to allow any remaining fluid to drain off. But when, as is most usually the case, there are numerous cysts, by far the most successful method of treatment is to pass a seton of fine silk or catgut through a portion of the tumour, and to leave it until some sign of inflammation is evident, but before suppuration has taken place, when it should be withdrawn.

Inflammation of this hypertrophied tissue is very easily excited, and it must be allowed to subside before the introduction of a fresh seton into any other portion of the growth. Should suppuration occur from any cause, an incision must be made and a drainage-tube inserted, the cavity being freely washed out with some antiseptic solution. It will usually be found that when a portion of the tumour has begun to contract, the rest will follow suit, and therefore due time must be given for this to occur. If a large portion appear to be solid, and yet the increase in size of the whole tumour be evident, the question of excision may be entertained; but this is seldom to be advised, on account of the deep connections of these cysts, and the tendency to resume growth shown by any portion which may be left. JOHN H. MORGAN.

HYDRONEPHROSIS, or the distension of the pelvis of the kidney with urine, is a comparatively common affection, especially when unilateral; double hydronephrosis is, on the other hand, rare.

The *causes* of this condition are many. The commonest is impaction of a stone in the top of the ureter; next to this the closure of the latter by some inflammatory change; then tubercular deposits blocking the ureter, or the contraction of a tubercular ulcer. Again, growths of the kidney of various kinds may cause retention and hydronephrosis, the commonest being papillomata. Besides these, pressure from without may initiate retention of urine in the pelvis of the kidney, and a consequent obliquity of the course of the ureter in the wall of the distending sac may perpetuate the condition. Among the sources of external pressure on the ureter may be mentioned the gravid uterus, perimetritis, tumours of the pelvis, and, finally, the presence of an aberrant renal artery. Finally, there is in some kidneys

an almost valvular arrangement of the mucous membrane at the point of origin of the ureter, which predisposes to the formation of this condition and maintains it when once produced. In no recorded case, so far as the writer can ascertain, has hydronephrosis been proved to have resulted from injury to the ureter itself from without, with cicatricial closure of its lumen. In a few cases, however, the history and symptoms at first appeared to point to such a cause (vide *Lancet*, January 17, 1885); but in all the accumulation was shown, later on, to be retro-peritoneal effusion of urine from a torn ureter, and not from distension of the pelvis of the kidney. This form of lumbar 'urinary abscess' might perhaps be called 'spurious hydronephrosis,' resembling as it does so closely the true form, and under this head it will be considered lower down.

The *objective symptoms* of hydronephrosis are usually the same, however the condition be produced. We find a large fluid tumour in either flank, having in all cases the same relations. It lies below the liver, and behind and outside the colon. It begins to grow above, and enlarges downwards and inwards towards the umbilicus, and may even cross the middle line of the body. With such a tumour there is dulness over the flank behind, between the ribs and iliac crest, and extending forwards until the colon note is reached at a varying point. This dulness reaches vertically from the liver to the iliac fossa as a rule, and over the same area a distinct wave can usually be felt on percussion with the fingers. In doubtful cases, the exact relation of the colon to the swelling can be ascertained by alternately filling and emptying the bowel, with fluid or air pumped in through the anus. The size of the tumour varies greatly, but as its presence is not usually accompanied by much suffering in the earlier stages, it is first met with by the surgeon, as a rule, when it has become very large, and contains many pints, or even gallons, of fluid.

The *subjective symptoms* are few, and only noticed definitely when the tumour has reached a large size. Slight pain, of a dull, aching character, may be complained of, but is usually absent. Digestive derangements, due to pressure of the growth upon the intestines and consequent constipation, may also be observed. The tumour may also produce a certain amount of dyspnœa by interfering with the descent of the diaphragm. There is one symptom which, if present, is characteristic of hydronephrosis. This is the sudden passage of very large quantities of urine, with subsidence of the lumbar swelling, and the rapid reappearance of the latter after the flux has ceased. This indicates the sudden removal of the obstruction for a time, and the escape of the contents of the hydronephrosis into the bladder. Exploratory puncture, with a fine aspirator-needle, will also generally settle the nature of the tumour. This should always be done from behind, midway between the iliac crest and last rib, and about two and a half inches from the spinous processes, at which point no structure of importance can, with ordinary care, be wounded. If a clear fluid is here drawn off from a tumour, having the relations detailed above, it is almost certain to be a hydronephrosis.

The *diagnosis*, thus made, is not weakened by the discovery that the fluid drawn off contains only a trace of urea and is rich in albumen, for it is now well known that urine secreted against a steady resistance, such as the elasticity of the sac receiving it in this case, is always deficient in urea in proportion to the resistance to be overcome; it is also noticed to contain, as a rule, much albumen and mucin. This is true even of a perfectly healthy kidney, whose ureter has only recently become blocked. The amount of urine secreted by a kidney, under such circumstances, is also diminished, but not to a very large extent. That all this is the result of the obstruction alone, is proved by the fact that if a recent hydronephrosis, whose fluid only contains 0·1 per cent. of urea, be drained through the loin by a carefully-fitting tube, the urine may rapidly regain its normal percentage of urea, &c., the resistance being removed. But where a hydronephrosis has lasted for a long time, it has been shown that the kidney becomes, at last, permanently damaged and incapable of secreting urea or even furnishing urine, except in traces. In such a case, not only is the pelvis enormously distended, but the kidney proper is found stretched into a thin, fibrous plate, as it were, which lies like a cap upon the upper and back part of the sac, covering, perhaps, an area of six or eight inches, and showing little or nothing of its original structure.

Prognosis.—If a hydronephrosis be left untreated, one of three results may be looked for. (1) It may go on enlarging until the patient is gradually exhausted by the distress due to its pressure upon other abdominal organs. (2) It may rupture, with or without external injury, the fluid escap-

ing into the peritoneal cavity and causing peritonitis, or, in very rare cases, becoming absorbed without further mischief. (3) It may grow to a large size, and then, owing to the complete atrophy of the kidney as the result of pressure, it may, at last, become slowly absorbed again.

The best *treatment* for hydronephrosis is a problem yet to be solved. In a few cases, where the condition is due to blocking of the ureter by calculus, the latter may, perhaps, be helped to pass into the bladder by manipulation over the track of the ureter, aided by hot baths and the use of sedatives and antispasmodics. But this could only be possible in comparatively recent cases of obstruction. The same may be said of the operation of cutting down upon the ureter and opening it for the extraction of the stone. This procedure will, probably, be put in practice in the future, when we have collected sufficient facts for a positive diagnosis, but, although proposed many years ago, it has, so far, not yielded any fruit. Even if a urinary fistula remained after such an operation, still the gain to the patient would be great, for a time at all events, and would not very unfavourably influence any subsequent procedure chosen for the final relief. In the more chronic cases, where the seat of the obstruction cannot be defined, the surgeon now-a-days will not be inclined to await the possible atrophy of the kidney and absorption of the fluid, knowing the remoteness of the prospect and the risks constantly incurred.

There remain, then, only three measures for relief: (*a*) repeated aspiration, (*b*) free drainage, (*c*) excision of the sac and kidney together. There are, perhaps, a very few cases in which repeated aspiration at the point of election (*vide supra*) may be followed by permanent cure. They are those in which the secreting powers of the kidney are almost, or completely, destroyed, and we have simply to deal with a cyst whose walls are practically inert. But such cysts would require very frequently repeated aspirations before they could be brought to contract finally, if they ever did so. Free drainage of hydronephrosis is not much more successful than aspiration, and is not devoid of risks. Of course a large sac will be in a better position to contract if freely and continuously drained, than if only occasionally emptied. But the time consumed in the process is usually very great, and the patient often suffers great distress from the process of drainage, and the necessity, lasting for months, for constantly changing the wet dressings. Again, there is always the risk of suppuration in the sac, with consequent septic infection. This may usually be guarded against by careful antiseptic treatment of the opening, which should always be made at the point of election behind. If kept aseptic the drainage may prove useful in relieving the patient's immediate distress, and preparing the way, in suitable cases, for the more radical treatment of nephrectomy (q.v.) But if allowed to suppurate the sac will contract firm adhesions to the parts around, and the difficulties of the latter operation will be greatly increased if it be undertaken. It must, therefore, be carefully considered, in every case, whether it would not be better to proceed to the removal of the kidney at once, without complicating the case further, at all events after a sufficiently free but short drainage. There are cases where, undoubtedly, immediate nephrectomy is the best treatment. The patient's age and general state of health, taken together with the duration of the disease, are the only guides, but upon these points no definite rules can be laid down.

A. E. Barker.

HYDROPHOBIA.—A disease in man resulting from inoculation with the virus of a rabid animal, and characterised, among other symptoms, by spasmodic contractions of the pharyngeal muscles, and consequently by inability, in the majority of cases, to swallow fluids.

The morbific substance is contained in the saliva or oral mucus of the rabid animal, and is harmless when applied to an unbroken cutaneous or mucous surface. If introduced into the subcutaneous tissues it produces in animals rabies, and in man hydrophobia, provided that the individual so inoculated possess the requisite susceptibility for the disease. This would appear to be a necessary condition, from the fact that of persons bitten by rabid animals a large majority, variously estimated at from 60 to 95 per cent., escape without further consequences. This might be explained by the assumption that those who so escape were not inoculated, and that the poison had been intercepted by the clothing, or that, by precautionary treatment, the poison had been neutralised. In support of this is the fact that bites on the face, hands, or other exposed parts more frequently result in hydrophobia than when parts protected by clothing have been bitten. But the experiments of Hertwig seem to prove that in dogs such susceptibility is essential, as only 37 per cent. of the animals

experimented upon became rabid. One dog, a pug, was fruitlessly injected nine times in three years with matter which induced rabies in other dogs. The recent experiments of Pasteur also appear to demonstrate the insusceptibility of some dogs to inoculation; for, although he was more successful than Hertwig in inducing rabies, three dogs, out of an unspecified number experimented on, proved to be insusceptible to repeated inoculations.

The symptoms of rabies in the dog and of hydrophobia in man are very different; but the fact that inoculation of dogs with the saliva of hydrophobic patients has induced rabies, establishes the identity of the diseases.

Inoculation is generally the result of the bite of a rabid animal, and dogs are the most frequent agents; but the bite of rabid wolves, foxes, jackals, hyænas, cats, pigs, and even herbivorous animals, has induced the disease. It does not appear to be proved that the animal must necessarily be rabid, so that precautionary treatment should be employed in all such wounds, whatever may be the condition of the animal. Some cases are recorded where the disease resulted from the scratch of a cat, whose claws were probably smeared with saliva. One case was caused by an accidental wound in the dissection of a dog which had died of rabies. Another case is said to have resulted from the patient having used his teeth to loosen the knots in a rope with which a mad dog had been tied. Such cases suggest the necessity of caution on the part of attendants upon hydrophobic patients.

Hydrophobia, compared with other acute specific diseases, is characterised by the long duration and variability of the latent stage. From recorded cases it would seem to vary from fourteen days to nearly as many years. But in the great majority of cases active symptoms manifest themselves within three months from the date of the wound, and in only six per cent. of 147 well-ascertained cases has the latent period lasted for more than six months. Very prolonged periods can therefore be only accepted with some reserve. The latent stage, or delitescence, is not marked by any characteristic symptoms. Some writers have observed unusual appearances in the wound or cicatrix, but these probably resulted from the treatment adopted; others have noted symptoms of mental disturbance for the first few days after the wound, naturally enough if the patients were aware of the risk that they had incurred. Marochetti's vesicles, or the so-called 'lyssi,' for some time attracted attention. They are vesicular or occasionally solid projections on the mucous membrane of the tongue, lips, or cheeks, which are said to form from the third to the twentieth day after the wound, and at one time the safety of the patient was believed to depend on their thorough extirpation. They are, however, not always found, and their significance has not been established.

In the active stage, or recrudescence, the first symptom which usually attracts attention is difficulty of deglutition. The patient when about to drink is checked by a sudden inspiratory spasm. In some cases this is preceded by sleeplessness and general malaise.

The patient now usually complains of a feeling of fulness and stiffness in the throat, of compression of the chest and difficulty of respiration, and of numbness, tingling, or neuralgic pains at the seat of the wound or its immediate vicinity. In one case, a boy aged fourteen, who had been bitten on the back of the right hand five months before the onset of acute symptoms, complained of such severe pain along the right ulnar nerve, which was relieved by pressure, that the writer was reluctantly induced to divide the nerve behind the internal condyle, without any benefit to the patient. Great restlessness and suspicious watchfulness are very marked at this stage. All the symptoms indicate disturbance of the central nervous system, especially of the lower part of the medulla oblongata, where the centres for respiration and deglutition are situated. As the disease progresses, hyperæsthesia is conspicuous. Convulsive spasms become frequent, and are excited not merely, as at first, by attempts to swallow fluids, but by any peripheral stimulation. A current of cold air, a flash of light, a bright colour, some glittering substance, a sudden noise, as the shutting of a door, trickling of water, or the mention or even thought of fluid, may excite them. These spasms especially affect the muscles, both ordinary and extraordinary, of inspiration, and are sometimes so prolonged as to threaten suffocation. Sometimes all the muscles of the trunk are convulsed, and there is marked opisthotonos. In the intervals the respiratory movements are shallow and hurried. The pulse is usually small and frequent. The salivary glands generally secrete abundantly, and the patient, being unable to swallow, expectorates in all directions. If the secretion be viscid the patient has much difficulty in getting rid of it. The tone of the voice is often altered from want of co-ordination of the muscles of vocalisation. Hence probably

originated the old stories of hydrophobic patients foaming at the mouth and barking like dogs.

As the higher cerebral centres become involved the patient may have hallucinations, or even violent delirium. But these symptoms are not persistent, and the patient is usually intelligent and fully conscious of his miserable condition. His sufferings are aggravated by great thirst. Sometimes there is vomiting of bilious fluid. At the commencement of the acute stage there is not infrequently, in adults, increased sexual desire, and there is often priapism even in children. The urine is scanty, and generally contains albumen.

In the intervals between the convulsions the patient sometimes sleeps, especially if narcotics have been employed; but usually the sleep is restless and of short duration.

The acute stage generally lasts from one to two days—very rarely longer. It is succeeded, if death has not occurred, by a period corresponding to the paralytic stage of rabies in the dog. The convulsions either cease altogether or greatly abate in force and frequency. The power of deglutition is regained, but the patient is weak and feeble; the respirations and pulse are frequent; the skin is bathed in clammy perspiration; and death, apparently from exhaustion, speedily supervenes.

The above description is not applicable to all cases. Indeed, no two cases are exactly alike. In some mental disturbance, in others convulsive seizures predominate. Occasionally even the test symptom of difficulty of deglutition is altogether absent or exists in a very slight degree. Some writers explain these variations by assuming that there are varieties of the disease, but they are probably due to idiosyncrasy of the patient and varying powers of resistance in the nerve-centres.

Pathological Anatomy.—The early onset of rigor mortis and decomposition, the fluidity of the blood, and congestion of the fauces, lungs, and kidneys, have long been noticed in this disease. These, with minute ecchymoses beneath the pleura, pericardium, and membranes of the brain and spinal cord, are usually the chief macroscopic phenomena. Microscopically, degeneration of the ganglion cells in the nuclei of the tenth, eleventh, and twelfth cranial nerves, and, to a less extent, of the ganglion cells in the cortex of the cerebral hemispheres, with exudation into the peri-vascular spaces of the brain and spinal cord, especially in the medulla oblongata, thromboses of small vessels and miliary abscesses, have been discovered. Klebs, quoted by Reder in the *Deutsche Chirurgie*, 1879, found in the lymphatic and submaxillary glands granular, very refractive corpuscles of a pale brown colour, aggregated in longitudinal bands or in stellate groups, usually in the course of the blood-vessels, which may, as he suggests, be the vehicles in the transmission of the disease.

Treatment.—All wounds caused by bites should be thoroughly cleansed as soon as possible. Bleeding should be encouraged, and the wounds then be cauterised. In quite recent cases the solid nitrate of silver will suffice; but, if some interval has elapsed, nitric acid or the actual cautery should be employed. Some recommend excision of the bitten part; but this seems needlessly severe as a merely precautionary measure. Some simple dressing should then be applied, and the patient's mind should be diverted from the subject. When acute symptoms have appeared, all sources of excitement should be prevented. The patient should be kept in a darkened room, with as little physical restraint as possible. If attempts to swallow induce convulsions, nutrient enemata should be administered. No specific has been discovered for this disease. Mercurial inunction combined with hot-air baths has been apparently successful in a few cases. Hypodermic injections of curare, in doses of from $\frac{1}{16}$ to $\frac{1}{4}$ of a grain, may be tried; but the effect must be carefully watched, lest paralysis of the respiratory muscles supervene. Aconite, preparations of arsenic, atropine, calabar bean, cold affusion and ice to the spine, have been employed, but mostly without any advantage. Narcotics alleviate the symptoms, and of these morphia, administered hypodermically, and chloral hydrate by the rectum, appear to be the most efficacious. Anæsthetics prevent the convulsions while the patient is under their influence, but in some cases they cannot be tolerated. In the boy before alluded to, whose ulnar nerve was divided, the attempt to administer chloroform induced a dangerously long-continued inspiratory spasm. This has been observed in other cases also. Tracheotomy has been suggested, and, if the spasm were limited to the laryngeal muscles, would be most serviceable; but as all the muscles of inspiration are generally affected, the utility of the operation is not apparent. Quietude, narcotics, and nutrient enemata would appear to be the most suitable treatment.

The *prognosis* is very unfavourable, although a few cases of apparently genuine hydrophobia have recovered. Pasteur's ex-

periments, which have not yet been completed, appear to indicate that dogs can be rendered insusceptible of rabies by being inoculated with the suitably attenuated virus of rabid animals. If this be substantiated we may look forward to the disappearance of hydrophobia, and prevention will indeed be better than the hitherto futile attempts to cure.

Diagnosis.—Hydrophobia so greatly resembles tetanus in some respects, that it has been proposed to classify it as a variety of that disease by the name of tetanus rabicus. From ordinary tetanus it may be distinguished by the duration of the period of incubation, by the absence of trismus, by the characteristic inspiratory spasm, and by the remissions during the acute stage. From the literature of hydrophobia it is evident that cases of acute mania and of hysteria have been mistaken for it, from the inability—real or pretended—of the patient to swallow fluid. But the absence of all the other symptoms of hydrophobia, and notably of the acceleration of the pulse, should suffice to prevent such mistakes.

JEREMIAH MCCARTHY.

HYDROPS ANTRI. *See* ANTRUM, Diseases of the.

HYGROMA. *See* HYDROCELE OF THE NECK.

HYMEN, Imperforate. *See* VAGINA, Affections of the.

HYOID BONE, Fracture of the.—Embedded in the soft parts, and placed at the retiring angle between the prominence of the chin and the front surface of the neck, the hyoid bone is rarely fractured.

The cause is almost invariably direct violence, such as a blow, an attempt to throttle, or a fall upon some projecting object. This lesion is also frequently found in the bodies of those who have been hanged. Instances are on record in which it has followed a muscular effort, e.g. in yawning, or a sudden movement of the neck. The great cornu is the part usually broken, and one or other of the fragments may project through the mucous membrane of the pharynx. Most of the cases on record have been in adults.

Symptoms.—Pain in the part, aggravated by all movements of the tongue and pharynx, such as speaking, masticating, and swallowing. In some cases also the attempt to open the mouth or move the neck is painful. Swelling and ecchymosis will be observed in the upper part of the neck, or about the floor of the mouth. There may be huskiness or loss of voice, with coughing and occasionally severe dyspnœa. There is sometimes a free flow of saliva, which may be mingled with blood if the mucous membrane has been wounded. On manipulation the mobility of the fragments can usually be ascertained, and crepitus can be felt where there is not much displacement. By introducing the finger through the mouth the diagnosis will be assisted, and any projection of the fragments beneath or through the mucous membrane will be readily detected.

Treatment.—If there is displacement, the surgeon must endeavour by manipulation to reduce the fragments. By the help of a finger in the mouth and gentle pressure with the fingers of the other hand externally, this object may usually be effected. The patient should then be kept in bed, and must not be allowed to speak. By means of a bandage placed round the head and attached below to a broad belt round the chest, the movements of the neck should be prevented. Hæmorrhage should be checked by giving the patient ice to suck. In severe dyspnœa and laryngeal irritation it will be necessary to resort at once to laryngotomy; or, if the injury extend to the laryngeal cartilages, or the soft parts covering them, tracheotomy may be preferable. Liquid food and sops should be given, but if the attempt to swallow causes great pain and coughing, or if it displaces the fragments, it may be necessary to feed the patient with nutrient enemata. In some cases, however, this difficulty may be met by the use of an œsophageal tube.

To relieve the local swelling and pain, a lead and opium lotion may be used, and leeches are sometimes beneficial.

As a rule the more acute symptoms subside in a week or two, and the consolidation of the parts allows a certain amount of movement. Bony union takes place in the course of a few weeks. Occasionally necrosis of part of the bone, accompanied by the formation of foul abscesses, may cause great delay in the healing process, and the patient may succumb to the exhaustion or septic condition thus produced.

N. DAVIES-COLLEY.

HYPERIDROSIS (Excessive Sweating).—*Cause.*—Hyperidrosis may be (1) symptomatic in some general disease of a febrile character—rheumatism, pneumonia, &c.; or (2) it may depend on the debility induced by exhausting disease (phthisis). (3) It may be due to some affection more essentially neurotic in character, as in cases

where it accompanies neuralgia or paralysis. (4) It occurs idiopathically, and may be regarded rather as an anomaly of function.

Pathology.—A functional disturbance of the sweat-glands, increasing the quantity of sweat secreted, but not altering its character.

Symptoms.—The condition may be acute or chronic, general or local. When accompanying febrile conditions it is more often general, and is sometimes attended by the formation on the surface of the skin of minute, evenly-distributed, and closely-set pellucid vesicles (sudamina). They are formed by small collections of sweat beneath the cuticle. Occasionally sudamina become somewhat turbid, in which condition they have received the name 'miliaria alba'; or they may be accompanied by a certain amount of inflammatory halo, and have then received the name 'miliaria rubra.'

It must be noted that excessive sweating is sometimes accompanied by a lowered temperature.

Local hyperidrosis is most frequently met with on the perineum and adjacent parts, axillæ, palms, and soles; but other forms of local hyperidrosis are met with, often unilateral, and as part of a local neurotic disturbance. The form of hyperidrosis which most often calls for treatment is the sweating of the palms or soles; this condition, which may be temporary or permanent, gives rise to great annoyance, interfering with an occupation, or with the patient's social duties and pleasures. The continued maceration may lead to changes in the skin between the fingers or about the perineum or adjacent parts—that is, to an erythematous eczema (intertrigo).

On the soles there are more often seen rounded patches of sodden, whitish epidermis, like that of the washerwoman's hand, the patches eventually desquamating and leaving the part beneath red and tender. Not infrequently the part drifts into a chronic desquamative condition, indistinguishable from eczema of the sole. This sweating of the feet is rarely unaccompanied by fetor, due to the proneness of the sweat to decompose after its deposit on the surface, or to the presence of a bacterium (Thin). Hyperidrosis is naturally worse in summer than in winter.

Treatment.—Quinine, iron, belladonna, or dilute sulphuric acid, may be given in cases where it may be desirable to treat the condition internally. The hypodermic injection of atropia (gr. $\frac{1}{100}$–$\frac{1}{60}$) is said to be of great service. In cases where the sweating is accompanied by debility, a general tonic treatment is obviously indicated.

It is, however, the local and more permanent varieties which call for treatment, and this is more likely to be successful when of a local character. Dusting powders, such as the following:—℞ Acidi salicylici, gr. xx.; zinci oxidi, ʒiij.; kaolin ad ʒj., may be perseveringly applied, after cleansing, night and morning; or the parts may be bathed in astringent waters—e.g. sulphate of zinc, alum, or acetate of lead, a drachm of either to the pint of water.

Tincture of belladonna, either pure or diluted, is well spoken of as a local application, but toxic effects should be watched for. For cases which resist such treatment, the following plan may be adopted:—The feet, after being washed and dried, are to be enveloped in neatly-applied dressings smeared with the following ointment—a modification of Hebra's unguent. diachyli: ℞ Emplast. diachyli, ʒiv.; olei olivæ, fʒiv. The plaster to be melted, and the oil added, and stirred until a homogeneous mass results; bandages to be applied, and clean stockings and new boots to be worn. In twenty-four hours the feet are to be redressed in the same way after being wiped (not washed), and dusted with dusting powder. The treatment is to be carried out for ten to twenty days, after which the dressings may be discontinued, and the dusting powder only applied. The process may have to be repeated. Desquamation occurs, beneath which the epidermis is tender at first. ALFRED SANGSTER.

HYPERMETROPIA, a congenital or acquired error of refraction of the eye, in which, with the accommodation at rest, the focus of the lens-system of the eye does not lie upon the layer of rods and cones of the retina, but at an imaginary spot behind. The physical state may be a short antero-posterior axis, too low refractive power of the media, insufficient curvature of the refracting surfaces, imperfect growth of the crystalline lens, or absence of the lens. *See* REFRACTION, Errors of.

HYPEROSTOSIS. *See* JAWS, Diseases of the.

HYPERTROPHY, in its surgical sense, is the term used to indicate enlargement of an organ, or overgrowth of a tissue. When analysed pathologically, it will be seen to include the results of very different causes

of increased nutrition. Thus, there are the Physiological Hypertrophies which happen as phases of the normal life-history of the body. Amongst these may be mentioned the enlargement of the uterus incidental to pregnancy; and the changes that develop in the female breast at the age of puberty, and prior to lactation. It may be said generally that physiological hypertrophies are intended to provide the means for a quantitative increase of functional activity, and that when the functional call ceases the increment of tissue is removed by consecutive atrophy.

Then there are certain cases in which a part passes beyond the level of natural growth, either as a congenital deformity—e.g. an enlarged hand or foot—or as an acquired excess and perversion of nutrition. The latter are apt to arise at certain epochs of life, and this feature is not the least of their characteristics. Diffuse hypertrophy of the breasts in young women, and enlargement of the prostate gland in old men, are familiar examples. Now, inasmuch as there is no sufficiently obvious explanation of such overgrowths, they have been designated *spontaneous*—a very convenient expression, but one which gives no information.

In hypertrophy of the prostate the glandular, muscular, and fibrous elements are all multiplied, and amyloid bodies are formed with tolerable frequency.

Compensatory Hypertrophies are induced for the purpose of overcoming increased resistance to muscular action; or for substituted service where one of duplicate glandular organs is, from some cause or other, crippled in its function. Numerous illustrations of the former group are met with in practice—e.g. stricture of the urethra entails hypertrophy of the bladder and ureters; stricture of the rectum a like condition of the contractile coat of the bowel above the seat of obstruction. The heart undergoes marked enlargement from incompetency of the valves or stenosis of the cardiac orifices. In these cases dilatation supervenes on the hypertrophy when the limit of compensation is reached, or, in other words, when the mechanical impediment interrupts the vascular supply of the muscles involved. In children, the bladder is occasionally hypertrophied without there being any recognisable obstruction to the flow of urine; indeed, it would seem that mere excess of function from long-continued derangement of the nervo-muscular dynamism—commonly known as 'irritable bladder'—is sufficient to account for the overgrowth of the vesical muscles. Elongated prepuce, ascarides, and polypus of the rectum may be the initial cause of the mischief, but, on the other hand, the functional disturbance may be purely intrinsic.

Hypertrophy is more common and more pronounced in the involuntary than in the voluntary muscles—(1) because the former are subject, in their normal state, to perpetually recurring frequent stimulation, and (2) because in them unusual resistance is more liable to arise and more difficult to remove. Up to a certain point the voluntary muscles grow in response to the extra call on their contractility, but beyond this the repair, during the shortened intervals of rest, is not equal to the loss sustained by over-exercise. When the muscular fibres are merely enlarged, the hypertrophy is termed 'simple;' when they are multiplied, it is called 'numerical.'

The disease known as *Pseudo-hypertrophic paralysis* (q.v.) affects the voluntary muscles, especially those of the calves. As regards the muscular fibres, it is essentially an atrophic change, the apparent hypertrophy depending mainly upon fatty infiltration within and without the sarcolemma.

When one kidney is undeveloped or atrophied, the other grows to meet the requirements of the system. The existing urinary tubules—and notably the secreting cells—are increased in size, and probably new ones are formed.

Irritative Hypertrophies.—The stimulus to increased nutrition is an artificial one, and its incidence often owing to chance. The results, which in the gross are classed with the hypertrophies on account of the bulk acquired, are largely inflammatory overgrowths, modified in each case under the influence of the special formative property of the tissues implicated. Intermittent pressure is a common cause of hypertrophy (continuous pressure leads to atrophy). It acts by teasing the structural elements into greater nutritive activity, and by determining an extra supply of blood to the part.

The pressure of tight and badly-fitting shoes is a fertile source of corns. Misdirected pressure, as when, through varus, the weight of the body is thrown on the outer surface of the foot, causes thickening of the skin and effusion into the subcutaneous tissue. The effusion is often so collected and circumscribed as to constitute a bursa, over which the callosity glides. The papillæ and hairs on the outskirts of chronic ulcers of the leg are always hypertrophied; and so, commonly, is the

underlying bone, which is then marked by a flattened node with well-defined margin.

Elephantiasis Arabum, a diffuse overgrowth of the skin and subcutaneous connective tissue, is a good example of irritative hypertrophy. It affects chiefly the scrotum and legs of Orientals.

Probably no other tissue shows such diversity in the degree and manner of hypertrophy as the osseous. In atrophy of the brain the cranium responds with concentric hypertrophy; and when the cranial contents are amplified, eccentric overgrowth of the encasing bone is the usual concomitant. Thickening of the cranial bones, with filling in of the diploe, is one of the features of senility.

Hypertrophic lengthening of a long bone may be due to some constitutional state—e.g. syphilis; more rarely it is complementary to shortening of another bone of the same or the opposite limb. Then there are those curious cases known as 'ostitis deformans,' in which a few, many, or most of the bones in the body are distorted by massive deposits and curvatures. Equally interesting, and puzzling as to its intrinsic nature, is the occasional progressive hypertrophy of the facial bones. 'In such cases the bony deposits are spongy, puffed, nodular, so that the bone acquires a resemblance to skin affected with elephantiasis.'—Billroth. AUGUSTUS J. PEPPER.

HYPOCHONDRIASIS (in the male), a mental condition, usually hereditary, akin, and often the prelude, to melancholia, characterised by great depression and a tendency to exaggerate or imagine symptoms of some physical ailment or defect.

In surgical practice it is generally met with in association with bleeding piles, so-called fissure of the anus, urethral stricture, apprehended impotence, varicocele, &c. Any local affection attended with pain, loss of blood, or prolonged purulent discharge will, in persons of feeble nervous organisation, react upon the system and increase the hypochondriacal tendency. Appropriate and successful treatment of the local ailment will therefore produce considerable improvement in the mental condition. But if there be no objective local ailment, the prognosis is very unfavourable.

If hypochondriasis be complicated by varicocele, the patient usually attributes his condition to this cause, and complains of aching pains and abnormal sensations in the corresponding testicle or spermatic cord. But varicocele very rarely requires operative treatment, and experience has proved that its removal in these cases does not benefit the patient, who still complains of pains when the supposed cause has ceased to exist.

Apprehension of impending impotence is a frequent symptom. The patient's thoughts are engrossed with the subject. He studies all his symptoms, and is alert to discover additional evidence of his incapacity. Stimulated more by curiosity as to his condition than by appetite, he attempts sexual intercourse, and if anxiety as to the result produce failure, as not infrequently happens, his mental depression is correspondingly increased. Such patients often volunteer confessions of self-abuse or of premature and excessive indulgence in venery. These aberrations are, in part at least, due to defective mental control; but indulgence in them reacts injuriously on the nervous system. Hypochondriasis is frequently met with in hospital practice, and many cases of so-called malingering are due to this cause. The patient wastes his life in going from one hospital to another, without benefit to himself or satisfaction to his surgeon.

The diagnosis of hypochondriasis is not difficult. The patient's exaggerated complaints and unusual sensations, without any objective cause, sufficiently indicate his condition.

Treatment.—Any local source of pain or irritation must be appropriately treated; but the ministering to a mind diseased belongs more to medical than to surgical practice. JEREMIAH MCCARTHY.

HYPODERMIC INJECTION.—By this term is understood the administration of drugs by injecting them in a concentrated form beneath the skin, into the lymph spaces, from which they are readily absorbed into the general circulation. This method possesses the following advantages:—(1) Rapid effect of drug; (2) more powerful effect produced; (3) direct local effect on tissues, especially nerve-trunks; (4) avoidance of direct disturbance of alimentary canal; (5) economy.

A. *Operation for Rapid Absorption.*—Care having been taken that the small hypodermic syringe is perfectly clean, and that the washer of the piston is supple and airtight, a sufficient quantity of the drug is drawn up into the body of the syringe, and all air excluded by turning the needle upwards and pressing the piston. The skin on the back of the forearm or elsewhere having been pinched up for about two inches and stretched tightly, the needle is driven, with a single rapid thrust, deeply

into the subcutaneous tissue, into which the fluid is then slowly injected; the needle is then as rapidly withdrawn, and the thumb placed on the puncture to prevent a possible slight oozing of the fluid injected.

Points to be noted in connection with the foregoing are—

(1) Syringe: the barrel should be of glass, upon which are directly screwed the fittings at each end. Minim or cubic millimetre divisions should be marked on the barrel, and not on the piston-rod, on which, however, should be placed an adjustable stop. The piston should have a double cup-shaped washer, the halves being separated by a groove. If the washer becomes dry it is always best to soak it in warm water. Before and after use, the syringe and needle attached should be washed thoroughly in pure water, the needle dried, and a wire inserted in it.

(2) Fluid, to be injected, must be in as small a quantity as possible without being so concentrated as to cause irritation on that account. (The irritative effect of many drugs can be avoided by judicious combination with atropa, &c.) If the quantity to be injected exceeds 15 minims or 3 cubic

Drug	Dose	Employment	Remarks
Acetic Acid	5 minims of 10 per cent. solution.	Check to new growths	Should be injected into growing margin. (Broadbent.)
Carbolic Acid	5–10 minims of 8 per cent. solution	To check infective inflammation and new growths.	In malignant pustule has been injected, 5–20 per cent., under pustule.
Lactic Acid	5 minims of 10 per cent. solution.	Check to new growths	Should be injected into growing margin. (Hüter.)
Osmic Acid	5 minims of 1 per cent. solution.	" "	Causes pain and inflammation.
Sclerotic Acid	3–5 m.	Excitor of involuntary muscular action in gut and uterus. Hæmostatic.	Far better than ergot. Inject into buttock deeply.
Bromine	1 m.	Check to hospital gangrene	
Iodine	1 gr.	Check to new growths (goître, &c.).	Of doubtful value.
"	⅛–½ gr. (10 m. Tinct. Iodi, or more.).	Strumous glands, tonsils, &c. Radical cure of hydrocele, &c.	
Iodide of Potassium.	3–5 gr.	Check to new growths. Chronic inflammatory disturbance.	Less powerful than iodine.
Arsenic	4 m. of Liq. Arsenic, + equal quantity of water.	Check to new growths, &c.	Painful.
Ferric Perchloride	3–5 m.	Radical cure of nævus, &c.	
Liq. Ferri Perchlor.	10 m.	Check to new growths	
Mercuric Perchloride.	1/10 gr.	Cure of syphilis	Should be combined with atropia and morphia.
Ammoniæ Liquor	10 m. in f℥j. of water.	Cardiac stimulant in shock, &c. Antidote to alcohol, opium, and snake poison.	Must be injected into a vein. Danger of local inflammation.
Sulphuric Ether	5–10 m.	Cure of epileptiform neuralgia, sciatica, &c.	Deep injection down to nerve-trunk.
" "	20–30 m.	Cardiac stimulant in shock or syncope from anæsthetics, &c.	Should be injected beneath skin of breast.
Chloroform	5 m	Local anæsthetic	Painful at first.
Aconitia	1/200–1/64 gr.	Check to neuralgia	Best to begin with small dose.
Apomorphia	1/15–⅛ gr.	As an emetic	Invaluable as emetic. Acts in 2 minutes.
Atropia	1/100–1/10 gr.	Antidote to opium, chloroform, pilocarpin, muscarin, aconite, &c. Checks excessive secretion.	Valuable to combine with other injections to reduce inflammatory mischief.
Cocaine	⅛–1 gr.	Local anæsthetic. Checks congestion of mucous membrane of nose, &c., &c.	Usually in 4, 10, or 20 per cent. solution. Inject 2–4 m. of last.
Curare	⅛–½ gr., or 4 gr. in 24 hours.	To cure tetanus and hydrophobia.	Of doubtful value. Only danger is paralysis of respiratory muscles.
Ergotin	⅓ gr., in water	Hæmostatic, &c.	Best to use sclerotic acid, q.v. If neither can be had, use 10 m. of Liquor ergot. ammon. and ¼ gr. morphia and 1/60 gr. atropia.
Eserine	1/120–1/60 gr.	To cure tetanus	
Hyoscyamin	1/200–1/20 gr.	Checks delirium of mania and delirium tremens.	
Morphia	¼–½ gr.	Anodyne. Hæmostatic. Writer has found, with Prof. Schafer, that it diminishes parenchymatous oozing when given just before operation.	Combine with 1/60 gr. atropine.
Pilocarpin	1/10–½ gr.	To produce sweating in cases of uræmia, &c.	Very useful combined with hot-air bath.

centimetres, it had better be divided, and each part injected in a different place.

(3) The point at which injection is to be made should usually be in the limbs, on the extensor surfaces, where the skin is loose. Least pain and tension will follow where the skin is loosest.

Deep injection is recommended by some, and then the needle is thrust, to the head, vertically into the muscles of the buttock or back.

(4) *Accidents.*—(*a*) Inflammation may be caused by want of cleanliness in the needle, &c., decomposition of the fluid to be injected (growth of fungi, &c.), excessive quantity of fluid injected, inflammation being set up by simple tension. (*b*) Injection into a vein, and consequent toxic symptoms from too rapid absorption of drug. These can all be avoided by ordinary attention.

B. *Operation for Interstitial Injection to check New Growths.*—Tumour to be cleansed, pedicle to be constricted, if possible, during and for a short time after injection. The needle is to be thrust deeply into the substance of the growth, the skin having previously been drawn aside to ensure a valvular guard to the puncture in the growth. Points to be noted are—

(1) Avoidance of vessels; accurate filling of syringe; thrusting the needle in first, and waiting to see (by flow of blood through it or not) whether it may chance to have penetrated a large blood-vessel; injection to be slow; quantity of fluid to be small at first sitting, viz. up to f℥j., or less if in such a position as the tonsil, &c.

(2) Accidents are—(*a*) Inflammatory disturbance, to be treated in the ordinary way; (*b*) injection into a vein, which may be fatal; this event to be avoided by observing the flow of blood from the needle, as just detailed.

C. *Operation for Checking Spread of Acute Specific Diseases.*—(*a*) To check spreading inflammation, such as erysipelas, hospital gangrene, traumatic gangrene, &c., inject beneath skin (in cases of gangrene, deep injection must be made as well) ½ inch or about 1·5 cm. in front of the red margin of inflammation, at points about ⅓ inch or 1 centimètre apart, 5–10 minims or about 2 cm. of fluid. (*See* table.) Has also been used (with very concentrated fluids) in malignant pustule.

Special modes of injection are referred to under the various drugs employed.

The drugs given are all soluble either directly in water or glycerine and water, or in water when they are in the form of salts —e.g. sulphates, &c. VICTOR HORSLEY.

HYPOPIUM. Pus in the anterior chamber of the eye. *See* HYPOPYON.

HYPOPYON denotes a collection of pus in the anterior chamber of the eyeball. It is distinguished from ONYX, which is an infiltration of pus into the lower part of the cornea, by being movable and shifting its position with the movements of the head, so as to gravitate to the most dependent part of the chamber. Its Latin form is hypopium. *See* CORNEA, Inflammation of the; IRIS, Diseases of the.

J. TWEEDY.

HYPOSPADIAS.—This deformity of the male generative organs is one common enough to attract the attention of most surgeons in practice, and is sometimes distressing enough to justify and even to call for persevering attempts to relieve it. It has been the fortune of the writer to see a great number of these cases during the last twenty years. The larger proportion of them have been comparatively slight cases, characterised only by an absence or a bifurcation of the frænum preputii. Usually, absence of a true meatus urinarius, and a backward position of the urethral opening, varying from a quarter to half an inch, were associated with this condition of the prepuce. In all cases, a deficiency of the prepuce at the under part of the glans penis is evident. In most, the prepuce is, on the other hand, redundant upon the dorsum of the penis. This redundancy, in many forms of the malformation, assumes a shape somewhat similar to a hood or cowl, concealing the glans penis as seen from above and in front. At the sides of the corona glandis it slopes off, and is lost on the skin of the penis at the side of the urethra, so that the frænum preputii is split like a hare-lip.

In most of the severer cases, the body of the penis, near the glans, presents a decided downward curve, always more evident during the state of erection. In some cases, the curve thus increased during erection becomes an obstacle to coition, even without any extremely backward position of the meatus. In such cases, the penis as an organ of micturition is efficient, but as an instrument of coition is not so. The curve depends, in all the instances the writer has met with, upon the presence of a rigid band of fibrous tissue, forming the under surface of the corpora cavernosa. This band (which is apparently the result of an attempt to repair or supplement the deficient development of the

corpus spongiosum of the urethra) being devoid of erectile tissue, does not accommodate itself to the changing bulk of the corpora cavernosa during erection, and, by its passive resistance, causes the downward curve of the penis peculiar to these cases.

In all the cases met with by the writer, the urethra has been more or less deficient in the proper development of its enclosing sheath of erectile tissue, the prolongation forward of the corpus spongiosum. Its walls are usually formed of mucous membrane, invested by a thin layer of fibrous tissue, which lies under a delicate and fine skin, and is a prolongation of the fibrous investment of the erectile tissue forming the bulb of the corpus spongiosum penis. The fossa navicularis is usually imperfect or entirely absent. The meatus urinarius is a transverse slit, forming a valvular aperture more or less contracted, and sometimes admitting only a fine probe. It may be the cause of a difficulty in micturition and trouble soon after birth. The opening varies in its position, being from a quarter of an inch or so posterior to its normal site, or extending to the base of the penis at the junction of the scrotum with the skin covering the penis, or even into the perineum beyond the scrotum. Frequently there is seen at the base of the penis a sort of navicular depression, indicating the abrupt termination of the bulb of the penis, even when the urethral aperture is placed considerably anterior to it. Between this depression and the actual opening the urethra in these cases is covered by a thin membranous skin, in addition to its mucous and fibrous investment. The skin on the under surface of the penis is generally thin and imperfectly developed, and often looks like an old cicatrix. In one remarkable case of the writer's, occurring in a young and vigorous man of the age of eighteen, this depression at the root of the penis was very marked, the urethra being, however, completed nearly as far as its normal termination by a thinner and finer skin. Although the urethra in this case was completed, and tolerably efficient as a micturating channel, the fibrous bands on each side of the urethra previously described were so thick and rigid that, when erect, the penis behind the corona glandis was bent almost double by their resisting action, so as to render coition quite impossible.

In a certain proportion of cases this deformity assumes a still more remarkable character. The cleft is continued backwards through the scrotum and into the perineum, separating the two halves of the scrotum into two labia, similar to the labia majora of the female. Each of the labia, however, is rather fuller, broader, and more pronounced than in most female children, and usually contains a testicle in a more or less perfect state of development. The urethral groove is continued backward through the anterior half of the perineum, completely severing the two halves of the corpus spongiosum, and ending at the membranous portion of the urethra in a distinct fourchette, resembling that of the vagina in the female. Often, in these cases, there is a prominent valve-like formation of a crescentic shape, somewhat similar to the virgin hymen, and still further increasing the resemblance to the female. When this condition is accompanied by an imperfect evolution and non-descent of the testicle, the resemblance is so close as to afford a real excuse for the common mistake as to the sex of the individual.

Some of these individuals, in whom the testes, although present in the upper part of the labia, are small and ill-developed, have been mistaken for females in whom the ovaries have been drawn down into the labia. Many such cases are recorded. The author, however, considers that all, or nearly all, these persons have been really males. He has never seen one in whom the evidence has been unmistakably in favour of a really feminine condition. They are never, so far as he has seen, provided with a vaginal canal, distinct and separate from the urethral one, and the uterus is altogether absent, the prostate often doing duty as a witness in evidence of that organ. The diagnostic signs most to be depended on are the absence of both vagina and uterus, on examination by the finger *per anum*, with a sound passed through the urethra into the bladder; and the passage of the urine through the opening which has the external appearance of a vagina.

The family history of cases of *hypospadias* usually shows, like that of hare-lip, cleft palate, ectopia vesicæ and epispadias, and other deformities resulting from deficient evolution or arrest of development, a distinctly hereditary tendency. In many families of boys, some degree of the deformity may be observed in more than one, and although the difficulties of ascertaining the atavic peculiarity in such cases are great, from the peculiar position and obscure indications of the slighter cases of the deformity, enough can often be gathered to

show that there is a family proclivity. In extreme cases only is it the cause of impotence, and thus the race is continued so long as the less serious results only are present in the individual bearer of the peculiarity. Some curious and valuable evidences of this are given by Mr. A. Lingard in the *Lancet* of April 19, 1884.

Treatment.—The slighter cases of hypospadias, in which the deformity is confined to the prepuce, frænum, and fossa navicularis, the penis serving more or less perfectly to carry the urine away from the clothes in micturition, may with great propriety be left alone. No attempt should be made to improve the slight deformity, which is by no means conspicuous. In more severe cases, where the urethra is open to the extent of its anterior half, the writer has succeeded in carrying forward the urethral tube to the end of the penis by transplanting the redundant dorsal portion of the hood-like prepuce, making a transverse incision or button-hole close to the coronal groove on the dorsum, and passing the glans penis through the aperture. The under surface of the penis was denuded of skin by turning over the urethral groove two lateral flaps, reversed, with the skin surface turned to the urethra, and reaching as far back as the groove extends along the urethra. These were stitched together by a continuous or glover's suture of fine carbolised catgut. The transplanted dorsal hood was then split up into two layers at the cut edge, which was opened and spread out over the raw surface of the reversed urethral flaps, and stitched to the edges by closely applied sutures of fine silver wire. At first, the transplanted prepuce looked rather lumpy, but this was soon diminished by the subsequent contraction, and served well the purpose of conducting the urine so as to make a definite and compact stream, clearing the clothes of the patient.

When the deformity extends as far back as the scrotum, it is usually necessary to take a flap from the front part of the scrotal integument, to eke out the deficiency of the prepuce, and to cover, when transplanted, the whole of the penile urethra. These cases usually give more trouble to cover the urethral groove, an imperfect union of the reflected and transposed flaps often resulting. They are still further complicated by the chordee or downward curvature of the penis during erection, resulting from the more complete arrest of development of the corpus spongiosum urethræ. They usually require operations for the cure of the chordee *previously* to the attempt to cover the urethra.

The writer has, in some cases, succeeded in diminishing to a great extent the degree of the downward curvature of the penis when erect, by making numerous transverse subcutaneous sections of the hardened and thickened tissues on each side of the urethral groove, and keeping the penis strapped upon a couple of thin metal splints covered with red rubber. The splints used were curved slightly in the opposite direction to the penis, so as to keep the latter upon a slightly convex surface. They were held on by india-rubber bands, which could easily be removed for the purpose of micturition. Two or three minor operations were usually required to obtain the best possible results. The cases, in which the imperfection of development is so great as to leave the genital organs in a condition resembling that of the female sex, require more extensive operations, but these are usually more directly and completely successful than those last described.

The result in the last case operated on by the writer, six months ago, was more than usually favourable. It occurred in a young man about twenty-one years of age who, up to the age of eighteen, had been trained and dressed as a female. It was not until the voice changed and the appearance of a beard and whiskers that suspicions were aroused as to his real sex. The penis was about the size of that of a boy of ten years, and the glans fairly formed and developed, but imperforate. The urethra was open as far as the perineum, the scrotum split into two labia majora, in each of which an oval, very movable, testis could be felt. When pressed upon, these gave to the patient the testicular sensation felt by a male subject. At the posterior extremity of the urethral groove was a lunated fold, with the general appearance of the fourchette and hymen. The aperture leading to the bladder was rather larger than the diameter of the prostatic and membranous urethra in a male of that age, but the compressors of the urethra were present, and acted completely in the retention of the urine. The urine escaped in a diffuse stream from the orifice, and the patient was obliged to sit down like a female to pass the water with comfort. On examination *per anum* no uterus or vagina could be felt, but the prostate, traversed by the sound when introduced, could be distinctly made out. The nymphæ were fairly represented by the folds of the split prepuce. An attempt was first made, by paring these folds and the sides of the

urethra down to the perineum, to unite them simply in the median line over a gum elastic catheter, by the use of thin silver wire sutures closely applied. This plan, however, totally failed. A second operation was more successful.

This consisted in dissecting up each of the halves of the scrotum freely, along the whole length of the sexual opening, laying down one flap, reversed, upon the urethral groove (denuded of skin on each side), and placing upon its raw surface the raw surface of the other side by the plan of reversed and superimposed flaps described under EPISPADIAS: *see* ECTOPIA VESICÆ and EPISPADIAS. These were closely stitched together with a large number of silver wire sutures, which were kept in for several weeks until the flaps were firmly grown together. Some straggling hairs, growing from the skin surface of the reversed flap, were destroyed by the application of a drop of strong nitric acid applied to the root of each hair, which removed them before the principal operation was done. The union took place all the way up to the glans penis, forming a very perfect substitute for the lower urethral wall.

The patient could pass his water over the clothes in a very fair stream, with some dribbling towards the end of micturition. The testes remained in the folds of the scrotum on each side of the perineum, and gave no trouble. The whole appearance of the genitals now left little doubt as to the sex of the patient.

Operations of the kind just described require on the part of the patient much confidence and some powers of endurance; and on that of the surgeon much previous consideration, ingenuity, and fertility of resource. Repeated attempts will often succeed in the long run, when the case appears to be hopelessly incurable. With care and caution in arranging the operation, the patient need rarely be left in a worse, even if he do not attain to a better, condition through the efforts of the surgeon.

JOHN WOOD.

HYSTERECTOMY. *See* UTERUS, Extirpation of the.

I

ICHTHYOSIS.—*Definition.*—A general disease of congenital origin, characterised by extreme dryness of the skin, and more or less development of scales, epidermal plates, or warty-looking growths.

Etiology.—The disease is due to some congenital defect in the cutis, and is hereditary in many cases, but by no means in all The heredity may be direct, may skip a generation, or may be through a lateral branch. Sometimes, only one child in a large family will have it; at another, several children in the family, often keeping to the same sex, which may be either the same or the opposite to that of the affected parent; but, taken as a whole, both sexes and all classes are equally liable to it. There is no other known cause for the congenital affection, but a local condition resembling I. simplex is sometimes seen after injuries or disease of nerves. Epidermal and papillary hypertrophy is also seen sometimes in chronic inflammatory conditions looking like ichthyosis, but these are referable to elephantiasis arabum.

Varieties.—Ichthyosis, in one or other of its forms, is a fairly common disease, but varies immensely in its development. Three clinical types may be recognised: the first two are general, and are called xeroderma and ichthyosis simplex; the third, ichthyosis hystrix or hystricismus, is usually more or less localised. All of these varieties are congenital. The two general forms are not really distinct, the milder form being connected by every gradation with the more severe, but their separate consideration makes the clinical description clearer.

Symptoms.—Xeroderma is the commonest and mildest form; in it the skin is dry, rough, and dirty-looking, with the natural lines more marked than usual from the thickening of the epidermis; the roughness is produced by slight furfuraceous scalyness, and also by the prominence of the hair-follicles due to the condition known as keratosis pilaris, which is always present, often in a high degree, on the extensor surface of the limbs and trunk.

In ichthyosis simplex the whole surface has a tessellated appearance, from being covered with large, angular, dirty-white, finely corrugated, papery scales, which are adherent, and therefore slightly depressed in

the centre (I. scutellata of Schönlein), while the edges are detached, transparent, and shining (I. nacrée of Alibert, or I. nitida). This and the following variations are often best seen on the leg, where the surface is frequently glistening above, with thicker scales below. In still higher grades, the scales adhere together to form thin plates, and being of a green tint look something like a serpent's skin (I. serpentina); when there are still thicker plates the appearance of a crocodile's hide is produced (Sauroderma). The older the plates, the darker they become, so that they may vary from an olive green to black (I. nigricans). A form of seborrhœa is sometimes called I. sebacea. While all these fanciful names are to be met with in literature, and are therefore explained, their use should be avoided as they only produce confusion. These extreme conditions are rarely extensive, and only occupy certain regions, a milder form prevailing elsewhere.

Although a general disease, it is unequal in its severity in different regions, and is always more developed on the extensor surfaces, especially over the tips of the elbows and knees and just above the ankles, where it may attain to the higher condition of warty growths or plates, even when the disease is moderate elsewhere; on the other hand, the flexures are comparatively free, often appearing quite normal. The palms and soles are often not much affected, except in the worst cases, but are nearly always harder and smoother from the absence of the smaller natural lines; the limbs are worse than the trunk, and the legs than the arms. The nails may be pitted and brittle, the hair is dry and harsh, and the scalp branny, while the face, though relatively less affected, is rough, and very often eczematous. In bad cases, there may be ectropion from contraction of the dry skin.

Itching is frequently experienced, especially when the clothes are taken off, but it is never severe unless eczema is present, to which the ichthyotic skin is very liable when exposed to cold, which may also produce painful fissures or chaps. The fully developed ichthyotic skin does not perspire sensibly, but some sweat may be seen in the flexures, especially the axillæ, and occasionally on the palms, soles, and face; the patients feel much relieved by it, and their condition is usually notably ameliorated in the summer.

Ichthyosis hystrix differs in so many ways from the other forms, that many regard it as a totally different affection, but there are connecting links with the commoner forms.

It is never general, though it may be widely distributed, and occasionally certain parts may be in the hystrix condition, while the rest of the skin may be xerodermatous; but in the majority of cases the intermediate skin is quite healthy. Moreover, it is seldom symmetrical and is often unilateral—sometimes sharply limited on the trunk by the median line—and frequently recognisably distributed in the course of the cutaneous nerves; hence it is usual to see it in lines running longitudinally on the limbs and transversely on the trunk, while the face is rarely affected, and then in a minor degree; in other cases the nerve-distribution cannot be traced.

The lesions vary from a small pin-point-sized papillary growth, covered with a horny cap which forms a nail-head-like prominence on the skin, up to warty or dark greenish, vertically striated, horny masses, with a wide base and truncated conical shape like limpet shells, projecting half an inch or more above the surface; when the horny part is soaked or pulled off, hypertrophied papillæ are brought into view.

Inconvenience is only experienced when the growths are in awkward positions, such as the palms and soles, on which they are common, or when the horny tops are torn off too roughly by catching in the clothes, &c.; but they are often shed spontaneously without any pain. Mental weakness is sometimes associated with very extensive cases of I. hystrix, and asthma is said to be more frequent among ichthyotic patients. In a unique unilateral case of Dr. Church's the mucous membrane of the cheek, soft palate, and tongue was affected on the same side; but for this exception it might be said that ichthyosis never affects the mucous membranes, the so-called 'ichthyosis linguæ' being an acquired affection of a totally different origin.

Course.—Although doubtless congenital, the skin does not usually show any abnormality for some weeks or months after birth, though a few cases have been born with it; while the higher grades are not attained to before the second year or later. This does not apply to I. hystrix, which develops sometimes quite early, and even at birth may show some signs of its presence. The disease tends, on the whole, to get gradually worse rather than better as the patient grows up, though there may be some remissions according to the season and to the amount of attention given to the skin. After full adult age is reached, some im-

provement appears to take place in cases of moderate severity.

Pathology and Morbid Anatomy.—There is evidently some congenital defect in the development of the cutis, chiefly of the epidermal layer; this is saying little, but we are unable at present to go further.

The morbid anatomy of ichthyosis simplex has not yet been made out; that of I. hystrix has been investigated by Kaposi and the author. The author's observations are here given:—In a horny growth the papillæ and their vessels are much enlarged, the Malpighian cells adjacent to the papillæ being normal, but instead of the intermediate layers of cells which in health fill or, so to speak, level up the inter-papillary spaces and so form a nearly plane surface on which the horny layers rest, the strata of horny cells dip deeply down into the inter-papillary spaces; so that the hyperplastic corneous layer follows the outline of the papillary layer, with a comparatively thin layer of rete cells intervening, in this particular differing from ordinary warts.

Diagnosis.—The diagnosis seldom presents difficulties. The disease dating back from a few months after birth; the general distribution; the dry, rough skin of xeroderma, the scales and plates of I. simplex, and the warty growths and nerve-distribution of I. hystrix are so characteristic as to leave no room for error, and the date of its onset will distinguish it from those secondary local conditions which resemble the congenital cases. When, however, extensive eczema complicates xeroderma, there is a great resemblance to prurigo, the more so as prurigo also commences in the first year of life; but the date of the onset of the eczema, the absence of prurigo papules and the enlarged glands, together with the result of treatment, will get over the difficulty.

Prognosis.—The prognosis is decidedly bad for its curability. Temporary amelioration can always be afforded in I. simplex, and, if the patient will take the daily trouble, the skin can be kept supple and free from discomfort. In very mild cases, steady perseverance for years with judicious treatment has effected a cure. I. hystrix is very hopeless as a rule, but a permanent removal of the growths, where the development has not been very great, may sometimes be effected.

Treatment.—This must be directed to removing the scales, and then making and keeping the skin pliable.

The first indication is best fulfilled by alkaline and bran baths, and friction in the baths, preceded, in bad cases, by soft-soap inunctions; the removal of the scales must be followed by inunctions of glycerine ointment or lotions, and animal and vegetable fats, vaseline or other petroleum fats. Almost any fat will do, such as lard, cold cream, neat's-foot, olive, and almond oils, or cod-liver oil; the last is very effectual, but too disagreable. Kaposi speaks very strongly in favour of a 5 per cent. napthol ointment, in conjunction with napthol soap. Whichever is selected should be well rubbed in twice a day at first; but glycerine lotion will be found the most convenient application for the face and hands, in the strength of 1 to 10. Steady employment of these applications will soon render the skin quite smooth and supple, and the patient will seem to be quite cured; but this state can only be maintained by inunctions two or three times a week and frequent baths, or the disease will very soon return, and only requires time to resume its former severity. Eczema as a complication requires treatment appropriate to that condition; callosities can be softened by strong potash lotions (1 to 2) or continuous applications of soft soap or salicylic acid plaster. The larger growths of I. hystrix should only be interfered with if they are in inconvenient positions, and can then be excised or scraped with a sharp spoon.

The smaller papillary growths may be removed by the continuous application of tar ointment, and though many of them return, some will be permanently removed. A pleasanter application, and one which has been more successful than tar in the hands of the author, is to paint the growths, after removing the horny caps, with a saturated solution of salicylic acid in alcohol. Internal treatment in all forms is absolutely useless. H. Radcliffe Crocker.

ILIAC ABSCESS. *See* Psoas Abscess.

ILIAC ANEURISM.—The term 'iliac aneurism' is applied to all aneurismal tumours in connection with the common, external, and internal iliac arteries. The disease is most common in the lower part of the external iliac artery, at its junction with the femoral ('inguinal aneurism'). The internal iliac is rarely affected.

Etiology.—The causes are those of aneurism in general. Syphilitic disease of the vessels appears, however, to be a relatively frequent source of the lesion, while a history of a violent strain, as in lifting heavy weights, or some other traumatic influence, may often be traced. It is most

commonly found in men, and about the middle period of life.

Symptoms.—The first sign usually noticed by the patient is the appearance of a pulsating tumour in some part of the iliac fossa, in the course of the common or external iliac artery. The form of the tumour is generally oval, but, when encroaching upon the common femoral, it may present a constriction at the level of Poupart's ligament. Thrill and bruit are distinct, and the latter may often be traced for a considerable distance along the femoral vessels. Pain is usually slight or absent in the deeper aneurisms, owing to the space available for the expansion of the tumour without interference with important structures; and hence the disease may reach an advanced stage, or the sac may even rupture, while the patient is still unconscious of its existence.

The condition mostly terminates by the bursting of the aneurism either internally or, more rarely, externally. In a recent case published by Mr. Gem, the hæmorrhage took place into the bladder (*Lancet*, Nov. 15, 1884). Gangrene of the limb has been recorded in one instance.

Diagnosis.—The characters of the aneurism are generally so well marked that little doubt can be entertained as to its nature. There are, however, two comparatively rare conditions which may be mistaken for the arterial disease—namely, pulsating tumour of the ilium and glandular or other growths in contact with the vessels.

Pulsating tumour of the ilium is distinguished from aneurism: (1) by the extent and position of the area of the growth, which is commonly traceable on the outer as well as on the inner surface of the bone, and external to the course of the arteries; (2) by the diffused character of the bruit, which spreads widely over the iliac fossa but does not extend along the course of the arteries of the thigh; (3) by the absence of the comparative enfeeblement of the femoral pulse observable on the affected side in the case of iliac aneurism; (4) by the possibility, in some instances, of tracing the pulsation of the artery by the side of the tumour.

A group of cancerous glands in the pelvis, compressing the three iliac arteries, has been known in one case, recorded by Mr. C. H. Moore, to cause symptoms so closely resembling those of iliac aneurism that the common iliac artery was ligatured, and the real condition was not discovered until the post-mortem examination (*Med. Chir. Trans.*, vol. xxxv.).

In rare cases, an aneurism of the abdominal aorta may descend into the iliac fossa even as low as the groin, as in an example reported by Letenneur. Arteriovenous aneurisms of the iliac fossa are extremely rare, only two cases having been narrated.

Treatment.—The cure of iliac aneurism has been attempted (1) by compression applied to the tumour itself or to the vessels above the point of disease; (2) by ligature, both distal and proximal; (3) by galvanopuncture; and (4) by injection of perchloride of iron.

1. *Compression.*—Owing to the position of the iliac arteries at the back of the false pelvis, the application of pressure, if long-continued, is less easily tolerated by the patient and is attended with more difficulty and danger, than in the case of compression of vessels in the extremities. The dangers attributed to the operation are those dependent upon the contusion of the peritoneum and viscera lying in front of the vessel. It has even been questioned by Mr. Holmes whether the measure is not more dangerous than ligature of the common iliac artery; but the statistics, for which we are indebted to the same authority (*see Lancet*, Oct. 10, 1874), do not lend countenance to this view. Of ten cases of compression for iliac and ilio-femoral aneurism, seven were cured. In the other three instances no beneficial effect was produced, and ligature was subsequently applied (in one case to the abdominal aorta) with fatal results, but the unfortunate termination does not appear to have been conduced to by the previous treatment.

The compression cannot usually be maintained for more than five or six hours, even with the aid of anæsthetics; but in one case it was applied for over ten hours, and was crowned with success just as the extreme limits of tolerance were reached. Direct compression of the aneurism by means of a bandage, associated with the application of ice, was tried in one case by Raynaud, in 1835, and effected a complete cure.

2. *Ligature.*—Iliac aneurism has been treated by proximal deligation of the external and common iliac arteries and of the abdominal aorta; by distal ligature; and by a modification of the operation of Antyllus.

(*a*) The external iliac artery has been tied many times for aneurism involving the lower part of this vessel and the upper part of the femoral artery. Of 141 examples of the operation collected by Rabe and Barwell (of which about three-fourths were

for femoral aneurisms), 31 terminated fatally from various causes, including secondary hæmorrhage (15), gangrene, suppuration of sac, tetanus, pyæmia, &c.; but there is good reason to believe that this mortality would be largely diminished by the resources of modern surgery.

(β) Ligature of the common iliac artery was first employed for iliac aneurism by Valentine Mott in 1827, and has since been frequently practised, but with indifferent success. Of 36 cases collected by v. Kümmell, only 9 survived the effects of the operation, the rest (75 per cent.) dying from secondary hæmorrhage, peritonitis, pyæmia, gangrene of the limb, and other causes. To the list may now be added a successful case by Stetter. In one case recorded by Sands the patient recovered at the expense of the limb, which became gangrenous after the operation. The results so far are not very encouraging; but, as remarked by Mr. Holmes, there is little doubt that, in future, the procedure will be rendered less fatal by the use of antiseptics and drainage, and by the employment of animal ligatures.

(γ) Ligature of the abdominal aorta is an heroic measure that has hitherto been uniformly disastrous. It has been performed seven times, including one case of temporary deligation, the operators being Sir Astley Cooper, James, Murray, Monteiro, South, M'Guire, and Stokes. In the case of Monteiro, the patient did not die until the eleventh day after the operation, when he succumbed to hæmorrhage, which was afterwards found to proceed from an aperture in the artery above the ligature. This case, although ultimately a failure, may be regarded as a proof that the operation is not necessarily fatal. In M'Guire's case the left ureter was included in the loop.

(δ) Ligature on the distal side of the tumour has been performed four times, in all without success.

(ε) Ligature of the artery above and below the sac, followed by the deligation of the internal iliac, which appeared to communicate with the aneurism, was performed by Syme with a curative result, but the operation has not been repeated.

3. *Galvano-puncture* was tried by the writer in 1878 in a case of aneurism of the external and common iliac. The patient, a man aged 35, was the subject of mitral and aortic valvular disease. The tumour, fusiform in shape, and about the size of a large turkey's egg, extended downwards nearly as far as Poupart's ligament, and was in process of rapid development during the period of observation. After a fruitless and ill-borne attempt at compression, it was determined to essay galvano-puncture in preference to ligature of the common iliac, as there was reason to believe that the coats of that vessel were extensively diseased. Two needles, connected with the positive and negative poles of a Stöhrer's battery of twenty cells, were introduced into the lower part of the sac, and the current was maintained for three minutes, after which the needles were left *in situ* for forty-eight hours. No immediate effects were apparent, but at the end of the second day consolidation had evidently begun, and twenty-four hours later the impulse was almost imperceptible. At this time the patient unfortunately took advantage of the temporary absence of his attendant, and got out of bed to avoid the use of the pan; on the next morning the pulsation was again distinct, and shortly afterwards regained its original force.

In cases where the aneurism is superficial, especially in the ilio-femoral form, the use of galvano-puncture in association with compression would probably favour coagulation in a marked degree without adding sensibly to the risks of pressure. It is suggested that well-insulated gold or platinum needles, one or more in connection with each pole, be introduced into the centre of the tumour, and the needles, after the discontinuance of the current, left in place for forty-eight hours or longer, during which period the galvanism may be repeated if necessary. *See* Electrolysis.

4. *Injection of Perchloride of Iron.*—This measure was adopted in the case just cited, when the tumour was enlarging with such terrible rapidity that rupture appeared imminent. A drachm of diluted liq. ferri perchloridi (1 in 4) was injected into the lower part of the sac, while the common iliac and common femoral arteries were firmly compressed. On removal of the pressure thirty minutes after the operation, the aneurism was found completely consolidated. The limb was powerless, insensible to touch below the level of Scarpa's triangle, blanched, cold, and pulseless, but there were no constitutional effects beyond a slight and transient shock. The extremity remained in the same condition day after day; the temperature was reduced by several degrees, and no indications of returning circulation could be detected; nevertheless signs of gangrene were equally absent, and the health of the patient underwent steady improvement. The sac remained solid, but was rather hot and tender.

The patient was kept in absolute repose, with the limb slightly flexed and enveloped in a thick covering of cotton wool. At the end of ten days, the area of sensibility began to extend downwards, reaching nearly as low as the knee, an increase of the local temperature was perceptible, and the constitutional condition was more satisfactory than at any time since admission. On the evening of the sixteenth day, a sudden and apparently causeless change took place. The patient became suddenly collapsed, and rapid gangrene set in, spreading as high as the hip. The extremity was amputated at the hip-joint without loss of blood, and the scanty and imperfectly vitalised flaps were washed with a strong disinfectant solution. As a result, the patient rallied to a great extent from his prostration, and for a time appeared to struggle for life with some prospect of success; but his powers were insufficient to support the profuse drain which ensued at the seat of operation, and he died of exhaustion ten days after the removal of the limb. No autopsy was permitted.

The termination of this case was unfortunate, but the results of the two powerful measures were not wholly discouraging, especially when the extent of the arterial disease and the complication with a serious cardiac lesion are borne in mind. There is little doubt that had the patient observed the injunctions strictly impressed upon him after the galvano-puncture, a complete cure would have been achieved, as in a case of axillary aneurism that had been treated in the same manner a few months previously. The injection of perchloride of iron produced an immediate consolidation of the aneurism, and although the collateral circulation was gravely compromised, the limb maintained a hopeful struggle for existence until some accident, probably the occlusion of the chief of the still permeable channels by a detached fragment of clot, inflicted the *coup de grâce*.

Amputation at the hip-joint has not yet been suggested as a means of treatment in iliac aneurism, but the expedient is perhaps worthy of consideration, as an alternative for ligature of the abdominal aorta, in cases where deligation of the common iliac is ineligible. The removal of the lower extremity would permanently lessen the circulation through the diseased vessel, and would confer all the immediate advantages of the distal ligature. At the same time the danger of the operation would be small compared with that of the aortic ligature, while, in the event of a failure to secure the desired result, the internal iliac might be tied, and the more formidable measure of ligature of the aorta would remain open as a last resource.

William Anderson.

ILIAC ARTERIES. — The Common Iliac Artery extends from the bifurcation of the aorta at the left side of the fourth lumbar vertebra; the vessel then passes downwards and outwards across the fifth lumbar vertebra, until it reaches the sacro-iliac synchondrosis, where it divides into its terminal branches—the external and internal iliacs.

Each common iliac averages two inches in length, but may vary from three-quarters of an inch to three inches. There is but little difference between the lengths of the right and left artery. I. *In front of* the right artery are—the peritoneum; the ileum just about to enter the colon at the ileo-cæcal valve; the ureter crossing just at the arterial bifurcation; sympathetic cords on their way from the lumbar ganglia to the hypogastric plexus; the ovarian artery and vein in the female. *Behind*, are the meeting of the right and left common iliac veins, and the commencement of the inferior vena cava in front of the fifth lumbar vertebra. To the *outside* is the psoas muscle; the inferior vena cava emerges from behind it to appear on the right. To the *inside* is the interval between the two common iliacs, where the left common iliac vein crosses, the arteria sacra media descends, and the hypogastric plexus is found. II. The left artery has—in *front*, the peritoneum, the ureter, and sympathetic nerves, as on the right; but the sigmoid flexure crosses it to become the rectum, with the trunk of the superior hæmorrhoidal vessels. *Behind* are the fifth lumbar vertebra, and the left common iliac vein running to the inner side and on a plane posterior to that of the artery. The other relations are almost identical.

The External Iliac Artery extends from the sacro-iliac synchondrosis to Poupart's ligament. This vessel always presents a curve in the centre of its course, being the spot where the flexure of the vessels comes in the sitting posture; this is sometimes so pronounced that it arches down into the pelvis. In *front* of the vessel, both right and left, are—the peritoneum; the ureter at the commencement of the artery; the vas deferens at the lower end; the circumflex iliac vein crosses the artery beneath the vas deferens, and close to the giving off of the deep epigastric at

Poupart's ligament; the genito-crural nerve descends upon the artery. The right artery has the ileum crossing to become the colon, the left the sigmoid flexure to become the rectum. The psoas muscle is first to the *outer* side and then at Poupart's ligament *behind* either artery—i.e. the vessel lies on the psoas at the groin. The *vein* on the left side is to the *inner* side of the artery all the way along; the vein on the right side is, at and above Poupart's ligament, to the inner side of the artery, but it then crosses beneath it to reach the common iliac vein, to form the inferior vena cava.

The Internal Iliac Artery commences opposite the sacro-iliac synchondrosis on either side, and drops down into the pelvis in front of that articulation, until it reaches the upper border of the great sacro-sciatic foramen, where it divides into two primary branches—an anterior and posterior.

In *front* are the peritoneum, the ureter, and the first stage of the rectum on the left side; *behind*, the sacro-iliac synchondrosis, separated by the internal iliac vein. The external iliac vein also, on the left side, crosses behind it on its way to form the left common iliac. *Externally*, is the pelvic wall with the obturator nerve; *internally*, the rectum and the structures in the middle line. The vessel touches the edge of the psoas at its commencement, and at its ending the upper border of the pyriformis muscle.

Ligation of the External Iliac.—During the operation the patient lies in a recumbent position, with the shoulders raised so as to relax the abdominal muscles.

In choosing either a modification of Abernethy's or Cooper's operation the surgeon will be guided by circumstances; and when it is uncertain what artery requires ligature, will perform Abernethy's.

I. *Abernethy's Operation.*—The cutaneous incision on the right side is commenced at a point one inch above and one inch internal to the anterior superior spinous process of the ilium; from hence it is carried downwards and forwards in a curved direction, with the convexity downwards, for a distance of four inches. The incision ends half an inch external to a point midway between the anterior superior spinous process and the symphysis pubis, and three quarters of an inch above Poupart's ligament; on the left side the same incision is made, but in the reverse direction. The structures cut through are—skin; superficial fascia, with some branches of the superficial circumflex iliac artery; there may be much or little fat; deep layer of the superficial fascia—i.e. Scarpa's fascia; the aponeurosis of the external oblique is nicked and its fibres separated; the muscular fibres of the internal oblique and the transversalis muscles are cut through, and then, the transversalis fascia being exposed, nicked, and raised on a director (a hernial director is safest), the subperitoneal fat is reached. The fingers should be used to separate the tissues after the transversalis fascia is cut. By the fingers the peritoneum, with its contents, is pulled inwards until the vessel is well exposed. Retractors now hold the margins of the wound apart, the surgeon opens the sheath not lower than one inch above Poupart's ligament, draws the vein inwards, the genito-crural nerve outwards, and passes the aneurism-needle from the vein towards the psoas-muscle—i.e. from within outwards.

Dangers.—(1) Cutting too far inwards, and thereby wounding the deep epigastric; if this vessel be wounded, tie it. (2) Wounding the peritoneum by rash cutting, or by neglecting to use the director properly. (3) Failing to find the vessel in the usual position; if it is not normal, it will be found bent downwards towards the pelvis. (4) Wound of the circumflex iliac vein. (5) Including the genito-crural nerve, giving rise, according to observation, to tetanus. (6) The subsequent dangers are—gangrene of the lower limb, secondary hæmorrhage, sloughing of the sac, tetanus and peritonitis.

II. When it is known what the exact extent of the disease is and where the ligature is to be applied, Sir Astley Cooper's operation may be performed. Make an incision through the skin from just external to the external abdominal ring to near the anterior superior spinous process of the ilium. The incision will be about three inches long and parallel to the fibres of the external oblique muscle. Cut through the integument, fasciæ, and external oblique, slitting it parallel to its fibres. With the director separate the deeper tissues from Poupart's ligament, drawing the spermatic cord and epigastric artery upwards and inwards, and the internal oblique and transversalis muscles upwards and outwards. Tear through the transversalis fascia, when the peritoneum is raised by both the retractors and the vessel is seen and secured, as in the operation previously described.

Dangers.—(1) Finding that the disease is of greater extent than diagnosed, which, on account of the limited space given by the incision, makes it difficult to reach the

sound artery. (2) Wounding the deep epigastric; this is to be immediately tied.

III. The so-called Esmarch's operation is practically a systematised Abernethy.

The Common Iliac Artery is ligatured by precisely the same incision as that employed in Abernethy's operation, only that the external limit of the incision given above is continued upwards towards the cartilages of the ribs for a distance of three inches. In other words, an incision is commenced just in front of the cartilage of the eleventh rib, and carried downwards and forwards to one inch and a half within the anterior superior spinous process of the ilium, and terminating by a sharp curve inwards just above the internal abdominal ring. The tissues cut through and retracted are the same as those met with in Abernethy's operation. The retraction of the tissues is continued until the pulsations of the external iliac can be felt, when the finger is run upwards, detaching the peritoneum, until the common trunk is reached. The needle is passed from within outwards on both sides.

Dangers.—Wounding the peritoneum, either when cutting down on the vessel or when it is being raised. To avoid wounding it open the transversalis fascia low down, where it is strongest, and, as the process of detachment is proceeding, gently but firmly support the parts, holding the peritoneum well out of the way. During the detachment the ureter clings to the peritoneum, and is pulled inwards with it. See also *External Iliac Artery* above.

The Internal Iliac Artery can be reached and ligatured by steps identical with those employed for the common iliac. Steven of Santa Cruz, however, who first tied the vessel, reached it by making an incision five inches long and half-an-inch outside of, and parallel to, the deep epigastric artery. Another incision has been employed, but with many evident disadvantages; it is an incision practised by White, commencing two inches to either the right or left of the umbilicus, according to the side required, and cutting downwards and inwards by a curved incision, with its convexity towards the ilium, and ending just above the external abdominal ring. James Cantlie.

IMMOBILITY, or absolute rest, is one of the most potent factors in the healing process of bruised or broken, diseased or wounded, hard or soft tissues. As a therapeutic principle, immobility underlies the whole surgical domain. It is one of the fundamental and most generally applicable lessons of physiological surgery, and one of the chief aims of surgical handicraft and mechanics; especially so in the treatment of wounds, sprains, and fractures, and of articular diseases. Repair is in direct proportion to rest; and the nearer this approaches to immobility, the more perfect will be the work of reparative surgery. Physiological position and equable pressure powerfully contribute to immobility; but, as a rule, this cannot be secured without mechanical contrivances. Of these, the best and most generally useful are moulds and splints, enclosing the joints above and below the point to be immobolised, sand, shot, and water-bags, weights, pulleys, and swings. For the construction of moulds, a great variety of materials are available —millboard, gutta-percha, paraffine, and poro-plastic felt, starch, dextrine, silicate of potash, plaster of Paris, and strips or sheets of wood and metal. The surgeon's choice must be regulated by the exigencies of particular cases, and by his opportunities of acquiring experience with different kinds of materials and methods. Wire moulds are easy of construction, and may be made strong, yet light. Another simple and efficient plan for immobilising a limb, or the trunk, consists in padding well, and then adding diagonal strips of moistened millboard or plastic felt, thin metal or deal veneer or scaleboard. Bandaging, lightly yet firmly, smoothly and without reverses, commences when the first strip is laid on. Successive strips and layers of bandage follow, until a perfectly fitting and comfortable mould is constructed, with all the strength possessed by alternately intersecting spirals. The addition of gum, starch, chalk, or other solidifiable material, over the layers of the apparatus in process of construction, materially contributes to its strength. Rigid splints and moulds, however constructed, may often be usefully combined with undulating suspension, in securing immobility; illustrating how in the treatment, as in the production, of injuries and diseases, a combination of causes, seemingly, but not essentially, different, may contribute to common ends. *See* Position; Pressure; Rest; Suspension.

Sampson Gamgee.

IMMOBILISATION. *See* Immobility.

IMMOVABLE BANDAGES. — The essential principle in all the substances used for immovable bandages is, that they can be applied in such a soft and pliant state as

to be accurately adapted to the shape of the part, and that, when they have set, they form a firm and even support for every portion of it. The most important materials used are bandages soaked in starch, dextrine, plaster of Paris, a mixture of gum and chalk, glue, silicate of potash or soda, paraffin or bees' wax; coarse flannel soaked in plaster of Paris; gutta-percha, leather, and poro-plastic felt. They are used to maintain accurate position and immobility of broken bones and excised joints, to secure perfect rest of diseased joints, to make spinal supports, to rectify deformities of joints, &c., and to fix interrupted metal splints in compound fractures, excisions, &c.

Some form of immovable apparatus is usually employed as a final support to fractures, but opinions differ with regard to their immediate treatment in this way; the only valid objection to it appears to be the danger of the limb swelling and causing localised sloughs or gangrene; but if the patient be watched for a few days, there need be no alarm on this score, for any swelling and blueness of the toes, or pain from the apparatus, should lead to its instant removal and the relief of pressure. There are, moreover, a number of advantages resulting from this method of treatment; perfect immobility is secured at once, so that pain and laceration of tissues resulting from muscular spasm are prevented, and the bones are placed in the most perfect condition for rapid union; the apparatus is so comfortable that it is unusual to have complaints of uneasiness, even from fidgety patients; the irksomeness of a fixed position is obviated, for the patient is able to turn about when the apparatus is set, and in the course of a few days he is able to get up and out into the open air; his stay in hospital is much diminished, and, if his occupation is suitable, he is very quickly enabled to attend to it in some degree.

Plaster of Paris Bandages.—The finest plaster, such as dentists and modellers use, is required; it must be freshly prepared, for any dampness will interfere with its 'setting:' and, if there is any doubt about its condition, it should be baked in an oven, so that it may be again rendered fit for use. The best bandages for this purpose are made of crinoline, the meshes of which are sufficiently large to allow of the plaster being well ground into them, but not large enough to let it fall through; it is very important that the plaster be well ground into the meshes, and that any superfluous powder be rubbed off, for if left it makes the bandage lumpy. The bandages should be rolled up loosely, and if not used all at once they should be placed in an airtight box, or they will quickly spoil. If there be no fear of swelling, the limb should be first covered with a flannel bandage; but if swelling be expected, as in a case of recent fracture, cotton wadding should be used by preference, as that will yield a little in the event of swelling occurring, whilst at the same time it exercises an elastic pressure on the limb, and also expands again as the swelling subsides. Place a bandage on end in a basin of warm water till it is saturated and all bubbles have ceased to rise, then squeeze out the superfluous water, and apply the bandage by spiral and oblique turns, rapidly ascending and descending the limb, till the whole is covered in. The oblique turns have the advantage that they lie quite evenly, without reverses, and run more nearly in the length of the limb, and so ensure greater strength and less liability to transverse cracking of the apparatus. While one bandage is being applied, another should be placed in the water to soak; as a rule, three or four thicknesses of bandage will suffice; reverses should not be used, but the final layer may be put on by figure-of-eight turns, so as to give a neat appearance to the splint. The whole apparatus may be smoothed over with plaster-cream, but the folds of the bandage should not be effaced by it. If greater strength be required, strips of wood or perforated tin may be placed between the layers of the bandage. If a window be required, the situation should be indicated by some contrivance, and a good one is to take a piece of card of the requisite size, prick a pin through the centre of it, and place it, with the pin projecting outwards, over the required spot, and as the bandages are rolled over that part, make the pin pass through them and stand off from the surface, as an indication of the centre of the area to be cut out from the plaster case.

Bavarian Splint.—Take two pieces of flannel, long enough to reach from the ham to the ball of the toes, and a few inches wider than the circumference of the leg, stitch them together along the middle line for the length of the leg, and beyond this cut them through in the same line; put the flannel behind the limb, with the seam exactly in the middle, bring the inner layer round and pin it along the front of the leg, the dorsum and sole of the foot, so as to form a tightly-fitting stocking; smear this layer all over with plaster of Paris cream, and before it sets, press the outer layer, already cut to the proper size, evenly over it. When the plaster has set, remove

the pins from the inner layer of flannel, and bring the borders of the latter round the edge of the splint in front and along the sole, and stitch it to the outer layer. The apparatus forms an accurately-fitting splint, which can be easily removed without in any way disarranging the limb, as the seam along the back of it acts as a perfect hinge.

Croft's Splint, for the immediate treatment of fractures of the leg, consists essentially of two well-moulded lateral splints, made of coarse house-flannel, thoroughly soaked in plaster of Paris cream; the flannel should be thoroughly shrunk, and from it four pieces, having the shape of the patient's stocking, and long enough to reach from just above or just below the knee to the middle of the metatarsus, should be cut, particular care being taken that the foot-piece is at right angles to the leg-piece, and also that the anterior border of the latter is a straight line. Arrange the four pieces of flannel in pairs—two for each side of the leg—and saturate the outer piece of each with plaster a little thicker than cream, and re-apply it to its fellow. The splints ready, the patient should be anæsthetised if necessary, the leg 'set,' and held in position with the foot at right angles to the leg, the splints applied and fixed by simple plaster of Paris bandage. The apparatus may be easily cut down the front, if need be, the edges trimmed, and the splint eased or tightened as required. If a window be needed, it should be cut in the flannel before it is soaked in the plaster of Paris cream.

Starch Bandages are used for similar purposes to plaster of Paris ones, over which they have the advantage of lightness, but the disadvantages of requiring a longer time to dry, and of not forming so strong a support. Prepare a bowl of hot 'clear starch,' and pass well-shrunk calico bandages through it, and re-roll them; next envelope the limb evenly with a layer of cotton wadding, and smear the latter with starch; then take pasteboard splints, which have been torn to the requisite size and shape, steep them in boiling water and then in starch, and whilst still hot, apply them to the limb outside the cotton wool, and fix them in position by a turn of bandage here and there. Let the limb be held in position, and then apply the starch bandages, and, as they are rolled, let more starch be rubbed into them by hand, or painted on with a brush; reverses should be avoided, as they cause uneven pressure, and add considerably to the difficulty of cutting up the bandages. When dry, the starch apparatus is often too loose, and if so, it should be cut up the front, and the edges pared and brought close together by another starch bandage.

Paraffin forms a light, non-absorbent splint, and has the advantage that it can be recovered from an old splint by steeping it in boiling water, when the paraffin will rise to the top and solidify there as the water cools. The paraffin should melt at from 120°–130° F. To make a splint of it, bandage the limb with a flannel roller, and over it apply a few layers of strips of flannel soaked in the molten paraffin. It is best to put on the paraffin in strips, like strapping, as it sets too quickly to be applied in a continuous bandage. Macewen's method is perhaps still better, and easier of application; he takes a piece of sheet cotton-wool, cut so as to ensheath the limb accurately, and steeps it in melted paraffin; he then applies a gauze bandage to the limb, adjusts the paraffin splint, and puts another gauze bandage rather firmly outside all.

Silica, or Liquid Glass, Bandages may be kept ready for use in bottles of the silicate solution. They 'set' sufficiently to restrain movement in less than an hour, but require two or three days to harden completely; they can be easily removed, as the silicate is soluble in water.

Gum-and-Chalk Bandages are applied in the same manner as the starched ones, over which they have the advantage of 'setting' more quickly, and forming a firmer splint; equal parts of gum arabic and precipitated chalk should be mixed up with boiling water, and the bandages passed through the mixture and re-rolled; gauze bandages do very well.

Glue Bandages form a firm and elastic splint, which can be easily cut up about twelve hours after application, and the edges fitted with 'eyelets' if required. Steep some fragments of the best French glue in cold water for a few hours, then melt it in the usual way, and add one-fifth part of methylated spirit, stirring the mixture well, so as to cause solution of the coagulum formed on the addition of the spirit; the spirit accelerates the hardening of the glue. Cotton bandages should be used and, as each one is applied, it should be thoroughly brushed over with glue; two or three layers of the bandage are usually sufficient.

Bilton Pollard.

IMPACTED CALCULUS. *See* Stone in the Urethra.

IMPACTED FRACTURE. *See* Fractures.

IMPETIGO (*Synon.* Impetigo contagiosa; Porrigo contagiosa).—The name impetigo was formerly applied to certain diseases of the skin attended with the formation of *pustules;* thus an eczema in which pustules were abundant was called impetigo. The pathological change seemed to the older writers to entitle the disease to a change of name, and the fact that pus-formation is only part of a *morbid process* which may occur in almost any inflammatory disease of the skin was apparently overlooked. In the sense above indicated, the name impetigo does not convey any very clear idea of a definite disease distinct from eczema, and therefore the name pustular eczema is to be preferred. Dr. Duhring, of Philadelphia, is the only writer of mark who describes, under the name impetigo, 'one of the rarer skin diseases' distinct from impetigo contagiosa and eczema, and says 'the initial lesion is a perfect pustule.' The writer of the present article has failed to identify Dr. Duhring's impetigo with any disease met with in England; indeed, it may be doubted whether the 'initial lesion' in any disease can be a 'perfect pustule.' The late Dr. Tilbury Fox drew a distinction between common porrigo and impetigo contagiosa; but the distinction, if any, is one of cause rather than of kind. German writers of the Vienna school, on the other hand, scarcely admit any form of impetigo as distinct from eczema; the distinction is, however, fully recognised by most American, English, and Continental writers, and is certainly convenient. The name impetigo is gradually and rightly displacing such terms as porrigo and impetigo contagiosa, which might with advantage be dropped out of our nomenclature.

Impetigo is an inflammatory affection of the skin, attended with a vesico-pustular eruption. The vesicles are usually isolated or scattered in small groups; their contents very quickly become puriform, and this is followed by rupture of their walls and the formation of thick, light yellow scabs, which completely cover an excoriated surface; the eruption is very easily reproduced by inoculation.

Impetigo is a disease which has given rise to much discussion. Many writers on the subject appear to lose sight of the fact that all pus, under certain favourable conditions, is capable of being inoculated with the result of producing more pus. The fact, that the pus of impetigo is usually more readily inoculated than other pus, depends on the surrounding influences of the case; unfavourable hygienic conditions are enough to explain the difficulty which seems still to puzzle some writers. The disease, though occasionally introduced into the schools and families of the well-to-do classes, never spreads rapidly, while amongst the crowded poor of our large towns it quickly attacks every young member of the household.

Etiology and Pathology.—The causes of impetigo are almost always local, combined with unfavourable hygiene. That the latter is an important factor is proved by the fact that the disease is almost confined to the poor, dirty, and badly-fed classes; the local cause is *pus-inoculation*, the origins of which are very numerous. Amongst the best recognised may be mentioned superficial whitlows, burns, vaccination or any slight wound that 'gathers' or 'festers,' as non-professional people are in the habit of calling the formation of pus. But by far the most common cause is pediculi capitis: here the lesions from scratching are numerous, and the pus is very easily transferred by the nails to other parts of the body, especially to the nose and corners of the mouth. In all cases the pus is quickly absorbed by the lymphatics, hence the rapid enlargement of the glands of the neck. This absorption by the lymphatics plays, in the opinion of the writer, an important part in the extension of the disease, as it does not seem possible to explain the very rapid and extensive eruption of pustules, which sometimes occurs, on the supposition that each pustule is the centre of a separate inoculation. The constitutional disturbance which often accompanies the disease also seems to point in the same direction.

Diagnosis.—The following points will especially distinguish impetigo from ordinary eczema:—(1) Each spot appears as a single vesicle or small group of vesicles, without the surrounding skin being red and inflamed, very unlike the first appearance of a patch of eczema; (2) it is easily inoculated; (3) it is usually unsymmetrical and more distinctly a local affection than eczema; (4) it is unattended with itching unless complicated with pediculi or eczema; (5) it is almost entirely a disease of the poor and dirty classes, and chiefly confined to children; (6) the children who suffer long from it are always pale and badly nourished; (7) pediculi capitis being the most common cause, it follows that the occiput is the most common primary seat of the disease; it is thence transferred to the nose and corners of the mouth and to other parts of the body, or from person to person; (8) when the occiput is affected

the glands in the neck are quickly enlarged.

Treatment.—Impetigo of the scalp is quickly cured by white precipitate ointment, which heals the sores and at the same time removes the cause. On the body, the best local application is a thick lotion made of calamine, zinc oxide, and lime water; this should be painted on with a brush and allowed to dry on, so that a crust is formed. If pus collects under this crust, it should be removed and the excoriated surface painted again with the lotion; when the crusts remain firmly attached the cure is soon effected. Tonics, especially iron, are useful. ROBERT LIVEING.

IMPOTENCE.—Incapacity for sexual intercourse must be distinguished from sterility, or incapacity for the secretion or ejaculation, at the requisite time, of normal seminal fluid. The subject of sterility is not necessarily impotent; but if we except the rare cases in which conception has occurred without penetration, impotence involves sterility.

Impotence may be congenital or acquired, complete or partial, permanent or temporary, and may result from widely different causes.

Enlargement of the scrotum, from a large irreducible scrotal hernia, or from a large hydrocele of the tunica vaginalis, or from elephantiasis, may prevent copulation. Malformation of the penis, such as extreme epi- or hypospadias, arrest of growth of the external genitals, so that they remain of infantile size in adult life, benign or malignant growths on the penis, may also prevent it. Inflammation or suppuration of part of the corpus spongiosum, or of the corpora cavernosa, sometimes results in the formation of cicatricial tissue, by which the penis may be so distorted during erection as to render penetration impossible. Induration and contraction of the frenum may have a similar result. Total loss of the penis from accident or disease necessarily causes impotence, but partial removal of the organ has not this effect, if enough be left to allow of penetration. Arrest of development of the testicles, or complete destruction of both glands from accident or disease, will usually be attended with impotence. In some cases, however, of double castration, the power of copulation has been retained for some time after the operation. Partial or complete defect of the erectile power from some abnormal condition of the central nervous system is the most usual cause of impotence. Erection is the result of a greatly increased supply of arterial blood through the temporarily dilated afferent vessels of the penis, combined with retarded outflow from the organ, in consequence of relaxation of the muscular fibres in its cavernous structures, and possibly of compression of the dorsal vein by fibres of the accelerator urinæ muscle. The process is controlled and regulated by nerves originating in ganglion cells, the so-called erection centre, in the lumbar portion of the spinal cord. This centre can be excited by peripheral stimulation of the afferent nerves of the genital organs, and possibly by the quantity and quality of the blood supplied to it. It is also connected, by fibres in the spinal cord, with higher centres in the cord itself and in the cerebrum, by which it can be excited or inhibited. These centres, with their connecting fibres, and afferent and efferent nerves, form a complex nervous system, and impotence from defect of erection, may result from disturbance of the due relation between the several parts of this system, or from injury, disease, or degeneration of it.

Impotence from the condition of the central nervous system may be classified as psychical, irritable, and paralytic.

Psychical impotence results from undue predominance of the cerebral inhibiting centres, so that erection does not occur. It is, in most cases, of only temporary duration. Newly-married men sometimes find themselves incapacitated from performing marital functions from this cause. In those who have led chaste lives, it may be due to nervousness or great excitement. But in cases where excessive venery or masturbation has been practised, the predominant inhibition may be due to diminished excitability of the lumbar centre. Patience, and the assurance that there is no physical incapacity, generally suffice to terminate this unpleasant condition. This form of impotence is sometimes more persistent, but is limited to attempted connection with one individual, and is not experienced with others. Such cases are very rare; but the story told by Herodotus of King Amasis and his wife Ladike, is corroborated by more modern apparently genuine instances. The inhibition in these cases is probably reflex, and excited by some peculiarity in the female.

In irritable impotence there is erection, but of very brief duration, and the semen is ejaculated before penetration has been effected. There may be varying degrees, and some cases are on the border line

between impotence and sterility. It is due to over-excitability of the nervous centres, and generally results from habitual masturbation or excessive venery.

Paralytic impotence may be due to injury, disease, or degeneration of the nervous centres. Blows upon the head, or injuries to the back, are sometimes the cause of permanent or temporary impotence, which can only be explained by the assumption of some affection of the nervous system. Fracture of the spine, producing paraplegia, must necessarily cause impotence. If the injury to the cord be above the lumbar centre, there is usually persistent priapism, from hyperæmia or irritation of the lumbar centre, or from accidental peripheral stimulation in the absence of all inhibiting control. But even if there be no priapism, reflex erection could doubtless be produced in such cases if the lumbar centre be intact, and cases are recorded where, despite the paraplegia, copulation, and even procreation, have been effected, the man being, of course, passive in the transaction. Diseases of the cerebrum and spinal cord may also cause impotence, which is sometimes an early symptom in locomotor ataxy.

Cases not infrequently occur of premature diminution, and ultimately of total loss of virility, without any symptom of disease or history of injury. These can only be explained by the assumption of premature degeneration of the nervous centres. The duration of sexual life is very variable, in some being prolonged to extreme old age, in others terminating at a much earlier period. The latter may be due to individual idiosyncrasy, but is more frequently the result of premature and excessive indulgence in venery, or of habitual masturbation. Impotence may be a symptom of general exhaustion, temporary after acute fevers, or permanent in wasting diseases, such as phthisis. It is often associated with Bright's disease, and, in varying degrees, with diabetes. Gout may induce it temporarily, and it is often the result of disordered digestion, especially if there be oxaluria or phosphuria.

Lastly, certain drugs are credited with producing impotence. Arsenic, according to Charcot, has this effect when taken for a long time, but on the cessation of its use virility is regained. Opium-eating and excessive indulgence in tobacco are also said to produce impotence, probably from their deleterious influence on the nervous and digestive systems. Considering the prevalent use of tobacco without such results, there may possibly have been some special susceptibility to its influence in the cases where this effect has been observed.

The prognosis with respect to impotence must depend upon the cause, which can be ascertained only by careful inquiry into the history and general condition of the patient.

Treatment.—This will vary with the cause. When impotence is a symptom of some other disease, the appropriate treatment for the exciting cause must be pursued. Impotence from mechanical hindrance, such as hernia, hydrocele, benign tumours, or growths, cicatrices, and the like, may in some cases be relieved by operative interference.

Psychical impotence, as a rule, requires only moral treatment. In irritable impotence, due to previous excess, complete chastity of mind and body for a time, cold bathing, and suitable tonics, will be of great service. Easton's syrup of phosphate of iron, quinine, and strychnia, is a very useful preparation in these cases. Electricity has been highly commended, and the frequent application of a constant current to the lower part of the spine may be of service in reducing the over-excitability of the lumbar centre. In persons of naturally feeble power, so-called aphrodisiacs, such as phosphorus and the tincture of cantharides, are sometimes useful; but in cases of exhaustion from excess they are of as little service as would be the spurring a jaded horse when a long journey has still to be performed. In impotence from injury to the head or back, blisters along the spine have been recommended;* but the treatment is so empirical and uncertain in its results, that it is difficult to estimate in the successful cases how much may have been due to art, how much to nature. Premature loss of virility, with retained sexual desire, is especially troublesome. Such patients are usually hypochondriacal, and sometimes develop suicidal tendencies. They appear to regard copulation as the only purpose of existence, and to have lost, with the ability to accomplish it, all inducement for living. Even in these cases, chastity of thought, exercise, cold bathing, and nervine tonics may effect some improvement. But the prognosis is not favourable, and the happiest result would be if they could be induced to adopt Cicero's philosophy, and regard their loss as gain. 'O præclarum munus ætatis, si quidem id aufert, quod vitiosissimum adolescentiæ est!'

JEREMIAH MCCARTHY.

INCARCERATED HERNIA. *See* HERNIA, Obstructed.

INCLINED PLANES are appliances by means of which broken limbs may be supported, and displacement of the bones prevented by relaxing the faulty muscles. The single inclined plane supports the lower limb with the knee extended and the hip flexed, and this has been recommended in treating fractures of the patella; it is also useful to support the limb when the venous circulation in it is impeded. The double inclined plane is so adapted as to support the lower limb with the knee and hip-joints both flexed, which position relaxes the psoas and iliacus, and prevents their traction on the upper fragment in fractures of the femur high up; it also relaxes the hamstrings and the calf-muscles, and so removes much of the cause of displacement in fractures close to the lower end of the femur. The apparatuses, to which the term inclined plane is primarily applied, are made of wood; some of them are made with fixed angles, but others have arrangements by which the angles may be altered. As a rule there are no lateral supports, but Esmarch's inclined plane is perforated by a number of holes into which pegs may be placed; when the limb is in position on the inclined plane, pegs are placed in the most suitable holes to form a barricade all along the limb, and so prevent it from slipping from its position.

McIntyre's splint and Hodgen's suspension splint are essentially inclined planes, and are more comfortable than the wooden ones above described. BILTON POLLARD.

INCONTINENCE OF URINE, or ENURESIS.—In this affection the will cannot control the action of the bladder, and urine is involuntarily discharged, greatly to the annoyance of the patient, and often seriously affecting the performance of his or her social duties. In these cases the bladder is always empty, or is periodically emptied by the involuntary efforts of the patient. There is, however, a condition known as false incontinence, which it is of great clinical importance to distinguish from the true variety; here the bladder is never really emptied but is habitually full of urine, while the overflow runs off and makes the bladder appear incapable of holding any water. Such cases are at once distinguished by the use of a catheter, when the chronically retained urine is drawn off. False incontinence results from long-standing urethral stricture, chronic enlargement and other affections of the prostate, and from atony and paralysis of the bladder. In women, in addition to atony and paralysis of the bladder, its expulsive power may be seriously interfered with by certain conditions of the uterus, notably, by prolapse and retroflexion of that organ. For the treatment of false incontinence *see* BLADDER, Diseases of the.

Men, women, and children may all suffer from true incontinence of urine. In men and women, true incontinence may result from defect in the primary nervous centres. When this is so, probably other organs will be affected besides the bladder. Here the surgeon can do but little. The treatment must consist of tonics and stimulants, diet, sea bathing, and the use of electricity. Vesical calculus may be the cause of constant dribbling of urine; in which case the stone is usually lodged in the neck of the bladder. In the same way prostatic calculus may cause incontinence. There is a peculiar form of chronic enlargement of the prostate, where the hypertrophy so affects the neck of the bladder that its action is rendered imperfect and urine constantly flows away, although there is absolutely no habitually retained water. Here the patient must wear an india-rubber convenience, and beyond careful attention to the bowels there is nothing to be done; fortunately such cases are of extreme rarity. At all ages, and in both sexes, incontinence may follow severe injury to the urinary apparatus, the result of kicks, falls, or tubercular or syphilitic ulceration.

Incontinence of urine, in women, may be caused by injury to the neck of the bladder or urethra, from the prolonged pressure of the child's head during labour, or from the use of instruments; and also from operations undertaken for the removal of stone from the bladder. In certain of these cases, plastic operations may be undertaken with some hope of success. After perineal lithotomy both men and boys occasionally suffer from incontinence. In children this unfortunate condition appears to come on quite independently of the size of the stone or of the roughness of the operation; but in men it appears to have some connection with the size of the stone, and the writer has known it follow the operation of lithotomy, when the wound has required firm and prolonged plugging on account of hæmorrhage. In these cases, during the night there is usually (except in children) no escape of urine, but in the daytime there is a constant leakage, the patient also making urine naturally at regular intervals. An india-rubber receptacle may

be worn, or a napkin only if the escape be very slight. An attempt may be made, but it is rarely successful, to retain the urine by means of the pressure of a perineal pad, secured by a truss, or by elastic shoulder-straps or braces.

Juvenile Incontinence.—In children there is a special form of urinary incontinence, which deserves particular attention. The bladder appears to be in a hyperæsthetic condition, and children of all ages and of both sexes may pass urine involuntarily during the night and day. Usually it is in the night only, and the child wets his bed and is said to suffer from nocturnal incontinence of urine. During babyhood the habit often escapes notice, or is looked upon as almost natural, but as age advances the debility is found very distressing, and sooner or later medical aid is called in; especially when the parent finds that the child is debarred from many educational and social advantages. Generally, there is nothing remarkable about the appearance of these children, although often they are exceptionally bright and intelligent. Sometimes, the habit has resulted from neglect on the part of the mother or nurse, who has omitted to rouse the child during the many hours it is naturally in bed. In other cases the affection arises from the local irritation of intestinal worms, from a tight, long, and perhaps adherent prepuce, or from a too acid or other morbid condition of the urine. In most cases, however, it is simply a nervous debility, either the expelling muscles of the bladder are unduly active or the retaining muscles are weak, or there is a want of proper co-ordination between the two sets of muscles. As puberty arrives the weakness usually, but not always, disappears.

Treatment.—In the first place see the child make water, and note if there is pain or difficulty in the act of micturition. Be on the look-out for symptoms of stone, and even for retention of urine; the latter may be suspected if there is a suprapubic tumour, the former if the incontinence is diurnal, and if there is much pain at the end of passing water; but, if all appears to be right, do not distress the child with the use of any urethral instrument. In treating the children of well-to-do parents, remember that it is very unusual for them to suffer from vesical calculus. Next, examine the urine, look for albumen, sugar, pus, blood, and for lithates, as well as earthy phosphates. Very likely the urine will be quite healthy. Inquire if red sand is ever noticed in the child's water. Inquire also about worms: ask if any have been seen, and if any anal itching is complained of. Examine the foreskin; if it is not easily retractable, perform circumcision. This operation is universally desirable, and, should the incontinence persist afterwards, the child will in every way be in a more advantageous condition than he was before. If worms are present (usually thread-worms), remove them by means of common salt enemata and vermifuge medicine, such as santonin, followed by a brisk purge. If the urine is habitually too acid, attention must be paid to diet, and a small dose of grey powder given; afterwards a little alkaline medicine may be administered, but all diuretic salts must be carefully avoided.

In all cases the diet must be regulated. The meals should consist of breakfast, dinner in the middle of the day, and supper. All stimulants, including tea and coffee, must be absolutely interdicted. No sweetmeats are allowable, and certainly not much butcher's meat. Some have advised entire abstinence from meat and even from broths, but this does not appear to be necessary. The child should live upon bread, vegetables, fruit (in moderation), milk, any farinaceous foods, butter, eggs, fish, fresh game, poultry, and a little meat. An effort should be made towards evening to curtail or even to avoid all fluids. The general habits of the child must also be superintended. He should be warmly clothed, and the skin kept active by plenty of hot water, soap, and good rubbing. His life should be a quiet one, all excitement such as is afforded by theatres and children's parties, is to be avoided, and in many cases a diminution of the school tasks will be advantageous. In rare cases, the child may be allowed to run wild in the country or at the seaside for twelve months. All terrorism is wrong, and parents, nurses, or schoolmasters using the rod in such cases deserve a hundred times the punishment themselves. The young patient should go to bed early, and should be taken up the last thing at night and early in the morning to pass water. In the daytime he should be encouraged to hold his urine as long as possible, and at night his bed should be a hard one, and the coverings not very heavy. He should sleep on his side, and not on the back; this is often managed by tying a knotted handkerchief round the waist, with the hard central knot just over the middle of the back. The bowels must if necessary be made to act daily, easily and gently.

It is surprising how much may be done by careful management, but in many cases

medicines must be resorted to. The drug most in favour, and which undoubtedly is frequently successful, is belladonna and its alkaloid, atropine. The tincture of belladonna and the extract are both used. Care should be taken that the drug is of the very best quality. It acts by partially paralysing the bladder. A small dose should be commenced with, three times a day, and gradually increased, while its effects are closely watched, so that directly any symptoms of excess are seen, such as dryness of throat and dimness of vision, its increased administration may be stayed. When the bladder is found to be controlled by this medicine, the dose is not to be further augmented, but the patient should be kept under its full influence about a week, and then the doses may be gradually diminished until the medicine is entirely left off. In the same category come the ordinary preparations of opium administered by mouth or rectum, and also chloral hydrate and the bromides. The writer has used codeia with satisfaction. These medicines act by diminishing sensibility, and enable the bladder to become tolerant of urine. On the other hand, in some cases stimulants and tonics are useful; all the ferruginous preparations, together with strychnia, cantharides, and ergot, have been largely used. It is almost needless to say that any condition of the general health requiring cod-liver oil or other special medicines must be attended to. Counter-irritation is sometimes of service. This is usually made by applying a large blister over the sacrum. The blister may be kept open by dressing it daily with savin ointment. Doubtless counter-irritation is often useful, and it is advantageous also in an indirect way, for, if applied over the sacrum, the sore place prevents the patient from sleeping on his back.

In boys the passage of a soft bougie is often beneficial, and in both sexes as a last resource a mild solution of nitrate of silver may be applied to the urethra. In boys this is done through a small catheter passed into the deep urethra. The solution at first should not be stronger than two grains to the ounce of water, afterwards the strength may be gradually increased up to eight or even ten grains. All mechanical methods of closing the urethra, by means of collodion, elastic ligatures, &c., are not recommended. In conclusion, it may be remarked that these cases are often very obstinate, and unless there is strict attention to details in the treatment, it had better not even be attempted, so far as the credit of the practitioner is concerned.

G. Buckston Browne.

INDURATION, in the majority of cases, is the sequel of inflammation. It then varies directly as the chronicity and inversely as the activity of the exudation. But the constitutional state of the patient and the intrinsic nature of the disease are very important factors in fashioning the final result. In strumous enlargement of the lymphatic glands, the degree and distribution of the induration change with the sequence of phases of the morbid process. At first the hardening is diffused, then it gives way, in the centre of the gland, to the softening of suppuration or caseation, whilst finally, the pultaceous débris not seldom becomes impregnated with lime salts, and a nodule of chalky or stony density, surrounded by close-grained cicatricial tissue, is the abiding mark of the previous disease.

Again, there are some maladies, mostly of a specific nature, like syphilis, diphtheritic croup, and croupous pneumonia, in which the exudation is highly fibrinous. The comparative induration of different venereal sores is a valuable aid to their diagnosis. It is not alone in the primary lesion of syphilis that the induration is so marked. The same holds good as regards the swelling of the lymphatic glands—indolent bubo.

Induration is one of the changes incidental to old age: thus the cranial bones become thicker and more compact from ossific deposit, and the parenchymatous organs—e.g. the brain—are subject to overgrowth of interstitial tissue. The terms *sclerosis*, *fibrosis*, and *cirrhosis* are employed to indicate indurating processes, which in former times were considered as inflammatory, but are now regarded as simple fibroid substitution—a distinction almost without a difference. Familiar examples are furnished by the so-called 'gin-drinker's liver' and by the sclerotic lesions of the spinal cord—posterior, lateral, annular, insular, &c.

It may be stated generally that the firmer the tissue in its natural state, the greater is the induration of disease: take, e.g., epithelioma of the skin, lip, or tongue, and a periosteal node in which ossification of the inflammatory neoplasia is a frequent event.

The condition known as *solid œdema* follows diffuse thrombosis of the veins and blocking of the lymph paths. It is slow to disappear, and in marked cases, where many vessels are obliterated by organised clots, there is permanent induration and enlargement of the part. The resistance to pressure in phlegmasia alba dolens may be

compared with the easy pitting in serous œdema from renal or cardiac disease.

The degree of the induration aids, as before said, in the differential diagnosis of venereal sores. It is likewise called into requisition when a doubt exists as to the cancerous or syphilitic nature of an ulcer of the tongue. In each there is hardness due to inflammation, but in cancer there is added that from cornification of the epithelial cells. A periosteal node is simulated by erythema nodosum, but the former is much the harder of the two.

Again, a localised indurated swelling in the breast may be a scirrhus, an adenofibroma, or a chronic abscess. Apart from other considerations, the greater the induration the stronger is the probability of its being malignant. The author's experience, however, leads him to the conclusion that too great a value is given to this sign in the diagnosis of mammary tumours.

Treatment.—Very little can be done for non-inflammatory induration, and the more chronic the latter the less is the chance of success. The indications for treatment are—(1) to remove the cause; (2) to administer absorbents, such as mercury and iodide of potassium; (3) to apply well-directed continuous pressure.

In the limbs a Martin's bandage will do good service. For enlarged indurated glands in the neck the patient should be directed to lie down for a few hours each day, with a bag containing from two to six ounces of shot placed over the swelling.

AUGUSTUS J. PEPPER.

INFARCT. *See* EMBOLISM.

INFLAMMATION.—The process of inflammation may be defined as the succession of changes which occur in a living tissue when it is injured, provided that the injury is not so severe as at once to destroy its structure and vitality; the extent of these changes depending on the length of time and the energy with which the cause acts. For experimental purposes inflammation is usually induced by the application of an irritant; and if we look at a part under the microscope in which inflammation has been set up in this way, two sets of phenomena are witnessed—the earlier, which appear to have their seat in the blood-vessels, and the later, in which changes in the tissue are most marked.

In looking at the early phenomena of inflammation we have to remark two things—viz. disorder of the circulation and transudation of certain of the contents of the blood-vessels. Before proceeding to consider these, it will be well to recall some of the facts with regard to the normal circulation, especially as witnessed in the web of the frog's foot. On looking at the normal circulation in the frog's web, one sees the arteries, veins, and capillaries, the arteries being considerably smaller than the accompanying veins, and constantly varying in calibre, not synchronously with the heart's action but independently of it. The blood is also seen to be circulating with great rapidity, the corpuscles passing with ease through the capillaries, and showing no tendency to accumulation or adhesion either to one another or to the walls of the vessels. Further, the flow is apparently a steady one, and it is impossible to tell from observation of the circulation when the systole of the heart occurs. In the frog's foot one also sees the pigment-cells in the skin and around the vessels. The pigment consists of minute granules, suspended in the protoplasm of the cells, and the cells are large bodies with numerous branches which anastomose freely with each other. It is by means of these pigment-cells that the frog changes its colour. When the frog becomes dark, the pigment leaves the body of the cell, and becomes diffused throughout the branches. When the frog becomes light, or when it dies, the pigment-granules collect in a dense mass in the centre of the cell. Between these two extremes there are all sorts of gradations. The extreme change is a reflex occurrence, the optic nerve being the afferent one, and variations in the distribution of the pigment are constantly occurring in health.

If the mesentery of a frog is spread out and placed under the microscope, the early phenomena of inflammation may be observed in it as the result of the exposure to the air. The first change seen is a dilatation of the arteries, which begins immediately and is progressive, the diameter of the artery often ultimately exceeding that of the vein; the normal variations in calibre also cease. In some instances, after application of an irritant to a frog's web, a preliminary contraction is observed; but this seems to depend on the nature of the irritant employed, alkalies, tartar emetic, and corrosive sublimate being those especially followed by this preliminary contraction. By-and-by the veins also dilate. At the same time, the rapidity of the movement of the blood increases in the first instance. This is, of course, the converse of a mere physical effect, for, supposing the capillary resistance to remain the same, dilatation of the vessels would be accom-

panied by decrease instead of increase of rapidity. This acceleration only lasts a short time, however, for the rapidity of the circulation soon becomes slower than normal, the individual corpuscles being readily recognised. This slowing is seen to be due to the fact that the corpuscles now find difficulty in passing through the vessels, more especially through the capillaries, from the tendency they have acquired for adhering to one another and to the walls of the vessels. This leads to heaping up of the corpuscles in the capillaries. The effect of the systole of the heart can be seen, and very soon complete stagnation occurs. This is termed inflammatory *stasis*. This stasis only occurs in the part on which the irritant has acted most intensely; in its immediate neighbourhood the circulation is going on with difficulty, while around the inflammatory area there is dilatation of the vessels and increased rapidity of flow.

These phenomena have been, at various times, attributed to the dilatation of the vessels, to changes in the blood, or to changes in the tissues. Dilatation of vessels alone will not give rise to stasis, as can be seen by division of the sympathetic nerve in the neck leading to dilatation of the vessels of the ear, but to none of the other phenomena of inflammation. The dilatation is, in the first instance, a purely functional phenomenon developed through the nervous system, and often affects a wider area than the inflamed part, as seen in the inflammatory blush. As regards the second point, there is no change in the blood, and no increased adhesiveness of the corpuscles drawn from the inflamed area over those taken from other parts of the circulation. Further, if the margin of the area of stasis is watched, it will be seen that, as the corpuscles pass out of the inflamed area, their tendency to adhere ceases, and they pass on in the healthy blood-vessels as readily as do the other corpuscles. It will also be observed that the corpuscles of fresh portions of blood, as they pass into the inflamed area, acquire this same tendency to adhere, a tendency which they lose again on passing into the healthy vessels. Further, as only one small portion of the blood was acted on by the irritant used, the blood which is present in the area of stasis cannot be that which was acted on by the irritant. That the irritant itself does not necessarily affect the blood is shown by the fact that, if chloroform is applied to the web, inflammation and stasis result, whereas chloroform added to blood prevents the adhesion of the blood-corpuscles. And also, after pinching a part, inflammatory stasis follows, although there can be no action on the blood.

We must therefore conclude that the cause of the slowing of the current and of the ultimate stasis is some alteration which the tissues have undergone, and that the corpuscles, when they pass into the injured area, there acquire the tendency to adhere. Experiments, carried on by Sir Joseph Lister, have shown that the walls of healthy vessels differ from ordinary solids in having no tendency to permit coagulation; but when the walls become unhealthy this power is lost, and there is a tendency to coagulation when the blood comes in contact with them, just as when it touches any ordinary solid. In further explanation of these phenomena, the study of the pigment-cells shows that this state of the walls of the vessels is a condition closely allied to death of the part, but recoverable—a suspension of the functions of the tissue. When death of the pigment-cells occurs, the pigment becomes completely concentrated; this is the constant post-mortem change. When, however, an irritant is applied of sufficient strength to cause inflammation, the pigment instantly ceases to move, and remains in the state in which it was when the irritant was applied, although the frog may afterwards change its colour elsewhere.

We now come to the second series of changes which occur in the early stages of inflammation—viz. the exudation of liquor sanguinis and corpuscles. It has been demonstrated that white corpuscles can move by shooting-out processes, in the same way as amœbæ do, and they also resemble amœbæ in taking up granules into their interior. This double property may be demonstrated by a very simple experiment. Introduce finely-divided cinnabar into the dorsal lymph-sac of a frog, and then put in the dead cornea of some animal. If the cornea is removed in a few days, it will be found that it has become infiltrated with leucocytes containing granules of cinnabar, thus proving that the leucocytes have come from the lymph-sac, and must have got into the cornea by some method of locomotion.

If the centre of a cornea is cauterised with nitrate of silver, the whole cornea will in a few days become more or less opaque, and this opacity will be found on examination to be due to the presence of numbers of leucocytes. If, however, the eye be examined one or two days after the cauter-

isation, the opacity—i.e. the leucocytes—will be seen in the form of a ring round the margin of the cornea, this ring later on spreading to the centre. If cinnabar was introduced into the lymph-sac before the cornea was cauterised, it will be found that a certain small proportion of the corpuscles in the cornea contain particles of cinnabar. If the cinnabar was injected into the blood-stream instead of into the lymph-sac, the number of corpuscles containing particles will be found to be much greater. Hence, it is clear that part at least of the leucocytes found in the cornea came from the lymph-sac or from the blood-vessels, and as every white blood-corpuscle would not take up the cinnabar, it is probable that the number of corpuscles which have come from the blood is much greater than the number of those which contain cinnabar.

How did these corpuscles get from the blood-vessels into the cornea? They passed out through the walls of the capillaries and smaller veins. This process has been seen to take place in the mesentery of the frog. If the mesentery is spread out on a glass plate, inflammation occurs as the mere result of the exposure to the air, and the whole process may be watched. The dilatation of the arteries and the subsequent slowing of the blood-stream are well seen. If now we observe a small vein, we see the following phenomena. As the circulation becomes slower the individual corpuscles may be recognised, and it will be found that, while the red corpuscles flow more or less in the centre of the current, the white corpuscles roll along the wall of the vessel, often adhering for a time, and then being ultimately detached and swept on, to stick again at another part. By-and-by, as the result of this tendency of the white corpuscles to stick to the wall of the vessel, they begin to collect in numbers, so that the vein becomes lined with a layer of these bodies, which remain almost motionless. If now the outer part of the wall of the vessel be watched, minute, colourless, button-shaped elevations will be seen to spring out, as if they were buds from the wall. These increase gradually till they become hemispherical, and at last a pear-shaped body is seen, the stalk of which is attached to the surface of the vein; gradually this mass of protoplasm becomes completely detached, shoots out processes, and moves on into the tissue. This migration of white corpuscles does not occur in the arteries, but is very rapid in the capillaries, from which red corpuscles have also been seen to escape.

While this is going on, the fluid contents of the blood-vessels also pass out, as the result, apparently, of a leaky condition of the walls of the vessels, and not, as at one time supposed, on account of increased attraction on the part of the tissues. The fluid part soon coagulates in the tissue, or on free surfaces, and this coagulated liquor sanguinis, with entangled leucocytes, forms the lymph which glues the cut surfaces of wounds together, and which is seen on the surface of serous membranes.

Up to this time the original structure of the tissue is still apparent; but if the process goes on longer, changes occur which result in the disappearance of the structure of the part and its replacement by a new tissue, which is called *granulation-tissue*. This name is given to the tissue because its structure is of the same elementary character as that of the granulations seen on the surface of wounds, consisting simply of a mass of roundish cells adhering to each other (i.e. embedded in an apparently homogeneous matrix) and of elementary blood-vessels. It does not matter what the tissue is, or how complex the structure of the organ in which the inflammation occurs; provided the disease has lasted long enough, the special structure of that tissue or organ disappears and its place is taken by granulation tissue. The question now arises, Whence does this new tissue come, and why has the original structure disappeared? As we have already seen, numerous white blood-corpuscles pass out of the blood-vessels during the early stages of inflammation, and some hold that these are the only source of the cells found in granulation-tissue. This view seems, however, exaggerated and difficult to reconcile with various facts, and therefore, while we admit that it is probable that leucocytes or their progeny form part of the cells of granulation tissue, we find that these have other and perhaps more prolific sources.

Irritate cartilage by passing a seton through it, and the following changes will be observed to occur. At a point far removed from the source of irritation, it will be seen that the cartilage-cells become larger and the protoplasm more abundant. The nucleus then divides, both portions remaining still surrounded by the same mass of protoplasm. The protoplasm then divides, and thus we have two cells instead of one, each of which excretes around itself a cartilaginous capsule. Nearer to the injury we find that this division of cells inside the mother capsule has continued, till a large number of young cells have

accumulated in it; but these have lost the property of excreting cartilage around them, and they have also become rounder so as to resemble leucocytes. While this multiplication of cells is taking place inside the capsule, its wall is dilating, and the intercapsular cartilaginous substance is disappearing. At length we find that these enlarged capsules have opened into each other and on the surface, where the cells form granulation tissue in which embryonic vessels appear. In this case, as cartilage is devoid of blood-vessels, and as no channels are as yet known by which leucocytes could penetrate into it, we must conclude that the granulation-tissue has been formed from the cartilage-cells. Similar facts have been stated as to other non-vascular tissue, such as the cornea, but there the matter is doubtful. Changes have, however, been observed in the endothelial cells lining the great omentum in adult animals, which seem to point to their hypertrophy and development into round cells.

In vascular tissues, multiplication of the tissue-cells has also been described. In the case of the subcutaneous cellular tissue the connective tissue cells hypertrophy, the fat disappears from the fat-cells, the nucleus divides, and several cells are formed in the original fat-capsule. While these changes are going on in the cells, the fibres of the connective tissue become soaked with fluid, less apparent, and ultimately disappear. The walls of the vessels also undergo changes, the cells constituting them become swollen, their nuclei more apparent, and they soon subdivide, the process ending in the complete disappearance of the old vessels or in the formation of new ones. Similar changes have been described in inflammation of muscle; the fixed corpuscles of the fibre sheaths and the cells of the connective tissue between the bundles of fibres undergoing multiplication, the muscular tissue ultimately disappearing, and being replaced by granulation tissue. That the new cells are formed in this way is often evident from their arrangement in rows corresponding with the position of the muscular bundle.

It thus appears that one, and perhaps the chief, source of the cells which constitute granulation-tissue is from proliferation of the connective-tissue cells of the part; but at the same time it cannot be denied that some are either white blood corpuscles which have passed out of the vessels or are derived from them. The young vessels are probably formed in the same manner as in the embryo.

Results of Inflammation.—1. *Exudation.*—In all inflammations there is exudation, but it varies much in character. As a rule, exudations are fibrinous. The liquor sanguinis escaping from the vessels contains large quantities of fibrinogen, and, meeting with the fibrinoplastic substance and the ferment contained in the tissues, more especially in the cells, it coagulates. At the same time, the white corpuscles also pass out of the vessels, and it is this coagulated liquor sanguinis, with entangled corpuscles, which is known as lymph. In some instances these exudations are of a mucous character, as in joints, and this mucin coagulates on the surface. On serous membranes the lymph, which also contains a little mucin, forms layers on the surface, and this goes by the name of croupous exudation. This croupous exudation also occurs in the lungs in croupous pneumonia, but it is not the same as the false membranes which form in croup, which apparently do not contain fibrin, but consist mainly of epithelial cells soldered together.

2. *Resolution.*—Complete resolution can only occur at an early period in inflammation, before the changes in the tissue have taken place. When resolution occurs, the stasis disappears, the tendency to slowing of the circulation and adhesion of the corpuscles diminishes and finally ceases, the effused and coagulated liquor sanguinis becomes granular, and is removed by the lymphatics, and the white corpuscles which have passed out of the vessels either re-enter them, or pass into the lymphatics, or become fatty and break down. Thus the part returns to its condition previous to the inflammation.

3. *Retrogression.*—In this case the tissue changes have gone on to such an extent that there cannot be a restoration of the original structure; there must be new formation. The character of this new formation varies according to the situation of the inflammation, but it almost always belongs to the class of connective tissues, though sometimes special tissues, such as nerve and muscle, may be regenerated to a slight extent. The changes which take place will be more fully considered under the healing of Wounds, but they consist essentially in elongation of the round cells and the formation of connective tissue. The numerous vessels of the granulation-tissue become atrophied as the process goes on, the whole tissue shrinks as it becomes older, and in this way depressed scars form in organs which have been the seat of acute

inflammation, even though suppuration has not taken place. In connective tissue this new tissue resembles connective tissue, in bone it resembles bone, in tendon it resembles tendon; but there is, as has just been said, no reproduction of complex structures.

4. *Suppuration.*—This process is described in detail under SUPPURATION.

5. *Ulceration.* *See* ULCERATION.

6. *Sloughing.* *See* SLOUGH AND SLOUGHING.

So far we have been considering acute inflammation, but there is another variety termed chronic inflammation, in which the changes above described take longer in their development, and differ somewhat in their results. As a consequence of chronic inflammation there is, as in the acute form, destruction of the tissue of the part and its conversion into granulation-tissue, but from the very first retrogressive changes are marked. Thus, in a part the seat of chronic inflammation, there may be very few round granulation cells, the majority having become spindle-shaped, and many of them having formed fibrous tissue. Chronic inflammation may go on without the occurrence of suppuration, or it may lead to suppuration or ulceration. When chronic inflammation continues without suppuration or ulceration, the inflamed part may assume two forms—one in which it becomes much larger than normal, and the other in which it actually becomes smaller. The latter form is probably preceded in its earlier stage by enlargement of the part. In white swelling of the knee-joint we have a good example of enlargement of a part as the result of chronic inflammation. If we examine a specimen of the inflamed synovial membrane, we find that there are numerous granulation cells in places, more especially around the vessels, but that the tendency is for these cells to become elongated and spindle-shaped, and to develop fibrous tissue. This fibrous tissue, however, remains swollen and imperfect, and the individual cells are often widely separated from each other by swollen intercellular substance. At parts the white cells become heaped together, and here abscesses may form. The appearances in this form are further complicated by the presence of tubercles at various parts. In the second variety of chronic inflammation the swelling of the intercellular substance is less marked, and the formation of fibrous tissue is the chief thing that is noticed. The result of this formation of fibrous tissue is that, as it contracts, it presses on the tissue in its vicinity and causes it to atrophy. This is well seen in cirrhosis of the liver. The results of chronic inflammation are retrogression, suppuration, and ulceration.

Varieties of Inflammation.—As we have seen, inflammation is a complex process consisting of congestion, exudation, new formation, suppuration, &c. One of these may be more prominent than the others, giving the inflammation a special character and leading to the formation of distinct varieties of inflammation.

1. Congestion may be most marked, as in the cutaneous erythemata, erysipelas, acute catarrhs, rheumatic inflammation of joints, &c.

2. Exudation may be the main element, as in pneumonia, pleurisy, pericarditis, &c.

3. Some inflammations are essentially suppurative, as those which occur in the course of pyæmia, puerperal fever, &c.

4. New formation may be the chief feature, as in periostitis, cirrhosis, &c.

In tuberculosis and syphilis the inflammations also present special characters.

Etiology of Acute Inflammation.—We have already defined inflammation as 'the succession of changes which occurs in a living tissue when it is injured, provided that the injury is not so severe as at once to destroy its structure and vitality: the extent of these changes depending on the length of time and the energy with which the cause acts.' We may therefore divide the immediate causes of inflammation into groups according to the length of time during which they act. The predisposing causes may be considered afterwards.

1. Some causes only act transiently, and corresponding to this transient action the inflammation soon ceases. In some cases, as possibly in the action of cold, the inflammatory phenomena do not go beyond the early stage, and resolution occurs in a few hours if no serious damage has been done to the part, or if no further cause keeping up the inflammation comes into play. The best example of the action of a transient cause is seen in the healing of a wound by first intention. The knife in its passage through the tissues causes damage, which results in the occurrence of the early stages of inflammation and the exudation of liquor sanguinis and white blood-corpuscles. But the cause having ceased to act and no fresh cause having come into play, the inflammation ceases, organisation of the exudation takes place, and the wound heals.

Whether, apart from any direct damage done to the tissues by mechanical or chemical agencies, disturbance of the nervous

system alone can set up and maintain inflammatory action, is a very moot question, although held by some. In any case, it seems improbable that nervous disturbance alone could keep up an acute inflammation and lead to suppuration.

2. Most of the causes act longer and more intensely, and set up a correspondingly severe inflammation. Various chemical substances, such as croton oil, tartar emetic, blistering fluid, &c., act for some time, and even after one application cause pustules or blisters. Why croton oil on the one hand should cause pustules, and blistering fluid on the other hand cause vesication, is as yet quite unexplained. Other chemical substances only cause a slight amount of inflammation at a single application, but, if frequently applied, will even set up suppuration; such are carbolic acid, iodine, &c.

3. In contrast to these various causes are those which, when once introduced, go on acting for a long time, and may produce various results, such as fibrous formation, suppuration, ulceration, gangrene, &c. Of these, certain foreign bodies may, by their mechanical action, keep up a state of inflammation leading to fibrous formation or to suppuration. But the most common causes are self-multiplying agents, the living ferments or micro-organisms. And seeing that almost all acute inflammations are due to some cause which goes on acting for a considerable time, and that in these cases micro-organisms are always present, we must conclude that the great majority of inflammations, and more especially of suppurations, are intimately connected with the growth of these organisms. In all acute abscesses, and in almost all suppurating wounds, micrococci are present, which are without doubt the cause of the suppuration; and they probably cause the inflammation by forming, as the result of their growth, products which irritate the tissues and cause them to inflame. It is in the highest degree probable, that it is the absorption of these same products into the circulation which produces the general febrile disturbance.

The character of the inflammation depends to a great extent on the species of micro-organisms present, for there are several different kinds associated with inflammation. Thus, one variety produces erysipelas, others cause the formation of abscesses, and others again cause phagedæna or spreading gangrene. But though much depends on the kind of organism present, much also depends on the place where it grows. Thus, the *staphylococcus pyogenes aureus*, growing in the cellular tissue will cause an ordinary acute abscess, growing in the glands of the skin will cause a boil or carbuncle, and growing in bone will cause acute osteomyelitis. Here the result is dependent mainly on the anatomical structure of the part. As has just been remarked, there are various micro-organisms associated with inflammation, and even an acute abscess is not always caused by the same species. Some of these will set up the disease at once, without any previous injury of the tissue predisposing to inflammation; others, apparently, act only when present in large numbers, and in a tissue already in the early stages of inflammation. When, for instance, a wound fails to heal by first intention, it is generally due to the entrance of micro-organisms. The tissue is already in a state of inflammation, as the result of the injury done by the knife, but this would soon subside, as the cause has ceased to act; but if micro-organisms, capable of growing in tissues, obtain entrance, they form a further and continuously acting cause of inflammation, and lead to continuance of the process and ultimately to suppuration.

Predisposing causes are causes which depress the vital powers, and may be divided into general and local. Of the general causes we may mention drunkenness, exhaustive diseases, starvation, bad food, ingestion of decomposing matters, &c. Under these conditions the vitality of the tissue is much diminished, repair after injury does not take place so readily as in a state of health, and in this enfeebled state a lower degree of irritation or injury is required to produce inflammation, than is the case under normal conditions. But, in the opinion of the writer, this is not the only mode in which these causes act: they also permit the entrance of the living exciters of inflammation—micro-organisms—into the body. When the body is healthy, no living organisms (except, of course, certain pathogenic ones) can penetrate into the blood, or, if they do reach the blood alive, they soon die. Hence, a collection of blood (hæmorrhage after a blow), or a piece of dead tissue (as in an infarct), may lie in the body without giving rise to acute inflammation—may, in reality, become absorbed and disappear. But where the vital powers are depressed, as by bad food, drunkenness, &c., micro-organisms may enter the circulation, and, not being destroyed at once, may become deposited in the piece of dead tissue or in the collection of blood, and, growing there, set up inflammation. The low state of

health thus predisposes to inflammation by permitting the entrance into the circulation of living micro-organisms. This has been experimentally proved in the lower animals, by feeding them on very foul putrid material and then causing subcutaneous hæmorrhages; abscesses containing micro-organisms have resulted. In Chauveau's experiments on *bistournage*, the effect of the presence of micro-organisms in the tissues was demonstrated. In the operation of *bistournage* the testicle is twisted till the cord and vessels are ruptured, the result being that the organ atrophies and disappears. But if, before *bistournage* is performed, a quantity of septic material be injected into the circulation, the testicle on which this operation is performed becomes inflamed, and a septic abscess results. And the writer has observed in the case of a drunkard suffering from albuminuria, and in a low state of health generally, that whenever he received a bruise, an abscess containing micrococci formed at that part.

Certain specific states of the system, as the gouty and rheumatic diatheses, are also often reckoned as predisposing causes, though they hardly come into the same category as the above.

The local predisposing causes are likewise such as lead to imperfect vitality of the part, such as local congestions, say from varicose veins, atheromatous arteries, imperfect innervation, &c.

Symptoms.—The symptoms of inflammation, both local and general, vary with the seat and intensity of the inflammation. Let us take a simple acute inflammation of the subcutaneous cellular tissue as the type. The symptoms are subdivided into local and general.

Local Symptoms.—The cardinal symptoms of inflammation are redness, heat, swelling, and pain. The redness may or may not disappear on pressure. At the marginal part of the inflammatory swelling the redness is of a bright colour, and disappears readily on pressure; it is there due simply to dilatation of the blood-vessels. Towards the centre of the swelling the redness is of a darker colour, and often persists in great part on pressure; there it is due to stasis in the blood-vessels or to extravasation into the tissues, or, it may be, to migration of large numbers of red blood-corpuscles. The swelling is due to the exudation of liquor sanguinis and blood-corpuscles. The pain is caused by pressure of the exudation on the sensory nerves either from the outside, or probably more generally by exudation into the sheath of the nerve itself. The heat is partly due to the increased flow of warm blood through the part, raising the temperature of an external part to that of the blood in the internal organs. Apparently, however, according to the researches of Mr. Simon, there is also a local production of heat in the inflamed part, the temperature of the venous blood leaving an inflamed part being higher than that of the arterial blood entering it.

Constitutional Symptoms.—Along with these local effects there is more or less disturbance of the general condition of the patient, varying in character chiefly according to the intensity and cause of the inflammation. The first symptom of inflammatory fever is generally a feeling of chilliness, followed by heat; the patient may even have a shivering fit. The temperature rises, the height varying with the intensity of the inflammation; it generally reaches 102° to 103° in from twenty-four to forty-eight hours, remains at that height for about twenty-four hours, and then, in the case of an open wound, as suppuration occurs, it rapidly falls till, on the fourth or fifth day, it is again normal. The pulse becomes quick, hard, and wiry; the tongue becomes dry and furred. The secretions are diminished or arrested; the skin hot and dry; the urine scanty and high-coloured; the bowels constipated. There is also headache, and, where the symptoms are severe, there may be delirium. The other symptoms disappear, along with the fall of temperature, when suppuration takes place in the case of an open wound, provided that no complication has occurred.

As has been previously remarked, the local and constitutional symptoms of inflammation vary according to the seat, intensity, and cause of the inflammation. The details of these symptoms will be found under the proper headings; it will be sufficient here to illustrate what is meant. In acute suppurative periostitis or osteomyelitis the pain is intense, but—especially if the bone be deep-seated, as the femur—swelling is little, if at all, noticeable. At the same time, the constitutional symptoms, which at first were those of inflammatory fever, soon undergo a change and resemble those of septicæmia; in fact, the patient suffers from septic poisoning due to absorption of septic products from the inflamed bone. Another example of the influence of the site of the inflammation on the symptoms is seen in whitlow, where the local symptoms and constitutional disturbance are out of all proportion to the extent of the affection. The cause of the inflammation also deter-

mines the severity of the symptoms. The passing inflammation which follows a cut or an injury is so slight, that it is not recognised as inflammation at all by many writers; while, in the infective inflammations, the symptoms are characteristic and generally severe.

When the inflammation is chronic, the symptoms are much less marked. There is generally no increased redness over the part, and the vascularity of the part itself is not nearly so great as in the acute. There is but little pain or tenderness, and even where in some situations, as in the periosteum, pain and tenderness are present, they are not as a rule severe. There is no increased heat of the part. As regards the constitutional symptoms, these depend on the same cause as the chronic inflammation rather than on the inflammatory process itself.

Treatment of Acute Inflammation.—In considering the treatment of acute inflammation, we must first speak of acute inflammation in connection with a wound or injury, and secondly of acute inflammation occurring without any evident wound. And the reason for this separation is the fact that, in the first class of cases, much may be done by preventive measures; while, in the second class, the cause has generally begun to act before we know that it is there, and, therefore, we can only use curative measures.

Preventive Measures. — The various local causes of inflammation in wounds may be summed up in the one word—unrest; and the causes of unrest are mechanical or chemical. The mechanical causes of unrest are movements of the part, either of a limb as a whole or of individual muscles, also pressure as from a pad in the wrong place, pressure of a splint, &c.; further, such causes as the weight of flaps, placing the limb in an extended position when a flexed position would allow the edges of the wound to lie easily together or *vice versâ*, allowing a limb to hang, thus impeding the circulation, tight stitches, &c. The chemical causes of inflammation are irritating chemical substances, but, more especially, decomposition in the discharges of the wound, from the growth of micro-organisms in them or in the tissues of the wound itself. These local causes being understood, it is quite plain how they must be remedied. Rest must be secured in one way or another. Mechanical rest will be secured by keeping the part still, in the case of an extremity by the application of a splint, by keeping the extremity elevated, by seeing that the position is such as to separate the parts as little as possible, and by avoiding pressure, tight stitches, &c. Chemical rest is obtained by avoiding the application of irritating chemical substances to the wound, but more especially by taking measures to exclude micro-organisms. In cases where aseptic treatment cannot be thoroughly carried out, means must be taken to hinder the development of micro-organisms, as much as possible, in some of the ways described in the article on Antiseptic Surgery, by free drainage, avoidance of tension, antiseptic irrigation, &c. The unrest produced by decomposition and growth of micro-organisms being much more serious than that caused by the application of antiseptics, the latter—the lesser of the two evils—must be chosen.

At the same time any general condition which predisposes to inflammation must be remedied as far as possible. Good food must be given (it is quite a mistake to keep a patient on low diet with the view of preventing inflammation); if necessary, stimulants, and tonics such as iron and quinine, while any constitutional peculiarity, such as gout, syphilis, &c., must be treated by specific remedies.

With regard to preventive treatment, it must be borne in mind that inflammation of glands may occur from absorption of poisonous (phlogogenic) materials from wounds. This can be avoided by preventing the development of these materials in the wound, as by antiseptic treatment.

The *curative* treatment of inflammation in wounds will be found under Wounds.

We next pass on to inflammation occurring without evident connection with an external wound, such as acute abscess. Here, as has been previously remarked, the inflammation has already begun before we see the case, and, therefore, preventive treatment does not come into play; though, if the inflammation be dependent on some constitutional state, attempts may be made to remedy that with the view of preventing future attacks.

1. Here, as in the preventive treatment, rest is a most important element. The inflamed part should be kept still; if an extremity, it should be laid on a splint and elevated. Special apparatus is required for special cases, and these will be found described under the proper headings. Thus, for an inflamed joint it is not only necessary to secure rest by means of splints or sandbags, &c., but the tendency to spasmodic contractions of the muscles

must be counteracted by a suitable extension apparatus.

2. The second point which is aimed at, in the treatment of acute inflammation, is to diminish the vascular excitement. This is attempted in three ways.

a. By the application of cold with the view of causing contraction of the arteries. That cold does act in this way even on deep-seated parts there can be no doubt; it is constantly evidenced by the effect of cold in checking hæmorrhage. Not that the cold need penetrate to the seat of inflammation; its effects are produced by reflex action. The necessary cold may be obtained by the application of ice or cold water or evaporating lotions. The ice is conveniently enclosed in a thin india-rubber bag, so that the skin remains quite dry. Ice-cold water is conducted through a coil of metal tubes (Leiter's tubes), which can be laid over the part or made to surround it. By means of a continuous flow of iced water through Leiter's tubes a constant low temperature is maintained, and this is in reality the most satisfactory method of applying cold. It is dangerous to apply ice or cold water directly to the skin, for it has been found that there is a great risk of frostbite and gangrene if this is done. On the other hand, with dry cold this danger is not nearly so great, though, at the same time, this method of treatment must always be employed with caution. As a rule, it is only useful in the early period of the inflammation, and when its application ceases to give the patient relief, it is time to discontinue it. By the use of evaporating lotions a certain amount of cold may be produced. Of these the most commonly employed are spirit and lead lotion or hydrochlorate of ammonia and spirit (Ammon. chlor. ℥ss., Spirit. rect. f℥j., Acidi acet. dil. f℥jss., Aq. ad f℥viij.). Whatever means of producing cold is employed, it must be continuously applied; intermittent applications only do harm.

b. By local or general depletion, by which a similar contraction of the arteries is brought about. Local depletion is carried out by means of leeches, cupping, or scarification. Great relief, and at least temporary improvement, is generally experienced as the result of this treatment. More effectual than these methods are free incisions, but this will be referred to again. General blood-letting hardly comes into consideration in the treatment of surgical inflammations.

With the view of diminishing the flow of blood to an inflamed part, it has also been suggested, and in some cases successfully practised, to compress or ligature the main artery leading to the part. This has been chiefly employed in inflammations of joints or bones, more especially after gunshot injuries.

c. By the use of the so-called antiphlogistic remedies. Of these the most generally recommended are antimony and aconite, more especially the former. Antimony is first given in sufficient doses to produce vomiting, and then is continued in small doses. For the same purpose laxative and purgative remedies are also used. These to a certain extent act like blood-letting by withdrawing fluid from the body, but probably their chief action is by the removal of waste products and by counter-irritation.

Where the inflammation is extensive and the febrile symptoms are of the acute sthenic type, the diet ought to be restricted; as a matter of fact, the patient has lost all appetite, and thus restricts his diet himself. Where the fever is of the asthenic type, depletion and antiphlogistic remedies are contraindicated, the diet ought to be of the most nourishing and easily assimilated kind, and tonics, quinine, and iron should be given. In addition to antiphlogistic remedies, benefit will often be obtained by the administration of sedatives, more especially of opium.

3. A third indication is to get rid of foreign bodies and to relieve tension. The greatest benefit is derived, in acute inflammations, from free incisions through the inflamed parts, even though suppuration has not yet occurred. Of course, these incisions must be made with all aseptic precautions, so as to prevent the entrance of fresh causes of inflammation. If this is done the process will very often cease, and there is no more striking instance of the benefit to be derived from free antiseptic incisions in the early stages of acute inflammation, than the results obtained in cases of acute periostitis or acute necrosis. The disease often ceases at once, and no dead bone comes away. Free incisions act to some extent by depleting the part, but chiefly by relieving tension, for tension is one of the chief causes which assist in keeping up inflammation in a part.

4. Counter-irritation, though more especially useful in chronic inflammation, is also very valuable in the acute disease. There, however, the more severe forms are but seldom employed. In deep-seated inflammations, as in acute meningitis, blisters may be used with advantage. In other

cases, as, for example, in the early stage of glandular inflammations, iodine is useful. But the most common form of counter-irritant employed, in acute inflammation, is the poultice or warm fomentation. How counter-irritants act in arresting inflammation is still purely hypothetical, but the most feasible view is that it is through the agency of the nervous system. Gonorrhœa ceases or diminishes during the occurrence of acute epididymitis; in mumps the parotid gland recovers as soon as the ovaries or testes become inflamed, &c. So, apart from the relief afforded by the warm and moist application, the use of a poultice often diminishes the inflammation deeper down, by reflex action. On the other hand, when once suppuration has begun, it seems to favour the further development of pus and the rapid 'ripening' of the abscess.

5. Certain acute inflammations are readily subdued by the use of specific remedies. Thus, gout is rapidly and favourably affected by colchicum, rheumatism by salicylate of soda, and syphilis by mercury or iodide of potassium.

Treatment of Chronic Inflammation.—Here, again, rest and a suitable position are essentials in the treatment, and the same principles have to be followed as in the treatment of acute inflammation. At the same time much good can be done by more active measures, such as counter-irritation, pressure, and various internal remedies.

The counter-irritants employed are of a more severe nature than in acute inflammation. The best are the actual cautery and blisters. The actual cautery is especially useful in deep-seated chronic inflammations, especially of joints, and in this case it must be thoroughly applied. Better than the button cautery, is the application of the cautery iron over a considerable extent of the skin, in the neighbourhood of the inflamed part. All that is desired is to destroy the surface of the skin, and not the whole of the true skin, and for this purpose the cautery should be at a white heat and rapidly drawn over the surface two or three times. For a few days poultices are applied, till the sloughs separate, and then the sore is dressed with savin ointment and kept open for about six weeks. If it tends to close sooner, in spite of the savin ointment, the healing edge can easily be destroyed by nitrate of silver or by potassa fusa. Issues may also be produced in the first instance by potassa fusa or by chloride of zinc paste, or, in some cases, setons are used. Repeated blistering is also of great benefit in chronic inflammations, and iodine is a favourite application with some, especially for enlarged glands.

Pressure is an excellent remedy in many chronic inflammations, and may be carried out by means of elastic bandages, cotton-wool firmly bandaged on, &c. *See* Pressure. In addition to pressure, massage of the part, more especially of a diseased joint (synovial disease), has been strongly recommended. The part is well shampooed once or twice a day for a quarter to half an hour, the pressure being especially applied in the direction of the trunk, with the supposed view of aiding the lymphatic circulation. On the principle of relief of tension, free antiseptic incisions have also been made in chronically inflamed tissues, such as diseased synovial membrane, with excellent results.

In chronic inflammations much benefit may also be derived from suitable constitutional treatment. Nourishing diet, and stimulants if necessary, are administered, along with cod-liver oil, iron, and other tonics, passive exercise in the open air, &c. Of course, in specific inflammations, the suitable specific remedies are invaluable, such as iodide of potassium in syphilis, &c.

W. Watson Cheyne.

INGROWING TOENAIL.—This apparently slight affection may become an extremely painful and crippling one. It is met with chiefly in adolescents, more often males, and is due to the pressure of the nail of the great toe into the soft parts, either from the wearing of ill-made boots, with pointed crowding toes, or from the rounding off the angles of the nail instead of cutting them square, and thus allowing the soft parts to encroach beyond their proper limit. The affection may be met with on either side of the nail. The first stage is tenderness, followed by ulceration. When this has lasted any time, a little mass of prominent and very tender granulations is met with at the affected spot, accompanied by unhealthy, foul discharge.

Treatment.—In the earlier stages, a few days' rest, with the foot in the elevated position, the use of lead lotion, allowing the nail to grow square, and, above all, the use of well-made boots, with straight inside borders and room for the toes, will be sufficient. But, later on, when ulceration is present, it is imperative that the pressure of the nail on the soft parts be removed. This may be effected by the following means:—The edge of the nail being raised by a flat, narrow, spoon-shaped spatula, or even by a piece of wood of appropriate

size and shape, shreds of lint pressed out of carbolic oil (1–30), or dusted with iodoform, are to be carefully packed with a probe between the nail and the soft parts, so as to press back the latter and elevate the buried nail. The quantity of shredded lint should be gradually increased every second or third day, till the nail is thoroughly raised from its bed in the soft parts. A better plan than the above, in that it requires fewer applications, is the introduction of a small, narrow piece of sheet lead under the edge of the nail. The nail being raised, as directed above, a narrow slip of metal, about two inches long, and slightly overlapping the nail, is introduced well beneath the ingrowing border, and then gently bent over and firmly pressed into position on the upper surface of the nail. Then, any superfluous metal being cut away, the strip is retained in position by narrow strapping and the use of a covering, like the finger of a glove, which is secured round the ankle by tapes. As attempts at introducing anything under the nail are often rendered futile by the pain they cause, it is best to give ether on the first occasion. Professor Humphry, from whom the writer learnt the above method, recommends silver rolled thin enough to bend easily. This raises the nail more efficiently than lead, but is more difficult to obtain. The administration of ether will also enable the surgeon to destroy thoroughly the prominent, painful, and fetid granulations which accompany this affection, by means of undiluted carbolic acid, acid mercury nitrate, silver nitrate, &c. Where the granulations resist the above, and the soft parts overhang the embedded nail, it will be found best, ether being given, to remove by one stroke of a sharp-pointed bistoury the soft parts at the side affected, including the above granulations. This step leaves a healthy sore, which, contracting quickly as it heals, leaves nothing for the nail to press upon.

The surgeon, failing with lint, or not being able to provide himself with metal, may place a bit of sponge-tent, wrung out of carbolic oil, or well powdered with iodoform, under the nail. The point of chief importance is to well elevate the nail on one or two occasions, by means of the above-mentioned spatula. When once this has been thoroughly effected, the pressure of the body well introduced, especially if this be metal, causes atrophy of the ingrowing granulations and soft parts beneath.

Where the patient refuses any operative interference, the granulations and soft parts over the nail must be drawn away by strapping, while iodoform, pulv. æruginis, powdered lead nitrate, lotions of copper or iron sulphate (gr. iv.–f℥j.), are perseveringly applied, and the centre of the nail rubbed down from matrix to edge with glass or a blunt knife, to cause its shrinking.

Removal of the nail is only to be employed in a limited number of cases, for it must always be remembered that, while the new nail may, with proper attention, grow straight and healthy, it may, on the other hand, assume a faulty direction, and appear, in addition, uneven and distorted, owing to injury inflicted on the matrix at the time of the evulsion, aided by preceding inflammation. Where the patient finds the introduction of the lint or metal unbearable, where in advanced cases previous treatment has failed, or where the nail is loosened or much diseased, evulsion is to be practised. The patient being under the influence of nitrous oxide or ether, one blade of a broad-bladed, stout dressing-forceps is driven down close to the nail as far as its root; the blades are then closed, and the nail, loosened by one or two lateral twists, is withdrawn by a direct pull. If it be desired to remove one half of the nail only, this should be first divided by the introduction of sharp-pointed scissors. In removing the nail, sufficient care is not usually taken to inflict as little injury as possible on the subjacent matrix. After removal the surface left should be dressed with iced lead lotion, carbolic oil (1 in 40), iodoform or powdered lead nitrate, and the patient should lie up on a sofa for a day or so, then going about with an easy shoe. *See* Nails, Diseases of the.

W. H. A. Jacobson.

INGUINAL HERNIA. — Inguinal ruptures may be divided into two great classes: 1. The external, oblique, or indirect. 2. The internal, or direct.

1. The External or Oblique Hernia. In this form the rupture occupies, in whole or in part, the inguinal canal. This canal runs obliquely from the internal to the external abdominal ring, and is about 1½ inches in length. The external ring is readily felt, in the male, by invaginating the scrotum with the point of the finger, and then passing the digit up in front of the cord. If the nail be kept against the cord, the pulp of the finger can readily recognise the triangular, slit-like opening. In normal conditions in adults it will just admit the tip of the little finger. In females the ring is somewhat less easily felt, owing to the

slighter laxity of the tissues of the labium pudendi. The internal ring is situate about half an inch above the middle of Poupart's ligament. The neck of the sac is at the internal ring, and just to the outer side of the deep epigastric artery. The hernial tumour, as it occupies the canal, lies in front of the structures forming the spermatic cord. The protrusion may appear merely as a bulging at the internal ring. It may occupy the inguinal canal, but not project beyond the external ring, in which case it is called a bubonocele. It may project beyond the outer ring, and may occupy the scrotum or labium (scrotal or labial hernia).

In external inguinal hernia the sac may be either acquired, or it may exist ready-formed, owing to certain congenital defects in the processus vaginalis.

The acquired hernia in this position is comparatively rare before adult life, and is much more common in men than in women. It forms slowly, but in time it may attain very considerable dimensions. In old acquired, herniæ not only do both the abdominal rings become much enlarged, but they are also approximated, so that a time comes when the internal ring is almost directly behind the external ring, and the inguinal canal has practically no existence. When such herniæ are reduced, they appear to go directly back into the abdominal cavity.

The oblique hernia, depending upon congenital defects in the processus vaginalis.—The descent of the testicle in the fœtus is preceded by the passage into the scrotum of a process of the peritoneum—the vaginal process. The testicle usually enters the internal ring abouth the seventh month of fœtal life, and by the eighth month is in the scrotum. The vaginal process is often found open at birth, and even for two, three, or four weeks after birth; but it is more usually found cut off from the peritoneal cavity, the portion thus isolated forming the tunica vaginalis. The manner in which it is cut off is as follows:—It becomes obliterated in two places, at the internal ring, and at a spot just above the epididymis, the obliteration usually beginning at the higher point first, and proceeding downwards. Supposing obliteration to have taken place at these two points, the vaginal process between them will be represented by an isolated tube. This soon shrinks, closes, and dwindles to an insignificant fibrous cord. It may, however, remain patent in part, and, if fluid accumulates in this patent portion, an encysted hydrocele of the cord is produced.

As regards the mode of closure three contingencies may happen, each giving rise to a particular form of hernia: (1) The process may not close at all. (2) It may close at the upper point only. (3) It may close at the lower point only.

(1) When the vaginal process is entirely open, gut can readily descend at once into the scrotum. Such a condition is called a *Congenital Hernia*. This form of rupture may be met with at birth, or may appear for the first time some months, or even years, after birth. When a rupture, having all the characters of a congenital hernia, appears for the first time many years after birth—say at the age of seventeen or twenty—the condition of parts is probably that found in cases where an infantile hernia may exist. The congenital hernia appears suddenly, and may pass at once into the scrotum.

(2) When the process is closed only at the internal ring, there is merely a thin septum between the peritoneal cavity and the cavity of the tunica vaginalis. The gut pressing upon this septum may push it before it, or come down behind it. In either case, three layers of peritoneum would have to be cut through before the gut could be reached. This is the *Infantile Hernia* of Hey, or the *Encysted* of Sir Astley Cooper. This hernia is not congenital, but is most commonly met with in infants and young children. It has been seen, however, for the first time in patients of seventeen, thirty, and thirty-five years of age.

There are no special features by which the rupture can be certainly diagnosed before the parts are exposed in herniotomy. It has the ordinary aspect and relations of an oblique inguinal hernia. It forms more gradually than does the congenital rupture, and seldom attains the same dimensions. An oblique inguinal rupture, of slow formation, in a patient under the age of puberty will probably be of this type. The condition of parts that favours the development of this rupture serves also to explain those anomalous cases of congenital hernia which appear suddenly, and for the first time, in adult life. Here, under some unwonted exertion, the septum above described gives way, and the gut at once passes into the cavity beyond, and so appears in the condition of a congenital hernia.

(3) In the last of the three above-named contingencies, a tubular process of peritoneum leads down as far as the top of the testicle, and there ends, the normal tunica vaginalis being beyond. Hernia into this

process is called a *Hernia into the funicular process.*

In the first of these three forms the testicle is quite enveloped in the hernia. In the second and third forms, as well as in the acquired form, it is distinct from the rupture, being behind and below it.

It is important to distinguish between the congenital and the acquired forms of inguinal hernia. In the congenital variety the rupture appears very early in life, and usually develops suddenly, whereas the acquired form is rare before puberty, and is of gradual development. In the former, the relations of the two abdominal rings remain unchanged, and the testicle is enveloped in the tumour. In the latter, the abdominal rings tend to become approximated, the testicle is distinct, and is to be felt behind and below the swelling. The congenital hernia is globular; the acquired, pyriform. The congenital hernia is much more liable to strangulation, and, when strangulated, is much more difficult to reduce by taxis.

The inguinal canal in the female is much smaller and narrower, although a little longer, than it is in the male. It offers such slight inducement to the formation of a rupture, that acquired inguinal hernia is quite rare among females. In the female fœtus a process of peritoneum descends for a little way along the round ligament, and is known as the canal of Nuck. If this process remain patent, as it not unfrequently does, it may lead to a rupture that corresponds to the congenital hernia of males. Indeed, in quite early life, the inguinal rupture is about the only form met with in female children, with the exception of umbilical hernia. In all such instances of early inguinal hernia, the gut has travelled down a patent canal of Nuck.

2. Internal or Direct Hernia.—In this form, the hernia leaves the abdomen through the space known as Hesselbach's triangle, and to the inner side of the deep epigastric artery. There may be two forms of direct hernia. In one form the gut escapes through the so-called middle fossa —a depression in the peritoneum between the epigastric artery and the obliterated hypogastric vessel; in the other, through the inner fossa between the hypogastric artery and the outer edge of the rectus muscle. The middle fossa is nearly opposite to the summit of the external ring. A hernia, escaping through that fossa, would enter the inguinal canal some little way below the point of entrance of an oblique hernia, and would have the same coverings as that hernia, with the exception of the infundibuliform fascia. The inner fossa corresponds with the external ring. A rupture escaping through this fossa is resisted by the conjoined tendon and the triangular aponeurosis. These structures are either stretched over the hernia so as to form one of its coverings, or the conjoined tendon is perforated by the hernia, or, lastly, the gut deviates a little in an outward direction so as to avoid the tendon and appear at its outer side. In any case, the hernia is forced almost directly into the external abdominal ring.

In distinguishing a direct from an indirect inguinal hernia, it must be first noted that the direct hernia is never congenital. In the oblique form the cord is behind the tumour, in the direct it is behind and external to it. In the congenital oblique hernia, and in recent examples of the acquired form, the rupture takes the direction of the inguinal canal, while the direct hernia has its axis almost, if not quite, parallel with the middle line. As has been already pointed out, old oblique herniæ lose a good deal of their obliquity, and, in time, present an axis which is not very divergent from that of the direct hernia. After the reduction of a direct rupture, the edge of the rectus muscle may be readily felt to the inner side of the aperture, and the pulsation of the epigastric artery may be detected on its outer side—features that are both lacking in the oblique variety. Finally, the direct hernia is usually much smaller than the oblique, and assumes a more globular outline.

Speaking generally, it may be said that inguinal herniæ, as a rule, contain small intestine, and often some omentum. In rare cases the rupture has contained the cæcum, the sigmoid flexure, an ovary, and the bladder. In cæcal ruptures there may be no sac, or only a partial one. When the bladder occupies the tumour, there is no sac.

Inguinal hernia is ten times more common in males than in females. It occurs with greatest frequency during the first ten years of life; it then diminishes in frequency, and rises again to attain the second maximum between the ages of twenty and forty. After forty it once more diminishes in frequency.

Inguinal herniæ have been mistaken for hydrocele, hæmatocele, varicocele, and other scrotal tumours; for tumours of the cord, for glandular enlargements in the inguinal canal, for suppurative collections in the canal, for retained testis. For the dif-

ferential diagnosis of these affections the reader is referred to the article GROIN.

In applying *taxis*, the thigh should be flexed and a little adducted. In congenital herniæ, and in recent acquired herniæ of the oblique variety, the pressure should be in the direction of the inguinal canal. In direct ruptures, and in old oblique herniæ that are not congenital, the pressure should be applied almost directly backwards.

In performing *herniotomy*, the external incision should be about 1½ or 2 inches in length, should be made along the middle of the tumour, and in its long axis, and should be so arranged that its centre shall correspond to the external ring. The superficial external pudic vessels are usually divided in the operation. It is impossible to distinguish the various layers of tissue that cover the hernia, the only one, as a rule, that is recognisable, being the cremasteric fascia. In dividing the constriction, it is recommended to cut upwards in all forms of inguinal hernia. The only vessel in risk of damage is the deep epigastric. In the oblique rupture, an incision directly upwards would quite avoid this artery; but in a direct hernia, where there is reason to suppose that the vessel is in close connection with the neck of the sac, it is well that the incision be directed a little inwards as well as upwards.

FREDERICK TREVES.

INHALATION. *See* ANÆSTHETICS.

INNOMINATE ANEURISM, uncomplicated by dilatation of the arch of the aorta, is of rare occurrence, and the difficulty of distinguishing it from purely aortic aneurism is confessedly great.

Symptoms.—The presence of a pulsating swelling in the region of the right sterno-clavicular articulation, which may be bulged forward or actually invaded by the tumour in its progress to the episternal notch, points to either an innominate or an aortic aneurism, or a combination of the two diseases. Deficient resonance is to be found over the upper third of the sternum, the inner half of the clavicle, and probably over the infra-clavicular region. A *bruit* may, or more probably may not, be present in the tumour, but the heart's sounds are apt to be propagated very clearly into the tumour, and, according to Barwell, while both sounds are heard as plainly as over the cardiac region, it is the second sound which is more especially exaggerated, being often louder than the first. Congestion of the veins of the right side is an early and marked symptom, and, later on, congestion of the left side may follow compression of the left innominate vein by the tumour. The diminution of pulse in both the right arm and neck is an important symptom of innominate aneurism, though not conclusive, since disease of the aorta at the origin of the innominate may give rise to the same symptoms. Dyspnœa and inability to assume the recumbent position are common in cases of innominate aneurism, and dysphagia is not an infrequent symptom.

Treatment.—The treatment of an innominate aneurism by rest and diet is singularly unsatisfactory, the disease making progress so soon as the patient resumes his ordinary habits, and ending before long in death by rupture, or by fatal pressure on the trachea.

The surgical treatment resolves itself into some form of distal ligature, for there can never be room to apply a ligature on the proximal side of the disease. Ligature of the common carotid, of the third part of the subclavian, and of both arteries consecutively or simultaneously, have all been tried, with varied results. According to Erichsen, of the cases in which one vessel alone was tied, in sixteen fatal results were accelerated, in three the progress of the disease was not materially interfered with, in two it was arrested, and in one the result was uncertain, and in one case only was the disease cured. Simultaneous deligation of the two main trunks, on the other hand, seems to have produced a cure in two cases of Barwell's, and one of King's, and to have given great relief in several other instances, both of innominate aneurism and of aneurism which proved eventually to be mainly aortic. Whatever may be the correct theory of the action of the distal ligature (*see* ANEURISM), there can be no doubt that the double distal ligature does produce a marked effect upon aneurisms presumably innominate, and that this is the best operative method to be pursued.

CHRISTOPHER HEATH.

INNOMINATE ARTERY, The, commences at the highest point of the aortic arch, opposite the middle of the manubrium sterni, and ends opposite the upper part of the right sterno-clavicular articulation. Its length is from 1½ to 2 inches.

In front are the manubrium sterni and the sterno-clavicular articulation, separated from the arterial trunk by the origins of the sterno-hyoid and sterno-thyroid muscles above, and below by the left innominate vein. *Behind* is the trachea; to the *left* is the left common carotid artery; to the *right*,

the pleura and the right innominate vein. No *branches* are given off from it normally.

Ligation.—I. The patient is to be placed on the back, with the shoulders slightly raised on a pillow, the head well thrown back over the pillow and the face turned to the left side. The surgeon stands on the right side of the patient, an incision is commenced from the middle line over the trachea and three quarters of an inch above the sternum, and carried outwards parallel to, and half an inch above, the clavicle, as far as the outer border of the sterno-mastoid muscle. Another incision is made upwards, from the inner end of the first, along the anterior border of the sterno-mastoid muscle for three inches. The angular flap thus shaped exposes the sterno-mastoid at its origin. A director or the finger is first passed beneath the sternal, and then the clavicular, head of the muscle, and each is divided, the inner wholly, the outer for about three-quarters of its extent. Reflect the angular flap; search for the outer edges of the sterno-hyoid and sterno-thyroid muscles; pass the director beneath them, raise them and divide. Recognise and open the common carotid sheath, following the artery downwards with the finger, when the innominate will be reached. Pull the pneumogastric nerve and the internal jugular vein outwards and see the subclavian. Clear the innominate artery, as well as possible, from the pleura on the right and the veins in front. Pass the needle from right to left, avoiding carefully the pleura. The description here followed is mainly that given by Mott. II. Sédillot recommends an incision through the integuments along the interval between the sternal and clavicular origin of the sterno-mastoid muscle. It is possible, says Sédillot, when the muscular heads are well separated and the patient's head flexed, to raise the sterno-hyoid and sterno-thyroid muscles, and, cutting them through, to obtain a view of the vessels which would allow of ligature of the innominate, the first stage of the subclavian, the first part of the common carotid, or the vertebral artery.

Of sixteen recorded cases, all have proved fatal except one, in which the common carotid was tied at the same time, and the vertebral artery later for secondary hæmorrhage. Twice the artery has been cut down upon and exposed without a ligature being passed, but good has resulted simply from the manipulation. James Cantlie.

INNOMINATE BONE, Fracture of the. *See* Pelvis, Injuries of the.

INTERTRIGO. *See* Erythema.

INTESTINE, Resection of. *See* Enterectomy; Colectomy.

INTESTINAL OBSTRUCTION.—The conditions which produce an obstruction in the bowels are numerous and varied. They depend upon many different mechanical circumstances, and are the outcome of diverse pathological changes. They can be most conveniently grouped and considered under the following headings:—

1. Strangulation by bands, &c., and through apertures. 2. Volvulus. 3. Intussusception. 4. Stricture. 5. Obstruction by tumours and foreign substances within the bowel. 6. Obstruction by the pressure of tumours, &c., external to the bowel. 7. Fæcal accumulation.

1. Strangulation by Bands, &c., and through Apertures.—Although many different anatomical conditions are met with under this general heading, yet the lesion to the gut, and the method of obstructing it, are practically the same in all the instances. No matter whether the involved loop of gut be ensnared beneath a false ligament, or a Meckel's diverticulum, or an omental band, or compressed by the margins of a normal or abnormal aperture, the intestine so obstructed is strangulated by precisely the same means that are concerned in a strangulated hernia. Indeed, this form of obstruction is practically that of an internal hernia, and the symptoms, and prognosis, and treatment, in the two varieties of obstruction, differ only on anatomical grounds.

The commonest method of strangulation that comes under the above heading is effected by *peritoneal false ligaments*. These ligaments are isolated adhesions, the result of local peritonitis. They are most commonly met with after the peritonitis attending inflammation of the cæcum, or of the connective tissue or viscera of the pelvis, and after that due to injury, to hernia, or to mesenteric gland disease. Adhesions, capable of producing strangulation, may indeed follow any form of peritonitis from which recovery is possible. Many of the adhesions formed during the progress of peritonitis no doubt disappear in time, others persist, and a few are apt to become elongated and cord-like from traction. Often only a single adhesion is found, and hence the term employed by Mr. Gay of 'the solitary band.' The obstructing band is usually narrow, slender, fibrous, and cord-like. Its length varies, and its attachments will depend upon the situation of the causative peritonitis. It is very

common for the band to be attached by one extremity to the mesentery. In most instances, the adhesion is found to be stretched in front of a resisting surface, such as the posterior abdominal wall, the floor of the iliac fossa, or a surface of the mesentery, and beneath the arcade so formed a loop of intestine is strangulated. In other and rarer instances, the band is unusually long and forms a loop or noose, in which a knuckle of bowel becomes ensnared, and by which it is ultimately strangulated. In some of the recorded examples, the loop or noose formed has been of a very complicated character.

In another class of case, the band is formed by the omentum, and is called an *omental cord*. In these cases, a part of the free border of the great omentum has become adherent at some spot, and the portion so bound down has developed into a cord-like structure. The attachment of the omental ligament is usually to the parietes or viscera of the pelvis, to the peritoneum in the cæcal region, or to the margins of a hernial orifice. In some cases the whole of the omentum has been rolled up into a fan-shaped structure, the base of the fan being at the transverse colon, and its apex at the point of attachment of the epiploon. More usually, however, the adherent segment separates itself from the rest of the omentum. As a rule, the omental cords are larger, coarser, and of greater length than those last mentioned.

Strangulation by *Meckel's diverticulum* also comes under the above heading. The true or Meckel's diverticulum is due to the persistence, or incomplete obliteration, of the vitelline duct. The diverticulum is always single, and comes off from the ileum from one to three feet above the cæcum. It arises from that side of the bowel which is most remote from the attachment of the mesentery. It is tubular, and its walls have, in all points, the same structure as the small intestine. In its most complete condition, it appears as a tube passing from the ileum to the umbilicus. Much more frequently, however, it forms quite a short projection from the ileum, and, indeed, the average length of the diverticle is three inches. It may be free, or it may have acquired an attachment at its distal extremity. This is more usually to the umbilicus, and is commonly effected by means of a ligament, which comes off from the end of a short tubular diverticulum, and continues the process to the vicinity of the navel.

The end of the diverticle or the cord, which is often continued from its free extremity, may be found attached to other parts, such as the small intestine, the cæcum, and, very commonly, the mesentery. Sometimes, in the position of the diverticulum, no tubular process is found but only a fibrous cord. This cord may represent a greatly atrophied and imperfect diverticulum, or may be the remains of the omphalo-mesenteric vessels. When the diverticulum is free, its extremity may be rounded like that of a test-tube, or it may be tuberose or clubbed, from the development of a false or protrusion-diverticulum.

This abnormal process may cause obstruction in several ways. The adherent diverticulum may form an arcade beneath which a loop of intestine becomes strangulated, or when of good length, and especially when in great part ligamentous, it may form a noose in which a knuckle of bowel may be snared. On the other hand, when the process is free from attachment, and has a clubbed extremity, it may actually tie itself in a knot around the pedicle of a loop of bowel. The precise nature and mode of formation of these remarkable diverticular knots has been well described by Parise.

In the fourth class of case, the strangulating agent may be *a normal structure which has become abnormally attached*. Thus intestine has been found strangulated beneath an adherent vermiform appendix or Fallopian tube, beneath a fixed portion of the mesentery, and beneath the pedicle of an ovarian cyst.

In many cases belonging to the present class, a piece of bowel is strangulated through some *slit* or *aperture*. In the majority of the instances, the slit is found in the mesentery. Some of the mesenteric holes are due to injury, while others are congenital. The congenital apertures are round and regular, and are found in the mesentery of the lower end of the ileum. In other instances, the aperture is in the omentum, and here also it would appear that certain of these unusual holes are due to injury, while others are congenital. A loop of bowel has been strangulated by the margins of the foramen of Winslow, by a slit in the broad ligament of the uterus, and in the suspensory ligament of the liver; by the ring sometimes formed by adherent intestinal loops, by the slit left between two parallel bands of adhesion, and through apertures of like peculiar and rare character.

The general form of strangulation, now under notice, may concern any part of the intestinal canal that is capable of becoming

strangulated. The lesion, however, almost invariably concerns the lesser bowel. In some few cases, a part of the colon has been involved, but such instances are quite exceptional. Of the small intestine, the segment most frequently involved is the terminal part of the ileum.

The amount of bowel implicated varies from the smallest knuckle to a mass of intestine measuring several feet. The average length of the involved coil, as gathered from the examination of a large number of recorded cases, is about fifteen inches.

2. Volvulus.—The term volvulus is applied to a condition where the intestine is so twisted that its lumen has become entirely occluded. In one form of volvulus, the bowel is twisted about its mesenteric axis, or even, in rare cases, upon its own axis; while in another form, two suitable coils of intestine are so intertwined or knotted together that obstruction is brought about. The first form of volvulus is comparatively common, the latter is very rare. Volvulus may concern the small intestine, the ascending colon and cæcum, or the sigmoid flexure. It is most commonly met with in the sigmoid flexure. Elsewhere it is exceptional. Indeed, it may be said that the usual form of volvulus is due to a twisting of the sigmoid flexure about its mesenteric axis, and that all other forms of twist are rare.

Volvulus of the Sigmoid Flexure.—The bowel, as has just been observed, is usually found to be twisted about its mesenteric axis. In a normal sigmoid flexure, especially when the loop has but a short meso-colon, volvulus of this kind is impossible. A certain arrangement of the gut is necessary before the twist can be produced. In the first place the sigmoid loop must be of considerable length; in the second place its meso-colon must be long and very narrow at its parietal attachment; and, thirdly, the two ends of the loop of bowel must be brought very close together. When these conditions are found, there exists a free and loose coil, with a narrow and fixed pedicle, around which it can, with great ease, be twisted. This arrangement of the sigmoid flexure is rarely met with except in the bodies of adults, and especially in those past middle life. There is evidence to show that it is most probably brought about by long-continued constipation.

When volvulus occurs, the loop is twisted around its mesenteric axis. The twist is sometimes from right to left, but it is more usually from left to right. When the volvulus has occurred, both ends of the loop are occluded, and the twist is soon rendered permanent. The heavy and loaded coil has no inherent power of righting itself; it soon becomes distended with gas, and this distension renders the volvulus irreducible. If the gas be evacuated, the distorted coil can probably be made to assume its normal position. The distension of the sigmoid loop in volvulus is often enormous. In some cases the involved coil has appeared to occupy almost the whole abdominal cavity. When the distension is moderate, the fundus of the twisted loop reaches the umbilicus; as the distension increases, it tends to move towards the right hypochondriac region, and, in extreme cases, the diaphragm may be pushed up by the dilated coil, and death be brought about by pressure upon the thoracic viscera. The involved loop is found to be intensely congested, and in the condition indeed of bowel in a strangulated hernia. If the volvulus be unrelieved, patches of gangrene appear upon the bowel, and spread rapidly. The colon, above the twist, is found much distended; its mucous membrane is often ulcerated, and such ulceration may lead to fatal perforation. Peritonitis is remarkably common in this form of obstruction. It begins on the involved coil, and then spreads over the rest of the serous membrane. It is rarely absent.

In the other form of volvulus of the flexure, the same anatomical conformation is found in the bowel as in the previous case, and, over or under the pedicle of the loop, a coil of small intestine has passed, and the loop and the coil have become so intertwined as to cause obstruction in both the segments of bowel involved.

Volvulus of the ascending Colon and Cæcum is met with under three aspects:—(1) The ascending colon may be twisted around its own axis. This form of obstruction is, without question, exceedingly rare. (2) The cæcum and ascending colon are together provided with an extensive meso-colon. The free and loose loop of bowel, so formed, may become twisted about its mesenteric axis, or may become intertwined with a suitable coil of the small intestine, just as in the case of the sigmoid flexure. (3) The cæcum is the subject of congenital malformation, and is found to be so bent upon itself, or so twisted about its long axis, that its lumen is wholly, or in part, occluded. The colon, in these cases, is often imperfectly formed, the ascending colon is absent, and the distorted cæcum

found in the right hypochondriac region or about the umbilicus.

All these forms of volvulus are rare.

In *Volvulus of the Small Intestine*, as in that involving the sigmoid flexure, two forms of twist may be found. In the one, a loop of the small intestine is twisted about its own mesenteric axis. In the other, a suitable coil of the bowel is engaged in a volvulus with another suitable coil.

It would appear that volvulus is not met with in the small intestine when the anatomical condition of that bowel is in all respects normal. Sometimes, a few adhesions hold the gut down in such a way as to render an irreducible volvulus possible. In other instances, the two ends of a large coil of small intestine are brought together. In this way the coil or loop becomes, to some extent, separated from the rest of the intestine. It has a pedicle, and is in a position to enter into either of the two forms of volvulus. The bringing together of the two ends of the bowel in the loop may be due to some old mesenteric gland disease, or to some local peritonitis involving the mesentery. Volvulus of the small intestine most usually concerns the lower ileum. The involved segment of bowel becomes occluded at both ends, and much distension is produced.

3. Intussusception.—By an intussusception is understood the prolapse or turning of one part of the wall of the intestine into the lumen of an immediately adjoining part. It forms more than one-third of the whole number of cases of intestinal obstruction. When an intussusception is viewed in vertical section, it is found to be composed of six layers of intestine—three on either side of the central canal—all more or less parallel to one another. On horizontal section it shows three concentric rings of bowel. In whatever way the section is made, the arrangement of the layers is found to be such that mucous membrane is in contact with mucous membrane, and peritoneum with peritoneum. The external of the three layers is known as the intussuscipiens or sheath. The innermost cylinder is called the entering layer, and the middle one the returning layer. These two layers, taken together, form the intussusceptum.

There are three anatomical varieties of intussusception:—(1) enteric; (2) colic; and (3) ileo-cæcal. The enteric involve the small intestine, and especially the ileum and lower jejunum. They are usually quite short. The colic may be found in any part of the colon, but are most common in the descending colon and sigmoid flexure. They also seldom attain great length. There are two forms of invagination at the ileo-cæcal region, viz. the ileo-cæcal and the ileo-colic. In the former, the ileum and cæcum pass into the colon, preceded by the ileo-cæcal valve, which forms the apex or free extremity of the intussusceptum. This form may attain great size, so that the valve reaches the anus and projects beyond it. In the ileo-colic form, the end of the ileum is prolapsed through the ileo-cæcal valve. The valve and the cæcum remain, for a while at least, unmoved, and the ileum always forms the apex of the intussusceptum. If the invagination increases after the ileum ceases to become prolapsed, the cæcum and the colon become the subject of a secondary invagination. Leichtenstern expresses the relative frequency of these various forms by the following figures: Ileo-cæcal 44 p.c., enteric 30 p.c., colic 18 p.c., and ileo-colic 8 p.c.

In all forms of intussusception, except the ileo-colic, the invagination increases at the expense of the external layer only. Thus, supposing the end of the jejunum to be invaginated into the ileum. If the mass increase, it will do so solely at the expense of the ileum, and no more of the jejunum will actively enter the intussusception. It thus happens that the apex of the intussusception always remains the same, no matter to what length the invagination attains. In the ileo-colic form, the end of the ileum is prolapsed through the valve, and as the invagination increases, more and more ileum is protruded through the ileo-cæcal opening, while the sheath remains unchanged. When, for various reasons, no more ileum can become invaginated, then, if the tumour increase, the cæcum will be turned in, and after it the ascending colon, the intussusception now growing solely at the expense of the external layer or sheath.

The true or obstructive intussusception must be distinguished from a form of invagination, which is supposed to be due to disordered intestinal movements occurring during the act of dying. These 'intussusceptions of the dying' are always small, are most common in the small intestine, are usually multiple, are frequently retrograde, and are in all instances very readily reduced. They produce no symptoms, and cause, indeed, no material narrowing of the lumen of the bowel. The true intussusception is always descending, i.e. always moves in the direction of the anus. In a few

instances a true ascending or retrograde invagination has been met with. Except under the rarest circumstances, the true or obstructive invagination is always single.

Some few cases have been reported of double and triple intussusceptions. In these cases an invagination forms, and then its sheath becomes itself the subject of invagination, so that a double intussusception is formed, composed of five layers instead of three. If the outer sheath of a double intussusception become in turn the seat of another invagination, a triple intussusception is produced, which will be found to be composed of seven layers.

The tumour generally has a somewhat curved outline, especially in the ileo-cæcal forms. This depends upon the traction on the mesentery, and the tumour will therefore be concave on the side to which the mesentery is attached. The traction of the mesentery also tends to make the aperture of the intussusceptum slit-like, and to pull it towards the mesenteric side of the sheath or receiving layer.

Some invaginations may exist for some length of time without the lumen of the involved bowel becoming occluded, and without any gross changes appearing in the layers of the distorted intestine. As a rule, however, the intussusceptum soon becomes engorged with blood and greatly swollen. From this engorgement, coupled with the constriction to which the neck of the intussusception is subjected, the inner and middle layers may soon find themselves in the condition of strangulated bowel. At first, the lumen of the intestine is comparatively free, but by slow degrees it becomes narrowed, and in time most usually becomes quite occluded. This occlusion is due mainly to the great swelling of the intussusceptum, and also to the curving of the tumour from the dragging upon the mesentery, and occasionally to the plugging of the canal with clots of blood. Another important change which is apt soon to take place in the intussusception is this—it becomes irreducible. This irreducibility may depend upon adhesions at the neck or between the opposed serous surfaces of the inner and middle layers, or it may be due to the great swelling of the intussusceptum; or to the presence of a polyp at its apex, or to some alteration in outline that the invagination has undergone, or—in the ileo-colic form—to the resistance offered by the ileo-cæcal valve. In many, and indeed in perhaps the majority of the cases, two or more of these factors in the production of irreducibility are found to be combined. The intussuscipiens seldom undergoes gross change. It may, however, become the seat of some local peritonitis, or become ulcerated, or even in rare cases gangrenous. With regard to the intussusceptum, it in time tends to become gangrenous. The gangrene is produced by the same conditions which foster it in strangulated hernia. The necrotic process may be limited to some portion of the intussusceptum, or the whole of that part of the invagination may perish *en masse*, and be discharged from the anus. It is by means of gangrene of the intussusceptum that an invagination may undergo spontaneous cure. By this process of elimination several feet of intestine have been separated and evacuated.

4. Stricture of the Intestine. — In stricture, there is a narrowing of the lumen of the bowel, due to changes in the coats of the bowel itself. It is convenient to divide all cases of stricture into two great classes, the cicatricial and the cancerous.

The Cicatricial Stricture depends upon the contracting of a cicatrix, consequent upon the loss of substance by ulceration or limited gangrene of the inner coats. The nature and extent of the stricture produced will obviously depend upon the situation and extent of the original loss of substance. In the majority of examples, the cicatricial stricture has followed upon some primary ulceration of the bowel. Dysenteric ulcers very often lead to stricture. These ulcers are usually met with in the lower parts of the colon, and become rarer as the cæcum is approached. They often cause extensive and very irregular contractions, and may lead to a severe form of stricture. The catarrhal ulcer—met with in acute and chronic catarrh—and the syphilitic ulcer may both be causes of stricture. The former is, as a rule, limited to the colon, the latter occurs most frequently in the rectum and the lower ileum. The peptic ulcer of the duodenum, which is said to be caused by the action of the gastric juice, may also lead to stenosis. Tubercular ulcers of the bowel are also frequent causes of stricture. They are most common about the lower ileum and the ileo-cæcal valve. It would appear that the ulcers due to typhoid fever never produce a very definite stricture of the bowel. In several instances, the loop of gut which has been involved in a strangulated hernia has become the seat of a stricture, the stenosis depending upon cicatrisation after ulceration or limited gangrene of the involved intestine. Certain cases also have been recorded, where a cicatricial stricture has been more or less distinctly

traced to the effects of some injury to the bowel.

The Cancerous Stricture. Two forms of cancer are met with in the bowel, the primary and the secondary. It would appear that any form of carcinoma may lead to secondary deposits in the bowel, and those deposits will of course present the same type of structure as is possessed by the primary growth. With this form of carcinoma, surgery has little or no concern.

With regard to primary cancer of the bowel, there are strong reasons for believing that it is strictly limited to one form of carcinoma—the epithelial. There is no evidence of a substantial character to show that scirrhus or medullary cancer ever appears in the bowel as a primary growth.

Epithelioma usually produces very definite and well-defined circular strictures of the bowel. The outer surface of the bowel at the seat of stricture is often very sharply constricted, and presents an appearance as if a piece of cord had been tied around it. The deposit in the interior of the bowel is apt to assume an annular outline, and to be attended early in the case by ulceration. The ulcers have often a thickened, indurated, and everted edge which is very typical.

In any case of stricture, whether simple or cancerous, the intestine above the narrowed part becomes dilated and hypertrophied, and its mucous membrane the seat of ulceration. In stenoses of the colon, ulceration is very commonly met with in the cæcum, even in cases where the obstruction is situated at some distance from the caput coli. It very frequently happens that the ulcer above the obstruction leads to fatal perforation.

Cancerous strictures are much more common than cicatricial strictures, and the colon is much more frequently the seat of the stenosis than is the small intestine. Excluding the rectum, the commonest seat of stricture of the intestine is in the sigmoid flexure; next in frequency comes the descending colon, and then the splenic and hepatic flexures. Indeed, so far as the colon is concerned, it may be said that strictures become gradually less and less frequent as one passes up the intestine from the sigmoid flexure. In not a few instances the stricture has involved the ileo-cæcal valve.

5. Obstruction by Tumours and Foreign Substances.—The following *Innocent Tumours* are met with in the intestine:—Fibroma, fibro-myoma, lipoma, angioma, and adenoma. The last-named is the most common, the other growths are rare. The adenoma grows from the mucous membrane, and is composed of glandular tissue, of the kind found in Lieberkühn's follicles. These tumours nearly always assume a polypoid outline. When the supporting connective tissue of the mass is loose and lax, it receives the name of a soft polyp; when it is more dense and fibrous, the tumour is called a firm or fibrous polyp, or papilloma.

Adenomata are most frequent in the rectum and colon, are most often met with in children, and are more usually multiple than single. After the colon, the lower end of the ileum is the most frequent seat of polypoid growths. Sometimes these growths may attain great size. They may cause obstruction by their great size or by their numbers, and not infrequently they lead to intussusception. In some cases the pedicle of the polyp has given way, and the mass has been discharged per anum.

Sarcomatous Tumours have been met with in the bowel, both as primary and secondary growths. They are usually of the spindle-celled variety. They only very rarely appear as polypi, and more commonly spread around the bowel, and then probably produce one form of what has been incorrectly called a cancerous stricture. In connection with Hodgkin's disease, immense masses of lympho-sarcoma have developed in the bowel from the adenoid tissue in the mucous membrane.

By a *Foreign Body*, as applied to the intestinal tract, is meant any substance that can resist the digestive action of the fluids of the stomach and bowels. These substances may be swallowed by accident or intent, and the victims are very often lunatics or hysterical individuals. Some of the foreign substances which are smooth and rounded, such as pebbles, coins, &c., may pass readily through the bowel, while irregular-shaped bodies, such as pieces of bone and porcelain, and plates carrying false teeth, are very apt to lodge in some part of the canal. The majority, however, of foreign bodies which are swallowed are in time passed by the anus. They may be retained for weeks or even months, and then be evacuated. If obstruction be produced, it most probably depends upon impaction of the foreign body in the lower ileum. The cæcum is another spot where such substances are very apt to lodge. The impacted body may excite ulceration of the bowel. This may lead to perforation and death, or may induce the formation of an abscess, upon the evacuation of which the foreign substance is discharged.

In many instances a *Gall Stone* has become impacted in the intestine, and has led

to fatal obstruction. The stone, to cause obstruction, must be of unusually large size, and it is probable that, in every instance, the calculus has reached the bowel by direct ulceration between the gall-bladder and the duodenum. If the stone is able to pass the bile-duct, it will certainly be able to pass through the intestine. When impaction has taken place, the stone is usually found to be lodged in the lower ileum, and next in frequency in the duodenum or jejunum. Impacted gall-stones have induced fatal ulceration and gangrene of the bowel, and have led to the development of fæcal abscesses, through which they have been discharged. These biliary calculi may be retained for weeks or months without causing any symptoms, or, after severe symptoms of obstruction have been produced, they may be spontaneously evacuated.

Obstruction in the bowel may be produced by *Intestinal Calculi* or *Enteroliths*. Some of these concretions are composed of phosphatic deposits, which are usually found to be formed around a nucleus composed of some undigested substance. Such enteroliths are stone-like, are usually single, and of small size. Other enteroliths are of low specific gravity, are porous and sponge-like in texture. These are composed mainly of densely felted masses of vegetable fragments, mixed with calcareous and fæcal particles. To this class belongs the avenolith, or oat-stone, which is said to be met with occasionally in the intestines of those who live largely upon oatmeal. Other of these calculi are made up of hair and fibres, which the patient is in the habit of introducing into the mouth from time to time. Thus a large mass, composed of cocoa-nut fibres, has been found in the intestines of individuals working with that material. In other cases, the concretion is formed of insoluble mineral matters which have been swallowed as medicines. These enteroliths are usually composed of magnesia, and may be of great size. In one instance, it was found to be composed wholly of gum benzoin.

6. Obstruction by the pressure of Tumours, &c., external to the Bowel.—As instances of this form of obstruction may be cited—occlusion of the intestine by a retroverted or retroflexed uterus, especially when enlarged by pregnancy, occlusion by uterine and ovarian tumours, by large abscesses, by tumours of the kidney and other parts, by enlarged spleens, and by hydatid cysts, &c. In this form of obstruction, the rectum suffers the most frequently, and after it the sigmoid flexure, and the terminal coils of the ileum.

7. Fæcal Accumulation.—The morbid condition, which forms the basis of this form of obstruction, is an insufficiency in the forces that move the intestinal contents forward. This condition may pass on to absolute paralysis of a segment of the bowel, leading to complete arrest of the intestinal contents and symptoms of obstruction. In chronic constipation it can only be said that the peristaltic movements are feeble, and inadequate to produce the effects expected of them. In the condition known as 'ileus paralyticus,' or obstruction by fæcal masses, the constipation has led to absolute occlusion of the bowel, and a considerable portion of the intestine is incapable of any peristaltic movements. Fæcal matters collect in this segment, and form a species of plug, which even vigorous action in the bowel alone is not able to dislodge. The retained fæces become more and more solid by absorption of their fluid parts, and the contraction of the empty or less distended bowel below the accumulation adds to the obstruction. As the case progresses, the paralysed intestine becomes more and more distended, its muscular fibres are stretched and even ruptured, and the possibility of a restoration of peristaltic movement is rendered gradually more remote. The condition may be further complicated by the appearance of chronic peritonitis. The gut above the occlusion becomes dilated and hypertrophied, and its mucous membrane the frequent seat of ulceration ('stercoral ulcers.') It is in the cæcum especially that these ulcers are very apt to occur. This form of obstruction is practically limited to the colon, although it may involve the lower ileum. The parts in which the accumulation most often forms are the cæcum and the sigmoid flexure. The dilatation of the bowel above the obstruction often attains enormous proportions, and the amount of fæcal matter accommodated in the bowel in these cases may be very considerable.

Rare Forms of Obstruction.—Among the rarer forms of obstruction which are excluded from the above classification, may be mentioned the following:—Occlusion of the bowel by acute bending or kinking, due to traction upon an isolated adhesion or an adherent diverticulum; occlusion by means of adhesions that compress the gut, and that mat several of the coils together; and narrowing of the bowel from shrinking of the mesentery after inflammation.

The Symptoms of Obstruction.—From a clinical point of view intestinal obstruction may be conveniently divided into

three classes :—1, acute obstruction; 2, chronic obstruction; and, 3, cases where symptoms of acute obstruction supervene upon those indicative of chronic obstruction.

1. In *Acute Obstruction* the patient is seized, more or less suddenly, with severe abdominal pains. The pain is of the nature of colic, and is usually constant, although liable to exacerbations. He vomits. The vomiting appears early, is copious, persistent, and in time very commonly stercoraceous. There is more or less absolute constipation, with some distension of the abdomen. There is collapse with great depression of strength, the temperature falls, the pulse becomes rapid and very feeble, the extremities are cold, the face is pinched and the eyes sunken, and the amount of urine is diminished.

2. In *Chronic Obstruction*, on the other hand, the onset is gradual, and the progress of the malady irregular. There are attacks of pain, which come on at first at long intervals, are often provoked by food, and are frequently ascribed to indigestion or colic. These attacks become more frequent, more severe, and of longer duration. They are attended with some vomiting and with constipation. The vomiting is probably slight and the constipation not absolute. Between these attacks the patient may feel fairly well, and suffer only from some abdominal distension, some irregularity of the bowels, with a sense of malaise and with loss of appetite. The attacks become more frequent and severe, the vomiting is more persistent, the constipation more pronounced, and the patient dies, exhausted and marasmic, and worn out by the pain, the continued vomiting, and the inability to take food. The abdomen in such cases may be very much distended, and the movements of the intestinal coils may be visible through the parietes.

3. In the *third class of case* the patient, after presenting for a variable period the evidences of chronic obstruction, succumbs at last to an acute attack. The course of acute obstruction is to be estimated by days, that of the chronic form by weeks and by months.

Before proceeding to the diagnosis of the various special pathological forms of obstruction, it will be convenient to analyse briefly some of the more conspicuous of the symptoms.

Collapse, as an early symptom, is seen only in cases of acute obstruction where the intestine is strangulated. It is due to the sudden lesion inflicted upon the peritoneal and intestinal nerves. The severity depends upon the rigour of the strangulation, the amount of bowel involved, and, to some extent, upon the part involved; for it is apt to be more marked when the active small intestine is involved, than when the more passive colon is the seat of the trouble. The collapse will be obviously influenced by the age and general condition of the patient. In some cases it may be very profound—as profound as the collapse of cholera.

The *Pain* depends, in the first instance, upon the damage inflicted upon the bowel by the strangulation, and, later on, upon the violent and irregular peristaltic movement which the obstruction excites. Pain due to the former cause will be more or less continuous, while that due to the latter will be paroxysmal and colicky. In acute cases, the initial pain is frequently referred to the region of the umbilicus, i.e. to the region of the solar plexus. A continuous pain—even though it present occasional exacerbations—usually indicates complete obstruction, while a distinctly intermittent pain is associated with an incomplete occlusion of the bowel. The early pain in obstruction cases is, as a rule, not attended by tenderness on pressure. This latter symptom is associated with engorgement of the bowel, with long-continued cramp in the intestinal muscle, or with the appearance of local or general peritonitis.

The *Vomiting*, which appears at the very commencement of an acute case, is no doubt due to the lesion inflicted upon the abdominal nerves. The vomiting, in the after-course of the case and in chronic cases, depends, for the most part, upon the obstruction. The bowel above the obstruction becomes distended, and peristaltic movements passing along it induce the backward axial current in the contents, whereby they are poured into the stomach. The persistent vomiting in intestinal obstruction does not require the theory of antiperistalsis to explain it. If the obstruction be at or above the middle of the ileum, the vomited matters cannot become stercoraceous, unless they have been long retained, when, from decomposition, they may acquire a feculent odour. An obstruction in the lower ileum, or in any part of the colon, may be associated with genuine stercoraceous vomiting.

The State of the Bowels will obviously be influenced by the nature and degree of the obstruction. It depends—in cases of partial occlusion—also to a great extent

upon the fluid or solid condition of the intestinal contents. The constipation may, in some cases, be in great part due to reflex nerve-action. Thus, in acute strangulation of the small intestine, there may be absolute constipation from the very onset of the obstruction, although the bowel below the occlusion is well occupied by fæces. In intussusception there is—in at least the earlier stages of the malady—diarrhœa. Tenesmus is a marked symptom in cases of invagination involving the large intestine, and is met with also in obstructions that implicate the lower parts of the colon.

The State of the Abdomen.—When the obstruction is complete, meteorism develops. With an incomplete obstruction—especially when a little diarrhœa exists—the abdomen may be quite flat and even retracted. Meteorism is most marked and is earliest seen, when the colon is obstructed. In no form of intestinal occlusion is meteorism at once more sudden and more severe, than in volvulus of the sigmoid flexure. In occlusions of the upper jejunum and duodenum, the distension of the abdomen will be limited to the region of the stomach.

An abdominal tumour may be felt in the following cases:—intussusception, fæcal accumulation, cancer, certain neoplasms, such as lympho-sarcoma, and in some cases of obstruction by gall-stones, foreign bodies, and enteroliths. A number of coils of small intestine, matted together by adhesions, have formed a species of tumour, and a localised dulness on percussion has been caused by collapsed coils of the lesser bowel which have become grouped together below an obstruction.

Local tenderness may correspond to a congested loop of bowel, or may indicate local peritonitis.

The diminished amount of urine passed in many of the acuter cases, does not depend upon the seat of the obstruction, as was once urged, but upon its acuteness, and upon the extent of the damage inflicted upon the nervous system. It is rather one of the symptoms of collapse; it varies with the extent and degree of the collapse and the severity of the pain. In these cases, a marked increase in the amount of urine passed as a rule immediately attends the administration of a full dose of opium.

Differential Diagnosis.—1. The case is diagnosed to be one of *acute obstruction.* The trouble may, in such an instance, be due to—*A.* Strangulation by bands and through apertures, including strangulation by omental cords, by Meckel's diverticulum, by an adherent appendix, &c., strangulation through normal or abnormal slits or apertures, and all forms of internal hernia. *B.* To volvulus of the sigmoid flexure or—in rare cases—of other parts of the colon. *C.* To acute intussusception; and, *D*, To some forms of obstruction by gall-stones, foreign bodies, and enteroliths. *See Table* 1.

2. The case is diagnosed to be one of *chronic obstruction.* The trouble may, in such an instance, be due to—*A.* Stricture of the small intestine, including the many conditions in which the lesser bowel has its lumen partly occluded by compression, by bending, by obstructing substances or new growths. *B.* Stricture of the colon, including the many conditions in which the colon has its lumen partly occluded by compression, by bending, by obstructing substances, or new growths. *C.* Fæcal accumulations; and, *D*, Chronic intussusception. *See Table* 2.

3. The case is diagnosed to be one of *acute obstruction supervening upon chronic obstruction.* In such instances, a form of chronic obstruction exists, in which the lumen of the bowel is only partly occluded, and in which a *complete* occlusion is suddenly brought about. Thus fæcal accumulation may lead to acute symptoms when absolute obstruction is produced. Or a stricture may have become occluded by a sudden bending of the bowel, or by blocking of its lumen by a mass of fæces or of undigested food. Or, again, in chronic intussusception, the lumen of the bowel may become in like manner suddenly occluded, and acute symptoms be thus developed.

In all such cases the previous history of the patient forms the most important element in the diagnosis.

Treatment.—1. *Acute Obstruction.*

A. Strangulation by bands, &c., and through apertures, including the conditions named under the heading in the diagnosis.

The patient must, of course, be kept absolutely at rest. No food of any kind should be given; it merely aggravates the vomiting, and could not be digested even if retained. Ice may be given to suck.

If there be very severe pain with collapse, and greatly diminished excretion of urine, morphia may be administered hypodermically. It must be remembered that morphia can have no really curative effect in these cases, and that it is apt to mask the symptoms, and effect such apparent improvement as even to alter the clinical aspects of the case. Laparotomy offers the only prospect of cure. In this form of obstruc-

tion spontaneous relief, while not absolutely impossible, is yet excessively rare, much rarer than the relief of strangulated hernia by spontaneous means. The operation should be performed at once. The simple opening of the abdomen is not in itself a serious measure. The delay is, on the other hand, extremely serious. Laparotomy should be a first and not a last resource. It is as useless to temporise in these cases, as it would be to temporise in a case of strangulated hernia after taxis had failed. For the various details of the operation, and the mortality attending it, *see* LAPAROTOMY.

B. Volvulus of the sigmoid flexure. There is no evidence to show that spontaneous cure ever occurs in this acute affection, when the twist is complete and well-defined. Unless relieved, the condition would appear to be inevitably fatal. The remarks on rest and diet, made respecting the previous form of obstruction, apply equally to this form. Morphia may be administered hypodermically. It stills the peristaltic movements which appear to constantly disturb the involved bowel. In some cases, where the distension of the loop has been relieved, the volvulus has become untwisted. The rectum should be therefore emptied by an enema, and the distended loop punctured through the parietes. Failing relief from this means, left lumbar colotomy should be at once performed. Left inguinal colotomy would merely open the distorted loop, and not the bowel above the obstruction. Attempts to reduce the volvulus, through an incision in the anterior abdominal wall, are not likely to be attended with success. The loop is often of enormous dimensions, and, if untwisted, the volvulus will most probably re-form again.

C. Acute intussusception. No food should be administered, and the patient only be allowed to suck ice. Morphia or opium should be at once given. The drug allays peristaltic movement, and prevents the increase of the invagination. It puts the disturbed parts at rest, and in some few cases—when given early—would appear to have effected a cure. Failing this, forcible enemata should be given. They should be administered by means of a syphon, so that the water can enter the bowel under a steady and easily regulated pressure. If much pain be occasioned, the enema may be given while the patient is under the influence of an anæsthetic. In any case, before the enema is used, the intestinal movements should be stilled by opium. The injection should be retained for at least fifteen minutes. Some surgeons prefer to distend the bowel with air, using for the purpose a common bellows. A better instrument for the purpose, however, is Mr. Lund's inflator (*Lancet*, vol. i. 1883, p. 588). These measures are worthy of a patient trial, and have been followed with considerable success. They are likely to be most effective in quite recent cases. They would obviously be useless when once adhesions had formed, or the invagination had become irreducible for other reasons.

If these measures fail, laparotomy should be at once performed. It is true that acute intussusception may in time take on a chronic course; but the great majority of the patients die long before they can enter upon the chronic disease, and, moreover, the mortality in chronic intussusception is very high. The general mortality of intussusception is 70 per cent., and 80 per cent. of the patients die before the seventh day. In young children the mortality is terribly high. It is well known that spontaneous cure may take place by elimination of the gangrenous intussusceptum. But such elimination only occurs in 42 per cent. of all cases, and, of those in whom it occurs, there is a subsequent mortality of no less than 40 per cent. The prospects of spontaneous cure by gangrene are too uncertain to be relied upon. As soon as the means already mentioned have had a fair trial and have failed, laparotomy should be performed without delay. In the young it has been urged that the operation should be performed within the first twenty-four or forty-eight hours.

In performing laparotomy the invagination should be reduced when possible, but, failing reduction, the mass should be resected by either of the two methods described under ENTERECTOMY.

D. Acute obstruction by gall-stones, foreign bodies, &c. In several of these cases relief has attended the free administration of opium, followed, after a while, by copious and repeated enemata and gentle laxatives.

Failing relief from these means, there remains no treatment other than by laparotomy and extraction of the foreign body. If the gut at the seat of the impaction be sound, the incision made in its walls may be closed by sutures and the loop returned. If it be gangrenous, or much ulcerated or inflamed, an artificial anus should be established, which can be closed subsequently by a second operation.

TABLE I.—ACUTE OBSTRUCTION.

SYMPTOMS	STRANGULATION BY BANDS, &C., AND THROUGH APERTURES	VOLVULUS OF THE SIGMOID FLEXURE	ACUTE INTUSSUSCEPTION	ACUTE OBSTRUCTION BY GALL-STONES, &C.
SEX; AGE.	More common in males than females. Mostly in young adults. Rare after 40.	Males to females as 4 to 1. Very rare before 40. Most common between 40 and 60.	A little more common in males; mostly in the young. One-half of the cases are under the age of 10.	Gall-stones are much more common in females than males. Average age, 50 to 65.
PREVIOUS HISTORY.	History of previous peritonitis in 68 per cent.	History of long standing, chronic constipation.	Nothing of note.	Gall-stones may have been passed. History of hepatic colic. History of foreign bodies swallowed.
MODE OF ONSET.	Sudden.	Sudden.	Sudden.	Sudden.
PAIN.	Appears early; is very severe; is colicky and persistent; is often situate about the umbilicus.	Appears early. Is severe, but not so severe as in previous case. Is intermittent at first, and then continuous, with exacerbations. Is most felt about navel and region of sigmoid flexure.	Appears early. Is severe at first; then tends to subside. Is at first, usually, distinctly intermittent, then becomes continuous, with exacerbations. May be localised about a tumour.	Appears early. Is severe and continuous, with exacerbations.
VOMITING.	Appears early; is constant, copious, and very severe. In 60 per cent. becomes stercoraceous, on an average, on the fifth day. It gives no relief.	Appears less early, and is less marked and less severe than in previous case. Often scanty. Is feculent in 15 per cent. It often gives much relief to patient.	Does not appear so early as in the two previous cases. In 8 per cent. there is no vomiting; is often scanty; is liable to great fluctuations; in 25 per cent. the vomiting becomes faculent, on an average, on the fifth day.	Appears early. Is often copious. May in time become stercoraceous.
CONSTIPATION.	Complete and absolute from the first. No discharge of blood from the anus.	Complete and absolute from the first. No discharge of blood from the anus.	Absolute constipation extremely rare; diarrhœa is the rule. In 80 per cent. a bloody discharge from the anus.	Complete from the first. No discharge of blood from the anus.
TENESMUS.	Absent.	Met with in 15 per cent.	Met with in 55 per cent.; is often very severe.	Absent.
PROSTRATION.	Marked. There is collapse, intense thirst, diminished urine.	Not so marked as in previous case. May be collapse and diminished urine. Often severe dyspnœa from distension of the abdomen.	Marked; often severe collapse in the young.	Marked, but seldom so pronounced as in the previous forms of obstruction.
ABDOMINAL PARIETES.	Flaccid, unless peritonitis has set in.	Soon become rigid, owing to early and almost constant appearance of local peritonitis.	Flaccid, unless peritonitis has set in.	Flaccid, unless peritonitis has set in.
METEORISM.	Slight. Seldom appears before the third day.	Appears early, increases rapidly, and becomes very extreme. It often causes displacement of the thoracic viscera.	Is rare, and, indeed, absent, except in cases associated with constipation.	Slight.
ABDOMINAL TUMOUR.	Tumours or limited areas of dulness, due to distended or strangled loops, are extremely rare. Coils of intestine are not visible through the parietes.	No tumour. Coils of intestine are not visible.	A definite tumour in 50 per cent.; is usually in the line of the colon. Is apt to change its place, to increase in size and density during attacks of pain, and to be the seat of tenderness; is dull on percussion. Is not felt over the hepatic or splenic flexures of colon. A tumour may be felt in the rectum, or the invagination may protrude from the anus. Coils of intestine not visible.	Large gall-stones and foreign bodies have in rare cases been felt through the parietes. Large enteroliths may form distinct and hard tumours.
AVERAGE DURATION BEFORE DEATH.	Five days.	Six days.	Of ultra-acute cases, 24 hours; of acute cases, 2 to 7 days; of sub-acute cases, 7 to 30 days.	Seven days.

TABLE II.—CHRONIC OBSTRUCTION.

SYMPTOMS	STRICTURE AND STENOSES OF THE SMALL INTESTINE	STRICTURE AND STENOSES OF THE LARGE INTESTINE	FÆCAL ACCUMULATION	CHRONIC INTUSSUSCEPTION
SEX; AGE.	Non-cancerous strictures occur about early middle life. Cancerous strictures are very rare before 40. Unaffected by sex.	The same.	More often in females than in males. In adults, often in lunatics, hypochondriacs, &c.	More often in males than females, and most common during active adult life.
PREVIOUS HISTORY.	In non-cancerous cases there may be a history of dysentery, tuberculosis, injury, hernia, &c.	The same.	History of long-continued and increasing constipation, with declining appetite, foul tongue, occasional nausea, feeling of languor and depression.	In 35 per cent. of the cases, begins suddenly and becomes after a while chronic; in other cases, commencement may be very insidious.
COURSE.	Very irregular. Acute attacks may appear from time to time, and one such attack may prove fatal. Symptoms often subside or disappear for a while.	The same.	The abdomen becomes gradually distended and the symptoms develop slowly and progressively.	Remarkable by its irregularity and fluctuations.
PAIN.	Intermittent at first, with long intervals of freedom from pain. In time, the intervals become shorter and the attacks of pain longer. Attacks become more frequent and severe. Pain is usually increased by food, especially by indigestible food. When the obstruction is complete, the pain is continuous, with exacerbations.	General character of pain the same, but is less severe. Is as a rule not affected, or but indistinctly affected, by food.	Pain develops gradually. Is at first paroxysmal, then continuous, with exacerbations. At any time evidences of acute obstruction may appear.	Distinctly intermittent. Is of irregular appearance and intensity. Is seldom severe; is often quite insignificant.
VOMITING.	Nausea during earlier attacks of pain. Vomiting during the later and severer attacks. Is often provoked by food. In any case appears late. Is scanty and very rarely feculent except towards end of an acute obstructive attack.	General characters the same. Appears later; is scantier; is not provoked by food; is never feculent except after many days of absolute obstruction. May be entirely absent.	Appears late; is scanty and irregular in its occurrence; is only feculent after a considerable interval of entire obstruction.	Is marked in only 50 per cent. Is of irregular occurrence. Is most often associated with attacks of pain. May be induced or made worse by food. Feculent in 7 per cent. May be entirely absent.
STATE OF BOWELS. TENESMUS	Constipation in 60 per cent. Constipation with diarrhœa in 40 per cent. Constipation absolute during acute attacks. No blood passed per anum. No tenesmus.	Constipation the rule. In cancer, diarrhœa, with constipation, is common. In cancer, blood per anum in 15 per cent. Tenesmus especially in cases with diarrhœa.	Pronounced and increasing constipation. No blood per anum. No tenesmus.	State of bowels varies greatly. Irregular, with sometimes a tendency to constipation, and more often to diarrhœa. Blood per anum in 50 per cent.; tenesmus in 13 per cent.
METEORISM	Absent except during obstructive attacks or with absolute constipation.	Often very pronounced, especially when constipation exists.	Is gradual, progressive, and often considerable.	Absent except during attacks of complete obstruction.
TUMOUR.	In non-malignant cases no tumour. In cancer a tumour in 30 per cent. of the cases. Coils of intestine in movement visible through the parietes.	In non-malignant cases no tumour. In cancer a tumour in 40 per cent. of the cases. Coils of intestine in movement visible through the parietes.	Tumour very usual. Is most often in cæcum or sigmoid flexure. Is firm; may be doughy; is often nodular; may be very large.	Invagination tumour in 50 per cent.; mass felt in rectum in 32 per cent.
GENERAL CONDITION	Patient emaciates, especially in cancer cases. Is worn out by pain and digestive disturbances. May be collapsed during acute attacks.	The same.	Suffers seriously from the occasional obstructive attacks. General condition the same.	The same. Often dies of marasmus.
DURATION.	Three to five months, or longer.	Five to six months, or longer.	Many months.	One to six months, or longer.

2. *Chronic Obstruction.*

A. Strictures and stenoses of the small intestine. In these cases, very special care should be devoted to the dieting of the patient. The food taken should be moderate in amount, should be taken in small quantities at a time, and should be composed only of the most digestible substances. The bowels should be kept properly open by gentle laxatives and repeated enemata. When the condition of the patient becomes more grave, relief may be afforded by enterotomy (*see* ENTEROTOMY); but permanent relief can only be obtained by resection. In simple stricture, in obstruction by innocent neoplasms, in stenoses which cannot be relieved by simpler means, and in epitheliomatous strictures of limited degree, and attended by limited gland-affection, enterectomy offers a means of permanent relief (*see* ENTERECTOMY). Occlusions, due to adhesions, may be treated by the division of the obstructing bands when they are not too extensive, and by enterotomy when the amount of bowel involved forbids the operation of resection.

B. Strictures and stenoses of the large intestine. In these cases, long-continued relief to the more distressing symptoms may be obtained by a careful system of dieting, and by the continued use of gentle aperients and enemata. The operative treatment, suitable for these forms of obstruction, is identical with that advocated in the preceding class of case, colotomy being substituted for enterotomy, and colectomy for the resection of the small intestine. In performing colotomy, it is important that the position of the stricture should be diagnosed, so that the gut be not opened below the seat of the obstruction. The great frequency with which stricture appears in the sigmoid flexure, and the increasing rarity of the affection as the cæcum is approached, should be borne in mind in speculating upon the position of the stenosis. *See* COLOTOMY; COLECTOMY.

C. Fæcal accumulation. The treatment of chronic constipation need not be here considered. The surgical treatment of this form of obstruction is concerned only with cases, where the occlusion has become complete and urgent symptoms have developed. In such cases aperients do more harm than good. Abdominal pain may be relieved by opium or belladonna and warm fomentations to the belly. A very limited diet of carefully-selected and digestible food should be enjoined. In the more active treatment, much good may be effected by the repeated use of copious enemata, and by the evacuation of the contents of the rectum—when that part of the bowel is blocked—by means of the scoop, in cases where enemata fail. Some surgeons advise injection of carbonic acid in this form of obstruction, while others have ascribed the relief obtained to the use of massage of the abdomen and electricity. If all these methods of treatment fail, and the symptoms persist and become so urgent as to threaten life, no alternative remains but to perform colotomy. This procedure is, however, very rarely demanded, and, when performed in these cases, must be regarded rather as a surgical calamity than as a recognised means of treatment.

D. Chronic intussusception. In the treatment of this affection, great attention must be paid to the dieting of the patient. In the most chronic cases, benefit has attended the use of laxatives and enemata. The benefit has been, however, of a temporary nature only. In less chronic cases, and especially in cases attended by pain and distinct intestinal colic, the use of opium is indicated as a palliative measure. Attempts may be made to reduce the invagination by enemata or insufflation. Such measures, however, are almost sure to be attended by failure. The only remaining means is laparotomy, with reduction of the intussusception, if possible, and resection of the mass if reduction be impossible. The extremely fatal character of chronic intussusception forms an urgent argument in favour of interference by operation.

FREDERICK TREVES.

INTRAORBITAL ANEURISM.

See ORBITAL ANEURISM.

INTRA-UTERINE FRACTURES

may be produced in three different ways:—1. By external violence or contre-coup. 2. By abnormal muscular contraction in the fœtus or the uterine walls. 3. By injuries during parturition. They may be simple or compound, disunited or united at birth. From the protection afforded to the fœtus by the liquor amnii when the membranes are intact, and from the softness and elasticity of the bones before birth, fracture *in utero* must be of rare occurrence. But the bones are subject to rickets at a very early period, and to faulty ossification with deficiency of earthy material, and in the majority of the cases where fracture has been found, some condition of this kind will have rendered the bones unusually brittle or pliable.

1. There are many cases on record where fracture of one or more bones, and even compound fracture, has been found to exist at birth, which has evidently resulted from some external injury to the mother, generally from falls upon the abdomen. The fractures are often at the epiphyses, but not necessarily so. The following are some of the cases recorded as having occurred after distinct falls upon the uterus: Fracture of the lower end of the tibia; fracture of the lower third of the humerus, ununited; compound fracture of the left femur; fracture through the epiphysis, with separation and displacement forwards and outwards of the inner condyle of the femur; fracture of the middle of the shaft of the femur, from a fall seven weeks before the birth of a seven months' child—the child died twelve days old, and the broken ends were found overlapped and firmly united by callus; a child was born dead with several fractures, three weeks after a fall from a window; another with fracture of the cranial bones with depression, from a severe fall on the uterus; a fracture of the middle of the tibia, ascribed to a fall six weeks before birth —the bone was shortened and bent, the wound still existed at the seat of fracture, and there was callus round both tibia and fibula; a fracture of the left clavicle, with the history of a fall three months before—there was swelling and slight overlapping of the fractured ends; birth of a child four months after a severe fall, with oblique compound fracture of the right tibia and fibula —for some weeks the mother had pain, the uterus being wounded at each movement of the fœtus, there was union at birth, but shortening and wasting, and only three toes, the right arm had also suffered—it was smaller, and had only three fingers. Dr. Flecken gives a case of a powerful woman delivered of a strong, living, full-timed child. After expulsion of a large placenta, another compact fleshy placenta in partial connection with the former followed. The accompanying membranes contained a six months' fœtus, the body of which had been compressed so flat, that the broadest part of the cranial and thoracic regions did not exceed five lines. The bones of the cranium lay separated from each other, the nasal bones projected as sharp points, and the broken malar bone penetrated the skin. While in the sixth month of her pregnancy, the woman had fallen downstairs. When fractures take place at an early period, there is generally arrest of development in the limb affected. Fractures of the cranium are exceedingly rare.

2. Fractures from muscular contraction are generally associated with congenital rickets, or with a cartilaginous or very imperfectly ossified skeleton. They are often multiple. Dr. Barker records the case of a child, which lived only ten minutes, where there was fracture of humerus, radius, ulna, femur, tibia and fibula on both sides; some of the bones being fractured in several places. There was also absence of the frontal, parietal, and expanded portion of the occipital bones, the earthy matter being deficient and irregularly deposited. Dr. Davies gives a case of compound fracture of the femur, the lower fragment overlapping nearly an inch. The child grew to be a man with an est of development, the limb being only a foot long. Mr. Murray's case, a seven months' child of a syphilitic mother, lived a few days only, the left humerus and left femur being fractured. There are many other cases.

3. The frontal and parietal are the only bones fractured and fissured by uterine contraction in the act of parturition. Defective ossification is usually present. The amount of injury to the vessels is proportionate to the extent of the fracture and the separation of the edges of the bone. In these cases, blood is generally extravasated beneath the periosteum and in the cellular tissue of the scalp. Also internal cephalhæmatoma may occur. Cases of fracture of these bones have been recorded by Dr. West, Dr. Gotz, and others, and there are a number of cases collected by Dr. Schwörer, of Freiburg. Amongst the latter there is one of a child still-born, received into his own hands at birth. The skin over the vertex was found swollen, and there was a large effusion of blood beneath it, especially over the right parietal bone. The bone was fissured in two places. Dr. Michaelis, of Kiel, reports a case of fracture of the right parietal bone in five places, where it came in contact during birth with an immovable coccyx. The head was much disfigured, and in the posterior third of the sagittal suture, where the parietal bones were firm and well-formed and the suture only two lines in width, were seen small livid portions of the longitudinal sinus forced between the bones. Dr. Busch had a case of fracture during birth, in consequence of ankylosis of the joints in the normal position in the uterus. The child was born dead.

The subject of fracture *in utero* is interesting from a medico-legal point of view, as attempts at destruction of the fœtus *in utero* have undoubtedly been made both by

the mother and by another person. The points to be determined in such cases are—the nature of the fractures, the condition of the bones, the period of the injury as shown by the presence of callus, &c., and the character of the labour. It is important that the surgeon should be acquainted with the forms of fracture that may occur *in utero* and at birth, independently of any intended violence. They are usually more limited in extent than in criminal cases. No surgeon should give evidence in respect to fractures in the newly born without a full examination of all the limbs of the child, and a careful consideration of the above four points.

The treatment of intra-uterine fractures should take the form of carefully regulated pressure, re-fracture if necessary, and sometimes the division of tendons which maintain deformity. GEORGE COWELL.

INTUSSUSCEPTION. *See* INTESTINAL OBSTRUCTION.

INUNCTION OF MERCURY.—The inunction plan of treating syphilis, though it has of late been superseded to a considerable extent, in this country, by calomel fumigation, and improved methods of administering mercury internally, is certainly in many instances an invaluable mode of applying this agent. When applied forcibly to the unbroken skin, mercury is taken up by the cutaneous glands and hair-follicles, from whence, after a probable conversion into the bichloride, it is transmitted to the general circulation by the lymph-vessels. The usual mode of inunction is, to rub into the skin of a certain region from half a drachm to a drachm of mercurial ointment, and to repeat this daily until a decided effect has been produced on the system and on the course of the disease. This treatment, to prove effectual and safe, must be carried out patiently and industriously, and with strict attention to many small details. The patient should take repeated warm baths during the course, spend at least a quarter of an hour every night in rubbing in the ointment, avoid very carefully exposure to cold and damp, be very temperate as to diet and alcoholic drinks, and keep the mouth in a clean and healthy condition by the frequent use of washes containing chlorate of potash, iodine, or chlorine.

A change should be made every night in the region to which the ointment is applied, the most convenient and suitable parts being the inner surfaces of the thigh and arm, the front of the forearm and of the chest and abdomen. Hairy surfaces should be avoided, as the inunction of mercury is apt to cause some irritation of the hair-follicles. As the manifestations of syphilis subside, the treatment, if tolerated by the system, should be discontinued very gradually. This plan of introducing mercury into the system is usually more rapid than others, and, in many instances, is more efficacious. The whole system is gradually and equably affected, and the mercury does not exert any special and excessive action on the liver and stomach, so that the latter organ, as has been pointed out by Sigmund, is left free for the reception of medicinal agents which may co-operate in the cure or relieve complications. Inunction seems to be specially indicated in cases of acute syphilitic affection of such important organs as the brain, the eye, and the internal ear. This method, however, is sometimes attended with bad effects. The local application of the mercurial ointment may cause a troublesome and obstinate erythema, and even a pustular eruption. Profuse and exhausting perspirations, and also diarrhœa, occasionally interfere with the good effects of the treatment. The objection to the plan of inunction, that it is troublesome and uncleanly, may be overcome by the substitution for mercurial ointment of the oleate of mercury. W. JOHNSON SMITH.

IODOFORM, Surgical Uses of.—This substance, which is chemically allied to chloroform, and contains 96·7 per cent. of iodine, is obtained in the form of small flat yellow crystals. It was first introduced into use, in this country at all events, as an application to chancroids, which fact, taken in conjunction with its tell-tale odour, accounts for the prejudice which to some extent still exists against its use. Since that time, however, its utility has been so marked in a wide variety of cases that its early use is becoming forgotten; although even now attempts are made to disguise its unmistakable odour, which is repulsive to many. Various means have been recommended for this purpose, such as tincture of musk, Tonquin bean, Peruvian balsam. The writer has for some years prescribed an ointment containing ʒj. of iodoform, fʒss. of compound tincture of benzoin to the ʒj. of vaseline; in which form the odour is altered, though not altogether disguised. According to Vulpius, the most agreeable way of applying it is dissolved in collodion, which will take up 15 per cent. of the powder; or in equal parts of turpentine and absolute alcohol, which will take up 4 per

cent.; in oil of lavender (7 per cent.), or oil of caraway (16 per cent.).

As before mentioned, it has been and still is used, extensively and most successfully, in the treatment of chancroids and their glandular complications. It appears to have not only an antiseptic, but a soothing action on these sores; and, applied in the form of fine powder, the sores having previously been lightly dried, the risk of auto-inoculation of neighbouring parts is much diminished, especially if followed by the application of collodion, as recommended by Mr. Walter Whitehead. Even in cases where a phagedænic action has set in, and in which, formerly, destruction of the sore with nitric acid would have been indicated, the writer has seen most marked and speedy benefit result from filling the sores with finely powdered iodoform, especially if the part has previously been cleaned with glycerine of carbolic acid. But the success which attended its use in such sores led to its use in the treatment of various foul ulcers and wounds, especially in subjects where there was a syphilitic or a strumous taint. Carbolic acid is, of course, a potent cleanser, but its prolonged use does not promote a healing action; and for this reason the writer had, before the introduction of iodoform, used a combination of tincture of iodine with carbolic acid lotion in the treatment of foul or of indolent wounds, and the action of that mixture much resembled that of the drug now under consideration, in not only purifying the wound, but in stimulating the formation of healthy granulations and producing a typical healthy sore. In sloughing or gangrenous wounds, such as bedsores, iodoform is most valuable. The simplest way of applying it is from an earthenware salt- or pepper-caster. The iodoform may be mixed with any dry powder, such as oxide of zinc or calcined magnesia, or it may be used unmixed; but it should be kept in a cool but dry place. Where it is required to apply the drug to a cavity, one of the various forms of insufflator must be used.

So far as the writer's personal observation extends, he has not met with any case where harm has arisen from its use in this way; but it is well to bear in mind the fact that some cases have been recorded in which alarming symptoms, and even fatal results, have followed the free application of iodoform. (See *British Medical Journal*, June 17 and August 26, 1882.) The symptoms of poisoning are fully described in the articles referred to; but the main feature has been more or less affection of the sensorium, varying from delirium to stupor, accompanied by pyrexia, with rapid pulse and varying elevation of temperature; the symptoms being relieved or removed as the wound was freed from iodoform. Iodoform-wool is an elegant dressing, which is now often used in place of, or in combination with, the Listerian dressings, and is free from any risk of causing constitutional disturbance. With regard to its antiseptic properties, the following observations by Sir J. Lister may be quoted:—'Iodoform, while volatile, is very slowly volatile, and at the same time so little soluble in the discharges that in these points of view it seems an admirable antiseptic; but it is by no means a potent agent in its action on micro-organisms. It is remarkable that iodoform has such an effect as it has in preventing putrefaction; but it is by no means a powerful germicide.'

The following are some of the uses to which iodoform is applied. Finely powdered, it is so unirritating that it has been dusted over the conjunctiva at the first onset of purulent conjunctivitis, and both at this and at subsequent stages it has been found of great benefit; and in the same manner it has been freely applied to the peritoneum after abdominal section. In the form of suppositories, made with cacao-butter, it is used in gonorrhœa, gleet, and in cancerous and other ulcerations of the cervix uteri. A 10 or 15 per cent. solution in collodion has been found a most beneficial application in erysipelas. Internally, iodoform has been given with apparent benefit for ulcer in the stomach, in doses of from three to five grains; also in cases of syphilis, cancer, and in some forms of neuralgia, but with questionable success. So far, its great use has appeared to be as a topical agent. CHAUNCY PUZEY.

IRIDECTOMY. — The operation of iridectomy may be required for various purposes, either for the relief of tension (*see* GLAUCOMA), for neutralising the effect of adhesions, or for the formation of an artificial pupil, through which the patient may obtain vision when the natural pupil is closed or in any way obstructed. When performed on account of adhesions, or for the relief of tension, the piece excised should be the central third of the upper half of the iris, so that the gap is covered by the upper lid, and is neither unsightly nor disturbing to vision. When performed for the sake of making an artificial pupil, the piece selected for excision must be that which will render the artificial pupil most useful. Generally

speaking, this will be determined by the state of the cornea, which may be opaque or distorted over some part of its surface, when the surgeon will endeavour to place the new pupil behind the best remaining portion. When there is a choice of situations, an artificial pupil is most useful when it can be made in a direction inwards and a little downwards. Next, as situations of election, come directly inwards, directly downwards, downwards and outwards, and directly outwards, in the order in which they are mentioned. When the only clear portion of cornea is above the pupil, so that the upper lid would interfere with vision through the new opening, good results have been obtained by the subsequent division of all the recti muscles save the inferior, so as to get the upper part of the cornea drawn downwards towards the centre of the palpebral fissure. In operating for the relief of tension, it is necessary to remove the whole width of the iris, right up to its peripheral attachment; and it is best to pursue the same course when operating on account of adhesions. In making an artificial pupil, it is often desirable to leave the periphery, and to cut out a mere notch from the pupillary margin. A small opening affords better vision than a larger one, and exposure of the margin of the lens is apt to produce troublesome distortion of the retinal image, by reason of spherical aberration.

The knife required for an iridectomy will vary with the condition of the eye. When there is a good anterior chamber, so that the lens, iris, and cornea maintain their normal relations to each other, and still more when the anterior chamber is deepened, the ordinary lance-knife is the most convenient. It should not be too wide, and its edges should become parallel at about seven or eight millimètres from the point. When there is high tension, with advancement of the iris and lens, the latter would be in danger of being wounded by the lance-knife before this could penetrate to a sufficient depth to afford the required length of incision; and, in these circumstances, it is necessary to use either a linear cataract knife or a very narrow lance-knife. The other instruments necessary are—an elevator for lifting the upper lid, a fixation-hook or forceps, iris-forceps and scissors, a blunt probe or spatula, some lint, bits of fine sponge, cotton wool, and a bandage. The sponges should be perfectly clean, and moistened with some antiseptic solution—that known as 'Sanitas' being one of the most convenient for the purpose. The eye should be brought thoroughly under the influence of cocaine, and it must be borne in mind that states of high tension interfere with absorption, so that rather more time must be given to the cocaine than would otherwise be required. The best method of applying it is, probably, by the discs rather than by solution, and three discs, each containing the fiftieth of a grain, inserted at intervals of five minutes, will usually be sufficient to render the eye completely insensitive.

Anæsthesia being complete, and the patient suitably placed on a couch in a good light, with the plane of the face nearly horizontal, the surgeon lifts the upper lid with the elevator and commits it to an assistant. He then secures the globe by the hook or forceps, making his fixation close to the corneal margin, at a point opposite to the centre of his intended incision. If necessary, he slightly rotates the globe, imitating the action of the corresponding rectus muscle, but never lifts or pulls it, and simply holds it still, without pressure, when the desired position is attained. If the ordinary lance-knife has been selected, its point is placed on the conjunctiva, a little behind the corneal margin, in the centre of the intended incision, and is made to pierce the sclerotic and to enter the anterior chamber immediately in front of the iris, by a steady gentle thrust directed towards the centre of the eyeball. As soon as the point of the knife can be seen through the cornea, its direction must be changed, the handle being sloped somewhat backwards so as to direct the point forwards in a corresponding degree; and in this position it is pushed steadily on, the operator watching the opposite margin of the pupil to see that the point rides safely over it. Supposing the aqueous humour to be retained, the thrust of the knife should be continued until the incision is of sufficient magnitude; but, if the aqueous humour should escape prematurely, before an incision of sufficient length has been made, the forward thrust must be immediately checked, and the knife withdrawn, lest the lens should be wounded. If the incision is nearly large enough, it may be completed by lateral cutting with the edge of the knife, as it is being withdrawn; if not, it may be enlarged at one or both of its extremities, either by scissors, or by any small knife which has a blunt extremity and a cutting edge. For the relief of tension, the wound should not be less than six or eight millimètres, but for other purposes it may be less extensive.

When the anterior chamber is too shallow for the thrust of a lance-knife to be

made with safety, the operator may either take a very narrow lance-knife, the so-called iriddesis knife, or a linear cataract knife. In using the iriddesis knife, fixation should be made at the corneal margin, close to the left-hand extremity of the intended incision. The knife should be carried into the eye close to the right of the fixation-forceps, pushed on in front of the iris until its point nearly reaches the pupillary margin, and then its right-hand edge should be made to cut laterally, against the traction of the forceps, until an incision of sufficient length is obtained. If a linear knife is used, its point must be placed at the outer extremity of the intended incision, and introduced into the anterior chamber nearly as far as the margin of the pupil, over which it must not pass for fear of wounding the lens. It may then either be brought up, so as to effect a counter puncture at the other extremity of the incision, and to divide the bridge of intervening tissue as in cataract extraction (*see* CATARACT); or it may be made to cut its way along, just outside the corneal margin, to the required extent, or until the escape of aqueous humour renders the presence of a sharp-pointed instrument in the anterior chamber dangerous. It is of the very first importance that the incision, however made, should be as smooth and clean as possible, and that its edges, whether in the conjunctiva or the sclerotic, should not be jagged or contused.

The section being satisfactorily completed, the eye may be freed from tears and blood by one of the morsels of moistened sponge. The patient is directed to look downwards, and then, if the iris has prolapsed, the surgeon has only to take hold of it with forceps and to perform the excision. If it has not prolapsed, the closed forceps must be passed into the anterior chamber, nearly to the margin of the pupil, and there suffered to expand to an extent proportionate to the size of the piece to be removed. They are then closed upon the iris as it rises between them, and the plait which is seized is drawn gently out of the eye. If the object is only to cut a notch, to serve as an artificial pupil, the first incision through the external tunics may be small, and the scissor-blades may be placed as close behind the forceps as possible, so that only the piece actually held by the latter may be taken out, and the rest suffered or coaxed to return into the anterior chamber. If the object is to relieve tension, the operator cuts in a different direction, close to or even within one extremity of the wound, and quite up to the ciliary margin of the iris. He then tears the piece still held by the forceps from its attachment, as far as the other extremity of the wound, holds it somewhat upon the stretch, and excises it within the lips of the wound as before. If any portion of iris remains entangled at either extremity, an attempt may be made to seize and snip it out, or it may be gently replaced by a small spatula, or caused to return by carefully managed friction. If it should resist these measures it must be left alone, and dealt with on a subsequent occasion. Any coagula between the edges of the incision should be carefully picked out by iris-forceps, and blood in the conjunctival sac removed by the point of a morsel of sponge. A compressive pad and bandage should be applied, and the patient sent to bed. By the third day, or sooner, the wound will usually be healed and the aqueous humour retained, but the blood poured out by the cut vessels of the iris may require a longer time for its absorption, and may keep up some degree of irritation until it is absorbed. During this period, the day should be spent in a dimly lighted room, the eyes should be kept entirely at rest, and the compressive bandage should be worn at night, or during recumbency in the daytime. As soon as the blood has disappeared and the irritation is diminishing, the patient may be suffered to go into the air in favourable weather. Any piece of iris, left incarcerated at either end of the cicatrix, will be itself liable to become a cause of iritis, and may be rendered harmless by being severed, by the thrust of a cutting needle, from the intra-ocular portion with which it is continuous. When an iridectomy has been perfectly performed, it will leave no trace behind except the coloboma which it occasions. The cicatrix of the external wound should after a time become invisible, being neither marked by incarcerated iris nor even stained by pigment.

For cases in which the iris is free and normal, and in which an artificial pupil is required in consequence of central nebula of the cornea, or of small laminar cataract, the writer several years ago devised a method of operating which he described, for want of a better name, as 'optical iridectomy,' and which he has now practised extensively with good results. The object is to cut out a small V-shaped notch from the margin of the pupil, the apex of this notch being directed towards the periphery of the iris. For this purpose, the eyeball being carefully fixed, a puncture may be made at the corneal margin with a narrow

iridectomy knife, the blade of which should pass in front of the piece of iris to be excised. The knife should be withdrawn with the smallest possible escape of aqueous humour, and should be replaced by De Wecker's iridotomy scissors, which should be carried closed into the anterior chamber, until the blunt extremities of the blades almost reach the pupillary margin. They are then suffered to expand, and the escape of aqueous humour lifts a small plait of iris between their edges, which plait is excised as they are closed, and may be brought out of the chamber as they are withdrawn. If it should be left behind, as sometimes happens, it may be extracted by fine forceps. In order to protect the lens, the external wound must be immediately in front of the iris, and the scissors must be directed forwards in the anterior chamber. The operation is one of considerable nicety, and should hardly be attempted by anyone who has not had experience in the less difficult manipulations of ophthalmic surgery; but, for certain cases, it affords a better pupil than can be obtained in any other manner.

R. Brudenell Carter.

IRIS, Diseases of the.—In order to understand the diseases of the iris, the principles on which they should be treated, and the consequences which may follow from neglect or from mismanagement of them, it is necessary to remember the structure and functions of the part in which they occur. The iris is an approximately vertical curtain, attached at its outer margin to the ciliary body, interposed between the crystalline lens and the cornea, perforated by a central aperture, the pupil, which varies in diameter with the amount of light falling upon the eye, and largely composed of muscular fibres, some radiating, some circular, by the action of which the diameter of the pupil is controlled. Besides muscular fibres, it is abundantly supplied with nerves and blood-vessels, is covered by epithelium, and, on its posterior surface, by a dense layer of pigment. The physical conditions of its surfaces are analogous to those of serous membranes, and, like these, it is liable to pour out a plastic exudation when it becomes inflamed. The pupillary aperture admits the rays of light to the interior of the eye, and, by its variations in diameter, regulates the amount admitted. In the healthy state, it is exceedingly sensitive to variations in the amount of light, contracting and expanding very freely; but in various states of disease this freedom of movement is impaired or lost. Besides admitting light it preserves a communication between the anterior and posterior chambers of the eye, permitting free passage of fluid from the latter to the former, and thus, indirectly, affording to the fluid of the posterior chamber, and even to that of the vitreous body, access to the circumcorneal zone immediately in front of the iris, a region which has been called by recent investigators the 'filtration area,' and through which the chief transudation of fluid from the eye is now believed to occur. In moderately dilated states of the pupil, the anterior capsule of the crystalline lens is in contact with the pupillary margin, and the centre of the lens projects slightly through the opening; but, when the pupil is widely dilated, its margin is removed from contact with the lens by the curvature of the latter; a relation between the two structures which has an important application in practice.

Coloboma.—The iris is occasionally the seat of a malformation called 'coloboma'—i.e. deficiency—which leaves a gap in some part of its circumference. A coloboma is usually seen extending directly downwards from the pupil, which appears to be enlarged in this direction as if it had been enlarged by an iridectomy. When thus situated, the gap may usually be seen by the ophthalmoscope to extend through the choroid up to the margin of the optic nerve; and, in such cases, it is manifestly due to imperfect closure of the tissues during fœtal life. Less frequently, coloboma iridis is met with in other parts of the circle, when the choroid seldom participates in the defect, the nature of which is then less easily to be understood. Coloboma may be complete, extending through the whole thickness of the iris and up to the ciliary margin, or it may be incomplete in either particular, in some cases consisting merely of a deficiency of the anterior portion of the structure, so that it does not affect the deeper layers and the posterior pigment; in others being a mere notch, extending only part of the way from the pupillary towards the ciliary margin. In all its forms it is an unimportant condition, the worst significance of which is that it may be part of a generally imperfect development of the organ. The practitioner should be on his guard against mistaking it for the result of an operation. In young women with light irides it forms a conspicuous disfigurement; but it is, of course, irremediable.

Cysts and Tumours.—The iris is occasionally the seat of cysts, which are usually

congenital, although they may for a long time be so small as to escape notice, and of morbid growths, chiefly either sarcomatous or gummatous tumours. The last-named, of course, require only constitutional treatment as parts of the general syphilitic affection; but both cysts and sarcomata, or tumours of any other kind, should, as a rule, be removed, together with the whole of the portion of iris with which they are connected. In such cases, there will sometimes be a difficulty in making the preliminary incision into the anterior chamber without wounding the cyst or other morbid growth; but this difficulty may be overcome by making two punctures simultaneously, with two very narrow knives, one of which should be introduced on either side of the growth. It will then be possible to introduce a Weber's probe-pointed lacrymal knife through one puncture, and to bring it out through the other, when, the back of the blade being towards the growth, the edge may be employed to divide the bridge between the two punctures. Various attempts have been made to treat cysts by something short of complete excision; as, by excising only the anterior wall, or by free laceration with cataract needles; but these devices have not been followed by a sufficient measure of success to encourage repetition. In several instances acute inflammation has been set up, and the eye either destroyed or greatly injured. For tumours, it is hardly necessary to say, complete removal is the only course, and, until the tumour is in the hands of the surgeon, it will seldom be possible to speak with certainty of its precise nature, or of the chances of recurrence to which the patient may be exposed.

Iritis.—The disease of the iris which demands most attention is inflammation. Iritis is a common affection, liable to occur in both sexes and at all periods of life. Its possible causes are various; its more common causes are injury, some dyscrasia, such as syphilis or rheumatism, and perhaps some forms of perverted innervation. It is often referred to an exciting cause, such as overwork of the eye, exposure to cold, to glare, to irritating particles or vapours; but these conditions, when not sufficiently intense to be included within the general term 'injury,' probably owe their efficacy to some predisposing influence. Iritis is seen under two chief forms—the plastic and the serous. In plastic iritis there is a considerable exudation of lymph, which sometimes forms nodules on the surface of the membrane or at the margin of the pupil, and which frequently produces adhesions of the iris to the anterior capsule of the lens. In serous iritis the effusion consists of turbid fluid rather than of lymph, and the adhesions, if formed, are smaller and less resistant; but the fluid often augments the tension of the eye-ball in a decided manner, and exudation is often deposited upon the inner surface of the cornea in a cloud composed of minute dots, which are usually arranged in the form of a pyramid, with its apex over the pupil, and its base at the margin of the cornea.

Plastic Iritis.—The first *symptoms* by which plastic iritis can be distinctly recognised are four in number, and they are usually all present together. They are: (1) A slight diminution of the ordinary lustre of the iris, with some apparent change in its colour; (2) some degree of impairment of the mobility of the pupil; (3) some impairment of vision; (4) a slight zone of peri-corneal sclerotic congestion. If only one eye is affected, the other must be used as a standard of comparison; and, in testing the mobility of the pupil, the sound eye must be screened from light and the affected eye must be alternately shaded and exposed without being touched. *See* Eye, General Examination of the.

A deceptive resemblance to iritis may occasionally be produced by some affections of the cornea; for a hazy cornea may at the same time conceal the lustre of the iris, diminish its mobility by diminishing the quantity of light which reaches it, impair vision, and be attended by sclerotic congestion. The removal of any doubt, hence arising, may be obtained by the application of a drop of solution of atropia, which for this purpose should not be of lower strength than two grains of the neutral sulphate to an ounce of distilled water. If this fully dilates the pupil within the customary time, half an hour or so, and if the dilated pupil preserves a circular outline, iritis is certainly not present. In actual iritis, generally speaking, even when the patient is seen for the first time, one or more points of adhesion will have formed; and atropia, if it dilates the pupil at all, will dilate it into an irregular outline, which at once renders the adhesions conspicuous. If more time has elapsed since the commencement of the disease, and if the case were either severe originally, or has been rendered so by maltreatment, the pupil may be wholly immovable, either universally adherent or totally insensible to the action of atropia; the surface

of the iris may present blood-vessels visible to the naked eye; the anterior chamber may be more or less filled with lymph, partly adherent to the iris, partly diffused through the aqueous humour, and sometimes passing into a purulent condition; vision may be reduced to quantitative perception of light, and the ocular conjunctiva may be intensely congested.

Pain is a very uncertain symptom. It is nearly always present when there is increased tension; but, in other cases, it seems to depend more on the condition of the patient than upon that of the eye. When there is pain, there is nearly always constitutional disturbance, either feverishness and a loaded tongue, with disordered secretions, or else a generally neurotic state, the pain ramifying more or less through the different branches of the fifth nerve, and often assuming an intermittent or paroxysmal character.

Intolerance of light is seldom present; but, when present in any marked degree, it is a symptom of grave import. It indicates at least a tendency on the part of the ciliary body to participate in the morbid action, and it gives to the whole case an entirely new significance.

In the *treatment* of iritis, in all its forms and stages, the first principle to be borne in mind, and to be acted upon in every case without exception, is a negative one. It is to do no mischief; and the only way to avoid doing mischief is to avoid all irritating local applications. In a case of commencing iritis, the application to the eye of a drop of a zinc or silver lotion will stimulate the disease into a state of intensity, which is hardly seen under any other conditions.

In plastic iritis of only moderate severity, which has not been aggravated by any irritant, the tendency is towards recovery; and the indications of treatment are two—first, not to counteract this tendency; next, to prevent the formation of adhesions, or to overcome them if they have formed already. For the fulfilment of the first indication it is necessary to give both eyes complete functional rest, and to protect them from changes of temperature, from irritants, and from glare. The fulfilment of the second indication is to be accomplished only by atropia or some kindred preparation; and hence the effectual use of atropia is the cardinal point in the early treatment of plastic iritis, the one thing which should never be omitted, save in the excessively rare cases in which it is found to act as a direct irritant to the conjunctiva. The margin of the pupil, as already stated, when the opening is of its ordinary diameter, rests in contact with the anterior surface of the crystalline lens. In this position, the effusion of lymph is followed by the immediate adhesion of the structures between which it is interposed. But full dilatation of the pupil removes its margin from contact with the lens, in consequence of the receding curvature of the peripheral parts of the latter. The anterior capsule is then separated from the iris by a film of aqueous humour, into which the lymph projects without becoming adherent, or through which it is diffused. Complete dilatation of the pupil, therefore, presents an insuperable physical obstacle to the formation of adhesions; and, as soon as the pupil is completely dilated, there is nothing more to do than to maintain the dilatation, and the iritis will die out harmlessly.

In order to dilate the pupil, when declared iritis exists, it is best to use a 4-grain solution of sulphate of atropia, and to place a drop within the conjunctival sac every four hours. If the iritis has existed twenty-four hours or more, the atropia will be likely to produce only irregular dilatation, the pupil expanding fully in some directions, while its margin is already fixed at certain points by adhesions. The atropia being continued, recent adhesions will in many cases give way, and when they do so the dilatation becomes complete. The atropia being still continued, the eye recovers in the course of a few days, and the pupil may then be suffered to return to its normal diameter. Complete dilatation is always attended by much relief to the symptoms previously complained of by the patient; but, if atropia is laid aside as soon as complete dilatation is produced, the improvement will often be only temporary. The pupil contracts again, the hyperæmia continues or increases, more lymph is poured out, and adhesions recur. In order to avoid such recurrence, it will usually be sufficient to continue the application of atropia with diminished frequency, as by a single drop night and morning, until all unusual vascularity has disappeared, until the media are clear, and until natural vision, save for the action of the atropia, is restored. When recovery is apparently complete, the atropia may be laid aside; but the eye must be carefully watched during the first few days, and the slightest blush of renewed congestion would call for an immediate return to the remedy.

When plastic iritis is of a high degree of original severity, or when it has been

aggravated by improper treatment, or even when it has been suffered to exist for some days unchecked, a state is produced in which atropia fails to exert its customary influence. Either the dilatator muscle is paralysed by the inflammation, or the greater part of the iris is adherent, or these conditions co-exist. The adhesions remain unaffected, and the intermediate portions of the pupil will only dilate partially and sluggishly, if at all, showing that the muscular fibres act only imperfectly, even where the margin is free. In such conditions, the demand for mercury is imperative; and its constitutional action must be obtained as rapidly as prudent administration will allow. It may therefore be said, as a rule, that it is sufficient at first to prescribe atropia solution for a case of iritis, which is at once mild and recent. But if, when the patient is first seen, the attack has been running on for a day or two, and is even moderately severe, it is better to prescribe mercury as well as atropia, giving perhaps two grains of blue-pill twice a day. In forty-eight hours, if the pupil is well dilated, the mercury may be laid aside; but, if the pupil has resisted dilatation, the mercury must be pushed, with the knowledge that the quantity already taken has laid the foundation of the effect which it is desired to produce. This effect should not exceed the formation of the slightest mercurial line upon the gums; and it should be maintained until resolution of the inflammation is accomplished. Improvement usually commences almost simultaneously with the first appearance of the mercurial line; and absorption of the effused lymph often proceeds with great rapidity. As the lymph disappears, the pupil yields more and more to the atropia, and, in favourable cases, rupture of all the adhesions may be produced.

The influence exerted upon iritis by mercury, and the necessity for administering it in certain cases, seem to be essentially independent of the syphilitic or non-syphilitic character of the affection. A patient who has iritis may also have syphilis, and may require mercury on account of that syphilis; but, speaking with reference to the iritis alone, the writer is not accustomed even to take into consideration, as a question bearing upon treatment, whether the iritis is syphilitic or not, but accepts resistance to atropia as a sufficient proof that mercury is needed.

It sometimes happens that iritis is attended, from the first, by an unusually active degree of vascular excitement. The face will be somewhat flushed, the eyelids hot, the temporal pulse increased in fulness and force. In such circumstances the action of atropia will be resisted, but it does not follow that mercury will be required. Before prescribing it, an endeavour should be made to subdue the vascular excitement, and, if this can be accomplished, complete dilatation of the pupil will often follow. A case might occur in which it would be proper to take blood from the arm; but two or three leeches to the temple, near the margin of the orbit, will generally be sufficient. Whenever there is evidence of active congestion, coupled with resistance to atropia, some form of depletion should precede the administration of mercury, and, if the pupil then become dilated, should supersede it. If there were any strong reason for abstaining from depletion, a minim or two of tincture of aconite might be given every fifteen minutes, until a manifest diminution of vascular excitement was produced.

When iritis is attended by pain, this may arise from either of two widely different causes, and may assume either of two widely different characters. It may be the pain of hyperæsthesia, of nervous exaltation or irritation, or it may be the pain of tension, due to the stretching of the ocular tunics by increased secretion within. The former is usually more or less neuralgic and paroxysmal, the latter is usually described as a permanent sensation of fulness, aching, stretching, or weight. But verbal descriptions of pain have no common measure; and, whenever pain is experienced in iritis, the state of tension of the eyeball must be carefully and frequently examined, and any decided increase must be diminished by paracentesis or iridectomy, according to circumstances, which will presently be considered. Pain of an irritative or neuralgic character must be subdued; for it may be laid down as a general principle that improvement is not to be expected while it continues. Until recently, the best way of subduing it was by the hypodermic injection of morphia; but the application of cocaine to the conjunctiva furnishes a still more valuable resource. A single cocaine disc, containing the fiftieth of a grain, will often afford relief in a few minutes, and may be repeated, without any countervailing disadvantage, whenever a return of pain may render it desirable.

The pain of increased tension is perhaps most frequent in 'serous' iritis, but it occurs also in the plastic variety. It calls for the prompt evacuation of the contents of the

anterior chamber. For this purpose, the eye being rendered insensitive by cocaine, a broad cutting-needle or a cataract-knife, or, in default of these, almost any sharp-pointed cutting instrument, should be thrust into the anterior chamber immediately in front of the iris, and withdrawn. A fine probe may then be introduced through the opening, and used to press back the posterior edge of the puncture until all the fluid contained in the anterior chamber has escaped. It is not safe to use the cutting instrument for the purpose of evacuating the fluid, inasmuch as the iris, or even the lens, might easily be wounded against its point. When carefully performed the little operation is free from risk, and may be repeated as often as the tension is restored, although a single puncture will frequently be sufficient. The evacuated fluid is usually yellow and albuminous, and its escape restores the natural colour of the iris, showing that the change in this respect, which is almost universal in iritis, is due to the change in the medium through which the surface of the membrane is seen.

By the foregoing means, by atropia, with or without mercury, and with or without local depletion and paracentesis, nearly every case of plastic iritis may be conducted to a successful issue, so far, at least, as the subsidence of the inflammation and the restoration of good vision are concerned. In some cases, however, adhesions remain, and these cases cannot be said to be cured. In a few instances no further mischief may ensue, but in the majority the adhesions will become exciting causes of recurrent inflammation. As a rule, the eye in which iritis has left a partially adherent pupil will suffer from iritis again. The function of the muscles of the iris is to regulate the diameter of the pupil in response to every variation in the quantity of light which falls upon it; and an adhesion is a perpetual obstacle to the discharge of this function, and serves to check the variation of the pupil abruptly, whenever it passes a certain limit. As an almost necessary consequence, the adhesion becomes a source of irritation, and maintains a condition of preparedness to inflame. Accidental injury, overwork, or general disorder of the health, finds in the affected iris a part in which the natural vital resistance of the tissues is diminished, and in which morbid action is readily set up. The second attack of iritis, in such circumstances, falls upon an eye in which there is a mechanical impediment to the dilatation of the pupil, so that the parts of its margin adjacent to the existing adhesions must remain in contact with the capsule of the lens, and are thus liable to be rendered adherent themselves. Under judicious treatment, the second attack will generally subside, but not until it has added to the extent of the adhesion left behind by the first.

When one recurrence has occurred, others are almost sure to follow; and each will bind down more and more of the pupillary margin, until at last this is rendered entirely adherent, and there is no longer any communication between the anterior and the posterior chambers. The resulting state is called, not very felicitously, 'exclusion of the pupil,' and, before it is produced, there is usually a good deal of lymph deposited over the whole of the anterior pole of the lens, which lymph, as it undergoes shrinkage, drags the pupillary margin together, and assists in closing the opening. As long as the pupil is not entirely 'excluded,' as long as there is an aperture even the size of a pinhole, the case may be amenable to treatment; but as soon as the pupil is entirely closed, a fresh series of changes will commence. The quantity of fluid contained within the eye, is regulated by the preservation of a certain balance between the internal secretion and the exhalation which occurs chiefly at the angle of the anterior chamber. When once the pupil is closed, the effect of this exhalation no longer extends to the regions posterior to the iris; and the fluids of the posterior and vitreous chambers, although continually increased by fresh secretion, have no longer any sufficient outlet, and hence rapidly increase the tension of the posterior parts of the eye. They push forward the peripheral or non-adherent zone of the iris, and thus afford evidence of the completeness of the 'exclusion,' which may be known to exist whenever this peripheral zone is stretched, convex, and prominent, while the central or pupillary portion of the iris is comparatively flattened or receding. In such circumstances all the tissues of the eye, probably already damaged by repeated inflammation, undergo speedy atrophy. The iris tissue wastes, the vitreous body becomes fluid, the lens becomes opaque and often calcareous, and the retina perishes in the common ruin. There can be no more hopelessly spoiled organ than an eye in which recurrent iritis has been suffered to run its course unchecked, and to produce its ordinary consequences.

It is therefore a matter of primary importance, in dealing with a first attack of iritis, to prevent the formation of adhesions, and it should never be forgotten that this can be done, with a very near approach to

certainty, by the early and efficient use of atropia. When, from any cause, the atropia has not been efficiently used in time, or when its action has been resisted, and the inflammation subsides leaving an adhesion behind, such a condition must not be accepted as a recovery. In the first place, an endeavour should be made, after the subsidence of the inflammation, to detach the adhesion, or, if it cannot be detached, to stretch it, by the continued use of atropia. Very considerable adhesions will sometimes yield if the pupil is kept fully dilated, and if mercury is cautiously administered. If an adhesion, without being ruptured or detached, can even be stretched into a linear band, it may afford the iris sufficient freedom of play; and it may generally be assumed that the action of atropia and mercury cannot be profitably continued for more than about a month. The condition which remains at the end of that time may safely be regarded as an established one, or at least as incapable of being altered except by operative interference.

The effect of adhesions in producing secondary iritis may probably depend somewhat upon their precise position with regard to nerve-filaments, upon their extent, and upon personal peculiarities. As these are uncertain elements, and as, in a few cases, secondary iritis does not occur, no operative interference with the adhesions left behind by a first attack can, generally speaking, be recommended. The exceptions to this rule are furnished by patients who are about to undertake long voyages, or to travel in countries where they might not, in the event of a recurrence, be within reach of skilled treatment. But after a second attack of iritis has occurred, there is no longer much prospect of escape from others, and the conditions previously existing become wholly changed. If successive recurrences are permitted, it is probable that total and incurable blindness will be produced in the course of a few years; and the only way in which this danger can be obviated is by the detachment of the adhesions or by the performance of iridectomy.

Detachment of adhesions may be accomplished in two ways: either by the operation of Mr. Streatfeild, or by that of Dr. Passavant.

Mr. Streatfeild's operation, to which he has given the name of 'corelysis,' is performed by making with a cutting-needle a puncture through the cornea, about midway between its summit and its margin, at a point opposite to the adhesion to be detached. The 'corelysis hook,' a fine and narrow spatula with a notch on one side, is introduced through the puncture, carried between the lens and iris, and so manœuvred as to engage the adhesion in the notch and to break or cut it by traction across the pupil towards the puncture. Dr. Passavant's operation consists in detaching the adhesions by forceps traction, in a direction towards the ciliary region instead of away from it. He makes a small incision with an iridectomy knife in the corneo-scleral junction, on the same side as the adhesion, and, so to speak, behind it. He then introduces forceps like common iris forceps, but without sharp teeth, so that they hold without wounding; seizes with them a fold of iris just behind the adhesion, and draws it towards the wound, as if he were going to draw it out for an iridectomy. As soon as he sees the adhesion yield he ceases his traction, suffers the forceps to expand, and withdraws them empty. If a portion of iris should prolapse through the wound, it is replaced by gentle rotatory friction through the closed lids, or, if that should fail of effect, by the extremity of a blunt probe. The eye, after either operation, is bandaged and treated in the ordinary manner, and is brought as soon as possible under the full influence of atropia, in order to dilate the pupil and to prevent reunion of the adhesion.

The writer has practised both these operations frequently, and has been induced by experience to abandon that of Dr. Passavant entirely, and to reserve that of Mr. Streatfeild for cases in which there is only one adhesion, or two placed near together, and in which there are strong cosmetic reasons for avoiding iridectomy. Upon a pretty girl with blue irides and well-opened eyes, to whom an iridectomy, even at the upper part of the circle, would be a serious blemish, it would be legitimate to perform corelysis, but hardly in any other circumstances. It is a fault common to both the operations that they must be repeated nearly as often as there are adhesions to be dealt with. When two adhesions are close together, they may be torn through by forceps traction from a point between them, or may be included in one sweep of the corelysis hook; but, if they are too far apart for either of these procedures, they will generally require distinct operations, separated by a sufficient interval of time. For every adhesion there must be a point from which the traction ought to be made in order to be most efficacious; and if a second or even a third adhesion can be reached from the

original wound, yet the hook or forceps will act at a mechanical disadvantage in detaching it. Moreover, however fully the eye may have been brought under the influence of atropia, the evacuation of the aqueous humour, and the irritation of the iris by instruments, will produce a contraction of the pupil by which the exact position of any remaining adhesions will be concealed; and it would not be prudent to make casts with a hook in the mere hope of catching something, or to pinch up iris here and there without good reason. A still more serious fault, also common to both operations, is that the adhesions, when detached, sometimes reunite while the external wound is healing, so that the objects of the operation are defeated. Lastly, in some cases, opacity of the crystalline lens has followed the traction. If this had only occurred after Mr. Streatfeild's method, it might be supposed that the capsule had been injured by the hook. But it has occurred also after the use of the forceps, which were separated from the lens by the iris, and never entered the region of the pupil at all; so that it is manifest that the capsule itself may sometimes tear, instead of, or together with, the adventitious band. Dr. Passavant's method, moreover, labours under a disadvantage which is all its own—namely, that an adhesion is liable to be formed between the cicatrix of the wound of entrance and the peripheral part of the iris. Such an adhesion might be both concealed and unsuspected; but it would not be any the less likely to occasion future attacks of inflammation. It may be admitted that with Mr. Streatfeild's hook, especially if the notch is made large enough to receive a cutting edge, a single adhesion may often be safely and certainly divided, with only a small chance that it will reunite. But when the adhesions are multiple, the chances of reunion are greatly increased, and the risks of producing new peripheral adhesions or opacity of the crystalline lens are too serious to be disregarded.

From the foregoing objections the remaining resource, iridectomy, is wholly free, and it has the additional advantage of being of almost certain efficacy in preventing the recurrence of iritis. Even if it should fail in this, it will at least prevent occlusion of the pupil by any ordinary attacks, inasmuch as a large gap in the peripheral portion of the membrane is hardly ever filled up and dragged together by lymph, except when the operation is performed in the course of irido-choroiditis, and fails to arrest it. It matters little what part of the iris is removed, and it is not at all necessary, nor in any way specially advantageous, to remove the adherent portions. The effect seems to be produced by breaking the continuity of the muscle; and hence the operation may be localised with reference to two chief considerations, vision and appearance. If the natural pupil is obscured by lymph, the artificial one made by the iridectomy should, if possible, be placed where it will be most useful for visual purposes—that is to say, downwards and inwards, inwards, or directly downwards. By choice, in these circumstances, the part excised should not include an adhesion; because this, when detached, is liable to leave a patch of hardened lymph and uveal pigment upon the surface of the capsule, and these residua would themselves interfere with sight. When the natural pupil is clear, and the vision nearly normal, the iridectomy should be made directly upwards, where it will be at least partly and sometimes entirely concealed by the upper lid; and it is then a matter of indifference whether the part to be removed is adherent or free.

The writer's experience of iridectomy, performed after a second attack of iritis and as a means of preventing further recurrence, is now large, and it is altogether favourable. The operation is scarcely ever followed by any kind of ill-consequence, and it scarcely ever fails of its object. When both eyes have been affected, the writer has in several instances operated first upon the worse of the two, with the result that it shortly afterwards became the better of the two, and that its increased usefulness and comfort occasioned a request that the other might be similarly treated. In many persons, the existence of an adhesion, while the iris is entire, is attended by painful sensations of dragging, and by congestion of the eyes after even moderate use, long before recurrent inflammation is excited. All symptoms of this kind are relieved by the iridectomy.

After several attacks of iritis, in some of which the choroid and vitreous have probably to some extent participated, and when the greater part of the pupil is adherent, the operations of Streatfeild and of Passavant are impracticable, and the performance of iridectomy is the only resource remaining to the surgeon. In these circumstances, the amount of benefit to be obtained must depend upon the actual condition of the organ, and the operation is no longer entirely free from risk.

Even a first attack of iritis does not invariably follow the favourable or partially favourable course which has been described. In certain states of bodily health, in cases in which the malady has been neglected at the outset, and still more frequently if the eye has been maltreated by nitrate of silver drops, or in any other manner, the inflammation may extend to the ciliary body and choroid, and may place the sight in great peril. In iritis which implicates the choroid the pupil is often obstinate in its resistance to atropia, and, in cases in which the cornea and aqueous humour retain sufficient transparency, dilated blood-vessels may often be seen upon the surface of the iris itself. The ciliary region is usually somewhat tender to the touch, the hyperæmia more pronounced, both in the conjunctiva and in the sclera, than in the simple iritis; and the impairment of sight is usually much greater than can be explained by the lymph-deposits in the pupil, or by the turbidity of the media in front of it. The ultimate tendency is to destruction of sight by wasting of the eyeball, and by complete separation of the retina from the choroid by effusion of lymph or serum. The effusions which proceed from the choroid not infrequently undergo calcareous degeneration, and in course of time they are occasionally converted into true bone, furnished with Haversian canals.

When extension of iritis to the ciliary body and choroid occurs in a case which has been under observation and skilful management from the outset, the prognosis is in the highest degree unfavourable, and the surgeon has to witness the effects of a process against which he is almost powerless to contend. It is only in irido-choroiditis which has not been treated, or which has been maltreated, that there is any hope, although even then not a large one, of arresting the morbid process, and of preserving a useful amount of vision. Our resources for this purpose are much the same as in the more severe forms of iritis, and their employment should be governed by the same principles. Unless there be some special contra-indication, the constitutional effect of mercury should be obtained as rapidly as possible. Pain should be subdued by anodynes. The strength should be supported by well-chosen diet; strict repose and protection from all irritants should be enforced; and any constitutional conditions which may be contributory to the disease should receive their due share of attention.

In such cases the pupil is usually completely closed, and, even if there be any portion of its margin which is not adherent, the muscular tissue of the iris is too profoundly modified by the inflammation to respond to atropia. In such circumstances, no good is to be expected from its employment, and it will sometimes act as a local irritant. The surgeon should bear in mind the general principle that the use of atropia, in iritis, is to dilate the pupil; and that, if the pupil cannot be dilated, the drug is superfluous, and may be hurtful. Iridectomy has often been performed in such conditions, but seldom, if ever, with benefit. The operation is attended by very free bleeding from the cut iris, and the anterior chamber becomes filled with a coagulum, which conceals the iris and pupil, often occasions great irritation, and is only very slowly absorbed. However large the piece of iris removed, the resulting gap will gradually be dragged together by lymph, and the occlusion of the pupil restored. A better resource is repeated paracentesis. If the anterior chamber be tapped, and its contents evacuated, in the manner already described, and if the puncture be re-opened with a probe sufficiently often to prevent it from healing, there will be no effusion of blood to do mischief, but a constant drain of fluid which must be supplied from the dilated veins of the eye, and which must in some degree diminish their congestion. The little wound is too insignificant to be hurtful, and the advancement of the lens and iris, consequent upon the frequent withdrawal of the aqueous humour, may prevent injurious pressure from being exercised upon the retina. If improvement be obtained, it is manifest that an iridectomy will eventually become necessary for the restoration of sight; and it should be performed during the first distinct remission of the inflammatory symptoms, before the lymph, which has been effused in the stroma of the iris, has had time to become a source of fresh mischief by the traction consequent upon its shrinkage. After the iridectomy, the treatment must be continued on the same general principles as before; and it will frequently be some months before the effused matters are fully absorbed, the media transparent, and such an amount of sight restored as the injury done by the inflammation may permit. It is not uncommon for the lens to be rendered opaque, or for its surface to be entirely covered by a semi-opaque film, and in either case it may eventually require removal. See *Secondary Cataract* under CATARACT. During

the subsidence of the disease, and the period of the absorption and removal of morbid products, the most important questions to be considered will usually have reference to the continuance or disuse of mercury, and these can only be determined by watching its action in each individual case, or, sometimes, by tentatively withholding it for short periods of time.

It is manifest that inflammation of the iris and choroid cannot exist without inflammation of the intervening ciliary body, or 'cyclitis,' as this affection has been somewhat clumsily called. But in some cases the cyclitis is a subordinate, while in others it is a prominent symptom; and, in the latter class, there is great danger of the occurrence of 'sympathetic ophthalmitis,' that is to say, of the excitation of an insidious and almost invariably destructive form of irido-choroiditis in the previously unaffected eye. Such an event is most frequent when the original inflammation was traumatic in its origin, and especially when the ciliary body has itself been injured, and is, therefore, primarily affected, the iritis and choroiditis being secondary phenomena. For further information on these points, *see* Eyeball, Injuries of the; Ciliary Body, Diseases of the; Sympathetic Ophthalmitis.

Serous Iritis is met with under two principal forms, in one of which the cornea participates, while in the other it escapes. In the former, the disease usually commences in an insidious manner, with little increase of vascularity, and the patient first complains of dimness of sight. The surgeon may then find one or two points of adhesion, a slight dulness and discoloration of the iris, and a fine cloud on the lower part of the cornea; which cloud, when carefully examined, is seen to be composed of an aggregation of minute dots on the inner surface of the membrane. The cloud is usually triangular in outline, its apex being in the pupillary region and its base at the inferior periphery of the cornea. There will, perhaps, be a slight zone of pericorneal vascularity, a slight increase of tension, and the second eye will, usually, be attacked in a similar manner. The disease was described by old writers as 'aquo-capsulitis,' and is apt to pursue a very chronic course. It is prone to occur in syphilitic subjects, but the writer has seen many instances in patients in whom no syphilis was discoverable. Complete functional rest of the eyes, protection from strong light and from changes of temperature, the use of atropia for the adhesions, attention to the general health, and the careful administration of iodide of potassium or of perchloride of mercury, with or without iron, and over a considerable period of time, will usually conduct such cases to a favourable termination. Such an administration of mercury as has been recommended for acute plastic iritis will seldom or never be required. If adhesions are left, when recovery is otherwise complete, they must be treated upon the general principles already laid down.

The other form of serous iritis, in which the cornea does not participate, is of a more acute character, and may be described as an attempt at acute iritis in a person incapable of yielding plastic lymph. The patients are often the subjects of some dyscrasia, often of renal disease. The effusion is more abundant than that of plastic iritis, and remains fluid, not producing adhesions, but distending the anterior chamber, pushing back the plane of the iris, indirectly increasing the tension of the whole eyeball, and thus producing great obscuration of vision. Functional rest, the relief of pain, and repeated paracentesis, constitute the chief treatment which will be required. If the tension is very high, and if the surgeon cannot see the patient frequently, so as to evacuate the contents of the anterior chamber twice a day, it will often be best to perform iridectomy. This procedure is usually followed by uninterrupted recovery; but the writer has operated on one case in which the distension had been so great, before the iridectomy was performed, that it left behind five dioptres of myopia in an eye which had previously been emmetropic.

R. Brudenell Carter.

IRRIGATION, or the plan of allowing gentle and continuous currents of liquids to flow over parts of the body, is an old therapeutic resource, possessing unquestionable antiphlogistic power. Irrigation may be practised with water of variable temperature, pure or medicated; but plain cold water is most frequently employed. As the fall of temperature from evaporation is considerable, it is rarely necessary or safe to irrigate with iced water. Dry cold (*see* Cold) is, on the whole, more useful and manageable than wet; but irrigation does possess special advantages. This is more particularly the case in treating diseases of, and in cleansing, cavities such as the nose, the pleura in empyema, the bladder, vagina, and rectum. In these cases, the best and simplest plan is to irrigate on the syphon principle, through an elastic tube deriving its supply from a vessel on a higher level than the body. In treating

wounds, especially foul ones, irrigation has the advantage, over stagnant wet, of promoting drainage by carrying off secretions as rapidly as they are formed; and it is readily intelligible that any antiseptic may be added to the liquid, if it be thought desirable to do so. The discomfort from wetting the body and bed-clothing is an objection to irrigation, and, to make it tolerable, every care must be taken to direct the outflow by adjusting the position of the body, and in making the bed, placing the pillows, and covering with waterproof cloth. The combination of position and irrigation greatly enhances the antiphlogistic power of the latter, as by elevation alone of an inflamed limb its supply of blood may be greatly reduced, and with it the temperature, all the more so if the raised limb be continuously irrigated.

Water may be allowed to flow from a tap or to drop on to a joint from a wide-necked bottle suspended over it, with some skeins of cotton hanging out of the bottle; or the liquid may be suspended in a small can or bucket, and left to trickle through an elastic tube, regulated by a stop-cock or a cleft stick at its lower end. Dr. James Macartney, in his *Treatise on Inflammation*, gives the following directions: 'Having laid some lint on the inflamed part, let the water be conducted by means of a strip of woollen cloth from a vessel holding the water or other fluid, which may be placed on a chair or table standing beside the bed. One end of the strip is to be inserted into the vessel; the other, which should be cut into a pointed shape, laid on the lint. The water will then proceed in the manner of a syphon continuously from the vessel, not by drops falling from a height, the sensation of which is disagreeable.' The important question as to how long irrigation should be continued, must be determined by the circumstances of particular cases. As a rule, it requires to be kept up for many hours, often for several days, before its beneficial effects are fully realised. The details of the method employed for irrigation are matters of secondary importance, affording great scope for ingenuity. The physical principles in operation are essentially those of the syphon and evaporation, and the patient's comfort is the best measure of the good done.

SAMPSON GAMGEE.

ISSUES are ulcers artificially produced and prevented from healing by the irritation of a foreign body; they may be employed as counter-irritants, and have been used to produce a continuous drain from the system.

Issues may be established by—1, caustics; 2, the moxa; or, 3, the knife; and in making them, bony prominences and the situation of nerves and vessels should be avoided.

1. To make an issue with caustic, the skin around should be protected by a piece of plaster, with a hole half the size of the required issue in the middle of it; a bit of caustic potash or Vienna paste, about the size of a pea, should be placed in the hole, and retained there by another piece of strapping for about three hours or fifteen minutes, according as the potash or the Vienna paste is used.

2. To make an issue by means of the moxa, a holder, known as the porte-moxa, having a wire-gauze receptacle at one end, is useful; some cotton-wool, tightly pressed and impregnated with nitrate of potash, should be placed in the gauze cage and ignited, and then held in contact with the skin until it is burnt. After both these methods, the injured part should be fomented to soothe the pain and irritation, and hasten the separation of the slough.

3. The knife is the least painful instrument for making an issue, but it is not so satisfactory as the other methods, on account of the difficulty of keeping the issue open. To make the issue, a crucial incision should be made through the skin by transfixion and cutting outwards, and into it a glass bead, known as the 'pea,' should be placed, in order to prevent healing and set up suppuration.

If the issue be inclined to heal too quickly, it may be dressed with savine ointment, or painted with liquor epispasticus.

BILTON POLLARD.

ITCH, the popular name for Scabies. *See* SCABIES.

J

JAW, Dislocations of the Lower.—Owing to the bony walls of the glenoid cavity, dislocation of the lower jaw is only possible in one direction—viz. forwards, over the eminentia articularis. The luxation is usually *bilateral*, but sometimes *unilateral*, and occasionally *congenital*.

The *bilateral dislocation* generally occurs during the act of yawning or laughing, when the mouth is widely opened, or it may be caused by straining the jaws apart, as in an attempt to bite a large apple. Rarely, it has been caused by violence. If the finger be placed just in front of the tragus whilst the mouth is being opened, the condyle of the jaw will be felt to pass downwards and forwards on the articular eminence, and it will be readily understood how, if the movement be carried beyond its natural limit, the condyle might slip over this bony ridge into the zygomatic fossa. Dislocation occurs less frequently in youth and age than in the middle period of life, a fact which may be to some extent explained by the obtuse angle which the ramus forms with the body of the jaw, towards the extremes of life.

Bilateral dislocation is almost invariably caused by muscular action, the mechanism of which is as follows. The digastrics, mylo-hyoids, and genio-hyoids draw the body of the jaw downwards towards the hyoid bone, which is in its turn fixed by the muscles passing from its lower border; then the external pterygoids complete the dislocation by drawing the condyles, together with the inter-articular cartilages, forwards over the eminentiæ articulares. When this has happened, the contraction of the masseters and internal pterygoids tends to maintain the dislocated position. The pathological results are stretching or slight laceration of the capsular ligaments, the carrying forward of the inter-articular fibro-cartilages upon the condyles of the jaws, slight laceration of the temporal muscles, and stretching of the lateral ligaments, the external ligament being directed downwards and forwards, instead of downwards and backwards.

The *symptoms* are gaping of the mouth with projection and fixation of the jaw. The saliva dribbles over the chin, deglutition and speech are interfered with, and the articulation of labial sounds rendered impossible. Immediately in front of the ear is a hollow whence the condyle has been displaced, and anteriorly, below the malar bone, is a projection caused by the coronoid process, whilst above the zygoma is a prominence produced by tension of the temporal muscle. The displacement gives a stupid expression to the face, and the patient, unable to express himself, points helplessly to his mouth in a manner apt to excite laughter rather than pity.

The *treatment* usually adopted is to place the patient in a chair, with his head supported against the back or by an assistant, and to introduce between his teeth the thumbs protected by lint, one on either side, in order to force the jaw back into position. The thumbs rest on the molar teeth and make pressure downwards and backwards, whilst the fingers are used to raise the chin. Another plan is to seat the patient on the floor and fix the back of his head between the knees of the operator. Two corks, two pieces of firewood, or the handles of a couple of forks are then introduced between the molar teeth, one on either side, and the surgeon placing both hands beneath the chin draws it steadily up. The condyles are thus directed into place by the jaw rotating on these artificial fulcra. A third method, recommended by Nélaton, is to press with the thumbs directly upon the coronoid processes so as to force the rami of the jaw backwards. Mr. Golding-Bird succeeded in reducing a case of eighteen weeks' standing by this method, one side being reduced before the other. Mr. Pollock reduced a case of four months' duration by placing wedges between the molar teeth and drawing the chin up by a Petit's tourniquet carried over the top of the head.

Unilateral dislocation gives rise to a projection of the jaw towards the sound side, and there exists a hollow just in front of the ear on the side whence the condyle is displaced. The deformity is not so obvious as in the bilateral dislocation, but articulation, closure of the mouth, and deglutition are all interfered with. It is, as a rule, more readily reduced than the bilateral, and by similar means.

Congenital dislocations are usually associated with deficient brain-development. *See* Congenital Dislocations.

Subluxation of the jaw was described by Astley Cooper as occurring from relaxed ligaments. The condyles ride too far forward on the articular eminences, and, becoming temporarily fixed, then slip back with a jerk. *See* TEMPORO-MAXILLARY ARTICULATION, Diseases of the.

In long-standing cases of unreduced dislocation the jaws become more nearly approximated, the deformity diminishes, and the lips may be brought into contact.

R. CLEMENT LUCAS.

JAW, Fracture of the Lower.—Fracture of this bone is apt to be overlooked. It is most common just in front of the mental foramen—i.e. near the canine tooth; but it may involve any part of either the horizontal or ascending ramus. Rarely it traverses the symphysis; occasionally it extends through the neck; or the coronoid process may be broken off. Fractures of this bone are often multiple or comminuted, and generally compound. Its arched formation and loose connection enable the jaw to resist considerable force. It is broken only by great violence, which is generally direct, in the form of blows or kicks; but the condyles may be broken off by falls on the chin, and the symphysis by lateral pressure, as when a wheel passes over the side of the face.

Symptoms are displacement, mobility of the fragments, crepitus, pain, free bleeding. Displacement is sometimes great, but it is often slight. Its direction depends on the line of the fracture, and therefore varies in different cases. The anterior fragment is generally drawn down by the digastric and other muscles, and lies internal to the posterior. Fracture is apparent in the altered outline of the teeth, which, however, it must be remembered, are often naturally very irregular, and in distortion of the outer surface and lower border of the bone. Mobility and crepitus are best detected by the tips of the fingers placed on the teeth, if the jaw can be opened, and the thumbs on different parts of the ramus; or the fragments may be manipulated from without. But roughness is unjustifiable, and even gentle examination causes severe suffering. There is dribbling of the saliva and fœtor of the breath. The inferior dental nerve usually escapes injury, but in some cases it has been torn through. Necrosis is not a rare consequence, especially in instances in which the injury has been overlooked, or when the fracture is compound and comminuted. Salivary fistula is rare. Troublesome suppuration is occasionally met with, which is generally associated with necrosis. Teeth that are much loosened are generally best removed. A tooth dropped into the fissure may hinder replacement. The condyles may be so forcibly driven up in falls on the chin that the base of the skull is injured.

Treatment.—As impaction is extremely rare, the adjustment of fractures of the body or symphysis is generally easy, though it may be difficult or impossible in fractures of the coronoid process or of the neck, especially if, as has sometimes occurred, there is dislocation also. Should the fragments be interlocked, an anæsthetic may be required. In a few cases of interlocked oblique fracture it has been necessary to saw off part of one of the fragments. This, however, can very seldom be called for. Retention is often easy, but it may be very difficult, especially in multiple or comminuted fracture.

I. In simple cases, the four-tailed bandage, the ends of which cross each other as they leave the symphysis, the two upper tying at the nape, the two lower over the vertex, will suffice.

II. A splint may be thus made. A piece of brown paper, six inches by four, is made four-tailed by cutting lengthways inwards from its ends to within an inch on each side of its centre. This is then shaped to the symphysis and body of the jaw, its two upper ends passing horizontally backwards and the two lower ends being brought vertically upwards across them. A gutta-percha splint is then cut out to this model, and (after the face has been shaved and well oiled to prevent sticking) when softened in hot water is moulded over the jaw, its ends being turned as those of the paper pattern were. It should be lined with lint, and kept in position by a four-tailed bandage.

III. As the splint just described is apt to press the anterior fragment backwards, Hamilton's splint is preferable. It consists of (*a*) a firm moulded cap (of leather or gutta-percha) for the symphysis and body of the jaw, the ends of which, prolonged with webbing, pass straight upwards in front of the ear and buckle at the vertex; (*b*) of a band encircling the head on the level of the forehead and occiput, and furnished with loops at the temple through which the ends of *a* are passed; (*c*) of a band passing longitudinally over the head, and connected with *b* at the forehead and occiput, and to which *a* is also fastened at the vertex. Thus *b* and *c* keep *a* in place.

IV. The fragments may be fastened together by a ligature passed round adjacent teeth to secure fixation; or an interdental splint may be made as follows:—A thick piece of cork is mortised on its upper and lower surfaces, so that the upper and lower teeth fit into it tenon-like, and so that it deeply overlaps the lower teeth laterally. A similar but better mould is made of gutta-percha, softened so that it accurately shapes itself to the teeth. With this splint Hamilton's bandage should be used.

V. Hammond's wire splint may be used. This excellent appliance is thus made:—A mould of the teeth is taken in soft wax, from which a plaster cast is made. To this cast is fitted a piece of stout wire, skirting the outer surface of the teeth, doubling round the wisdoms, and continued so as to skirt the inner aspect also. Its ends are now soldered together. When accurately fitted to the cast, this frame is slipped over the patient's teeth, and its inner and outer portions are fastened together by wires passing between the teeth at convenient intervals. This splint allows the patient to open and close his mouth and clean his teeth—a privilege that none should despise. Sometimes the fragments, otherwise not to be kept in place, can be drilled and wired together—a troublesome operation. Union seldom fails, but it is often tedious, especially if the fragments are not securely fixed. If it is delayed, examination for sequestra should be carefully made. If suppuration occurs, the mouth must be frequently rinsed with Condy's fluid, or borax and chlorate of potash lotion. HOWARD MARSH.

JAWS, Closure of the.—Inability to separate the jaws may be temporary or permanent. In the former case, setting aside cases of *trismus* from nervous affections, the cause is contraction of the muscles of mastication, especially the masseter, due to irritation from an uncut wisdom-tooth. Owing to want of room between the second molar and the ramus of the jaw, or owing to some malposition of the tooth itself, the wisdom-tooth is unable to assume its normal position, and by the pressure which it exerts on the neighbouring structures, sets up irritation, which induces a state of tonic spasm of the masseter and internal pterygoid muscles.

The majority of these cases occur, as might be anticipated, about the age of twenty; and the diagnosis is easy, unless very great swelling, and possibly abscess, should have supervened and obscured the nature of the case. The treatment consists in administering chloroform thoroughly, so as to relieve the spasm somewhat and allow of the introduction of a screw-gag between the teeth, in order to separate the jaws. This must be done slowly and steadily, so as not to inflict injury upon the front teeth, and the back of the jaw may then be reached. If the wisdom-tooth is presenting in its normal position, a free division of the gum over it, and removal of the flaps thus made with scissors, will be sufficient treatment, if the patient can quietly bear a little inconvenience for a time. But when there is obviously not space for the wisdom-tooth to be erupted, room must be made by extracting the second molar, unless the wisdom-tooth itself can be reached and extracted, which is seldom the case. Occasionally the extraction of the upper wisdom-tooth, against which the lower wisdom-tooth is pressing injuriously, may completely relieve the trouble.

In whatever way room is given, relief is sure to follow, and in the course of a few hours the spasm of the muscles passes off.

PERMANENT CLOSURE OF THE JAWS may depend upon destruction of the temporo-maxillary articulation, or more frequently upon the contraction of cicatrices in the cheek, following ulceration or sloughing. This latter condition is frequently the result of gangrenous stomatitis occurring in childhood, in which case destruction of the whole thickness of the cheek not infrequently takes place; but the same result may follow an attack of fever, &c., at any age. When the mischief is confined to the lining membrane of the cheek, the soft parts become firmly adherent to the alveoli of both jaws, and a rigid cicatrix of fibrous tissue, in which bone not infrequently develops, binds the jaws firmly together.

Under these circumstances, the patient is often nearly starved, for he can only rub soft food between the teeth, or push it with the finger behind the teeth on the unaffected side. In the cases where destruction of the cheek has taken place, although the deformity is more unsightly the patient is generally able to feed better, particularly if one of the molar teeth is wanting.

The treatment of cicatrices by simple division within the mouth is perfectly futile, for although wedges may be employed for a time to keep the jaws apart, they will certainly be drawn together by the rigid contraction of healing. In order to secure improvement in the patient's condition, it is necessary to prevent the adhesion of the cheek to the alveoli, and to restore, as far as possible, the pouch of

mucous membrane between them. This can only be done by adapting to the teeth metal plates, or shields, which can be constantly worn after free division of the cicatrices, and which, reaching well beyond the gums, can prevent adhesion taking place between the cheek and the alveoli. After a long time, a formation of mucous membrane takes place in the sulcus thus formed, and the plates may then be dispensed with in the daytime, but must be worn for many months at night. It is obvious that treatment of such a protracted nature cannot be carried out in children, and that the co-operation of an able mechanical dentist is essential for success.

The method is applicable only to cases where the whole thickness of the cheek is not involved; but the extent of the adhesions is comparatively unimportant, since the plates can be adapted to both sides of the mouth.

In the case of unilateral adhesions, division of the lower jaw in front of the cicatrices, and the formation of a false joint, give very good results. Esmarch removed a wedge-shaped piece of bone, so as to secure fibrous union with free mobility, while Rizzoli contented himself with dividing the jaw from the mouth, and trusted to the subsequent movements to establish a false joint.

Esmarch's operation is a very simple one—an incision along the lower border of the jaw easily admitting of the use of a narrow saw for the removal of a wedge of bone, the base of which should be below. The only point of importance is that the section should be made thoroughly in front of the cicatrix in the cheek; for, if this is not attended to, the operation will fail. The operation is applicable to cases in which one side of the mouth is affected, and restores to the patient a very useful, though one-sided amount of masticatory power in two or three weeks, with very little suffering or annoyance.

One side of the jaw remains of course permanently useless, and there is necessarily some deformity left, but the relief is permanent.

A patient, upon whom the writer operated in 1864, called in 1880 to show how satisfactory the movement of her jaw was.

See Temporo-Maxillary Articulation.

Christopher Heath.

JAWS, Diseases of the.—Periostitis, both acute and chronic, affects the jaws; but the former is so prone to run into suppuration with consequent necrosis, that it is only in the early stages that it can be recognised. The more chronic form is commonly connected with syphilis, and leads to the formation of nodes about the palate, and enlargement of portions of the lower jaw. In these latter cases the administration of the iodides, in full doses, gives most satisfactory results. Many cases of persistent facial neuralgia, which are unrelieved by quinine, &c., yield to the administration of iodide of potassium, and may be concluded to depend upon chronic periostitis or ostitis, with, probably, pressure upon the dental nerves.

Necrosis affects the lower, much more frequently than the upper jaw, probably in consequence of its being less abundantly supplied with blood. Beginning as periostitis, from tooth-irritation, injury, or the action of some specific poison, the general symptoms are pain, with pyrexia; and the part affected will be found to be swollen, injected, and hot, the teeth being raised from their sockets and unable to bear the slightest pressure. If relieved by timely depletion by leeches, or, better, a free incision, and the assiduous use of hot gargles and poultices, the symptoms may subside without further mischief; but usually matter has already formed beneath the periosteum before the patient is seen, and then, although promptly evacuated, necrosis is very apt to follow. Fortunately, necrosis sometimes affects the outer plate of the alveolus only, so that the teeth are supported by the inner plate, and can be kept *in situ*; but when the entire socket is involved, the teeth are rendered loose and useless, and are better away, since they only plug the openings through which the discharge should find its way out. It is very undesirable to attempt the removal of sequestra until they are completely loosened, since, by doing so, damage may be inflicted on the surrounding parts, and the process of repair be interfered with; and this is especially the case in children in whom the second teeth are still undeveloped.

It is impossible to lay down any rules for the period of separation, which must depend upon the extent and position of the sequestrum, and the strength of the patient; but ordinarily from six weeks to three months must elapse before large sequestra can be safely extracted.

By *exanthematous necrosis* (Salter) is meant the necrosis occurring in young children, for the most part, after attacks of the specific fevers, especially scarlet fever and small-pox. Necrosis of portions of the

alveolus of either jaw, and usually on both sides symmetrically, or even of the whole thickness of the lower jaw, is fully recognised now as one of the sequelæ of these disorders; and doubtless many of the cases which were attributed to the administration of calomel in former days, were really due solely to the action of the specific poison. The course and treatment of these cases differ in no respect from those of ordinary necrosis.

The action of the fumes of *phosphorus* in producing necrosis of the jaws in persons employed in lucifer-match making, has now been recognised for upwards of forty years. It was found that so long as workers with phosphorus had perfectly sound teeth, their health remained unaffected; but so soon as the teeth became carious, or were from any cause extracted, the fumes of phosphorus found their way to the periosteum of the jaws, exciting periostitis with rapid necrosis.

The symptoms were severe, the swelling of the jaws and tissues of the face being extreme, and the discharge of purulent fluid from the mouth being constant and in large quantities. The general health became secondarily affected, the patient being worn out with pain and inability to take solid food, and in very severe cases being liable to gangrene of the gums and cheeks. All these discomforts have been put an end to by insisting upon cleanliness in the use of the phosphorus, by the careful examination of the mouths of the workers, but more especially by the employment of the amorphous phosphorus in the manufacture of lucifer matches.

The remarkable point about phosphorus-necrosis is the peculiar deposit of pumice-like bone, which takes place upon the sequestra. This is doubtless derived from the periosteum, although so closely adherent to the sequestrum as to be invariably brought away with it; and though resembling true bone in some particulars, it is decidedly of a lower development. A form of bone, closely resembling this pumice-like deposit, has, however, been noticed in cases in which no phosphorus was involved, and it would appear that, in some instances, possibly of rheumatic origin, the deposit of new bone partakes of this character.

Besides phosphorus-necrosis, *mercurial* necrosis was once common, not only as a consequence of the excessive administration of mercury for antisyphilitic purposes, but as a result of the destructive ptyalism produced by the fumes of liquid mercury as formerly employed in the manufacture of looking-glasses. When glass plates were converted into mirrors by sliding and compressing them on to sheets of tin-foil covered with pure quicksilver, the men employed were liable to have their teeth drop out, and frequently lost portions of the jaws, their lives being notoriously shortened. Since the introduction of a chemical process by which the mercury is deposited on the glass, these cases of induced necrosis have become almost unknown.

In ordinary cases of necrosis of the *upper* jaw, no reproduction of bone takes place, the gap left in adults being permanent, though in children the subjects of exanthematous necrosis, the granulation-tissue is slowly converted into fibrous tissue, which does not as a rule ossify. In the *lower* jaw, abundant new bone is produced by the periosteum, and, for a time at least, most extensive losses are repaired. It is certain, however, that, in course of years, a great, if not complete, re-absorption of new bone thus formed takes place, the patient being left ultimately with very little, if any, support for artificial teeth. Salter has suggested that the early application of artificial teeth would tend, by use, to strengthen and maintain the permanence of the new bone; but there are no facts to support this view.

Under the name Hyperostosis may be conveniently grouped together a number of cases in which general enlargement of the maxillary bones occurs, without any tumour which could be properly placed among the osteomata. Enlargement of the angles of the lower jaw, quite unconnected with the development of the teeth, and giving a peculiarly broad appearance to the face, occurs in otherwise healthy subjects of about twenty, and they appear to remain stationary. In true hyperostosis, however, there are large bosses of bone, often symmetrical, thrown out by the bones of the face and cranium, which slowly but steadily increase in size, producing hideous deformity, and ultimately causing the death of the patient. Cases in which the disease is unilateral may fairly be submitted to operative procedure, and the writer has twice relieved patients from considerable deformity by sawing or gouging away a portion of the projecting bone, without any external incision. In one case, that of a lady aged 39, the enlargement of the right upper jaw was attributed to a blow on the cheek; in the other, a man aged 46, the enlargement in the same situation came on apparently without cause. *See* Ostitis Deformans.

Cysts occur both in the upper jaw (*see* Antrum, Diseases of the) and in the lower, where they may be single or multiple. The origin of these cysts is probably in the cancelli of the bone, and is in many cases due to the irritation caused by neighbouring teeth; a cancellus being filled with fluid expands, and produces gradual absorption and obliteration of neighbouring cancelli, until a cyst of considerable size is produced.

The multilocular cysts of the lower jaw appear to be more closely connected with the teeth than the single cysts, since, in many cases, the extraction of teeth or stumps gives exit to a quantity of glairy discharge. Distension and absorption of the alveoli go on as the cysts increase in size, so that the walls at length become membranous, and the macerated bone shows great gaps in its outline. One remarkable clinical feature in these cases is the length of time over which they extend, without materially affecting the health of the patient, except by their size and the consequent inconvenience produced.

The *treatment* of multilocular cysts in the lower jaw depends somewhat upon the extent of the disease and the amount of solid growth connected with them. Removal of any portion of the whole thickness of the jaw should be avoided as far as possible, though this may be advisable in extreme cases. Mason Warren and Butcher have shown that by evacuating the contents of the cysts from within the mouth, and crushing in the thin walls with the fingers, a great amount of consolidation can be brought about, and if the thick lower border of the jaw be unaffected, as it usually is, a very firm basis of support for artificial teeth may thus be obtained. The operation may require repetition, and will give satisfactory results when there is little, if any, solid material connected with the cysts. When there is a solid growth in connection with the cysts, it may, if small, be removed with the gouge, but if it should be reproduced, the portion of jaw involved should be excised, since experience has shown that these growths in connection with cysts are epitheliomatous, and apt to become generalised throughout the body.

Tumours.—Non-Malignant.

I. Fibroma of the jaws closely resembles fibroma in other parts of the body, and especially the uterus. It is dense in structure, and frequently lobulated, and on section shows interlacing bundles of fibres. Two varieties of origin are found, the periosteal, springing generally from the alveolus, and indistinguishable except by its size from epulis, and the endosteal, which springs from the interior of the bone, and in the upper jaw generally makes its way into the antrum and nasal cavities, or in the lower jaw expands the inner and outer plates of compact bone. Fibroma produces absorption by pressure, and may thus destroy a great part of the skull; it stretches the skin of the face, and may by tension produce ulceration, and thus cause an aperture, but it never involves the skin, which is always loose and movable over the tumour.

Fibroma appears to owe its origin, in many cases, to the irritation of decayed teeth, which may sometimes be found embedded in the tumour or displaced by it. No treatment less radical than the removal of the portion of bone, from the periosteum of which the tumour springs, can be of avail in the periosteal variety of fibroma; but in the form in which the bone, and particularly the lower jaw, is expanded by a slow-growing tumour within it, less heroic measures may be successful. The writer has removed a fibroma by enucleation from within the antrum with complete success, and numerous museum specimens serve to show that the lower jaw is often expanded by fibrous tumours, which are amenable to the same treatment.

II. Enchondroma is of less frequent occurrence in the jaws than fibroma, and like it may be divided into periosteal and endosteal. The disease appears ordinarily early in life, springing from the surface of either jaw, or from within the antrum or the interior of the lower jaw, and grows steadily, and more rapidly than the fibroma.

It is more tuberous than the fibroma and harder than it, and, in the case of the upper jaw, is apt to send processes into the fissures and cavities of the skull, thus giving rise to great deformity by involving the nose and orbit. Many remarkable specimens of this kind are to be found in museums, the patient in some cases being suffocated by the growth involving the mouth and pharynx. And yet in these cases it will be seen that the tumour does not invade the surrounding parts except by its pressure, and could have been enucleated.

Enchondroma has undoubtedly a greater tendency to recur locally than has fibroma, and it is essential, therefore, in its treatment that free removal should be undertaken. Enchondroma of the jaws may have fibrous tissue mixed with it, or may in great part be converted into bone, and no doubt many of the remarkable osseous tumours of the jaws to be found in museums were originally cartilaginous in their nature.

III. Osteoma is found in the jaws as a cancellous or as an ivory tumour.

The simplest form is the condensed hypertrophy due to the presence of a misplaced tooth; and the fact that numerous serious operations have been performed in these cases, should make the surgeon especially careful as to his diagnosis. The cancellous osteoma has a covering of compact bone of varying thickness, but sometimes so thin as to crackle under the finger. It grows slowly to a very large size, but when removed by section of the healthy bone beyond, shows no tendency to reproduction. The ivory osteoma is met with both as an outgrowth from the lower jaw and as a tumour of the upper jaw, of which the ivory is but a portion, the rest being composed of dense cancellous bone. *See* Exostosis.

In the *treatment* of these tumours, an exploratory puncture or trephining may enable the tooth, which is the cause of the malady, to be extracted, and hence this should never be neglected, except in the case of the ivory growth. This again may be sawn off, and shows no tendency to recur, or may be extracted from the cavity of the antrum, or from the interior of the lower jaw. As a last resource the upper jaw, or a portion of the lower, may be removed with the tumour, but extensive mutilations should not be undertaken for benign and slowly increasing tumours, if they can be avoided.

Under the old term 'Cystic-Sarcoma,' was included more than one variety of solid growth in which cysts were developed. The presence of cysts was held to mark the non-malignant character of the disease, and the clinical histories of recorded cases appeared to support this view. The naked-eye appearance of the solid growths was that of a fibrous or fibro-cellular tumour, and this was considered to be its nature until the last few years.

In his 'Erasmus Wilson Lectures' for 1882, Mr. Eve fully discussed the question of these tumours being really a variety of epithelioma; and certainly the fact of a solid tumour forming after thirty years' existence of cystic disease, as occurred in a patient of the writer's, would tend to show that the disease in question is not so harmless in its course as has hitherto been supposed. Still the clinical history of these cases, and also of the cases of ordinary 'cystic-sarcoma,' differs so completely from that of ordinary epithelioma as to rapidity of progress and recurrence after removal, that further observation is necessary before a decided opinion can be arrived at on the whole question.

Sarcomata.—In connection with the jaws, various forms of sarcoma are found, many of which have hitherto been known by other names, and many recurrent growths, formerly called cancers, come properly into this class.

1. Spindle-celled Sarcoma is of frequent occurrence about the jaws, forming many of the specimens formerly indiscriminately named 'osteo-sarcoma.' The principal clinical features of spindle-celled tumours of the jaw, are rapidity of growth with invasion of surrounding parts, but no glandular infiltration, at least in the earlier stages. Free removal is essential because of the tendency to creep along the periosteum beyond the defined tumour, which is common in these cases, and recurrence is frequent. A remarkable feature in the recurrent growths is the tendency to become softer with each recurrence, and the patient dies worn out, with, rarely, secondary deposits in internal organs.

2. Round-celled Sarcoma (encephaloid sarcoma of Cornil and Ranvier and others), is a more vascular and softer growth, and hence has more of the character of a malignant tumour. It grows very rapidly, invading the skin and forming fungous protrusions, and leads to deposits in internal organs. Many of the recorded cases of 'medullary' cancer of the jaw belong to this class.

3. Myeloid Sarcoma has long been recognised in relation with the jaws, in which situation it was originally described by Paget. It is found in connection with the alveolus, forming the so-called myeloid epulis, and also in the interior of the lower jaw. Occurring in children or young adults, the myeloid growth springs from the interior of the alveolus, and protrudes between the teeth, which may be displaced. The growth is softer than the fibrous epulis and more vascular, and occasionally presents characteristic dark spots beneath the mucous membrane; or, when developed deeply in the interior of the lower jaw, it expands the bone without forming an external protrusion. The development of cysts is not infrequent in the interior of the growth, which may pulsate. A section of the tumour shows the maroon colour resulting from hæmorrhages within the tissue, so common in myeloid growths. The question of recurrence, in connection with myeloid growths, is a very important one, and it may be considered that after complete removal recurrence does not take place.

4. Alveolar Sarcoma occasionally affects the jaws, and in the Museum of the Royal College of Surgeons of England will be found a specimen of the kind. This form of sarcoma was called by Wedl 'a fibrous form of cancer arising from bone,' and should undoubtedly include the cases hitherto described as examples of scirrhus of bone.

5. Fibro-sarcoma closely resembles fibroma in external appearance, and generally grows beneath the periosteum.

6. Chondro-sarcoma, in which spindle- or round-celled sarcoma is mixed with the cartilage forming the bulk of the tumour, occurs in both jaws, and frequently leads to secondary deposits in the lungs.

7. Ossifying Sarcoma, and Osteoid Chondro-sarcoma, imply the occurrence of ossification in tumours containing sarcomatous elements, and include the cases hitherto described as 'osteoid cancer.'

Carcinoma.—The only form of carcinoma affecting the jaws is epithelioma, which is found in at least two varieties, the squamous and the tubular. The position of these depends upon the nature of the normal epithelium of the part; thus, the squamous epithelioma is developed primarily in the mucous membrane of the palate and gums, the normal epithelium of which is squamous; whilst the tubular form with cylindrical epithelium begins in the antrum or nose, the epithelium of which is columnar. *See* Antrum, Diseases of the.

Both forms of epithelioma have a great tendency to invade surrounding parts, especially the bones, and hence the difficulty of completely extirpating the disease, except by proceedings of a magnitude which may not be justifiable in the weak condition of the patient.

Squamous Epithelioma of the palate and gums begins very insidiously, and its nature is therefore often mistaken at first. Commencing as a small, ragged ulcer on the mucous membrane of the gum, it is often, and probably correctly, attributed to the irritation of decayed teeth or fangs, or to secondary syphilis, but is regarded of little importance, or is perhaps irritated by the application of nitrate of silver or other irritants.

Ulceration of the palate of an epitheliomatous character is more frequently attributed to tertiary syphilis; and even large gaps in the hard palate, caused by epithelioma, are supposed to be the result of a broken-down gumma. But epithelioma of the gum or palate probably never occurs before the age of 40, and more often nearer 60 than 50, whereas the secondary manifestations of syphilis take place as a rule earlier in life, and the tertiary symptoms are much less urgent than those of epithelioma.

By involving the subjacent bone, necrosis is induced in the course of an epithelioma, and here again error may arise if the presence of bare bone be regarded as pathognomonic of necrosis, without considering the cause.

Tubular Epithelioma has been described by Reclus under the title of *epithéliome terebrant* (boring or burrowing epithelioma). *See* Antrum, Diseases of the.

The treatment of epithelioma of the jaws, like that in other parts of the body, consists in prompt and free removal of the affected part. When the disease is confined to the gum and margin of the alveolus, comparatively mild proceedings may be justifiable in the first instance; but if the disease has gone at all deeply, removal of the upper, or of a large portion of the lower, jaw should be undertaken without hesitation. Even then it may be impossible to clear away the whole of the disease, which may extend through the lower wall of the orbit, into the spheno-maxillary fossa, and up between the temporal and masseter muscles, and beneath the temporal aponeurosis. Christopher Heath.

JAWS, Operations on the.—In all operations upon the jaws, the greatest care should be taken to avoid extensive scarring of the face and the infliction of unnecessary deformity, particularly by breaking the line of the lower jaw. Incisions for the relief of inflammation or the evacuation of matter, and punctures for emptying cysts or the antrum, should invariably be made within the mouth. Extraction of sequestra may be performed in most cases more conveniently through the mouth than by external incision, though the surgeon may occasionally avail himself of existing sinuses. The removal of epulis, in its varieties, can be readily accomplished through the mouth, if the operator is provided with proper bone-forceps of various kinds, and even large portions of the jaws may be thus removed with success. The late Mr. Maunder on two occasions removed large portions of the right side of the lower jaw, with the surrounding tumour, without any external incision, separating the soft parts with a raspatory, and sawing the bone in front of, and behind, the tumour. The principal difficulty in these operations was not so much the

separation of the tumour as its 'delivery' through the mouth, which was slightly split in one instance. Fortunately, the hæmorrhage in both cases was slight, and the patients did well; but another surgeon was less fortunate, and lost his patient by secondary hæmorrhage, but, considering the close proximity of the facial artery, and the necessary division of the inferior dental artery, this is not to be wondered at. It may be doubted whether the extra trouble and risk of the proceeding are balanced by the absence of a scar, which, in the majority of cases, need not involve the lip, and, if properly placed, will be nearly invisible afterwards.

The same may be said of the so-called 'sub-periosteal resections' of the upper and lower jaws. In cases of necrosis it is, of course, advisable to preserve all the periosteum, and in extracting a sequestrum it may be occasionally necessary to turn aside soft parts with a raspatory; but any systematic stripping of the periosteum from a jaw involved in a tumour is not only impossible in most instances, but, if undertaken, will only leave shreds of periosteum, with possibly some portions of the disease.

Removal of the Upper Jaw, whether partial or complete, may be most conveniently performed as follows, the incisions being extended as the gravity of the case may indicate:—

A straight incision through the median line of the upper lip, and prolonged on one side of the columna nasi into the nostril of the affected side, will allow the tissues of the face to be readily dissected up off the jaw, so as to expose completely the front wall of the antrum. This may then be perforated, and removed with bone-forceps, so as to permit of the extraction of a tumour from within, or room may thus be found for the removal of large portions of the palate.

In a case of more extensive disease, in addition to the incision already made, one should be begun near the inner angle of the orbit, and be carried down by the side of the nose, and around the ala into the nostril. This will allow of further reflection of the soft tissues, and more complete exposure of the bone, so that it would be easy to cut away large portions of the jaw with suitable bone-forceps, or a small saw could be readily carried horizontally from the nostril at any level desirable, so as to preserve either the palatine or orbital plate. For removal of the entire upper jaw, it will be advisable to make an additional incision below the orbit from the inner angle to the malar bone, following the natural curve of the skin-markings of the part. This incision may be prolonged on to the malar bone as far as may be necessary, and may be met at its extremity by another at right angles to it, in very extensive disease of that bone. The flap of skin is now to be reflected outwards, and this method has the great advantage of preserving the facial nerve, and of dividing only small branches of the facial artery.

Division of the bone will be required at three points—(1) the palate, (2) the nasal process of the maxilla, and (3) the malar bone, and these sections may be made with the saw or bone-forceps, or more conveniently with both. A narrow saw, with movable back, is to be passed into the nostril, and the hard palate divided with the alveolus, from which a central incisor tooth should have been previously extracted.

The saw should be kept horizontal in the nostril, and there need be no fear of damaging the pharynx with its extremity. The movable back allows the blade of the saw to pass through the bone into the mouth, thus dividing the whole of the hard palate, without the splintering which usually follows division with bone-forceps. The soft palate escapes injury from the saw, and any attempt to dissect off and preserve the soft covering of the hard palate is futile.

The nasal process of the maxilla may be conveniently notched or completely divided with a small saw, which is next to be applied to the malar bone parallel to, and immediately in front of, the masseter muscle. This cut will then run into the spheno-maxillary fissure, and the prominence of the cheek will be preserved; but in cases of very extensive involvement of the malar bone, it will be necessary to remove the whole of it by dividing the zygomatic process, and the frontal process at its junction with the frontal bone.

Before dislocating the bone, it is well to divide the soft palate transversely close to its attachment to the hard palate, which can be readily done from the mouth.

With a pair of angular bone-forceps the three cuts made with the saw should then be thoroughly cleared, and it is convenient to take them in the reverse order, viz., malar bone, nasal process, palate. The bone-forceps, when dividing the palatine attachments, may be conveniently used to tilt the whole jaw forward, and the lion-forceps should then be employed to grasp it, and forcibly depress the mass, while the scalpel is used to divide the infra-orbital

nerve behind the bone, so as to prevent its being stretched, and also any soft tissues which may remain attached to the jaw.

The hæmorrhage, which is often sharp for the moment, is best checked temporarily by thrusting a sponge into the opening, and this, after a few minutes' pause, may be withdrawn in order to allow of the application of the actual cautery at a black heat, so as to sear any bleeding vessel. A careful examination should be made to see that all the disease is removed, and the flap of skin is then to be replaced and fixed with fine wire sutures and hare-lip pins for the lip, the red margins of which are best approximated by a fine silk stitch.

Unless the oozing of blood is so considerable as to necessitate plugging the wound, it is better not to introduce any lint beneath the cheek, since it only collects discharge, and becomes very offensive in a few hours, when its withdrawal is both difficult and painful. Free syringing with antiseptic lotions from the first is useful, and for this nothing answers better than the continuous stream of the syphon nasal douche. *See* Nasal Douche.

Removal of the Lower Jaw.—In removing portions of the lower jaw, the incision should, as far as possible, be placed below its border, so that the cicatrix may be hidden.

An incision from the median line to the angle, thus placed, will divide the facial artery immediately in front of the masseter muscle, and both ends should be at once secured with a ligature. The tissues of the face can then be dissected up, and the cavity of the mouth opened by dividing the mucous membrane close to the gums, when any part of the body of the jaw can be removed by making a section, with the saw, on each side of it.

In making these sections, it is better not to complete one before the other is begun, because of the loss of resistance consequent upon breaking the continuity of the bone; but each cut being carried nearly through the bone with the saw, may be conveniently finished with the bone-forceps. Should it be necessary to prolong the incision beyond the median line, and to remove the symphysis, care must be taken to guard against the falling back of the tongue by having a stout thread passed through it, upon which traction may be made. The mylo-hyoid muscle and mucous membrane inside the bone can then be divided and the piece removed, but, whenever possible, the alveolus alone should be divided, and the lower border of the jaw be preserved.

For removal of one half of the lower jaw, it will be advisable to divide the lower lip in the median line; for though it is possible to perform the operation without this, yet, if the disease is at all serious, it unnecessarily complicates the operation to save the lip, which reunites readily enough. The incision should then be carried, at right angles to that in the lip, along the lower border of the bone as far as the angle, and then upwards to near the lobule of the ear. This will necessarily divide the facial artery, but no important branches of the facial nerve, unless prolonged into the parotid gland. The tissues of the face and of the masseter being dissected up off the bone or tumour, the jaw is to be divided at a convenient point, a tooth having been previously extracted. The scalpel is then to be carried closely along the inner surface of the jaw, to divide the tissues forming the floor of the mouth, and care must be taken not to detach or damage the sub-lingual gland.

The cut end of the jaw being grasped with the lion-forceps can now be everted, so as to bring the internal pterygoid muscle into view, and this must be dissected from the bone. Should the disease be of a non-malignant character, and not involve the articulation, the ramus of the jaw should be sawn across in preference to disarticulating; and, even when the tumour encroaches very closely upon the joint, it may be possible to divide the neck of the condyle and the coronoid process separately with bone-forceps.

In order to disarticulate the condyle, the soft tissues should be held out of the way with spatulas, and the jaw being firmly grasped with the lion-forceps, is to be depressed, so as to bring the coronoid process forward and allow of division of the insertion of the temporal muscle. This is sometimes rendered difficult by an unusual length of the process, or by its being jammed against the malar bone by the bulk of the tumour. In that case, it may be necessary to cut off the coronoid process with bone-forceps, or to break it by force.

The coronoid process having been cleared, the depression of the jaw from before backwards is to be continued, in order to throw the condyle forward; but great care must be taken not to rotate the jaw outwards, or the internal maxillary artery will be stretched around the neck of the bone, and be either torn or divided, when the hæmorrhage would be severe and difficult to arrest. The condyle being made prominent, the knife is to be carefully

applied over it, when the bone will start forward, tearing through and bringing away with it a portion of the external pterygoid muscle. The knife must not be used to divide the muscular fibres, which bleed less if torn, but may be employed to divide the inferior dental nerve, so as to save it from being pulled out of the bony canal. When, from the nature of the tumour, the leverage of the jaw is lost, and consequently disarticulation of the condyle becomes difficult, recourse may be had with great advantage to the broad elevator recommended by Professor Gross for disarticulating the condyle from the glenoid cavity. In this way the bone may be forced from its socket, and the risk of hæmorrhage from the internal maxillary artery be completely avoided. Any bleeding vessels should be secured with ligatures, the lip united with hare-lip pins and the wound with sutures, care being taken to leave a dependent opening for the discharges. CHRISTOPHER HEATH.

JOINTS, Diseases of.—In considering the subject of joint-disease, it is well to bear in mind the structure and function of the part concerned; for it will be found, in practice, that in no class of diseases are these more intimately related to symptoms and treatment. Thus, the structures which usually enter into the formation of a joint are bone, cartilage, synovial membrane and ligament; surrounding the joint are muscles, with their corresponding vascular and nervous supplies, the arterial anastomoses being in most cases very free, and the nerves supplying the joint being derived from those that are distributed to the muscles which move it.

The *symptoms*, in any individual case of joint-disease, will vary in accordance with the particular structure which in that case is chiefly affected; and the determining of the part in which the disease originated, will often aid our diagnosis of the constitutional or other condition upon which it depends. So also in regard to function. The proper function of a joint is limited movement, which should be accomplished without pain or sensible friction. In disease, this function is disturbed in a manner which is indicative of the character and seat of the morbid process.

It will be observed that nearly all *acute* inflammations of joints commence as synovitis, although, if the process is not soon arrested, the other structures—cartilage, bone, ligaments—also become involved. These acute inflammations have their origin either in injury—as, for example, a sprain or wound—or in the constitutional diseases pyæmia and rheumatism, of which the joint-affection is but a part.

The *subacute* and *chronic* joint-diseases exhibit a much greater variety both in the tissues affected and in the mode of origin. These are either secondary to the more acute forms, of which a chronic traumatic synovitis is a common example; or they are due to divers constitutional conditions, of which the most frequent are scrofula, rheumatism, syphilis, gout, and some of the milder forms of septic infection. Very often too, an injury will be found to be the starting-point of a chronic joint-affection, the persistence of which depends upon constitutional disease.

It will be convenient to describe the diseases of joints, first in relation to the particular tissue which is chiefly affected; and secondly in relation to the associated constitutional condition.

DISEASES OF THE SYNOVIAL MEMBRANE. Of all the joint-structures, the synovial membrane is the most liable to the various forms of inflammatory disturbance. It is exceedingly sensitive to injury, and to any changes in the amount or character of its blood-supply.

In *Acute Synovitis* the synovial membrane rapidly becomes swollen and vascular, losing its natural smoothness, and presenting a velvet-like surface; at the same time the cavity of the joint becomes distended with an abundant secretion of slightly turbid synovia. Minute blood-vessels are seen traversing the membrane and giving it a brilliant red colour, with here and there patches of deeper tint, so that its encroachment upon the cartilages is rendered very obvious. Under the microscope, the synovial fluid is seen to contain leucocytes, oil-globules, and shreds of fibrinous material; the cellular element increasing in proportion to the severity of the inflammation, and the fluid approximating in varying degrees to the character of pus.

The *symptoms* are pain, heat, and swelling of the joint, together with pyrexia. The pain is of an aching and throbbing character, greatly aggravated by movement or interarticular pressure; the joint not only feels hot to the patient, but its temperature is actually raised; the swelling corresponds to the limits of the synovial sac, it obscures the natural outlines of the bones, and fluctuation can be felt across the joint. The muscles which act upon the joint are in a state of rigidity, and fix it, usually in the position of partial

flexion. The pyrexia varies in proportion to the size of the affected joint and the acuteness of the process. There are often some premonitory rigors. The result may be either the complete subsidence of the inflammation, the joint being left for a time somewhat tender and loose from the stretching its tissues have undergone; or there may be partial subsidence into the condition of chronic inflammation; or suppuration may ensue.

The occurrence of *suppuration* is indicated by marked increase in the constitutional disturbance; rigors occur and may be repeated, the temperature rises, the pulse is quickened, and if the joint affected be a large one (e.g. the knee), the patient is gravely ill. There is not necessarily any increase in the amount of fluid in the joint, but the tissues around usually become œdematous, the skin red and hot, and the pain very severe, so that appetite and sleep are lost. Painful startings of the limb now occur, and any movement of the joint-surface is attended with severe suffering. The ligaments also become softened, so that, unless means are taken to prevent it, displacement of the bones takes place in the direction in which the muscles have most power.

If exit is not now given to the pus, it makes its way out of the joint into the surrounding tissues and then to the surface. As the suppuration progresses, the cartilages become ulcerated and detached, the bone-surfaces exposed and displaced, and the joint is thus irretrievably damaged; while at the same time the patient is in danger of pyæmia, hectic, and exhaustion, from which he is often only to be rescued by amputation of the limb.

Suppuration of a joint is not, however, necessarily attended with ulceration of the cartilages, though it usually is. Early incision and free drainage may be followed by recovery, with little or no impairment of movement. In the majority of cases, however, the most favourable result that can be obtained is a joint more or less fixed by adhesions, and weakened by softening and destruction of its ligaments; limitation of the natural movements by adhesions being often accompanied by too great mobility in other directions.

The *treatment* of acute synovitis in a healthy person should be antiphlogistic and decided, for it is of great importance to arrest the morbid process at the earliest possible stage. The maintenance of the joint in a condition of rest is the first essential; this must be attained by the application of suitable splints or other apparatus for ensuring immobility. *See* Ankle, Elbow, Hip, Knee, Shoulder, Wrist.

At the outset of the inflammation, leeching is of great value; ten leeches applied to a joint such as the knee, or six to the elbow, may cut short the attack at its commencement. Great pain is a special indication for leeching, which almost always gives relief. If the abstraction of blood is undesirable, cold should be applied to the joint by means of an ice-bag, Leiter's tubes, or evaporating lotions. In the beginning of traumatic synovitis, elastic pressure made with an india-rubber bandage, over which an ice-bag can be placed, is often very useful. In some cases, however, it will be found that warm fomentations are more comfortable and equally beneficial.

Besides such local measures, a purgative will generally be needed, and, if the constitutional disturbance be severe, opium should be given in small doses frequently repeated, to which, if the pulse be hard, a little tartar emetic (gr. $\frac{1}{10}$th to gr. $\frac{1}{6}$th) may be usefully added. If the distension of the joint is not thus diminished, it should be punctured with a fine trocar or aspirating-needle, and the distending fluid be withdrawn. Every possible care must be taken to prevent the entrance through the puncture of any septic material into the joint, and gentle elastic pressure should be maintained after the evacuation of the fluid. A convenient method of procedure is to encircle the joint with an elastic bandage, between two of the folds of which a small interval is left; in this interval the joint is punctured with a fine hollow needle attached to a syringe with a glass barrel, so that the nature of the fluid can be observed. The skin around the point of puncture is to be previously washed with a solution of carbolic acid (1 in 20), and the needle thoroughly cleansed in the same solution. The needle should be introduced obliquely, and the fluid gently and slowly withdrawn, the suction of the syringe being arrested as soon as the fluid ceases to flow readily, or if it become tinged with blood. On the needle being removed, the little wound is immediately closed with plaster.

Puncture of a distended joint, thus performed with strict antiseptic precautions, is a safe method of relieving tension, and the withdrawal of even a small quantity of the fluid is often followed by immediate subsidence of the inflammation and the gradual absorption of the remaining effusion. If, after the acute stage has passed, there still remain an excess of fluid in the joint,

its removal will probably be obtained by the application of a blister, or by maintaining even pressure by means of an elastic bandage or frequently renewed strapping. After an attack of acute inflammation or distension, the tissues of a joint are left loose and softened; support should therefore be given, by strapping or bandaging, for some weeks after the use of the joint is recommenced.

If the inflammatory process passes on to the stage of suppuration, the gravity of both local and general conditions is greatly increased. The time for depletion is now passed, the patient's strength will require supporting rather than depressing, and our efforts must be directed to maintaining the best local and constitutional conditions for the repair of the damaged joint. If, then, the symptoms are such as have been described above as indicating suppuration of the joint, and especially if the patient's temperature remains persistently high, the character of the contained fluid must be ascertained by antiseptic puncture with the exploring syringe. Should the fluid withdrawn prove to be only turbid, and not actually purulent, its removal may be the first step towards recovery, and the avoidance of suppuration may still be hoped for. If, however, the fluid prove to be pus, its free evacuation is urgently needful. For this purpose the joint must be freely incised in such a situation as will best ensure complete drainage: its cavity must be syringed out with an antiseptic solution (e.g. 1 part of carbolic acid to 40 parts of water), and the wound dressed with absorbent antiseptic dressings.

The success of the treatment will depend very much upon the efficient drainage of every part of the joint-cavity, and upon the avoidance of septic infection. The strictest antiseptic precautions must be observed. The incision must be made, if possible, in the most dependent position, a drainage-tube must be inserted to ensure the patency of the wound, and, if the joint does not thoroughly empty itself, it must be daily washed out by gentle irrigation with carbolised water. A good form of dressing is a pad of carbolized wool enclosed in a double layer of eucalyptus or carbolized gauze, which should be changed sufficiently frequently to prevent the discharge soaking through or decomposing. The temperature should be carefully watched, and any sudden rise taken as an indication for an examination of the joint, to make sure that the route of exit for the matter is quite free.

The incision of a large joint is doubtless a very serious proceeding, but the detention of matter within the cavity of a joint is still more dangerous; and, if the precautions indicated above are observed, the operation is often followed by an immediate improvement in the general condition of the patient, and may even lead, in young subjects, to complete recovery of the functions of the joint; in the adult, however, ankylosis is the more common result.

Should the evacuation of matter not be followed by a satisfactory improvement, the question of amputation will have to be considered. The decision must be based upon a consideration of the reparative power of the patient, the severity of the constitutional irritation, and the probable usefulness of the limb if preserved. Age, habits, diathesis, and environment must all be taken into account, and of course each case must be decided on its own merits; but in general terms it may be said that amputation is called for when, in spite of free drainage of the joint, the suppuration does not diminish, and the patient is losing ground, and becoming worn out by pain and fever. When under such circumstances the source of irritation is removed by amputation, health is often recovered with surprising rapidity.

During the period of suppuration, the environment of the patient should be carefully looked to, for the progress of the case will be greatly influenced by hygienic precautions. A well-ventilated room, nourishing and easily-digested food, scrupulous cleanliness, protection of points of pressure against the formation of bedsores, the administration of suitable tonics (of which quinine is especially to be commended) and stimulants (which often act most usefully in promoting sleep as well as supporting the strength)—these, and the care of an efficient nurse, are the aids to recovery which are to be especially desired.

Sub-acute Synovitis is a distinction which it is convenient to maintain, both from the acute form which has been described above, and from that variety which is from its commencement characterised by indolence and chronicity. Every gradation is, in practice, met with between the most acute and the most chronic form of joint-inflammation; but there is a large number of cases in which the causes at work are the same as those which give rise to the acute disease, but which, operating less actively, produce effects similar in kind but less in degree.

This is the subacute group, which in no way resembles, either in its causation or in its local and constitutional concomitants, the chronic form to be subsequently described, but which has everything in common with the acute form excepting its virulence. An example of subacute synovitis would be that caused by a sprain in a healthy person. The injury is followed by a rapid effusion into the joint of nearly clear synovia, giving rise to a corresponding amount of swelling, tension, heat, and pain. Movement of the joint is restricted and painful. There is slight constitutional disturbance, the temperature reaching, perhaps, 100°. If the part be kept at rest, the symptoms soon subside. There is but little tendency to suppuration, the health is unaffected, and in a few weeks the joint is restored to partial or complete activity.

The *treatment* of this class of cases must be regulated in accordance with the degree of activity to which the inflammatory process attains. At their commencement, severe or increasing pain may usually be taken as an indication for leeching; but the majority of the subacute inflammations of joints are to be arrested by the application of cold and pressure, and the maintenance of rest. After the subsidence of the early symptoms, there very commonly remains more or less excess of synovial fluid in the joint, and for this repeated blisters should be used, followed by elastic pressure or the application of strapping.

It is often necessary to maintain some form of pressure upon the joint for several months, in consequence of the tendency to re-accumulation of fluid within the joint which these cases exhibit. Should this passive form of effusion recur without fresh inflammatory symptoms, the application of what is usually known as a 'Scott's dressing' will be found very useful. This is a combination of pressure with mercurial inunction. The joint is to be enveloped in strips of lint, on which is spread the camphorated mercurial ointment; over this several layers of firm adhesive plaster are to be strapped, so as to make even pressure on all parts of the joint, to restrict its movement and to give support; outside all a gummed bandage is to be placed. It is to be borne in mind that an essential part of this method is the use of even pressure, so that the joint must be re-strapped every few days, or as often as the plaster becomes loose. In some instances, this passive effusion is persistent in spite of such treatment, or recurs immediately that the joint is released from pressure. This condition, found chiefly in the knee, is called *hydrops articuli*. For this the removal of the fluid by aspiration, followed by the use of a Scott's bandage, should first be tried. If this fails, the joint is to be injected with a mild aseptic stimulant. A 1 per cent. solution of carbolic acid in water may be injected by a fine syringe into the previously emptied joint; the solution, having been brought into contact with every part of the synovial cavity, is then withdrawn, and finally the joint is covered with a layer of cotton wool half an inch thick, which is bandaged over it so as to maintain moderate pressure and yet allow of some swelling. *See* Hydrarthrosis.

The result of the injection will probably be some slight inflammation and swelling, which on its subsidence leaves the synovial membrane in a condition less prone to excessive secretion. The joint must be kept at rest during this treatment, and, should any acute symptoms arise from the injection, they must at once be combated by the use of cold or other antiphlogistic measures. Should the mild solution recommended not suffice, a stronger must be used, or a mixture of tincture of iodine and water (1 in 10) may be substituted.

Many cases of subacute synovitis are kept up by the presence of adhesions within the affected joint. This cause may be suspected when a joint, which has previously been more acutely inflamed, is liable to frequently recurring attacks of pain and swelling, provoked by any unusual exercise or freedom of movement. On examining such a joint, pain will be evoked whenever the limb is moved in some particular direction, in which also movement will be found to be unnaturally restricted; very often a painful spot can be exactly indicated by the patient. In these cases the synovitis is kept up by the stretching of the adhesion, and may be promptly brought to an end by the forcible rupture of the adhesion, which must be done by a sudden and unexpected movement, so that the muscular resistance is evaded by surprise; or else while the patient is under the influence of an anæsthetic. *See* Bone-Setting.

Chronic Synovitis is the most common of joint-affections, and will often be found to be associated with some morbid diathesis, such as scrofula or rheumatism. Yet there are many cases—especially in children—in which the joint-affection is the only sign of disease, and which are, without doubt, of local origin. These are mostly due either to neglect of the original injury, so that the joint is not given a fair chance

of recovery—a condition often met with among the children of the poor owing to their domestic difficulties; or they arise from repeated injuries to a damaged joint—a not uncommon occurrence, because a joint once weakened by inflammation is all the more prone to subsequent accidents.

But the very persistence or chronicity of a synovitis, unless it be thus accounted for, should lead us to suspect some constitutional error, the discovery of which may be essential to the effectual treatment of the disease. Chronic inflammation of the synovial membrane may be the result of the subsidence of the acuter forms, in which the membrane, instead of recovering its normal condition, remains somewhat swollen and vascular, and secretes an excess of synovial fluid; or the process may be, from the commencement, of a slow and indolent kind. The joint is observed to be swollen, partly from fluid in its cavity, and partly from thickening of the synovial membrane; it is slightly hotter than the corresponding joint of the opposite side, and is moved a little less freely. There is tenderness, often of limited area, and confined to one or two spots. Pain is trifling, and perhaps only elicited upon extreme flexion or extension. If the affected joint be of the lower extremity, there is more or less lameness, chiefly owing to the involuntary restriction of the natural movements.

As the disease progresses, the synovial membrane becomes gradually more thickened and pulpy, the bony outlines of the joint are concealed by a general elastic swelling, giving to the touch a deceptive sense of fluctuation; the ligaments soften, the bone-surfaces become displaced, and the functions of the joint are slowly but surely lost; at the same time the related muscles undergo proportionate wasting. If the interior of such a joint is examined, it will be found that the synovial membrane presents morbid changes of much greater extent and degree than the other joint-structures. The ligaments may be softened and stretched, and the cartilages eroded here and there, but the bones remain unaltered. The delicate synovial membrane of health is replaced by a thick, semi-opaque, gelatinous mass, which is adherent to the cartilages, and bulges into all the less resistant parts of the joint.

In some few instances, the thickened membrane develops a fringe of pendulous growths, which project into the cavity of the joint; these may become elongated sufficiently to allow of their free movement within the joint, or may become entirely detached, and so give rise to the symptoms of Loose Cartilage. But more usually the growth affects uniformly the whole of the synovial membrane; it may attain the thickness of a quarter or half an inch; it is of yellowish-brown colour, intersected with white streaks and a few small blood-vessels; its consistency varies from that of friable granulation-tissue easily breaking down under the finger, to a toughness almost approaching that of fibro-cartilage. Microscopic sections of this material show it to consist of a delicate fibrillated stroma, containing in its meshes free nuclei and nucleated cells of varying size and shape, but mostly of somewhat oval outline.

This stage of the disease may last a long time—months, or even years—giving rise to but little pain, and causing but slight inconvenience beyond the weakness and diminished mobility of the affected joint; but nevertheless, when the synovial membrane has once undergone pronounced gelatiniform degeneration, the condition is one which does not admit of the restoration of the integrity of the joint. Usually, indeed, the disease is slowly progressive. In advanced cases, numerous points of fatty degeneration and of suppuration may be seen in the thickened synovial tissue, and sometimes its entire free surface is covered with a distinct layer of pus-secreting granulation-tissue.

When suppuration occurs within the substance of the pulpy membrane, matter may make its way either to the surface or into the interior of the joint. If it come to the surface, a localised swelling forms over some part of the joint; if this be not opened the skin slowly ulcerates, ill-formed flocculent pus escapes, and an indolent sinus remains. If, on the other hand, the progress of the matter is into the interior of the joint, a chronic suppuration of the joint ensues, which gradually leads to its complete disintegration. But suppuration of a joint, thus altered by previous chronic inflammation, differs entirely, both in its gravity and its symptoms, from the acute form which has been described above. There is usually some little increase of pain and swelling, and the temperature rises at night; but in many cases the symptoms are but little aggravated, and the destruction of the joint is indicated more by the increasing displacement and ligamentous softening than by any marked constitutional disturbance.

The *treatment* of the earlier stages of chronic synovitis resolves itself chiefly into

securing the immobility of the joint, and the use of some form of counter-irritation. At the same time the constitutional condition of the patient should be carefully regarded, any morbid tendencies as far as possible counteracted, and the reparative powers assisted and maintained. As the joint must be kept at rest for a considerable period, it is important to arrange this without confining the patient to the house. In the upper extremity this is easy; but when the joints of the lower limb are affected, some ingenuity is necessary to allow of locomotion without harmful joint-movement. In the majority of cases, it will be found that a well-moulded leather splint is by far the most comfortable apparatus for maintaining immobility. A cast of the limb should be taken, and the leather moulded thereon. The splint should extend sufficiently far, above and below the affected joint, to keep the muscles which act upon the joint in complete rest; it should be made to lace, so that it can be easily removed and reapplied; and great care should be taken to avoid undue pressure upon all bony prominences. Plaster of Paris, paraffin, and similar kinds of splints have the great disadvantage that they do not allow of the inspection and cleansing of the skin, so easily permitted by the laced leather splint. Most of the felt and other plastic materials invented for the purpose have the defect of becoming softened by the heat of the body, and thus soon losing their efficiency. Gutta-percha is worse than useless.

In the upper limb, in addition to the splint, the arm should be carried in a sling.

In the lower limb, the affected joint being fixed by a splint, the patient may move about with the aid of crutches, the boot of the sound limb being sufficiently raised, by adding to the sole, to keep the diseased limb off the ground; or, if the tarsus be affected, the weight may be borne upon a knee-rest with a wooden leg. A Thomas's splint—i.e. a metal band moulded to the back of the limb, with cross-grips to keep it in position—is also very useful for the hip or knee.

If the synovial thickening be only slight, great benefit will be obtained by the light application over the joint of the actual cautery, repeated at intervals of about a week; or by the use of small and frequently repeated blisters, after which the joint should be strapped in camphorated mercurial ointment. Sulphur ointment, rubbed into the joint and applied beneath a flannel bandage, is also useful; and as recovery is approached, friction, the warm douche, and passive movement may be added with advantage. If, however, the synovial disease has advanced to the stage of pulpy degeneration, a cure must not be expected. The intractable nature of this form of joint-disease has long been recognised, and the accuracy of Sir Benjamin Brodie's statement that in its advanced stage it does not admit of cure, still remains undisputed. It is true that a long perseverance in treatment of the kind indicated above—i.e. rest and counter-irritation—may succeed in reducing the joint to a condition which is tolerable to a person in good circumstances. A splint being worn, and the limb but gently used, the joint may remain in a lamed but painless and quiescent condition for many years. But to those for whom an active or laborious life is a necessity, or whose means do not allow of a long period of idleness, some more radical treatment is needful. In the upper extremity, and especially when the elbow is the joint affected, excision offers a very satisfactory prospect; and indeed the condition is one to which this operation is particularly applicable. In the lower extremity we have a choice of several methods of treatment.

In children and young persons an attempt may be made to dissolve away the morbid synovial growth. For this purpose, a solution of sulphuric acid (one part of acid to two parts of water) has been freely applied to the interior of the joint by means of strips of lint soaked in the solution and introduced through free incisions. More or less ankylosis usually results, but in some instances very useful movement has remained. Iodoform has also been injected into the thickened membrane, and in some cases with decided benefit; its action appears, however, to be somewhat uncertain. Another plan is to open the joint and scrape away, with a Volkmann's spoon, as much as possible of the diseased membrane and granulation-tissue.

If there is much displacement of the bones, and the health and age of the patient are such as to warrant the expectation of sufficient reparative power, excision will be the appropriate treatment. In these cases of synovial disease it suffices to remove a very thin slice of bone, the aim being the removal of the pulpy synovial tissue, and just so much of the articular surfaces of the bones as to enable ankylosis to take place in a favourable position of the limb. When abscess has occurred, and the joint has suppurated, the same treatment will be necessary. In the upper classes to

whom time and expense is of less consequence, the evacuation of matter, the cleansing of the cavity of the abscess or of the suppurating joint with antiseptic dressings, and careful support of the reparative powers, will in most cases lead at last to the desired ankylosis; so that excision or amputation are but rarely called for. But amongst the poor, who cannot afford either the time or the other aids needful to this end, it is best to rid them of their disease at once by excision or amputation. Amputation is indeed sometimes urgently necessary on account of the drain upon the health caused by the suppurating joint; and it must be remembered that excision is much the more severe operation of the two, and requires for its successful issue a much greater amount of endurance and reparative power.

Diseases of the Articular Cartilage. It has been frequently asserted that there is no such thing as primary disease of the articular cartilage, and it is certainly true that disease of this structure is generally secondary to affections of the joint-ends of the bones or of the synovial membrane. Yet there is good reason to think that the changes associated with the disease known as 'chronic rheumatoid arthritis,' or 'osteo-arthritis,' have their origin in a low form of inflammation or degeneration of the articular cartilage. *See* Osteo-Arthritis. There are, moreover, certain cases to be met with, wherein the ulceration of the cartilage occurs at an early stage of the joint affection, and in which the symptoms depending upon this ulceration and the consequent exposure and inflammation of the articular lamella of the bone are notably predominant.

Such cases are characterised by the early occurrence of extremely painful startings of the limb, and by the slight degree of accompanying swelling and constitutional disturbance. In this form of joint-disease the limb is very soon disabled for use, because of the extreme painfulness of any movement of the joint surfaces; and a distressing feature of such cases is the disturbance of rest by the muscular spasm, which is apt to occur just at the commencement of sleep, and which brings into acutely painful contact the sensitive bone-surfaces where exposed by the removal of the cartilage. This is especially the case in disease of the hip-joint, and gives rise to the characteristic 'night scream' of children thus affected. This symptom depends, not upon the mere inflammation of the cartilage (which there is good reason to believe is not a particularly painful process), but upon the inflammation and exposure of the articular lamella of the bone; and the occurrence of this symptom, during the progress of any case of joint-disease, may be taken as highly significant of the destructive process having reached the stage of ulceration of the cartilage and exposure of the bone.

Articular cartilage, which is undergoing inflammation and ulceration, exhibits to the naked eye changes both of colour and texture. Instead of the pearly blue colour and perfect smoothness of health, there will be seen patches and lines of a yellow tint. The surface is sometimes roughened and fibrous, sometimes marked with little pits, giving it a worm-eaten appearance. In some parts the cartilage is seen to be eroded, thinned, softened, or entirely removed; it is easily separable from the bone, or may have become detached in pieces of considerable size. Microscopic examination shows the process to consist of an increase in the size and number of the nuclei of the cartilage-cells, and absorption of the hyaline intercellular material. This leads to rupture of the cell-wall and escape of the nuclei which have undergone granular degeneration, and thus to loss of substance or ulceration. In more chronic cases, the cartilage is found to have undergone fibrillation rather than ulceration: or its destruction may be due to encroachment upon its attached surface by granulations springing from the bone beneath. If the disease is arrested before any considerable destruction of the cartilage has occurred, the surface may heal by the formation of fibrous tissue, which may merely fill up the gap, or may form an adhesion to a corresponding spot upon the opposite surface of the joint. If the cartilage be extensively removed, either the joint will be destroyed by suppuration or, the destructive process coming to an end, there will be an effort at repair, and the opposed bone-surfaces will become firmly adherent by fibrous or osseous ankylosis.

In the *treatment* of this variety of joint-disease, counter-irritation, especially by the actual cautery, will be found of great efficacy. Rest, by extension or suitable splints, is also of course essential, and may be much aided by the internal administration of opium, or the subcutaneous injection of morphia. Tenotomy of muscles, the contraction of which is producing inter-articular pressure, is also sometimes useful.

Disease of the Articular End of a Bone.—A great number of cases of joint-disease have their origin in inflammation

of the adjacent bone. This may be acute or chronic.

In acute periostitis and osteo-myelitis, the inflammation may spread to the joint-end of the bone and thence to the joint, terminating often in acute suppuration. But, if the disease begin in the shaft of the bone, it is often limited by the epiphysial cartilage, and thus, though the joint may be somewhat disturbed by the contiguity of the inflammation and show signs of effusion within its cavity, it may yet escape the destructive suppuration which has attacked the adjacent bone.

Acute inflammation may, however, commence in the epiphysis, and when this occurs the joint is almost certain to become involved. This is a disease chiefly of early infancy; it has been described by Mr. Thomas Smith as 'acute arthritis of infants,' and of 22 cases related by him, 8 occurred in infants under a month old, 4 in infants under two months, 7 between the ages of two months and six months, and 3 in children between six months and one year old. The disease is an acute one, and runs a rapid course, usually to destruction of the joint and death, often by pyæmia, but sometimes to recovery, with a shortened limb and weakened joint.

The first *symptom* is usually impaired movement: the child keeps the limb fixed in a position of partial flexion, and gives evidence of pain on any attempt at movement of the joint. The pain rapidly increases, the joint becomes hot and swollen, and the child is very ill; suppuration rapidly ensues, and the abscess bursting or being opened, either death soon follows, or the discharge quickly diminishes, healing takes place, and the child is left with a more or less crippled but often very useful limb. Ankylosis rarely results in this form of joint-disease.

The suppuration occurs, in many of these cases, in the centre of the epiphysis, the matter making its way into the joint by a small sinus; or it may begin just beneath the articular lamella; or the joint-surface of the epiphysis may be first attacked, and destruction and separation of the whole or part of the epiphysis rapidly ensue. Several joints may be simultaneously or consecutively affected, but this is not incompatible with recovery. *See* Epiphyses, Affections of.

The *treatment* of this disease consists of early evacuation of matter, careful feeding and support of the child's reparative powers, and the maintenance of rest in the joint. This last is often best attained, in these young infants, by surrounding the limb with a soft pillow or junk, rather than by the application of the ordinary splints.

Chronic Articular Ostitis is a much more common affection than the acute form described above. Although frequently met with in children, it prevails at a somewhat later age than the acute disease. The result of chronic inflammation of the cancellous tissue of the expanded joint-end of a bone is, very often, the formation of a circumscribed central slough. A limited portion of the cancellous tissue in the centre of the bone dies, suppuration occurs around it, and the result is a circumscribed abscess, in the centre of which is either a defined fragment of necrosed bone, or a small round mass of softened carious bone, separated by a perfectly-defined line from the surrounding healthy tissue, from which it can be easily turned out. Usually the matter at last makes its way into the neighbouring joint, but occasionally the inflammatory products undergo caseous degeneration and remain enclosed in the surrounding bone, as circumscribed yellow masses, which have been sometimes described as 'crude tubercle.' In other cases, however, the process leads to ulceration of the bone, either upon the surface of, or just beneath the articular lamella, and thus to the earlier implication of the joint.

The *symptoms* of chronic articular ostitis are, as a rule, very slowly and gradually developed. A dull aching, in one of the bone-ends entering into the formation of a joint, may persist for many weeks or months before any other signs are manifest. Then comes slight restriction of joint-movement, and some tenderness on pressure. Later still a little swelling may be detected, and this is chiefly a thickening of the periosteum and other structures immediately over the bone, so that the natural outlines and prominences are less easily felt and seen than on the corresponding healthy bone of the opposite limb. The swelling is but slight, and is often irregular—that is to say, more marked on one side of the bone, or there may be a circumscribed and painful swelling at one spot.

A careful examination will often detect some small area, over which deep firm pressure will always produce pain. At last there usually appear signs of implication of the joint; swelling, due to fluid effusion into the synovial cavity; starting pain and muscular spasm; peri-articular œdema and increased local heat. At the same time the temperature of the body rises, and there are other signs of constitutional disturbance, such as rigors, loss of appetite, and impaired

sleep. The earlier the joint-implication the more severe are its symptoms. When the disease has been of long duration before it penetrates to the joint, its progress is usually accompanied by chronic synovial thickening, and in such cases the commencement of suppuration of the joint is not necessarily manifested by any very marked increase of the symptoms. Matter may slowly make its way along the epiphysial junction to the surface, or burrow along the tendons and intermuscular planes, and point at a considerable distance from the joint. Sinuses are thus formed, which have the prominent granulations at their orifices significant of their leading to diseased bone.

Treatment.—It has been the fashion to speak of this type of joint-disease as 'scrofulous,' and there can be no doubt that many cases occurring in children are associated with other marks of the scrofulous diathesis. But certainly the majority have no such connection, and are met with in persons otherwise quite healthy; a large number of these may be traced to a traumatic origin. No reminiscences, therefore, of the name 'scrofulous' should deter the surgeon from adopting antiphlogistic treatment at the commencement of the disease.

Deep-seated pain in a joint-end, such as is significant of commencing articular ostitis, is often immediately and permanently relieved by the application of a few leeches, or of the actual cautery; and there is no reason to doubt that the disease has often been thus arrested at its outset. The joint must be kept at rest by means of splints; and a gentle course of biniodide of mercury is certainly frequently beneficial. Later on, if pain is persistent in one spot, and especially if there be deep-seated tenderness, an attempt should be made to reach the inflamed area by incision of the bone. Even if suppuration may not have occurred, this measure will probably be followed by relief. If the painful spot is accessible without interference with the joint, it should be cut down upon and its surface carefully examined for any evidence of disease. Sometimes the opening of a minute sinus may be found leading into the suppurating cavity, or the periosteum may be raised by a little inflammatory effusion, or the bone surface may be altered in colour; any such indications as these should, of course, be followed with regard to the direction in which the bone should be perforated; should no change be discoverable on the surface, the locality of the pain must be taken as the guide.

If the reflexions of the synovial membrane have such a relation to the seat of pain, as to prevent the possibility of cutting down directly upon it without opening the joint, the inflamed part must be reached indirectly by perforating the bone at the nearest accessible spot outside the limits of the joint. If the bone is hard, it is best opened with a small trephine; if soft, a gouge or a narrow chisel may be conveniently used; for exploratory purposes a carpenter's bradawl will be found a useful instrument. If a spot of central caries or necrosis is found, the diseased or dead bone should be removed, as well as the granulation-tissue which surrounds it. If an abscess be opened, its wall should be scraped, and the cavity and any sinus leading to it should be sponged out with a solution of chloride of zinc (40 grains to the ounce). If the necrosis be of the joint-surface, it is still sometimes possible to remove the sequestrum and leave a comparatively useful joint. If the synovial membrane have undergone much thickening, and there is extensive caries of the articular lamella, excision or the treatment by sulphuric acid, described above, will probably be indicated, if the patient be still in childhood or youth. In those past this period of life amputation will generally be the safer treatment.

When the bones of the carpus or tarsus are the seat of destructive inflammation, and the disease is limited to one or two bones, excision of the affected bone or bones is often attended with excellent results. This is especially the case in the foot, wherein the disease is very often confined to the calcaneum or astragalus.

Diseases of the Ligaments. — The ligaments are seldom the seat of primary disease, and, from their resistant qualities and somewhat passive function, are usually amongst the last of the joint-structures to yield to the destructive influence of surrounding inflammation.

When, in consequence of an acute synovial distension, the ligaments are considerably stretched, their nutrition is so far interfered with that they undergo an amount of softening which leaves the joint weak and loose, long after the fluid has been absorbed. So also after sprains, the ligaments which have been stretched or torn are softened by the resulting inflammation. In such conditions it is wise, therefore, to support the joint by accurately moulded splints, by strapping, or by bandages. A well-made and softly padded leather splint is the most efficient support, and this

should be removed daily for the application of a cold douche to the joint.

In chronic joint-diseases, when the interior of the joint is filled with granulation-tissue, this material surrounds and invades the ligaments, creeping in between and separating their fibres, and leading to their softening, degeneration, and eventual destruction. The result of this is that the bones become displaced in whatever direction the action of the muscles is predominant. This tendency to displacement must therefore be anticipated and provided against, in all cases of long-continued joint-disease, by the use of proper splints.

In rickets and other forms of debility the ligaments share in the weakness of the locomotive apparatus, which manifests itself in the occurrence of flat-foot, splayed-foot, knock-knee, lateral curvature of the spine, and other such distortions. The muscles failing in their weakness to hold the joints in position with firmness, undue stress is thrown upon the ligaments, the stretching of which gives rise to the aching pain which so commonly accompanies these affections, and which is sometimes mistaken for rheumatism.

Pyæmic Joint-disease.—The affection of the joints most often met with in acute pyæmia is a rapidly progressive suppurative synovitis. The process is one of extreme acuteness and virulence; in no other form of joint-inflammation are the tissues involved so quickly destroyed. The joint may be found full of pus, and the cartilages extensively ulcerated, within forty-eight hours of the first sign of inflammation. The earliest symptom is usually swelling, which rapidly increases, and is soon followed by pain and heat. At this stage the synovial membrane is swollen and vascular, and the joint is filled with slightly turbid fluid. Soon the tissues around become œdematous, suppuration occurs, the cartilages ulcerate, and the joint is quickly disorganised.

Early aspiration should therefore be made; and, if the fluid be purulent, an incision must be made into the joint in such a position as will best ensure free drainage, the synovial cavity washed out with a mild antiseptic solution (e.g. carbolic acid in water, 1 to 80), and a drainage-tube left in the wound. It is of great importance to give exit to the matter at the earliest possible moment. As ankylosis is to be anticipated, every precaution must be taken to maintain the joint in the most useful position.

Besides this acute disease, there is also met with in association with the less virulent type of pyæmia, a more chronic and much less grave affection of the joint. This is characterised by a painful swelling of the joint, which rapidly attains its maximum, and which is attended with but little of the heat and tension that accompany the acute form. There is a milder degree of constitutional disturbance, and much less tendency to suppuration. In these cases several joints are often affected, the effusion subsiding in one as it appears in another, and gradually becoming of a less active character. Every degree is met with between the mildest form, in which there is an almost passive synovial effusion lasting only for a few days, and the severe and acute type above described. Among the diseases giving rise to the more chronic form of septic synovitis may be mentioned scarlatina, typhoid fever, gonorrhœa, and vaginitis. In these the effusion is generally not purulent, though often resulting in stiffness and adhesions, both intra- and extra-articular. Nevertheless, sometimes these same diseases give rise to the acutest form of the malady.

The local *treatment* will be the same as for ordinary synovitis, with the addition of whatever measures are needful to get rid of the source of the infection. Of medicines, quinine and sulphite of soda are the most useful; and, as in other septic diseases, a supporting plan of treatment is indicated.

Rheumatic Synovitis may be acute or chronic. In the acute form it accompanies the characteristic fever, sweating, and other symptoms of rheumatism; it attacks chiefly the larger joints, and subsides with the diminution of the pyrexia. Not infrequently, however, in spite of the subsidence of the general disease, effusion and pain persist in one joint, and at this stage the case often comes under the treatment of the surgeon. Moreover, persons of rheumatic diathesis are liable to recurring synovitis of a subacute or chronic type, which has an obvious relation to their constitutional condition. These cases do not tend to suppuration, but very commonly lead to adhesions. In the acute form, rest, even pressure by cotton wool applied beneath an elastic bandage, or warm alkaline and opiate fomentations, are the appropriate local applications; in the chronic form, blisters, stimulant liniments, warm douches, and frictions.

The rheumatic tendency must also of course be treated (as by salicylates, alkalies, opium, and appropriate diet). In the later and chronic stage, 'rheumatic joints' are much benefited by Turkish baths, shampooing, and a residence in a dry, warm climate. *See* Gonorrhœal Rheumatism.

Chronic Rheumatic Arthritis, *see* under that heading and also Osteo-arthritis.

Gouty Arthritis is an acute form of joint-inflammation characterised by extreme pain, rapid swelling both in and around the joint, œdema and redness of the skin, local heat, and a variable amount of pyrexia. It affects the smaller joints, especially the metatarso-phalangeal joint of the great toe, giving rise to deposits of urate of soda in the cartilages, ligaments, and adjoining structures. It occurs in persons of the uric acid diathesis, comes on usually after middle life, and is often inherited. Although gout is considered a medical rather than a surgical disease, and comes under the treatment of the physician, the surgeon will observe that many traumatic and other joint-affections, when they occur in persons of gouty habit, are considerably modified thereby; especially in the direction of chronicity and the deposit of urate of soda, with corresponding deformity and stiffness. The recovery of such cases will be aided by attention to the condition of the urine, and the judicious use of alkalies, colchicum, abstinence, and other remedies appropriate to the gouty state.

Syphilitic Disease of Joints.—A not uncommon concomitant of the earlier secondary symptoms of syphilis is a transient synovial swelling, attended with aching pain and some heat in the part. The joint should be kept at rest while the swelling persists; under appropriate anti-syphilitic treatment recovery is usually complete.

A much more troublesome affection of the joints is that which occurs in the late stages of syphilis, and which consists in a gummatous infiltration of the synovial membrane or other joint-structures. This form of disease is of an indolent and persistent character. There is dull aching pain, often increasing at night, and there is irregular pulpy swelling, sometimes of the synovial membrane, sometimes of the soft tissues outside the joint, sometimes of the periosteum at the lower end of the bone. These growths may develop into fibrous thickenings and adhesions, or they may break down and ulcerate on to the surface or into the joint.

For *treatment*, the joint should be fixed by a splint, and full doses of iodide of potassium given, combined with tonics. The success of the treatment will depend much on the state of the patient's health; the condition is often met with in debilitated persons who will require the aid of good food, fresh air, and cod-liver oil. When the health has improved, much benefit is to be obtained from a mild course of mercury, especially the biniodide. Locally, the joint should be kept warm, but not otherwise stimulated.

A similar affection is sometimes met with in children about the age of puberty, who are the subjects of inherited syphilis. Infants suffering from inherited syphilis are liable to an epiphysial disease, which consists in an inflammation of the ossifying layer, giving rise to a separation of this layer, with the epiphysis, from the shaft of the bone. Several bones are usually attacked. *See* Epiphyses, Affections of.

The *symptoms* are a pseudo-paralysis of the affected limbs, and swellings at the position corresponding with the epiphysial line of some of the bones, most often the femur or humerus: later on, the epiphysis is felt loosened from the shaft, and there is probably fluid swelling around the end of the bone. There is an absence of any acute pain or marked pyrexia. The history, and usually some other symptoms, will be found to indicate the inheritance of syphilis.

If not very advanced the disease yields rapidly to mercurial treatment.

Scrofulous Joint-disease.—Scrofulous children are in a more than ordinary degree liable to chronic affections of the bones and joints. These affections have often a traumatic origin, but, occurring in scrofulous subjects, they exhibit a pertinacity and a tendency to degenerative changes less often met with in the healthy. But it must be remembered that there are other causes besides scrofula for the persistence of joint-diseases in children; as for example, lack of care, repeated injuries, and the physiological activity of the part; so that it is both inaccurate and confusing to apply the epithet 'scrofulous' to chronic joint-diseases unless they occur in connection with other signs of the scrofulous constitution. If, however, an indolent joint-inflammation is met with in combination with other symptoms of scrofula (e.g. glandular enlargements, chronic pulmonary, nasal, or intestinal catarrh, ophthalmia, persistent dermatitis), it is reasonable to assume that the joint-disease is of scrofulous origin. The most common forms of scrofulous joint-disease are chronic articular ostitis and pulpy degeneration of the synovial membrane (described above).

Either of these conditions occurring in a scrofulous subject is characterised by the extreme slowness and indolence of the process, and by the tendency of the inflam-

matory products to undergo retrogressive rather than developmental changes. Thus, in the bones the inflammatory cell-growth goes on very slowly, and is apt to lead to caseation and softening. So also the thickened synovial membrane shows much more tendency to fatty degeneration and suppuration than to fibrillation and cicatrization. Another marked peculiarity of scrofulous inflammations is the slightness of the pain and the small amount of pyrexia which accompany them. So that these scrofulous joint-diseases go slowly on for months and years; indolently, and often almost painlessly, progressing from slight and sometimes imperceptible beginnings, through gradually increasing swelling and softening of synovial membrane or joint-end of the bone, to ulceration of cartilages and yielding ligaments, displacement of the bones, and degradation of inflammatory products into ill-formed pus, and thus at last to destruction or permanent crippling of the joint. Yet if the child's health can be tended and improved, and if unlimited time can be given, many of these diseases at last come to an end. For scrofula is a disease of early life; it tends to wear itself out, and under improved hygienic conditions and appropriate remedies to disappear as the child gets older, though of course its effects may remain through life. Hunter said truly, 'Puberty often produces a cure.'

In the *treatment* of scrofulous joint-disease, therefore, the environment of the patient is of the greatest consequence, and every possible aid should be given towards improving the condition of nutrition and health. Long residence at elevated situations in bracing mountain air, or at the sea-side, is especially to be desired; and, when this cannot be obtained, as much as possible of sunlight and fresh air. Plenty of nourishing food, especially fatty foods, warm clothing, careful attention to the state of the digestive organs, early hours—all these are material aids in the treatment; of medicines, cod-liver oil and iodine are of the greatest value.

The local treatment must be in great measure determined by the general condition. As long as the health is improving, it is worth while to practise much perseverance in the management of the joint. A splint must be applied to maintain rest, and in the early stages counter-irritation by light touches of the actual cautery is of great use. If the synovial membrane is the seat of the disease, counter-irritation is to be followed by strapping over mercurial ointment, or some of the other measures described above (*see* above—section on *Chronic Synovitis*). If the bone is affected, regard must be had to any signs of central suppuration, calling for perforation or removal of sequestra. Even excision may often be permissible and successful after the health has been improved. But, if the general state of the patient is becoming deteriorated by the irritation of the local disease, amputation will probably be the wiser measure, for removal of the diseased limb is frequently followed by rapid recovery of the health.

Tabetic Arthropathy.—M. Charcot has called attention to a form of joint-disease occurring in connection with locomotor ataxy, which he considers to be peculiar to that disease. The first symptom is usually a sudden effusion of fluid within the joint, without pain or fever. This may gradually become absorbed, but after a time recurs, and is followed by rapidly progressive degenerative changes in the cartilages and bones, which give rise to great alterations of shape, to crepitation, and to displacement of the joint-surfaces. An examination of such joints shows the bone-tissue to be rarified, the Haversian canals widened, and the fatty elements largely increased; the joint-surfaces greatly worn away, and the ligaments softened and stretched. The knee is most often affected, but similar changes have been found in the hip, shoulder, wrist, and tarsus. It will be observed that this affection closely resembles chronic rheumatoid arthritis, from which the chief anatomical distinction is said to be that there is less formation of new bone and greater destruction of the articular sufaces. It is indeed, by some observers considered to be osteo-arthritis, modified by its occurrence in an ataxic subject. But the clinical history seems to justify the separation of these cases into a separate class; the sudden and painless onset, the rapid destruction of the joint-surfaces, and the comparatively slight interference with movement, contrasting notably with the aching pain, the chronicity and the immobility of ordinary rheumatoid arthritis. *See* Charcot's Disease.

Hysterical Joint-affections: *Neuromimesis.*—The nervous mimicry of joint-disease is amongst the most common manifestations of the neurotic or hysterical diathesis. Such cases often resemble very accurately the true disease, especially in the position assumed by the limb, in the rigidity of the adjacent muscles, and in the character of the pain. But it will be observed that there is usually some inconsistency in the

symptoms. Thus, it may be noticed that the pain is out of all proportion to the other evidences of disease; that there is no heat or swelling about the joint even after weeks of acute suffering, neither is there the muscular wasting which would have occurred in bone-disease; that inter-articular pressure does not give pain, while any attempt at movement is at once complained of; or the symptoms may vary in a manner incompatible with organic disease. The aspect and family history of the patient, and an account of the manner in which the affection commenced and progressed, will usually help the diagnosis. Sir J. Paget has pointed out the close alliance of this condition with insanity and other disorders of the nervous system; and it will often be found on inquiry that there is an hereditary predisposition to nervous disease, and that the joint-affection has followed closely upon some mental strain or disturbance. In doubtful cases, the administration of ether will often decide the diagnosis; for in the mimic disease the joint can be moved with perfect freedom and smoothness directly the patient is unconscious, and the unnatural posture and rigidity are only resumed when consciousness has been fully recovered, instead of, as in real disease, immediately upon the slightest return of sensation. Neuromimesis is not confined to the female sex, though it is more common therein (the writer has recorded a well-marked case in a boy of eleven years); it prevails mostly in young persons, and among the upper classes.

The *treatment* of this condition must be directed towards the improvement of the tone and stability of the nervous system; for this it is essential that all undue strain and excitement should be avoided. The habits and employment should be regular and of even tenour, plenty of food and rest should be taken, and the patient withdrawn from sympathetic petting and the society of persons of similar temperament. Any functional disturbance, uterine or otherwise, must be attended to; constipation, which is often prevalent and interferes with nutrition, must be overcome by proper medicines and diet; and, if indicated, tonics —iron, zinc, arsenic, valerian, and the like —administered: shower-baths, shampooing, and mild gymnastics may also be found useful aids.

For local treatment the first essential is that all splints and apparatus of restraint be cast aside. The patient must be encouraged to use the joint, and the necessary effort of the will may be sometimes aided by proving the mobility of the joint by a sudden and unexpected movement of it. The administration of an anæsthetic will occasionally produce a cure. It must not be forgotten that persons of this mobile and sensitive condition of the nervous system suffer in an exaggerated degree from any real cause of pain; so that any cause, however slight and apparently inadequate, for their suffering should be sought for and removed. J. Warrington Haward.

JOINTS, Excision of.—The excision of a joint implies the removal of part or the whole of the articular surfaces of the bones concerned, in such a manner that fibrous union or osseous ankylosis may result. This is usually accomplished by means of an incision laying the joint freely open, through which the bones are cleared of soft parts and divided at a level corresponding to the extent of the disease or injury.

Excision may become necessary on account of (*a*) disease, (*b*) injury, or (*c*) ankylosis.

(*a*) The disease most commonly calling for excision of joints is chronic synovitis.

When pulpy degeneration of the synovial membrane has rendered a joint useless, excision is often the best method of treatment. This is especially so if there be ulceration of the cartilages and caries of the articular lamella, and if chronic suppuration has occurred. So also caries or necrosis of the articular surfaces, chronic articular ostitis, and abscess of the articular end of a bone opening into the joint, are conditions in which excision may be successfully resorted to. Excision may occasionally, though rarely, be desirable in cases of chronic rheumatic arthritis.

Cases of acute disease are not suitable for excision; neither is it wise, as a general rule, to resort to the operation in persons past the middle period of life. In considering the question of excision of a joint, it must be remembered that a successful result requires a good deal of reparative power on the part of the patient; that the operation itself, if upon a large joint, is one of some severity; and that, in the lower extremity it involves a more or less prolonged confinement to bed, and for a time complete immobility of the limb. So that for persons past the period of youth, or of broken-down constitution, or who are worn and weakened by prolonged suppuration, or who bear confinement badly, amputation is by far the safer operation. Excision is, moreover, inappropriate in cases compli-

cated with visceral disease, such as tuberculosis, amyloid degeneration, or Bright's disease. Yet the so-called scrofulous constitution does not forbid the operation, partly because the subjects are children, and also because the morbid tendency may to a great extent be counteracted by treatment.

The size and function of the joint concerned must also be taken into account. The larger the joint, and the nearer to the trunk, the more serious is the operation. Then with regard to function: in the knee and ankle, excision leaves the limb in much the same condition as when ankylosis occurs without operation, with the disadvantage of some shortening on the side of excision. So also the natural cure of hip-disease often leads to as useful a limb as is obtained by excision. In the upper extremity, ankylosis of the shoulder is to a great extent compensated for by increased mobility of the scapula; but a stiff elbow-joint is so much less useful than a moveable one, and excision of the joint is so successful that the argument is much more often in favour of excision than of the other alternatives. The extent of the disease is also of much importance in deciding the question. For the complete removal of the diseased parts by excision would, in some cases, involve an amount of shortening which would leave a useless limb; while in other instances, in which the bones could be successfully treated, the soft parts may be so extensively destroyed or undermined by suppuration as to preclude the probability of a satisfactory amount of repair.

Here again, however, it must be borne in mind that in situations where a moveable joint is desired, as in the hip, shoulder, and elbow, much more bone may be removed than if a stiff joint is the result aimed at, as in the knee. It is always desirable, if possible, to avoid dividing the bones beyond the epiphysial junction, both because of the increased danger when the medullary canal is opened, and because of the interference with the subsequent growth of the bone in young persons. The presence of sinuses leading to the diseased bone need not interfere with a successful excision; but these canals, as well as any abscess-cavities in connection with the joint, should be scraped out with a Volkmann's spoon, or freely cleansed with a solution of chloride of zinc.

(*b*) Excision may be required in consequence of severe injury to a joint, such as compound comminuted fracture or gunshot wound. Here again, the decision concerning the operation must be based upon the same general principles as have been enunciated above with regard to excision for disease. The health of the patient, the size and function of the joint, the nature and extent of the injury, must all be carefully considered, as well as the possibility of obtaining the requisite care and nursing during the after-treatment. It will be obvious that the conditions, under which military surgery is usually practised, are not such as to admit of excisions of the joints of the lower extremity being performed with much chance of success. *See* Gunshot Wounds.

(*c*) Excision is also performed in cases of ankylosis, either for the purpose of improving the position of the limb or for obtaining movement by a false joint. In the upper extremity, excision of the elbow may be very properly resorted to in young and healthy subjects, to avoid the inconvenience of a stiff joint. In the knee, it would, of course, only be called for when the ankylosis has occurred in the flexed position. In the hip-joint, such a condition should be treated, not by excision, but by division of the neck or shaft of the femur.

The operation will of course vary with each particular joint, but the general principle is that the sections of the bones should be made at such points as will ensure the removal of the diseased articular surface, with as little interference as possible with the epiphysial junction or the shaft of the bone. The incision through the soft parts should be so arranged as to give free access to the joint; the extent of the disease should then be accurately ascertained, and a corresponding amount of bone removed by an even section. Diseased synovial membrane and granulation-tissue should then be dissected out or scraped away, sinuses cleansed, and the whole wound rendered aseptic; finally, the bones must be placed in an appropriate position, a drainage-tube inserted, and the wound in the soft parts closed by sutures. The dressings should be of antiseptic material, and the splints or other apparatus of restraint be so arranged as to allow of the dressing of the wound, with as little disturbance of the limb as possible. A dressing of dry carbolized wool appears to the writer to have the great advantage in this, as in many other operations, of absorbing discharge, of keeping up gentle elastic pressure on the part, and thus preventing oozing of blood and maintaining the wound in accurate apposition, and of an even temperature.

The subperiosteal method of excision has been advocated by M. Ollier and others, who claim for it the advantage

that there is a more complete reproduction of the excised portions of bone, and that the attachments of the muscles around the joint are less interfered with than by the ordinary operation. The principle of the method is to cut down upon the ends of the bones entering into the joint, making the incision as far as possible parallel to the axis of the bone, then to separate the periosteum with the attached tendons and ligaments by the insertion of appropriate raspatories between it and the bone, and finally to divide the bone, either by turning it out of the wound or by passing round it a chain saw.

The operation is troublesome and tedious, and the separated periosteum does not always survive; if it does, however, there is doubtless usually an abundant production of new bone, more or less resembling in shape that which has been removed. But this is not always an advantage; for instance, in the case of the elbow, the irregular growth of new bone may be an impediment to the free movement of the new joint; and it is doubtful whether, in the majority of cases, any distinct gain results from the adoption of the subperiosteal operation as applied to joints. When, however, any large portion of the shaft of the bone has to be removed as well as its articular surface, it is very desirable to leave as much as possible of the periosteal sheath (which in such cases is often easily separable), so as to provide for the more complete regeneration of the excised bone, and obviate excessive shortening or flail-like union.

The after-treatment of joint-excisions must be directed to the maintenance of the nutrition of the patient and the promotion of the rapid healing of the wound. The larger excisions involve considerable shock, and make large demands upon the reparative powers, so that plenty of nourishing and digestible food should be given from the first. As much fresh air and sunlight as possible should be admitted to the room; and, in the case of the upper extremity, the patient should not be kept in bed longer than is absolutely necessary. The wound must be kept aseptic and at rest, that there may be as little formation of cicatricial tissue as possible. When, as in the knee, ankylosis of the bones is desired, absolute immobility must be maintained during the process of union, and the part supported afterwards by a proper splint. When a false joint is required, as in the hip and elbow, passive movement must be practised as soon as the healing is sufficiently advanced.

Excision of the Ankle.—This operation involves the removal of the articular surface of the tibia and fibula, and of the upper surface of the astragalus. It is practised both for injury and disease.

The cases of *injury* which admit of this operation are not numerous, for usually, if the bones of the ankle-joint are sufficiently comminuted to require resection, the soft parts are also so much damaged as to necessitate amputation. Nevertheless, some gunshot wounds and compound fractures of the ankle are met with, in which the main vessels and nerves have escaped, and in which the stress of the injury has fallen upon the bones; and in such cases, if occurring in young and healthy persons, resection should certainly be attempted.

With regard to *disease*, also, it must be admitted that, although chronic affections of the ankle-joint are sufficiently common, yet that cases to which excision can hopefully be applied are not very often met with. For, the chronic diseases of the synovial membrane and bones, which are so prevalent in this situation, are seldom limited to the ankle-joint proper, but commonly affect the bones and joints of the tarsus also. Yet we do meet with instances in which the disease is of traumatic origin, and occurs in subjects of otherwise good health, and in which the mischief is confined to the limits of the ankle-joint, and has not spread beyond the surfaces of the tibia and astragalus. These are the cases to which the operation of excision is most properly applicable.

The *operation*, as devised by Mr. Hancock, is performed as follows:—Esmarch's bandage having been applied, an incision is made over the outer ankle, commencing three inches above the tip of the malleolus, and running down the posterior border of the fibula as far as its point, and then passing forwards to within half an inch of the base of the fifth metatarsal bone. The flap thus marked out being dissected forwards, the fibula is divided with cutting forceps, and its lower two inches removed, the peronei tendons being left uncut. A similar angular flap is next turned up over the inner ankle, the incision running from three inches above the malleolus along the posterior border of the bone, and as far forwards as the inner cuneiform bone. The knife must be kept close to the bone, so as to avoid the posterior tibial vessels and nerve. The internal lateral ligament is then divided close to the tibia, and the foot twisted outwards so that the astragalus and tibia present at the inner wound. A

narrow-bladed saw is then introduced through the inner wound and projects at the outer, and by this means the lower end of the tibia and the upper surface of the astragalus are sawn off.

The bones are then brought together so that the tibia and astragalus may become ankylosed, a drainage-tube introduced, and the wounds closed by sutures. The limb is then placed on a splint with the foot at a right angle to the leg. If the astragalus be found extensively diseased, the operation may be modified to the extent of removing all the bone instead of only its upper part; and in cases of injury, the amount of bone removed and the line of incision must of course be altered to suit the exigencies of the case. Repair after the operation is often slow, but in successful cases a most useful foot is left.

Excision of the Elbow.—This operation is required in cases of compound comminuted fracture, and in gunshot wounds of the elbow, in chronic disease of the joint, and in certain forms of bony ankylosis. In severe compound fractures, in which the lower end of the humerus is comminuted, the filling up of the fossæ into which the ulna plays is a common cause of impaired movement, so that a more useful limb is usually to be obtained by excision. When ankylosis has occurred in a useless or inconvenient position, or when it is desired to regain the movements of a fixed joint, excision may be undertaken with every prospect of success. Excision of the elbow is most often required, however, for chronic suppuration of the joint with ulceration of the articular surfaces of the bones, the result of degenerative synovitis, or articular ostitis.

Operation.—The joint is to be opened on its posterior aspect, either by a single longitudinal incision, or by a combination of this with a transverse incision made at right angles from its centre.

In cases in which there is very great peri-articular thickening, it may be convenient to adopt the method practised by Mr. Syme of making a longitudinal incision on each side of the back of the joint, joined by another across the upper border of the olecranon. In the majority of cases the single incision is sufficient. It should be made parallel to the outer border of the ulna, directly down to the bones, and be of sufficient length to allow of the soft parts being dissected off, and the bones protruded as far as their removal is intended. The joint should be opened just above the olecranon, and the condyles of the humerus carefully cleared by dissecting close to the bone.

Care must be taken to avoid injury to the ulnar nerve, which should be raised with the surrounding tissues from the groove between the internal condyle and the olecranon process, and drawn with the soft parts to the inner side of the condyle. In excisions for disease the nerve is not usually seen, as it is embedded in the adjacent thickened cellular tissue.

The lateral ligaments should next be divided, the forearm flexed, and the ends of the bones thrust out of the joint and sawn off. The ulna should first be divided at the level of the coronoid process, leaving the base of the process when possible; then the head of the radius is cut off, and lastly the humerus sawn through just above the condyles. Or, many surgeons prefer to remove only the olecranon process, thus gaining ready access to the interior of the joint. The lateral ligaments are then divided, the coronoid process and head of the radius sawn at the same level, and lastly the condyles removed through the supra-condyloid fossæ.

The wound should then be sewn together excepting where a drainage-tube is inserted, dry antiseptic dressings applied, and the limb placed upon an internal angular splint, or in the straight position on a pillow.

In the subperiosteal method, the bones having been freely exposed, the periosteum, with the attached tendons, is carefully separated with raspatories from the portion to be removed. The ulna is treated first, then the radius, and lastly the end of the humerus. There is nothing, however, to show that the results of this tedious proceeding are in any way superior to those obtained by the ordinary method; while, on the other hand, there are cases on record which prove that the reproduction of bone after the subperiosteal operation may be a distinct disadvantage, by interfering with the freedom of movement in the new joint.

Seeing that fibrous union is desired after excision of the elbow, a good deal of bone may be removed without interfering with eventual success; but the amount indicated above is that which is followed by the most satisfactory result, and is usually found to include the whole of the disease. If less is removed the movement obtained is apt to be limited; while, if more is taken away, the process of repair is less perfect, and a much longer time elapses before the muscles shorten sufficiently to act efficiently

upon the forearm. Nevertheless, if the bones be extensively diseased, the surgeon may venture upon a more free excision in this than in most other joints; and the writer has seen what seemed, for several months, to be a flail-like union after excision eventually result in a perfectly efficient joint, with a limb as useful as that of the opposite side. It is well, therefore, to have patience with such cases, giving time for the muscular shortening to draw the bones together; and, should the disease recur, even to perform a re-excision rather than sacrifice the arm.

In the after-treatment of excision of the elbow the limb should be kept at rest till the wound is healed or nearly so; but at the end of three or four weeks it is well in most cases to begin passive movement. When more bone than usual has been removed, it is of course desirable to maintain rest for a longer period. The patient need not be kept in bed after the first week or two. The results of excision of the elbow are usually most satisfactory, an excellent false-joint being formed and very perfect movement obtained.

Excision of the Hip-joint. *See* Hip-disease.

Excision of the Knee.—Excision of the knee-joint is performed chiefly for chronic suppuration or pulpy degeneration of the synovial membrane, caries of the joint-surfaces, or chronic articular ostitis. It is also occasionally required in cases in which ankylosis has been allowed to occur, with the limb in a flexed position.

For *injury*, the operation is seldom practised. In the gunshot wounds of military practice the condition of the limb and the environment of the patient are seldom such as are necessary for a satisfactory recovery from excision of the knee; and in civil practice very few injuries of the joint are met with which, if they are of sufficient severity to call for operation, are not also too extensive to allow of successful excision. Primary excision of the knee, it must be remembered, is a very severe operation, requiring much greater reparative power than amputation, and only applicable, even when the local conditions are suitable, to the young and healthy.

For chronic *disease*, however, when limited chiefly to the synovial membrane, or affecting the bones only to a superficial extent, excision of the knee may often be advantageously preferred to amputation in young subjects, as a means of preserving a limb which, though ankylosed, may yet be very useful both for progression and support. Here again, however, it must be borne in mind that the operation is one of considerably greater severity than amputation, and requiring for its success a much greater amount of reparative power and a much longer period of careful after-treatment. The operation is therefore not suitable in persons past middle age, and seldom in those past youth; nor in those whose health has been exhausted by prolonged suppuration or pain; nor in cases of serious visceral disease, as tuberculosis or amyloid degeneration. Nor should it be attempted in any acute disease.

Operation.—This consists in freely laying open the joint at the front and sides, dividing the ligaments, and exposing the articular surfaces of the bones, so that a slice can be sawn off the femur and tibia, leaving two even surfaces of healthy bone to become ankylosed, with the limb in a straight position.

The most convenient incision is one commencing over the posterior part of one condyle, and extending in a curved direction across the front of the joint below the patella, to a corresponding point over the other condyle. This should divide the integument only, which should be dissected back from the patella and the front of the joint. The joint should then be freely opened by dividing the ligamentum patellæ and the lateral ligaments, while an assistant forcibly flexes the limb and thrusts the bones upwards out of the wound. The knife is then to be carried round the femur at the level at which the bone is to be divided, the blade being kept close to the bone and guided by the finger, and a slice of the bone is to be sawn off. The bone is to be sawn from before backwards and at right angles to the long axis of the shaft; and not more than about half the cartilaginous surface is to be removed, or the epiphysis would be encroached upon. The head of the tibia is then similarly cleared, so as to allow of its articular surface being sawn off just below the cartilage, the section also being kept carefully at a right angle with the shaft of the bone.

In using the knife or saw towards the posterior part of the joint, care must of course be taken to avoid injury to the popliteal artery, which is only separated from the bone by a small quantity of loose cellular tissue; the best protection against injury of the vessel being to have the bones thrust well upwards out of the wound. An ordinary amputation-saw may be used, and the bones be steadied by the lion-forceps. The patella is then removed and

the diseased synovial membrane dissected or scraped away; after which the bones are to be carefully adjusted with the cut surfaces in even apposition, the soft parts brought together by sutures, a drainage-tube inserted, and the limb bandaged to an appropriate splint. All this should be done, and the patient placed in bed with the limb suitably supported and fixed, before the anæsthetic is discontinued.

The operation has been variously modified from the description here given. The transverse incision may be altered to two lateral ones joined by a third across the front of the joint, or a long semilunar flap may be turned back from the front of the joint; or again, the operation has been completed through the lateral incisions alone, the patella, with the attachment of the quadriceps, being left intact (Jones of Jersey). Another method is to saw through the patella transversely, and turn each half of the bone up or down with the adjacent soft parts; the operation being then completed in the usual manner, the cut surfaces of the patella are sutured together, the integuments adjusted, and the bone left in position (Golding-Bird). The writer believes, however, that in the majority of cases it is better to remove the patella.

Whatever method is adopted, the operation should be performed with antiseptic precautions, and every care taken to maintain the bones in accurate apposition and at perfect rest, so that firm bony union may be obtained. A variety of splints has been invented for application after excision of the knee. That most commonly in use is a metal splint with foot-piece for the back of the limb, to which can be fixed a bracketed side splint. A short anterior splint for the thigh is also sometimes a useful addition. Or the limb may be put up in a paraffine or gypsum bandage, enclosing a posterior light wooden splint and an anterior suspension rod. The splint and dressings should be so arranged, that the wound can receive the necessary attention without disturbance to the position of the limb.

The operation is a severe one, and is usually attended with considerable shock; so that in young and irritable subjects the free administration of opium is often desirable for a few days afterwards. The reparative powers must be assisted by a liberal diet, as much fresh air and sunlight as possible, and, if needful, tonics and stimulants. In successful cases bony ankylosis occurs, but is not usually firm till about six months have elapsed. When the use of the limb is resumed, a leather splint strengthened by light metal plates at the back and sides must be worn for support, and an addition must be made to the sole of the boot to compensate for the shortening.

Excision of the Shoulder. — This operation is practised chiefly for chronic joint-disease, but may also be applicable to some cases of severe injury of the joint, such as gunshot wounds and compound fractures.

In *injuries* opening the shoulder-joint and involving severe comminution of the bones, it may be possible to remove loose fragments without sacrificing the entire head of the humerus; and it must be borne in mind in the treatment of such cases, that ankylosis of the shoulder leaves a more useful limb than usually results after excision of this joint. Nevertheless, in gunshot wounds and compound dislocations, if the head of the humerus be severely crushed, the complete excision of the injured portion of bone may save a long period of suppuration and separation of necrosing fragments.

For *disease* of the shoulder-joint, the removal of the head of the humerus is usually all that is needful, for the glenoid cavity is often only superficially affected, and may be treated by scraping, or left untouched. The condition for which the operation is most commonly performed is chronic suppuration of the joint, with ulceration of the cartilages and caries of the articular surface of the humerus, which has originated either in degenerative synovitis or in chronic articular ostitis.

Operation.—In ordinary cases, the joint can be conveniently exposed by a long straight incision, starting from the point of the acromion process (or, as preferred by some operators, close to the outer side of the coracoid process), and passing downwards over the head of the bone and a few inches along the shaft. The knife should pass directly down to the bone, and the soft parts, including the long tendon of the biceps, being held aside with retractors, the humerus should be rotated first outwards and then inwards to allow of the division of the muscles attached to the two tuberosities. This having been done, the head of the bone can be protruded through the wound and removed by the saw to whatever extent seems necessary, usually below the tuberosities.

The articular surface of the scapula should then be examined, and, if deeply diseased, may be removed by a narrow-bladed saw, such as is used for dividing the neck of the

femur, or by strong cutting-forceps. This, however, should be avoided if possible and is seldom needful, for the disease is mostly confined to the head of the humerus; but any granulation-tissue or diseased synovial membrane adhering to the glenoid cavity should be scraped away with a Volkmann's spoon. In this, as in other excisions, a convenient protection to the soft parts when the bone is being sawn, is a strong curved steel director, made for the purpose, which is passed under the bone to be divided, and then turned, by means of a hinged handle, with its groove upwards towards the saw.

If, however, the head of the humerus be much enlarged, or there be abscesses or sinuses which require to be laid open, the first incision may be modified accordingly. For instance, a semilunar flap may be cut through the deltoid over the outer aspect of the joint, and the operation completed by the division of the muscles attached to the tuberosities, and the removal of the head of the bone in the manner described above. Or the joint may be opened posteriorly by an incision, starting from just behind the acromion and curving downwards and outwards, but stopping short of the bicipital groove and its tendon, which latter may be preserved if entire, as it seldom is in cases of disease.

For the subperiosteal method as practised by M. Ollier, a longitudinal incision is made down to the bone through the anterior part of the deltoid, a little behind the cephalic vein. The periosteum, with the tendons and other soft parts, is then separated from the bone by raspatories as low down as the section is intended to be made; the bone is then protruded from the wound and sawn through.

The divided vessels having been secured, and the wound rendered aseptic, a drainage tube should be inserted and the wound closed by sutures except at its most dependent part. After the dressings have been applied, a pad should be fixed in the axilla to prevent inward displacement of the bone; and when the patient is up, the arm must be supported in a sling. In successful cases a very useful arm is left, most of the movements excepting abduction being fairly performed. The arm cannot be raised above a right angle to the trunk, but the deltoid often regains considerable power of lifting it from the side.

Excision of the Wrist-joint.—This operation consists in the removal of the articular surface of the radius and ulna, the carpal bones, and the carpal ends of the metacarpal bones; and is practised in cases of caries and suppuration of those joints. The instances, however, to which this operation is applicable are not very numerous, for, in the majority of cases of extensive disease of the carpus, the soft parts are so immediately damaged, the tendons so matted together or destroyed, and the suppuration so diffused, that there is no prospect of obtaining a useful hand. Nevertheless, considering the importance of preserving, if possible, even a somewhat disabled hand, it is worth while to attempt the operation whenever there seems a reasonable probability of success; and especially as the results obtained by the method of operating introduced by Sir Joseph Lister are in successful cases very satisfactory. The operation is a tedious and somewhat severe one, requiring a long period of subsequent repair, and its success will depend very much upon careful and constant attention to the after-treatment.

The method of Professor Lister is as follows:—An Esmarch's bandage having been applied, lateral incisions are made in such a manner as to allow of the removal of the bones with as little injury of the tendons as possible.

The incision on the radial side commences on the dorsal aspect of the radius, on a level with the base of the styloid process; thence it passes towards the inner side of the metacarpo-phalangeal joint of the thumb, running parallel and internal to the tendon of the extensor secundi internodii pollicis; but, on reaching the radial border of the metacarpal bone of the index finger, it diverges at an obtuse angle, and is continued downwards along the border of that bone for half its length. In this way the incision avoids on the inner side the extensor of the index finger, and on the outer side the radial artery and the extensor of the thumb.

The soft parts on the radial side are next carefully detached, and the tendons of the extensor carpi radialis longior and brevior divided at their insertions. These, together with the extensor secundi and the radial artery, are then pushed towards the radial side and the outer bones of the carpus exposed. The connections of the trapezium with the adjacent bones are then severed with the cutting forceps, and the soft parts on the ulnar side of the incision raised from the carpus as far as convenient. The ulnar incision is next made along the subcutaneous margin of the bone, extending from two inches above the styloid process downwards, between the tendons of the extensor and flexor carpi ulnaris, as far as the

middle of the fifth metacarpal bone. The tissues on the dorsum are then raised through this incision, and the tendon of the extensor carpi ulnaris is cut close to its insertion into the fifth metacarpal bone. The extensor tendons of the fingers are next raised from the carpus, but not divided, and the dorsal and internal lateral ligaments of the wrist divided. The anterior surface of the ulna is now cleared by dissecting close to the bone, the pisiform bone with the tendon of the flexor carpi ulnaris being separated from the rest of the carpus, and the hooked process of the unciform bone cut off with the bone-forceps. The flexor tendons having thus been raised, the anterior ligaments are divided and the carpal bones extracted with sequestrum forceps. The articular surfaces of the ulna and radius are next sawn off, the bones being pushed out of the lateral wounds, and then the bases of the metacarpal bones are removed by the cutting pliers.

The trapezium is now dissected out, care being taken to avoid injury to the radial artery and the tendon of the flexor carpi radialis; and then the metacarpal bone of the thumb is pushed up and its articular surface cut off. Lastly, the cartilaginous surface of the pisiform bone is removed, the rest of the bone, if healthy, being left, as well as the hooked process of the unciform.

During the after-treatment, besides attention to free drainage of the wound, it is most important to keep up passive movement of the fingers, to prevent the stiffness which would otherwise ensue. Before the commencement of the operation, and while the patient is under an anæsthetic, the adhesions of the tendons which are usually present should be broken down as far as possible. Systematic passive movement of each joint of the fingers should be commenced within a few days of the operation.

Sir Joseph Lister advises the use of a splint with a wedge of cork to raise the palm of the hand, so that the fingers can be exercised without removing the splint. As the parts consolidate, the wrist also should be moved and voluntary motion be encouraged; and when the wounds have healed, an elastic bandage may be worn for a term to give support to the wrist.

J. Warrington Haward.

JOINTS, Wounds of.—A wound of a joint may have a direct communication with the surface of the body, and be in this way exposed to contamination by particles floating in the atmosphere; or it may be subcutaneous, and thus protected from external influence. Between these two classes of injury there is a very marked distinction—one which the older surgeons did not fail to recognise, though they attributed the serious results of an exposed wound to the influence of the air itself, and not to the ferment-causing particles with which an impure atmosphere is loaded. A dislocation is perhaps as good an illustration of a subcutaneous wound of a joint as can be given; for when this form of injury is complete, it often happens that every ligament of the joint is ruptured, the articular surfaces are displaced and lie in contact with structures with which they have no natural affinities, the synovial membrane is torn and bleeding, the muscles in the neighbourhood are lacerated, tendons displaced, and vessels and nerves often seriously damaged. Yet, after all this disturbance of a joint and its environment, it often happens that, following reduction, no acute inflammation occurs, there is no general rise of temperature, and the severed parts reunite and readapt themselves to their normal functions in a marvellously short space of time.

Very different is the result when some small instrument has penetrated a joint, and exposed the surface of the delicate synovial membrane to the influence of a ferment-exciting or putrescent material. We then have developed all the symptoms usually described under the term *acute traumatic arthritis*, but, perhaps, more correctly named *septic arthritis*. A severe sickening pain is experienced by the patient, and the joint rapidly becomes swollen and, later, red. After some hours, when the joint has become distended with fluid, the pain becomes acute and throbbing in character, and severe constitutional symptoms begin to manifest themselves. The temperature rises rapidly, and the patient becomes restless and anxious. He loses appetite and may vomit his food; his tongue becomes furred, his pulse rapid, and his urine scanty and high-coloured. If the communication with the joint remain patent, the clear viscid synovia, which at first escapes, is followed by a more watery fluid accompanied by flakes of lymph, then by sero-pus, and later by pus. When pus is present in the joint the skin over it becomes œdematous and of a more dusky red, and the superficial veins become distended. Rigors, followed by a temperature of 103° to 105° F., and then profuse perspiration, may also occur, and the patient is in the greatest danger from general septicæmia. If relief be not given by free incisions, the distended

capsule yields at its weakest points, and the pus burrows among the muscles and in the cellular tissue around the joint, tending to make its way towards the surface. Should the patient escape death from general pyæmia, he will be exposed for many months to the exhausting influence of prolonged suppuration and its accompanying dangers, and at last may recover with an ankylosed joint.

The *pathological changes* which take place in a joint thus injured are first evident in the synovial membrane, which becomes injected and red, whilst its fringes are swollen and turgid; its surface soon loses lustre, and its cavity becomes filled with a watery, opalescent fluid containing lymph-flakes, leucocytes, and bacteria. The further progress of the inflammation is characterised by the rapid growth and intense vascularity of the synovial membrane, which brings it into strong contrast with the slow-growing œdematous granulations present in pulpy disease. Under its influence the cartilaginous surfaces become quickly destroyed, leaving at first, here and there, isolated portions of apparently healthy cartilage. The granulations developed in the joint in the later stages may be coated with a greyish lymph, giving them a sloughy appearance, and the interior of the joint is then bathed with pus. The ligaments, as the result of the inflammation, become softened and, under the influence of the muscles, may give way and allow of dislocation. The cartilage is also in part removed by granulations springing up from the bone. For a time the joint may be an abscess-cavity lined throughout with granulations; then these meet, interlace, and unite, becoming converted first into fibrous tissue, then into bone, as a result of which process ankylosis is effected.

Not every open wound of a joint is followed by the acute septic inflammation described, and the milder type of inflammation which frequently occurs bears some relation to the nature of the wound inflicted, but depends mainly upon the absence of infection by impurities in the air or on the penetrating instrument. It has long been known that a clean incised wound may be made into the knee-joint for the purpose of removing a loose cartilage, and that, with care, primary union may be obtained and little or no synovitis follow. An even severer test is the operation devised by Ogston for knock-knee, wherein a narrow saw is introduced into the knee-joint and the internal condyle sawn off. The joint becomes a receptacle for blood and bone-dust, yet rarely inflames severely as a consequence. The writer has sawn off the internal condyle of both knees of a patient on the same day, and the temperature during repair has not risen above 100° F. The free incision of the knee-joint, made for the purpose of wiring a fractured patella, may be also cited in illustration of the difference between an aseptic and septic wound of a large joint. Lacerated and bullet wounds of joints are among the most serious, inasmuch as primary union in these cases is almost impossible, and suppuration or sloughing of the skin-edges will almost certainly convey septic matter to the interior of the joint. The addition of splintered fractures, which often complicate gunshot injuries, renders these even more dangerous and difficult to treat.

A large wound of a joint is not necessarily more grave than a smaller one, even when primary union cannot be obtained; for a wound of considerable extent allows of freer drainage, which is one of the most important considerations should acute inflammation follow. When acute traumatic arthritis has set in, the size of the joint will be found to bear a definite relation to the amount of constitutional disturbance excited; and when prolonged suppuration results, childhood or youth will bear the strain better than adult life or old age.

The *diagnosis* of a wound of a joint may be made by noting the escape of viscid synovial fluid, by the exposure of articular cartilage, or by the depth to which a wound over a joint is found to penetrate. The first sign alone is usually sufficient, but a wound of a bursa in the vicinity may lead to error, as when the ligamentum patellæ is partially divided and the bursa behind it opened. Exposure of cartilage requires no comment; but the advisability of probing a wound to ascertain if it has penetrated the capsule is at least doubtful, and should be performed with great caution. It cannot be too strongly insisted upon that the probe should be disinfected before being used, and, in the presence of bad air, when no spray is at hand, it may be well to drop some disinfectant fluid from a sponge over the wound during the probing, to sterilise any air which may tend to enter. If the wound be large and it be a question of foreign body or splintered bone, the finger, first dipped in some disinfectant fluid, is a far better instrument for determining the nature of the injury than any probe.

The *treatment* of wounds of joints depends largely upon their character and extent, but, in every case, it may be insisted upon that complete fixation and rest upon

a splint are among the most essential provisions for favouring recovery. The form of splint employed will vary with the practice of the surgeon, and in simple cases will matter little; but the writer is strongly of opinion that the splint, padding, and bandages should be so arranged that, in the event of suppuration, no change need be made. It is well, therefore, to fix the limb from the first upon a metal splint lined with waxed lint and secured with waxed bandages, that in the event of suppuration they may not be soaked with discharge, and thus become a hot-bed of decomposition. A small, clean, incised wound will often heal immediately under a pad of lint dipped in the old-fashioned antiseptic—compound tincture of benzoin. It is advisable, when trusting to simple remedies, to place over the joint an ice-bag or a Leiter's coil to lessen the tendency to inflammation. An incision of larger size may be brought together by fine wire stitches, and a piece of green protective and carbolised gauze dressings may be applied over the wound; these can be removed at any time under the spray, for the purpose of taking out stitches or securing drainage. Should the wound be soiled at all with dirt, the greatest care should be taken in cleansing it with an antiseptic lotion, and in gently syringing away any adherent particles. The wound in this case should only be closed at the upper part, the lower being left open for drainage, and antiseptic dressings should be employed. When it is clear that the joint has been exposed to contamination through a lacerated or contused wound of considerable extent, some more thorough means should be resorted to for allaying, as much as possible, the inflammation which may be anticipated. The joint should be thoroughly syringed out with a five per cent. solution of carbolic lotion, and counter-openings should be made at the most dependent spot on either side of the joint for the insertion of drainage-tubes. The whole should then be covered with antiseptic dressings, which should be reapplied every day, or whenever the discharge may have soaked through them. The drainage-tubes may often be removed in five or six days, but, if the discharge be profuse, they should be retained until it lessens. In any case, where acute suppuration with high fever follows a wound of a joint, free and dependent incisions should be made to allow of the escape of pus.

There are other cases of wounds of joints where the surgeon cannot hope to save the articulation, and in which he will have to decide between excision and amputation. Extensive laceration of the soft parts around an open joint will generally call for amputation, but the age of the patient has a strong determining influence in many cases where excision is practicable. It must be here remarked, that excisions for injuries of joints do not run the same even course towards recovery that excisions for disease may be expected to follow, and this is mainly due to the lacerated and bruised tissues having already become contaminated with living organisms. Hence a good deal of suppuration is apt to follow, and the surgeon has a difficulty in keeping the wounds sweet. To expose an old person to this exhausting process can never be advisable, and, therefore, after the middle period of life, there are few cases in which excision can be adopted in preference to amputation. How far fractures complicating the wound will weigh on the side of amputation or excision, may sometimes be decided by the position of the joint. Thus, at the knee, should there be much comminution, after the removal of the fragments it may be impossible to adapt the ends of bone so as to obtain the necessary ankylosis; whereas at the elbow the usual treatment after excision is directed towards the avoidance of ankylosis, and great sacrifices of bone may be made to save the hand, even though the arm remain a flail.

In the general treatment of a wounded joint there is much that requires attention. The diet during the early inflammatory stages should be light, nutritious, and unstimulating; whilst in the later stages stimulants may be freely administered and a liberal diet be given, to support the patient's strength whilst suppuration is proceeding. In the inflammatory period an effervescing saline mixture is of advantage to the patient, and in the later stages quinine and iron are of service; but opium is the drug which gives the patient most relief, and is almost essential to procure for him the necessary rest. A hypodermic injection of a quarter or a third of a grain of morphia may be given every night till the pain subsides. Chloral and bromide of potassium may occasionally be used as substitutes, but they are, as a rule, less to be relied upon than opium. R. Clement Lucas.

JUGULAR VEIN, EXTERNAL, Venesection of the. *See* Venesection.

JUGULAR VEINS, Wounds of the, may complicate homicidal or accidental injuries of the neck, or may occur during

operations upon tumours, &c. Those of the internal jugular are most important. They may prove fatal from the loss of blood, the admission of air, or, at a later stage, from purulent infection through detached clots. Occasionally, after passing a tenaculum through both edges of a small wound in this vessel, surgeons have successfully applied a ligature round a portion only of its circumference. But it is better to pass an aneurism needle beneath the vein, and, having surrounded it with a double ligature of silk or catgut, to tie one part above and the other below the opening. There appears to be no danger from the disturbance of the cerebral circulation thus produced, and the risk of thrombi being carried into the circulation is very much diminished by this mode of treatment. A wound of the anterior or external jugular vein usually requires only the pressure of a small pad; but, if it is made during the course of an operation, it is prudent to ligature the vein above and below the wound. N. Davies-Colley.

JUNKS.—The junk proper consists of a thin cushion measuring, for an adult, 26 inches by 15 inches, stuffed moderately firmly with horsehair, and, when new, about 2 inches thick. To prevent displacement of the stuffing whilst in use, the cushion must be sewn through or 'tufted,' to employ the technical term. The cover is best made of ticking. The cushion can be strengthened, if necessary, by longitudinal strips of cane sewn into the cover on its outer side, and, thus made, forms a strong splint for the leg, especially useful in military surgery. The apparatus is completed by the cover, which consists of a piece of strong calico or cloth ('loom linen sheeting,' specially made in Dundee for hospital purposes, is the best material), measuring 26 inches by 16 inches. Two cylindrical pieces of stick or thick cane, 22 inches in length and 1 inch in diameter, are sewn into the edges as in an ordinary 'wringing' contrivance. The cover is retained in position by two straps or webbings, encircling the whole apparatus.

The leg is placed in the junk, the lower end of the cushion projecting a few inches beyond the heel; the cover is placed outside the cushion, which is then bent up into the form of a trough, when completed, by buckling the straps. The foot usually requires some support. This junk is well adapted for the treatment of sprained ankle, fractured fibula, fractures of the leg with much swelling, or as a fixation apparatus for 'first treatment' of fractures, or when it is necessary to transport the patient. It has the disadvantage of being rather hot, and is apt to get foul if used for cases where there is much discharge. A pillow and a piece of common sheeting make a very efficient roll junk on an emergency.

The ordinary junks are merely flat cushions, measuring (for adults) 28 inches by 16 inches, and, when newly stuffed with horsehair, from 4 inches to 6 inches thick. They are best covered with strong ticking and should be tufted. These junks are used to keep limbs raised, and are usually placed, wrapped in a draw-sheet, under the injured part, but often are more comfortable when placed beneath the mattress. When used for cases in which there is much discharge they should be wrapped in macintosh sheeting.

A special and very useful form of junk is made in the form of an inclined plane. The side elevation (for an adult) should have the following measurements: Length of base, 24 inches; height, 10 inches at one end, sloping down to 3½ inches. A convenient width for the junk is 16 inches. The inclined plane is hollowed out into a trough about half an inch in depth at its shallowest part, and adapted a little to the shape of the leg and thigh. The junk is firmly stuffed with horsehair and covered with ticking. It is admirably adapted for elevating and resting the limb in cases of fractured patella, synovitis of the knee, &c. The patient must be kept on his back, and, in this position, is unable to bend the knee. A single fold of bandage, passing over the thigh and secured on either side to the junk, is sufficient to fix the limb. The foot usually requires a little support. The apparatus is also well suited for elevating and resting the arm.

Stump junks are small pillows, stuffed with horsehair covered with ticking, and designed to support and raise the stump after amputation. If too much stuffed they are apt either to press injuriously on the stump or to allow the stump to slip off readily. Many surgeons employ splints for stumps immediately after amputation. When this is done, the junk can be fastened to the splint.

In using junks, of whatever shape, to raise and support an injured limb, care must be taken to give uniform support to the whole of the limb. For example, if the leg alone is raised on a junk, after an hour or two much discomfort will be felt from the strain thrown on the hamstrings. Injudicious arrangement of junks will greatly disturb the fragments in fracture.

C. T. Dent.

K

KANGAROO TENDON LIGATURE is prepared from the tail of the kangaroo. When fresh, the tendons may be split up to any thickness required, and average about eighteen inches in length. They may be preserved dry for any length of time, or kept in some antiseptic solution. Before use, they should be soaked for at least twenty-four hours in carbolic solution. When soaked, they swell up to about twice the thickness they have when dry. Care should be taken that the tendons chosen for use show no longitudinal split, and that there are no nodosities in the course of the ligature. This ligature is best suited for tying arteries in their continuity. The writer has used them, with great advantage, for large atheromatous vessels in amputations, in cases of varix and varicocele, and for the ligature of the stump in castration. They would seem to be well suited for cases of oöphorectomy and the like. The knot should be tied without any jerk as firmly as may be desired, and the ends cut off short. The changes that follow in the ligature, consist in the splitting up of the tendon into longitudinal bands by an infiltration of small cells. These cells elongate, and subsequently form the walls of newly-developing capillaries, similar to those seen in granulation tissue. New blood-vessels also, forming in the coats of the artery, pass out into the interspaces of the tendon fibres. This is the process termed 'organisation of the ligature.' The tendon itself sets up no irritation whatever, if perfectly aseptic. It disappears very much more slowly than the catgut ligature; there is no need, therefore, to rupture the internal coat of the artery, though such rupture in all probability usually takes place. C. T. Dent.

KELOID. *See* Cicatrices, Pathological Conditions of.

KERATITIS. *See* Cornea, Inflammation of the.

KIDNEY, Injuries of the.—Injuries of the kidney are by no means uncommon, both in peace and war. They may be classed as 'non-penetrating' and 'penetrating.'

Non-penetrating Injuries of the Kidney.—*Symptoms and Diagnosis.*—These in civil life are most frequently produced by falls upon the back or side, by crushes, as in the case of 'buffer accidents' on the railways, or by carriage accidents in the streets, where the flank is struck by the shaft, or a wheel passes over the waist. Cases are also recorded, in which indirect violence has caused rupture of the organ. Thus, falls upon the buttock have been known to cause a tear of the kidney by the severe jarring induced. These and similar kinds of violence will produce, without any external wound, every degree of damage, from a slight bruise or tear in the cortex to complete pulping of the whole organ.

Symptoms (Objective).—A bruise or laceration of the kidney from non-penetrating violence to the side is recognised, in the first place, by the appearance of *blood* in the urine. This blood is, as a rule, thoroughly mixed with the voided urine, which varies in colour from slight 'smokiness' to bright red, and, unless poured out in great amount, does not form clots. When very abundant the latter are produced freely, and may even completely prevent the passage of the remaining blood and urine through the ureter or urethra. These symptoms, together with the history and the presence of bruising of the soft parts, will often be enough for a diagnosis. But there will occasionally be felt, besides, a *fulness in the flank* corresponding to the situation of the kidney. This may appear immediately after the injury, and, in such a case, will be due to the outpouring of blood from the wounded organ, either into the areolar tissue external to it, or under the capsule external to the surface of the kidney, or into the distended pelvis, the ureter being blocked by clot or bruise; in the latter case the hæmaturia will quickly cease. If the fulness make its appearance a little later, after the lapse of some hours, it is more likely to be urine effused in the same regions, though it may still, possibly, be blood. Bleeding from a moderate injury to the cortex soon ceases, as a rule, so that the amount of blood effused will probably not be sufficient to form a swelling in the loin, perceptible to the fingers. But if the peritoneal aspect of the organ be torn, there will usually be more or less blood poured out into the abdominal cavity, which will be perceptible or not by palpation and percussion in different positions of the body, according to

its amount. If abundant, the dulness will be quite apparent, and the diagnosis will be aided by the weakness and pallor due to loss of blood. If the effused fluid in this case were *urine*, neither of these last two symptoms would be present, and the patient might continue to improve in strength and colour as the effusion increased, until possibly peritonitis set in with its usual symptoms. Besides these symptoms, wounds of the kidney have been observed to produce *retraction of the testicle* and *frequency of desire to micturate*, but this is not invariably the case.

The *subjective* phenomena usually noticed with injury to the kidney are, first, *shock*, although this is due more to the violence to the parts around than to the renal lesion. As is pointed out under KIDNEY, Surgery of the, there may be little or no shock observed in those cases where the injury is limited to the kidney alone. Next in order comes *pain*, that complained of being usually of a dull, aching character, increased to a sharp 'stitch,' perhaps, by deep inspiration or exertion of the abdominal muscles. But most characteristic of all is great *tenderness on palpation* in the situation of the kidney. This tenderness, taken in conjunction with the other symptoms enumerated, leaves no doubt as to the diagnosis. But in some cases a clot may form in the ureter and prevent the passage of blood into the bladder, the urine first drawn off having perhaps a trace of blood, but that subsequently voided being clear. Here, however, the patient will almost certainly show all the evidence of the condition known as renal colic, which in itself is very characteristic. *See* RENAL COLIC.

Diagnosis.—In forming a diagnosis in these cases, we are most concerned to know, in the first place, whether the blood seen in the urine comes really from the kidney, bladder, or urethra; and next, to what extent the kidney is damaged if it be the source. Blood derived from the bladder, unlike that coming from the kidney, is not *usually* thoroughly mixed with the urine (although sometimes perfectly so), and shows clots, or varies in the amount seen in the stream during micturition. At the end of the act there is usually some apparently pure blood passed, and often with much pain and straining, owing to the difficulty in forcing the clots through the urethra. If the bladder be ruptured, the blood may come away almost pure and unclotted, but the power of the bladder is gone. Blood derived from the urethra, on the other hand, is usually passed pure at the beginning of micturition, and is followed by clear urine producing little or no pain. *See* HÆMATURIA.

Wounds of Pelvis.—That the pelvis of the kidney may be wounded by non-penetrating injuries independently of the kidney is proved by, at least, two cases; but the author, after careful search, is unable to find any others recorded in home or foreign literature. The first case was reported by Mr. C. Hawkins; the next occurred in the practice of Mr. Vincent, of St. Bartholomew's Hospital. In both, the pelvis was injured by the same kind of violence—viz. a cart-wheel crush—and both died about ten weeks later from spurious hydronephrosis or urinary abscess. By this is meant an effusion of urine into the post-peritoneal tissues, with the formation of a distinct sac limited by plastic inflammation. The *symptoms* were practically the same as those of ruptured ureter (vide *infra*). The nature of the case was not recognised during life; but after death, in both instances perforations of the anterior wall of the renal pelvis, leading into the newly-formed sac, were found.

Wounds of Ureter.—The only case known to the writer in which a positive diagnosis could be made, during life, of injury to the ureter alone from a non-penetrating injury, is that of a child lately under his care in University College Hospital. This patient, a boy of three years and eight months, was run over by a cab in August 1884, the wheel passing across just above the right iliac crest, and leaving extensive bruising of the parietes. At first nothing was to be made out but this bruising and some hardness of the side; then, some days later, a swelling with all the characters of hydronephrosis was felt on the right side. This was aspirated, and forty-five ounces of fluid were drawn off with all the characters of urine, but containing (as was to be expected of urine secreted under pressure), only a small percentage of urea, (0·5 per cent.); it also contained albumen. This aspiration was repeated on six occasions at intervals of about a week, with practically the same result. The *symptoms* upon which the diagnosis was based were—first, the nature and position of the injury, then the absence of severe shock, then the presence of two small worm-like clots in the urine first passed, not followed by any bleeding, and lastly the formation of a fluctuating tumour in the renal region, dull on percussion, of a distinctly rounded form, with the liver above and the colon in front of and internal to it; finally, by the result of

the exploratory aspiration, which gave exit on each occasion to fluid with all the characters of urine and a definite amount of urea. This urea was present in very small amount so long as the sac was a closed one, but, as soon as a drain-tube was introduced and the fluid allowed to drain off without any obstruction, the percentage rose to 1·7 for many days. Here the writer proved the accuracy of his diagnosis by excising the kidney, which at once arrested the flow and relieved the child from all his distressing symptoms. In this case the urine was poured out into the areolar tissue behind the peritoneum, and there formed a large sac for itself, bounded by plastic inflammation. The wound of the ureter appears to have been not far below the pelvis of the kidney, the lower end of which was found, on excision, to be covered with granulations and phosphatic matter. The pelvis was healthy. The urine might, in another case, be poured out into the abdomen, being limited by lymph to a definite sac, or the torn end might be closed by clot or plastic material and the pelvis of the kidney be distended; or, finally, the last condition might be produced by simple bruising of the ureter, without destruction of its continuity. A case very like the above was recorded in 1843 by Stanley, but the patient recovered, and a positive diagnosis was impossible. These are the only instances known to the author of injury to the ureter alone.

Penetrating Injuries of the Kidney. But the kidney may also be injured by direct violence *penetrating* through the surface of the body, and many interesting cases of the kind are to be found, especially in the records of military surgery. Thus, it has been slit from top to bottom with one or other form of sharp instrument, as well as punctured by bayonets, lances, and swords. The wound in the flank has, in some cases, allowed the kidney to be forced out on the surface in the act of coughing. In many of these cases there was little or no constitutional disturbance, and the patient recovered quickly after replacement or removal of the protruded kidney. Again, the organ has been wounded by bullets either passing quite through it or lodging in its substance, recovery in each case being frequent. Any of these injuries may implicate either the proper renal tissue alone, the pelvis, or the ureter alone; and the symptoms, prognosis, and treatment will vary accordingly in each case.

The difficulties in the *diagnosis* and *prognosis* of penetrating wounds of the kidney are usually smaller than in the case of non-penetrating wounds of that organ. We have in the first place the *direction of the wound* and the nature of the weapon to guide us. For a simple uncomplicated wound of the healthy organ to take place, it can only be reached over a limited area in the loin just below the ribs, and then only in its lower portion. Except here, no penetrating wound can reach the kidney without producing a lesion of far more important parts, which will mask the renal mischief. Then the *amount of blood* effused immediately on receipt of the injury will aid the diagnosis; bleeding from the kidney being usually very free for a short time, but soon ceasing altogether. Renal blood in the urine, passed *per urethram*, is an almost constant symptom from the very first in all these cases; but this bleeding may be so free as to give rise to clots in the ureter or bladder, with all the intense suffering of renal colic or urethral dysuria respectively. *See* Renal Colic. *Retraction of the testicle* and *increased frequency of micturition* are often marked symptoms in these injuries. The *pain* in an uncomplicated case will be but an uncertain guide; but, on the other hand, we may be able to see the organ, which has often been partially or completely prolapsed through the wounds in the soft parts. As to *shock* after penetrating wounds, it may or may not be present, depending as it does rather on the effects of the wound upon the neighbouring structures than upon the kidney itself.

It may be conveniently noted here, that we are not to expect urine to flow from the first out at the lumbar wound, when the kidney has been damaged. As a rule this has not been observed for several days, or even in some recorded cases for weeks after the injury. In some cases again, urine does not appear at all in the external wound. But in those instances in which the latter does not heal kindly, urine usually makes its appearance at about the same time that suppuration becomes free in cases not completely aseptic — viz. about the fifth day or so. Having once commenced to escape from the lumbar wound, it may continue to flow for an indefinite time, amounting to months or years. But it may be stated generally, that penetrating wounds of the kidney through the loin have usually a great tendency to heal. Indeed, this is often one of the most serious points about them; for, if there be any suppuration, inflammatory swelling is apt to diminish or even completely arrest the

flow of the urine down the ureter, and thus the only mode of escape for the products of inflammation and the secretion is through the wound. If, then, the latter close, there are, as a rule, the most severe constitutional disturbances — fever, anorexia, insomnia, &c.—lasting until either the wound has burst open again or has been re-opened by operation. This point ought never to be lost sight of, as it will materially influence the question of trying to make a permanent urinary fistula in the loin in preference to performing an early nephrectomy, which in many cases would be attended with less risk than usually follows tedious suppuration here.

Treatment of Injuries of the Kidney. This will depend upon whether the injuries are *penetrating* or *non-penetrating*, *recent* or *suppurating*. In the case of *penetrating* wounds, as they will probably be either incised, punctured, or bullet wounds, the earliest danger will be hæmorrhage. This may often be controlled by the application of firm pressure by the hand or bandage, with the addition of the ice-bag. Bleeding from the arm, until syncope has been produced, has also been resorted to with the best results in healthy plethoric individuals. Then, the hypodermic injection of ergot and free doses of gallic acid should be tried. If, however, one or more of the larger branches about the hilus is wounded, and neither pressure, cold, nor internal styptics are sufficient, there is little doubt that the proper course to pursue is, to enlarge the wound in the soft parts and seek for the bleeding vessel. If this be not easily found and secured, it is best to include the whole pedicle in one ligature and remove the kidney. *See* Nephrectomy. Cases intermediate between these two may be treated by plugging the wound with some antiseptic dressing, as iodoform or salicylic wool, with firm external bandaging and cold. The whole treatment, from beginning to end, should be conducted on the strictest antiseptic principles. In those instances in which the organ is prolapsed through the side as well as wounded, if seen at once it may be replaced after careful cleansing, and some such cases have recovered perfectly. But if it have been long prolapsed, strangulated, and rendered thoroughly foul, or otherwise seriously damaged, there ought to be no hesitation about its immediate removal after ligature of the pedicle.

In the case of *non-penetrating* injury to the kidney, the immediate treatment will be essentially the same as the above in the milder forms; but when severe, the surgeon is justified in waiting longer before resorting to operation on the organ, in view of the greater uncertainty in diagnosis. But here, too, where injury to the peritoneum and other organs seems improbable, and the patient is bleeding slowly to death through his ureter or into the perinephral tissues, if other means have failed the surgeon will be justified in cutting down and removing the torn kidney. In addition to the local treatment of the renal wound, another condition depending upon the hæmaturia will require careful attention, and that is the formation of clots in the bladder. This is often a source of much suffering and some danger; the clots may be too large to pass out by the urethra, and in their attempt to do so they act as a valve and completely prevent the escape of urine. The latter then goes on accumulating to an enormous extent, and causes most acute suffering. Any endeavour to relieve the bladder by an ordinary catheter fails in most cases, from clogging of the instrument at the outset. In the female, the urethra may be dilated in the usual way, and the clots extracted through a speculum. But in the male, washing out should be avoided, as the injected water will increase the distension and will not return. The use of Bigelow's large catheters and suction bottle will, probably, in the future supersede all other active treatment for the adult. The pelvis should be well raised while this is being used, so as to throw the clots well back from the neck of the bladder. By this suction-method the writer has lately succeeded in removing large clots, otherwise impossible to evacuate. If all means fail, we must only wait for the softening of the clots, and endeavour to relieve the suffering in the meantime by anodynes, with hot-air baths to diminish the flow of urine from the kidneys. The clots will usually break down in the course of a day or two, the relief being then speedy.

It should never be forgotten that bleeding from the kidney, with or without external wound, may be made to return, days or weeks after it has ceased, by over-excitement of the organ, such as the use of strong drinks or fluids which throw much work on its excretory functions.

The treatment of suppurating penetrating wound of the kidney will depend upon the extent of the injury in a great measure. If diagnosed to be moderate in degree its eventual closure, if kept aseptic and carefully drained, may still be hoped for,

and this line of treatment should be tried. But as a rule the external wound tends to close long before the urine has returned to its normal route down the ureter, if it ever does this at all. This tendency to closure of the wound is most troublesome if the ureter be impervious, and often leaves the surgeon but little choice as to his line of action eventually. Increasing experience points to the conclusion that it would be well to perform nephrectomy early in such cases—that is, so soon as there appears to be no reasonable hope that the closure of the wound will be permanent. But in cases of extensive injury, where suppuration has commenced, nephrectomy should be undertaken very early if the patient's condition be otherwise satisfactory. Here we can hardly hope for proper repair of the organ, and the risks of prolonged suppuration, with decomposition of urine, in this region are very great.

The treatment of suppurating non-penetrating wounds, which are rarer, but which, when met with, indicate very grave lesions of the organ, probably associated with extravasation of blood and urine around, is a most difficult question to determine. In these cases, free antiseptic incision and drainage appear the proper means to take; but on incising, the organ should be carefully examined with the fingers, and if much injured it should be removed immediately. This will at once do away with the risks of bleeding and reduce the amount of decomposition, and will not add very materially to the shock. The treatment of bullet wounds of the kidney must be conducted upon the same principles which guide us in dealing with punctured wounds of the organ. But an element of danger is often met with here not present after ordinary penetrating wounds—namely, the presence of a foreign body. This is either the bullet, a fragment of a rib, or some material carried with the bullet in its course, such as a portion of clothing. Now, if this is left *in situ*, we may usually look forward to very prolonged suppuration. It is therefore better to anticipate this by extraction, if possible, of the foreign body, and in seeking for it we must not shun free incision either into the soft parts or the kidney itself if necessary. But, if the kidney have been much disorganised by the projectile, and extensive suppuration have been the result, it will probably subject the patient to less risk to remove the kidney early, than to leave the foreign body to be thrown off by disintegration, and the wound to granulate up. Cases, however, are on record where bullets have passed into or through the kidney, making a clean wound, which has healed up without any complication. Also, foreign bodies driven into the organ by a bullet have, in certain cases, after a time passed down the ureter and out *per urethram*.

The treatment of wounds or rupture of the pelvis or ureter will be the same in most cases—i.e. repeated aspiration from behind, until we have convinced ourselves of the nature of the tumour by an analysis of the fluid, especially its percentage of urea if any, and until we have satisfied ourselves as to the soundness of the opposite kidney by a careful daily examination of the urine passed from it. (See *Lancet*, January 17, 1885.) If the kidney on the damaged side show any signs of ceasing to secrete, we must wait; but if not, we may try antiseptic drainage from the loin. This, however, from the evidence of recorded cases, seems a very unsatisfactory proceeding where a healthy organ is being dealt with, on account, among other things, of the blocking of the drainage opening by phosphatic concretions and grave constitutional disturbance consequent thereon; and sooner or later it will be necessary to remove the kidney itself in most cases.

ARTHUR E. BARKER.

KIDNEY, Surgery of the. — The surgery of the kidney includes the consideration of two great groups of conditions—viz. injuries and diseases of the organ, which will be considered severally under special headings.

A great variety of *injuries* to the kidney has been described, but these have for the most part been associated with damage to other besides the renal structures, and the phenomena observed in connection with them have been complicated. When simple and uncomplicated, injuries to the kidney are not so serious as has usually been supposed, the chief dangers being, first, hæmorrhage; second, extravasation and suppuration, with all its attendant risks of septic infection and exhaustion. Shock has been purposely put last of all, for it is a mistake to suppose that wounds of the kidney alone are necessarily followed by much shock; this is not so. The organ has frequently been punctured, slit open, or otherwise wounded, without any notable effect upon the patient's nervous system; it has even been removed without an anæsthetic, and the operation has given rise to little or no suffering or general disturbance in the patient's system. It is rare, however, for

injury to reach the kidney exclusively, and when the peritoneum, intestine, liver, spleen, or nerve-plexuses and vessels of the neighbourhood are involved in the same violence, then it is that the severe shock is seen so frequently, and erroneously attributed to the damage to the kidney.

Hæmorrhage also, though it is one of the great dangers after wounds of the renal tissues, is not necessarily severe, as is often supposed, even when the injury is extensive. It is only when some of the larger vessels towards the hilus of the organ are divided, that great bleeding is inevitable. This has been shown over and over again, as well by accident as when incisions have been made into the organ in the living subject; the bleeding, as the writer has seen in some of his own cases, and also in several in the practice of others, has been free for the moment, but has ceased very quickly either spontaneously or on a little pressure. It is otherwise, of course, when any of the larger renal vessels are torn, especially the veins; but even then, firm pressure and the application of cold, with ergot or gallic acid internally, will often arrest the bleeding. It is important to remember this tolerance of the renal tissues to injury; it will encourage us, on the one hand, to await patiently in certain cases the efforts of nature for the repair of injuries to the organs, and, on the other, it will stimulate us to undertake, in special instances, the local treatment of severe lesions more promptly and fearlessly than has yet been done.

As has been noted of bleeding, so it may be said of extravasation of urine, that in uncomplicated cases of moderate injury to the organ, this is not a certain or even frequent consequence. Slight bruises, lacerations, or incisions of the organ usually heal rapidly, without the pouring out of urine to any dangerous extent, and even in severe lesions this is not always a prominent factor. When either the pelvis or ureter is torn, urine may continue to be secreted into the post-peritoneal tissues without any immediate danger to life, the fluid being aseptic and of a non-irritating character when the organ is healthy. Effused into the peritoneum, it is usually followed by peritonitis, but not of an inevitably fatal form, as it may become limited by lymph and so form a sac, within which it is almost harmless.

Again, suppuration rarely follows simple and uncomplicated wounds of the kidney of moderate degree, and is only seen when a patient survives the severest lesions, and there is an abundant effusion of blood and urine around the organ. It is not necessarily a very dangerous complication, if promptly dealt with on antiseptic principles. It is more likely to follow upon lacerations or contusions of the renal substance than upon incised wounds, whereas the latter bleed more freely but are less liable to suppuration. The form of injury most likely to be followed by pus-formation is wound by a bullet, and, as a matter of fact, in most cases where such a lesion has not proved fatal at once, suppuration has been free and prolonged.

In *disease* the same tolerance of change is noticed in the kidneys. So long as one organ remains fairly healthy, the other may be extensively affected before it makes any serious difference to the economy. It may be the seat of new growth, a stone, pyonephrosis or hydronephrosis or a tubercular deposit, and yet the patient may go on for a considerable time without any serious evidence of constitutional derangement. Indeed it is remarkable how much both kidneys may be damaged without interfering with the general system, provided parts of the organ remain sound. From these considerations, as well as from the facts recently collected from the experience of operations upon the organ and its removal, we may gather that the kidney, though an organ of much importance, is not so easily embarrassed in its functions by mechanical disturbance or morbid alteration of structure as has been hitherto commonly supposed; and further, that the organ possesses a vast excess of secreting and eliminative power beyond what it is usually called upon to put forth, and, consequently, may be deprived of this margin temporarily or even permanently, without much apparent injury to the system, so long as a proportion of its secreting tissue is left, sufficient for the ordinary uses of the economy. Thus, it has been shown experimentally on animals, and more recently by operation on man, that one sound kidney is amply capable of doing all the work of the body when the other has been removed; just as it had often before been shown by pathological study that even a single kidney, though itself seriously damaged, might still continue to carry on fairly well the work of the system, perhaps for years, after its fellow had been completely destroyed by disease.

But it should not be forgotten, in these days of renal surgery, that there are certain diseases which are prone to develop in both kidneys at or about the same time, and that the operator is called upon to exercise the greatest caution in regard to

them. This is notably the case with Nephrolithiasis, the condition which, perhaps more than any in this region, is likely to require surgical interference. At the root of this disease is a general constitutional vice of digestion and elimination, whose expression is the deposit of crystalline matter in the renal tissues for want of proper solution, or, possibly, as the result of a local catarrhal condition besides. What takes place on one side, then, is very likely to take place more or less on the opposite sooner or later. The same may be said perhaps of tubercular disease, and of the forms of suppurative Pyelitis. A knowledge of these facts will, on the one hand, incline us not to postpone operation too long when we have reason to believe that the disease is still unilateral, and on the other will deter us from any officious interference where it has lasted a long time.

No notice of the surgery of the kidney would be complete without a brief sketch of the modes in which the organ should be examined. Such an examination ought to be conducted with the utmost care, so that the surgeon may have in his possession every fact it is possible to collect, before he thinks of interfering with so important a region. After a careful inquiry into the patient's personal and family history, we should proceed to learn what we can of the state of the kidneys by a general physical examination of the body, but specially by (*a*) palpation and percussion of the renal region, and (*b*) by an examination of the condition of the urine. Palpation should be conducted as follows:—One hand should be placed crosswise beneath the last rib, as the patient lies on the back, with the knees drawn up and the abdominal muscles relaxed. Then, the other hand is placed anteriorly just below the cartilages of the ribs, and pressed backwards to meet its fellow. In this way the lower third of the organ can be felt between the two hands, the upper two thirds being, as a rule in health, above the last ribs and out of reach. If the organ be enlarged by morbid change, and indeed sometimes in health, it lies lower and more internally than this, and can be readily felt. The larger it becomes, the more it descends and the nearer it approaches the umbilical region, and in some cases it has been felt even a little beyond the middle line of the body. By this palpation the position, size, shape, and consistence of the kidney may usually be made out if the patient be under the influence of an anæsthetic, as ought always to be the case if an examination is to be thorough. By careful percussion, on the other hand, the relation of the abdominal contents to the kidney will be established. The colon will always be found in front of or to the inner side of renal swelling, no matter how large the latter may be. If it be emptied of gas, however, this may not appear at once, though the fingers may feel a ridge, formed by the empty colon, running down over the front of the tumour. But even then it may be brought out clearly by inflation with air or slow injection of water from the anus, the patient's pelvis being raised for the time, during the percussion and manual examination of the abdomen. Again, if the surgeon have a slender hand and the patient be an adult, much information may be obtained as to the state of the kidney by passing the hand up the rectum, the patient being under chloroform. This can, however, only be done in certain cases, and should not be forced.

Finally, much insight may be gained into the nature of renal swellings by needle-puncture through the loin. The kidney can always be reached with safety by introducing a needle just below the last rib, and about 7 or 8 centimètres (2¾ to 3 inches) from the middle line of the back. If the needle be now thrust inwards directly across the axis of the body and towards the spine, it ought to strike the lower end of the healthy kidney. But, as this manœuvre is rarely necessary for the examination of the organ when of normal size, the point chosen should be lower down—viz. between the last rib and the crest of the ilium, and the direction of the needle should be somewhat forwards and a little downwards—in short, as nearly as possible towards the umbilicus. This is the direction the writer has been in the habit of adhering to as a routine practice. It is always best in such an examination to use a fine aspirator needle about four inches long, by which much information may be obtained as to the nature of the tumour, and warning be given at once should a vessel of any size be punctured. The dangers of this exploration are insignificant, the operation being post-peritoneal if performed with care; the writer is not aware of any injury having ever been produced by it, and he has both seen it used by others and employed it himself in a large number of cases. With very large renal tumours, considerable latitude may be given to the direction of the needle, so long as it is entered behind and kept away from the vessels entering the hilus. Catheterisation

of the ureter is a manœuvre which in some cases, if feasible, may yield important results. It is only possible in the female, and then only in a very few cases. The difficulty of introducing the long slender instrument into the vesical orifice of the ureter after passage up the urethra is so great, and in very many cases insurmountable, that it is not likely ever to come into general use.

Examination of the urine will embrace an estimate of its total amount for the twenty-four hours, for a series of successive days (normal 40 to 50 oz.); its specific gravity (1,015 to 1,025) on the gross amount; its reaction (acid); and the percentage of urea (2 per cent. to 2½ per cent. = 3 to 3½ grs. to every pound weight of the body of the adult, somewhat more for children). Further, it will include tests for albumen and sugar, and a microscopical search for elements of tissue and crystalline deposits. Again, much valuable evidence may be obtained by a careful and extended observation of the temperature of the body in the morning and evening. There are conditions of the kidney in which this record will be of special value, taken, of course, with other symptoms. They will be referred to under the several diseases.

Nothing but the most careful examination in all these directions ought to satisfy the surgeon; and it is only by the greatest watchfulness and the fullest consideration of all the data obtained that grave errors are to be avoided, especially where operations are in contemplation.

ARTHUR E. BARKER.

KIDNEY, Tumours of the.—These may be classified for convenience' sake into fluid and solid. Of the fluid tumours the most common are HYDRONEPHROSIS and PYONEPHROSIS, the less common the cystic kidney and hydatid swellings.

CYSTIC KIDNEY seems to be produced by similar causes to those originating hydronephrosis, but probably operating in a different way. It appears to arise, usually, from obstruction of one kind or another to the escape of urine from the kidney, but probably of an incomplete or intermittent character. In some cases, the mode of production is almost impossible to discover. But what is most frequently found is obstruction, either of the ureter or of one or more calyces or of some group of renal tubules, due to the presence of calculous matter or some catarrhal condition, or both combined. This may produce changes extending over every part of the organ, or may affect only a portion of it. The retention of urine, due to this obstruction, dilates the parts behind the latter until a number of loculi are produced containing cloudy urine, or until the whole organ is converted into a cluster of sacs, varying from the size of a pea to that of an orange. With a moderate degree of cystic change a kidney will secrete freely and well; and, were the obstacle removed, would probably continue to yield urine of an average quantity and quality for an indefinite time. But, in extreme cases, so much interstitial change has taken place that secretion is most seriously interfered with, if not totally arrested. This has been learned from the operations, which of late years have become common for these conditions, leaving a fistula in the loin from which the urinary flow can be watched.

The symptoms of cystic kidney are in most cases very obscure, unless the condition give rise to a very distinct tumour, which is rare. We have to depend here upon local pain, usually of an intermittent character, often very severe, and upon traces of catarrhal products in the urine passed, and also upon the absence of evidence of other disease. But, in many cases, cystic kidney is found after death in persons who have never complained of any renal disorder. Fortunately for surgeons, the patients afflicted with this disease who seek their aid are usually suffering from renal calculus as an exciting cause, and have the characteristic pain and other evidence to guide them, and a definite evil to remove.

The *treatment* is the same as for renal calculus. In other words, if a stone is found on exploring the organ through a lumbar incision, it is to be removed; but if the source of obstruction is not found, and the suffering be severe and the cystic change far advanced, the organ should be removed, provided there is evidence that the opposite kidney is sound. It would be better probably to do this as a secondary operation in all cases, and only after patient trial of drainage through the loin; for in some cases the latter has been found to relieve and even cure the pain, and, on the other hand, the question as to the state of the opposite kidney is always a most difficult one to decide. *See* NEPHROLITHIASIS.

HYDATID CYSTS of the kidney are very rare, and need only be alluded to here so far as to say that the symptoms will be those of a fluid tumour of the kidney (*see* HYDRONEPHROSIS), together with the extra evidence to be obtained by aspiration of the tumour in the loin, and examination of

the fluid removed for hooklets, &c. The urine passed *per urethram* will also in some cases contain the latter.

The *treatment* for hydatid disease of one kidney alone would be free incision through the loin into the sac, and removal of its contents and cyst wall, with free drainage of the resulting cavity.

Among the primary *solid tumours* of the kidney are nearly all the neoplasms—if we include under this term syphilitic and tubercular deposits, as is often done. Thus we find sarcomata, carcinomata, lipomata, angiomata, rhabdomyomata or tumours containing striped muscle-fibres, also some curious heterotopic growths formerly supposed to be lipomata, but now recognised as derived from fragments of the supra-renal capsule included in the kidney-substance during its development, which have taken on new growth at a later period of life. In the pelvis of the organ we also find papilloma, and, in any part, syphilitic gumma and tubercular deposit. These new growths are met with at all ages from infancy upwards, and apparently with equal frequency in both sexes. It is a point of some interest to note that, with the exception of the papillomata, syphilomata, and tubercular deposits, all the new growths appear to originate in the cortex and to spread inwards towards the pelvis. The sarcomata are mostly of the small-celled, soft, and vascular variety, and bleed readily; the carcinomata are also very soft, and cause hæmaturia in many cases; the same may be said of the papillomatous and tubercular masses. All the others as a rule do not bleed. It should be remembered here, as an important point bearing upon the question of operations on the kidney, that the new growths of the organ appear to limit themselves for a long time to it alone, and do not readily infect either surrounding tissues or the adjacent glands or circulation. They sometimes attain enormous size without any sign of generalisation anywhere.

The *diagnosis* of these tumours is based upon the same general considerations which guide us in their diagnosis elsewhere. We have, indeed, few special indications to help us except the state of the urine. Here, in the case of the sarcomata, carcinomata, and papillomata, we may find blood and, as in one of the writer's cases, shreds of the tumour; and, in the case of the tubercular kidney, there may also be hæmaturia, and, besides, a purulent sediment with shreds of caseous matter. But of the presence of the other growths no special signs are known. In all cases the history, both personal and family, must be carefully made out; then the duration and nature of the symptoms; then the urine be carefully examined, both before and after palpation of the tumour; finally, much information may be gained by careful puncture of the mass from behind, at the point of election, with an aspirator needle, and examination of the material withdrawn.

As to the *treatment* of these new growths, further study is required before definite rules can be laid down. But enough has already been learned to point to the conclusion that, with a clear history of malignant tumour, an exploratory incision should be made as early as possible, and if a growth be found, that it should be removed by Nephrectomy. Many cases are on record in which this has been done successfully, and many more in which the want of success has been due to delay of the operation until matters had gone too far. For the benign tumours little treatment is ever called for; they often give no sign of their presence during life.

Arthur E. Barker.

KNEE, Diagnosis of Affections of the. *See* Thigh and Leg, Diagnosis of Affections of the.

KNEE, Dislocations of the.—Although the bony surfaces of the knee-joint offer little impediment to dislocation, the ligaments holding together the bones are so strong that complete dislocation is very uncommon, except as the result of disease, and partial displacements are far from frequent.

Dislocation may take place *outwards*, *inwards*, *forwards*, *backwards*, and by *rotation outwards*. The lateral dislocations are incomplete; the forward and backward may be either complete or incomplete.

Partial dislocation outwards of the tibia is the most frequent accident, and may be caused by a weight striking the outer condyle when the limb is extended, or by an outward fall when the leg is caught in a hole. The outer condyle rests on the inner articular facet of the tibia, the inner condyle projects internally, and the outer tuberosity of the tibia and head of the fibula form a prominence on the outer side of the joint. A certain amount of rotation outwards of the leg usually accompanies this injury. *Reduction* is easily effected either by flexion or extension, combined with pressure, and an ice-bag or Leiter's coil should be applied to allay inflammation, after which the joint should be kept on a splint for a month to allow time for the reunion of the ligaments. After this, a knee-

support should be worn for some months. There is a rare accident with which this dislocation may be confounded, viz.: oblique fracture of the outer tuberosity of the tibia with fracture of the fibula, caused by a jump from a height on to the feet.

Partial dislocation inwards is usually caused by a fall on the outer side of the leg, the limb being bent under the body. The inner tuberosity of the tibia forms a prominent tumour immediately beneath the skin on the inner side, whilst the external condyle of the femur projects externally. The internal saphenous vein is liable to be injured by the displaced tibia. *Reduction* is easily effected by pressing the tibia outwards, at the same time that the foot is drawn inwards.

Dislocation forwards gives rise to very great deformity, and, when complete, the tibia may be forced up on the femur to the extent of two to four inches. It may be caused by some force striking the front of the femur when the leg is fixed, or by a heavy weight falling from the shoulders and striking the calf of the leg, whilst the person is stooping. The tibia forms a distinct prominence anteriorly, whilst the condyles of the femur project into the popliteal space, stopping pulsation in the artery and giving rise to great pain by pressure on the nerves. The dislocation is usually easily *reduced* by extension, after which it is necessary to keep the knee at rest for a month or six weeks. Passive motion should then be employed, and the knee be supported for some months in a leather cap.

Dislocation backwards is about half as frequent as dislocation forwards. The tibia projects into the popliteal space, compressing the vessels and nerves, and the condyles of the femur ride forward. The limb is usually found in a state of over-extension, and the patella lies with its surfaces horizontal beneath the projecting femur. *Reduction* can be effected by the surgeon fixing the foot with his knee in front of the ankle, and then clasping his hands behind the displaced head of the tibia, and drawing it downwards and forwards into a state of flexion. Should this method fail, ordinary extension may be tried. The after-treatment will be same as in the other forms.

Dislocation by rotation outwards is very rare. The tuberosities of the tibia are directed antero-posteriorly, and the patella projects on the outer side, whilst the inner surface of the leg is directed forwards and the fibula backwards. *Reduction* is to be effected by first making extension, and then twisting the leg inwards.

Congenital Dislocations are usually forwards.

Compound Dislocations as a rule necessitate amputation of the limb.

R. Clement Lucas.

KNEE, Excision of the. *See* Joints, Excision of.

KNEE-JOINT, Amputations at the. Disarticulation at, or amputation through the knee-joint, although alluded to and performed by the older surgeons, including Hildanus, Hoin of Dijon, J. L. Petit, Blandin, and Brasdor, did not find general acceptance until Velpeau, in 1829, strongly advocated the procedure, which he carried out by a circular amputation four fingers' breadth below the patella. Even then, it had but a short-lived popularity until Malgaigne expressed his emphatic opinion that it had been too soon abandoned, having regard to its special advantages in facilitating the movements of the hip-joint. His advocacy was supported subsequently in America by Smith, Markoe, and Brinton, and in England by Holmes, Pollock, and others. The advantages mentioned by Markoe are —(1) the slight shock attending the operation; (2) the limited section of the tissues; (3) the non-exposure of the muscular interspaces and the consequently diminished risk of suppuration in the thigh; (4) the comparatively few vessels requiring ligature; (5) the attachments of the thigh muscles being mainly preserved; (6) the absence of muscular retraction; (7) the diminished risk of osteo-myelitis and exfoliation, from the femur not being sawn across; and (8) finally, the useful character of the resulting stump. In spite of these advantages, the operation, owing to the irregular surface of bone on the face of the stump, the alleged liability to exfoliation of the cartilage of incrustation, and the high mortality, fell again into disfavour.

The next procedure adopted was the operation, recommended by Syme, through the condyles of the femur, but with a short anterior and long posterior flap taken from the calf of the leg, almost similar to the flaps made by Hoin in amputation through the knee-joint. The long posterior flap is, however, an obvious disadvantage. Hence Carden introduced a modification, dispensing with the posterior flap and substituting a long anterior skin flap. Carden's modification, which possesses many advantages, is still frequently performed. 'The operator, standing on the right side of the limb, seizes it between his left forefinger and

thumb at the spot selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round, through skin and fat, below the patella, to the spot pressed by his thumb; then, turning the edge downwards, at a right angle with the line of the limb, he passes it through the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upwards and the saw applied.' This operation, however, has two defects—(1) the danger of sloughing of the anterior flap, and (2) of a large gaping wound, owing to the tendency to retraction of the posterior tissues. These defects are to a great extent remedied by Gritti's operation, which consists in a somewhat square-shaped or rectangular flap taken from the front of the knee, retaining the patella, the femur being divided on a level with the condyles. In addition, the cartilaginous surface of the patella is removed, and the patella and the cut surface of the femur are placed in apposition, in the hope of bony union taking place. This operation suggests Pirogoff's amputation transferred to the knee-joint.

But in Gritti's operation there is a difficulty to be overcome—that of keeping the patella and the cut surface of the femur together. With this object, the writer has suggested a higher femoral section—namely, at a point from half to three-quarters of an inch *above* the antero-superior edge of the cartilage of incrustation. This point is selected, as a femoral section lower down inevitably leads to the tilting forward of the patella during the healing of the wound; and, on the other hand, were the section made higher than the point indicated, the medullary canal would be opened with increased danger to the patient; besides, the risk of the split patella hanging down at a lower level than the cut surface of the femur would be present. The femoral section being well above the condyles of the femur, the writer has suggested that this modification of Gritti's amputation be designated 'supra-condyloid.' Its steps may be briefly described:—The anterior flap, not rectangular, but oval, should reach from a point one inch above either condyle to the other, and thence downwards below the tubercle of the tibia. A posterior flap, at least one-third the length of the anterior flap, should also be formed, since the posterior tissues retract so much more than the anterior. Unless the flap be made in the situation indicated, there is the risk of a gaping wound, as in Carden's and Gritti's operations. By suturing the two bones together and leaving the sutures in the wound, displacement of the bones is effectually prevented, and the chances of bony union largely increased, while the condition most favourable to fibrous union exists.

The special advantages of the supracondyloid amputation are:—(1) The posterior surface of the anterior flap is furnished with a natural synovial lining, which largely diminishes the risk of exhaustive suppuration and purulent absorption. (2) By suturing the bones together, as described, the possibility of the split patella shifting from its place on the cut surface of the femur is prevented. (3) The osseous curtain, formed by the split patella covering the surface of the femur, lessens the risk of pyæmia and sloughing, as in the case of the periosteal curtain recommended by Von Langenbeck. (4) The vessels are divided at right angles to their continuity, instead of obliquely, as in other flap operations. (5) The posterior flap lessens the risk of a gaping wound posteriorly. (6) The diminished liability to tubular sequestra. (7) Only one large artery requires ligature. (8) There is less of shock than in the higher amputations, the divided muscles being few, and cut, not through their fleshy bellies, but at their tendinous extremities. (9) There is less liability to suppuration. (10) The medullary membrane not being interfered with, there is less liability to osteo-myelitis. (11) The preservation of the normal attachments of the extensors of the leg.

In suturing the bone, wire or chromicised catgut should be used. Having had in his earlier experience to deal at times with serious hæmorrhage from the popliteal vein, the writer now ligatures that vessel with chromicised or carbolised catgut, and no such trouble has since ensued. The cases for which this method of amputation is most suitable are—(1) Fractures of the leg necessitating amputation, in which the injury to the soft parts extends high up; (2) extensive necrosis, or abscess of the head or upper third of the tibia; and (3) cases of malignant growth, in which the removal of the whole leg is expedient.

William Stokes.

KNEE-JOINT, Diseases of the.—The knee-joint, from its prominent position, mobility, and active function, is peculiarly prone to disease.

Acute synovitis is very common in the knee, and is usually of *traumatic* origin. The swelling of this joint is obvious;

it reveals the outline of the synovial reflexions, making a rounded prominence over the lower end of the front of the femur, and bulging on either side of the patella. Fluctuation is easily felt from side to side, and the bulging is increased by pressing back the patella, which is thrust forward by the fluid, and can be made to 'rap' against the femur. The increased temperature of the joint can also be easily felt by the hand. Movement will be resisted and the joint fixed in the slightly flexed position, by the rigidity of the surrounding muscles.

If the synovitis be of *rheumatic* origin, other joints will probably be affected, and there will be, in addition, the general symptoms of rheumatism. It often happens however, that inflammation persists in one joint after the subsidence of the fever and the recovery of the other articulations, and the knee is especially liable to be the joint selected. Synovial effusion persists or recurs, and, when the swelling is removed, the joint is left stiff by adhesions both within and around the joint.

Pyæmic synovitis frequently attacks the knee, and in the acute form usually leads to rapid and destructive suppuration. The occurrence of suppuration is indicated by increase of the constitutional disturbance, and by the presence of œdema along the sides of the condyles of the femur and the head of the tibia.

The first essential in the *treatment* of all acute inflammations of the knee is to ensure perfect immobility of the joint. A splint must be applied, extending to the upper part of the thigh and including the whole of the leg and foot; and to this the limb is to be bandaged in a position of slight flexion. A McIntyre's splint is a convenient form, but whatever kind of splint is used must have a foot-piece, and include the whole limb as far as the upper fourth of the thigh. In many cases much comfort is given by swinging the limb, as in a 'Salter's cradle.' In the early stage of synovitis the joint may be leeched, or cold applied; and when the acute symptoms have subsided, blisters and pressure are useful.

When suppuration is suspected, the nature of the effused fluid is to be ascertained by aspiration, and, if pus is present, the joint must be freely laid open by an incision on each side of the patella, as far back as possible, so as to thoroughly drain the cavity.

Subacute synovitis, leading to hydrops articuli, is more commonly seen in the knee than in any other joint. The joint is weak, and bulges in all directions from the contained fluid. If blistering or pressure by an elastic bandage or strapping does not remove the fluid, the joint must be emptied by aspiration, and pressure be afterwards maintained; and if it again fill, an injection may be used, such as a 1 per cent. solution of carbolic acid, or a mixture of tincture of iodine and water, 1 to 10 or 20. An elastic knee-cap must be worn afterwards. *See* Hydrarthrosis.

Recurrent synovitis in the knee is sometimes due to adhesions within the joint, in which case movement will be restricted, and perhaps painful, in certain directions. The adhesions are to be ruptured by sudden flexion during anæsthesia.

Chronic synovitis of the knee-joint is commonly met with in the form of pulpy degeneration, giving rise to an indolent elastic swelling of the synovial tissue, and leading eventually to ulceration of the cartilages and softening of the ligaments. After a time, displacement of the bones occurs, the tibia being drawn backwards and rotated outwards and the limb flexed, so that the articular surface of the femur projects in the front of the joint, and the patella rests on the outer condyle.

Scrofulous disease of the knee may commence thus, or, as is more commonly the case, in a chronic articular ostitis. In either case, the disease makes very indolent and slow progress, the products of inflammation showing an early tendency to degenerative changes, so that the synovial membrane, having first become thickened and pulpy, slowly caseates or suppurates; or the expanded joint-ends of the femur and tibia gradually undergo central softening, and ulcerate either in the direction of the surface or into the joint. These changes are accompanied by but little pain or pyrexia.

At the commencement of chronic disease of the knee-joint, the limb must be at once fixed upon a splint; if there be any considerable heat or pain about the joint, perfect rest must be enjoined, but if these be slight, a well-fitted leather splint, or a Thomas's splint, may be applied, and the patient allowed to get about on crutches and with a thick sole to the boot on the sound limb. Every possible attention must be paid to the general health and to improving the reparative power; while, at the same time, local counter-irritation may be effected by the cautery or repeated small blisters, and followed by strapping over mercurial ointment.

In more advanced cases of synovial degeneration, in young subjects, the pulpy

tissue may be scraped or dissolved away through lateral incisions made on each side of the patella. A Volkmann's spoon should be used for scraping out the diseased membrane; sulphuric acid diluted with two parts of water may be used for its solution. The remaining alternatives are excision or amputation.

If the disease commence in a chronic ostitis of the end of the femur or head of the tibia, symptoms of suppuration must be carefully watched for, and any indication of the presence of matter within the cancellous tissue must be followed by perforation of the bone, to endeavour to obtain its exit upon the surface rather than into the joint. It is not uncommon in performing excision of the knee to find, on making the section of the tibia, the cavity of an abscess from which matter has made its way into the joint. If such a cavity does not extend far from the joint surface, it may be scraped out, and a satisfactory ankylosis may still be obtained; but if the bone be extensively softened or carious, amputation will be necessary. The same may be said of abscess in the end of the femur.

Syphilitic disease of the knee is met with, both as a synovial effusion accompanying the secondary stage, and also as a gummatous infiltration of the synovial membrane, or of the sub-periosteal or other tissues around the joint.

The joint must be kept at rest during the administration of antisyphilitic remedies, and under these the secondary synovitis usually subsides. The tertiary disease often leaves much stiffness from thickening and cicatricial contraction, both within and without the joint. This form of disease is also met with in inherited syphilis. In addition to the constitutional treatment, shampooing, passive movements, and friction with oleaginous liniments must be resorted to.

The knee is one of the joints most frequently the seat of *osteoarthritis*, the symptoms of which are usually easily recognisable. There is a moderate amount of synovial effusion, marked and often loud crepitation on movement, and alterations in the shape of the ends of the bones, obvious both to sight and touch. Much lameness results, and sometimes much wasting of the muscles of the thigh and leg. The disease may be retarded and ameliorated, in its earlier stages, by treatment directed to the correction of rheumatic tendencies, and by the local use of warm douches and frictions; the joint should be supported, as by a flannel bandage, but not fixed; and unless there be much or increasing swelling, moderate use of the limb may be permitted.

Loose cartilages, though occasionally met with in other joints, are found chiefly in the knee, wherein their presence is the more obvious because of the grave inconvenience to which they give rise. The anatomical structure of the joint and its free movement make it especially easy for the loose body to slip between the ends of the bones; this gives rise to acute pain, and may cause the patient to fall. Recurrent synovitis is set up, with increasing weakness of the joint, and the usefulness of the limb is materially impaired. The body can be pushed to the surface of the joint and felt through its coverings. Sometimes it is pedunculated, and its movements therefore restricted to one part of the joint. Loose bodies are often multiple.

If the patient be in good health the loose cartilage is best removed by direct incision of the joint, with antiseptic precautions. If this be not desirable, attempts should be made by strapping and bandaging to fix the loose body in one part of the synovial sac, and an elastic knee-cap be worn to restrict movement and support the joint. *See* Loose Cartilages.

J. Warrington Haward.

KNOCK-KNEE. *See* Genu Valgum.

KOCHER'S OPERATION. *See* Tongue, Operations for Removal of the.

KYPHOSIS. *See* Antero-Posterior Spinal Curvature.

L

LABIA PUDENDI. *See* VULVA.

LABYRINTH, Affections of the. *See* EAR, INTERNAL, Diseases of the.

LACRYMAL APPARATUS, Diseases of the.—ACUTE INFLAMMATION OF THE LACRYMAL GLAND, or of the connective tissue immediately surrounding it, is acknowledged by all observers to be of rare occurrence. The local signs are redness, heat, pain, swelling, and disturbance of function. In some cases, the secretion is greatly increased in quantity; Schmidt, for example, stating that he collected by means of a sponge, in the course of twenty-four hours, no less than two pounds seven and a half ounces of fluid. In other instances it is diminished. The globe of the eye is pushed downwards, or downwards and inwards, and its movements are interfered with, so that diplopia results. Vision is not, however, materially lowered, because the elasticity of the optic nerve permits some stretching to take place without impairment of function. Intolerance of light and spasm of the lids have been occasionally noticed.

The process of suppuration in the lacrymal gland is attended with considerable disturbance of the general health. The swelling remains for some time hard and resistant to pressure, owing to the dense tissues surrounding it. It is limited to the outer part of the orbit and eyelid, and in the course of ten days or a fortnight begins to soften, and may point either in the conjunctival sac or on the skin near the margin of the orbit. The pre-auricular lymphatic gland is sometimes swollen. The treatment consists in the application of leeches, irrigation with cold water, purgation, and general antiphlogistic measures. Owing to the deep situation occupied by the gland, the abscess, if allowed to burst spontaneously, is apt to leave a fistulous tract behind it. It should therefore be opened freely as soon as fluctuation is perceived. The incision should be made parallel with the margin of the orbit and the fibres of the orbicularis muscle. A drainage-tube may be introduced.

CHRONIC INFLAMMATION OF THE LACRYMAL GLAND is also of rare occurrence. The symptoms resemble those of the acute form, but are more subdued. The formation of a fistula is not infrequent. Where this unfortunate event has taken place, attempts may be made to effect its cure. The most effective method consists in threading two needles with a piece of fine silk. One of the needles is then introduced through the external orifice, and made to travel for some distance up the fistulous passage before perforating the conjunctiva; the other needle is carried through the conjunctiva close to the cutaneous orifice of the fistula. On tying the two ends of the silk together, a portion of the conjunctiva is enclosed in the loop, which on cutting its way out establishes a new opening for the tears. After the edges of the fistula have been freshened, and brought together with a suture or two, the cutaneous passage closes. Another method consists in heating to redness, by means of a galvanic battery, a wire, which has been introduced into the fistula.

CHRONIC ENLARGEMENT OF THE LACRYMAL GLAND may be due either to simple hypertrophy of the gland-tissue, or to the formation of such benign tumours as adenoma, fibroma, myxoma, and chondroma; or lastly to the gland becoming the seat of the malignant and recurrent tumours known as round-celled and spindle-celled sarcoma, which usually occur in children, carcinoma and epithelioma, which are most common in old persons. In several of these forms of disease cysts and partial colloid degeneration may supervene. Cases of syphilitic disease of the lacrymal gland have been recorded by several observers; one by Mr. Streatfeild was cured by the use of mercury and iodide of potassium. It is very difficult to diagnose a chronic enlargement of the lacrymal gland from a node, and it is probable that the two affections have sometimes been mistaken for each other, especially as both may proceed from the same cause, and may both disappear under the same treatment.

EXTIRPATION OF THE LACRYMAL GLAND. The lacrymal gland consists of two parts, one superior, the other inferior and in close relation with the conjunctiva. If the upper or larger mass alone require removal, it is sufficient, in prominent eyes, to make a cut through the skin just below the eyebrow, parallel to the margin of

the orbit, and, in deep-set and low-browed eyes, to shave the hairs and divide the skin along the middle of the eyebrow for the space of an inch and a half. The depth at which the gland is situated is considerable, and the dissection must be continued till it can be seized with vulsellum forceps and drawn down. A little manipulation with the handle of the scalpel will then effect its removal. When the gland is greatly augmented in size, or when both parts have to be removed, the palpebral fissure may be enlarged by a cut made towards the temple from the external canthus. The small branches of the facial artery which are divided should be tied, and the upper lid can then be dissected up till the gland is exposed, when it may be seized and removed as before. Mr. Z. Laurence, who extirpated the gland on several occasions, not only enlarged the palpebral fissure in the manner just described, but made a cut below the eyebrow, which was continued till it met the first incision at an acute angle. The triangular flap thus made was dissected back towards the nose, till the gland was exposed.

Obstruction of the Canaliculi.—The orifice of one or other of these minute tubes is sometimes occluded by a delicate pellicle, which may be broken down with facility by the pressure against it of a sharp-pointed probe or a breast-pin. It appears to be a congenital defect when the opening is obstructed in this or any other manner. The tears collect at the inner corner of the eye, and, if not wiped away, from time to time trickle over the margin of the lid and down the cheek, which they redden and excoriate. This condition, which is named *Epiphora*, is especially marked on exposure of the eye to cold winds, bright lights, and after food, and during any mental excitement occasioning congestion of the vessels. In such cases there is usually some redness of the conjunctiva, both ocular and palpebral. A little puriform mucus appears in the conjunctival sac, and the lids stick together during sleep. When these symptoms have suddenly appeared, a careful inspection should be made of the puncta lacrymalia with a hand lens. An eyelash or other foreign body may sometimes be discovered, the removal of which at once relieves the symptoms. Small dacryoliths, and occasionally accumulations of leptothrix, have been observed to occlude the canaliculi. As a rule, they require removal by an incision. Occlusion of the canaliculi is often the result of burns, lacerations, and surgical operations performed upon the lids, as well as of the development of polypi. In the former cases, efforts should be made to restore the patency of the canal, which may sometimes with care be effected.

Deviation of the Puncta.—It is of great importance that the puncta should occupy their normal position. If the margins of the eyelids are turned inwards, they become applied to the globe of the eye; if outwards the fluid cannot enter these orifices, and in either case epiphora results. The conditions leading to deviation of the puncta are very various. In old people eversion of the lower lid is often attributable to mere relaxation of the skin and loss of power of the orbicularis muscle. It may also be due to paralysis of the facial nerve, a condition that has been observed in infants as the result of the employment of forceps in delivery. Such cases are commonly incurable, and removal of the lacrymal gland holds out the best prospect of improvement. Thickening attended with some eversion of the lids is a frequent result of ciliary blepharitis; and when this is ascertained to be the cause, the conditions which have led to the inflammation of the lids should be carefully studied, attention should be paid to the refraction of the eye, and appropriate local and general measures be adopted, before resorting to any of the operative measures which are about to be described. See *Blepharitis Ciliaris* under Eyelids, Diseases of the.

Mucocele or Chronic Dacryocystitis. This condition is usually but not necessarily associated with epiphora—that is to say, where mucocele exists there is almost always epiphora, but epiphora may exist without mucocele. It is probably, in most instances, the result of antecedent inflammation of the sac.

The symptoms are those of a smooth, rounded, or oval tumour presenting itself at the inner angle of the eyelids in the position of the lacrymal sac. It is often bilobed in consequence of the position of the ligamentum palpebrale internum, which crosses the sac at right angles, and binds it down near its centre. It is painless and tense, though possessing a considerable amount of elasticity. In some instances no impression can be made upon it by pressure, whilst in others it may be partially or completely emptied, the contents either altogether passing down the nose, or being regurgitated through the canaliculi and puncta into the sac of the conjunctiva. Not infrequently it flows in both directions. The fluid which regurgitates is at first clear, thin, and transparent, as though com-

posed of tears alone, but almost immediately becomes thick and glairy, and if the pressure be continued puriform mucus is usually discharged. The flaccid sac can then be felt. In most instances the conjunctiva, especially near the inner angle of the eye, is red and inflamed, and not infrequently pustules appear on the margins of the lids; whilst, in a large proportion of cases, the epithelium of the cornea at the sclero-corneal junction may be detached, a condition which may develop into an ulcer of considerable depth with whitish slimy base. According to Panas, in the healthy state the membrane of the sac secretes a glairy fluid, in which columnar epithelial cells destitute of cilia may be seen with the aid of the microscope. In disease, lactescent striæ appear in the fluid, which at first sight look like pus, but which are only accumulations of mucus-globules, resembling those met with in the fluid secreted from other inflamed mucous membranes. It is only when the inflammation has attained a certain degree of intensity and has become the seat of an epithelial exfoliation or ulceration, that the contents of the sac become really purulent. In some instances, small plates of cholesterine are to be found in the fluid. In the early stages of chronic inflammation of the lacrymal sac, the membrane is either uniformly reddened or presents patches of congestion. After some time it becomes thickened and soft, bleeding freely when touched; and it is stated by those who have laid the sac open—an operation now rarely performed—that the mucous membrane presents a villous aspect, with rugæ that must greatly tend to occlude the passage.

At certain points constrictions are apt to occur, the most common site being the point where the lacrymal sac becomes continuous with the nasal duct, the next the point of entrance of the canaliculi into the lacrymal sac, and perhaps the next the inferior orifice of the nasal duct. In the dissection of a lacrymal fistula which had existed twenty-two years without treatment, A. Voisin found that the common opening of the two lacrymal ducts into the lacrymal sac was obliterated; the sac when empty and retracted presented friable walls. There was a complete obstruction at the point of junction of the sac with the nasal duct. In some instances, the lacrymo-nasal passage has been observed to be constricted at the point where the sac is continuous with the nasal duct; in others the mucous membrane of the sac has been found to be of a vivid red colour, with considerable thickening of its walls; in others the sac has been found to be filled with a polypoid growth.

In regard to the etiology of chronic dacryocystitis, it is generally acknowledged to be associated with signs of strumous diathesis. The patients are often soft and flabby, with dull turbid complexions, and are subject to chronic inflammation of the eyelids and of the mucous membrane of the nose. In such cases the course of the disease is easy to read. The inflammatory process, affecting the Schneiderian membrane or the conjunctiva, spreads by contiguity up or down the naso-lacrymal passage. The secretion of mucus is augmented and, gravitating towards the bottom of the nasal duct, the orifice of which may be congenitally small and is now still further reduced by the general swelling of the mucous membrane, plugs and occludes it, or at all events renders the passage of tears very difficult and slow. The conditions now react on each other. The mucus and tears accumulating, still further distend the sac and increase the congestion, and the state of the whole sac and its contents is ripe for an explosion of acute inflammation, which may readily be excited by a slight blow, by the entrance of some septic matter, by cold or, possibly, even by disease of the adjoining bones caused by the long-continued pressure. Badal is of opinion that errors of refraction play an important part in the production of disease of the lacrymal organs. The error is as a rule moderate, and is on the side of hypermetropia.

In some instances of mucocele, however, a totally different condition of disease is present, and we have to deal, not with a constriction of the lacrymo-nasal passage, but with the growth of a cyst in the lacrymal sac. In such cases, the tumour may for a time only partially occlude the duct, and digital pressure over the sac may cause some fluid to regurgitate into the conjunctival sac and some to descend into the nose; but, after emptying it as thoroughly as possible in this way, there still remains a swelling which cannot be dispersed by pressure, and at a later period, when the cyst has grown sufficiently to fully occupy the sac and to distend its walls, no fluid will escape even when the pressure is very firmly applied.

If left to itself, chronic inflammation of the lacrymal sac has a strong tendency to induce caries and necrosis of the bones surrounding it. In some instances there are outgrowths from the bone itself, which may be painful or indolent; in others there is thickening of the periosteum, resulting

from specific periostitis; in others, again, some portion of the lacrymal bone or ascending process of the superior maxillary is carious or necrosed. The writer has seen one case in which the frontal sinuses were filled with thick muco-purulent fluid, and in which there was caries of the ascending process of the superior maxillary bone and perforation of the palate-bone. A cure was effected by slitting up the canaliculus and passing the large end of Weber's probe, making a deep incision in the palate and removing some sequestra, and the sedulous use of antiseptic injections. There was no history of syphilis in this case, nor the slightest suspicion of such disease having existed. Many cases have been reported, however, in which the caries and necrosis of the facial bones have followed syphilis, and its pre-existence would certainly modify the treatment to some extent.

Treatment.—The different methods suggested may with advantage be considered under the following heads:—1. The prevention of the flow of tears. 2. The obliteration of the lacrymo-nasal passages. 3. The restoration of the patency of the lacrymal passages; and, lastly, 4. The formation of new passages for the discharge of the tears.

1. The prevention of the secretion of tears can only be accomplished by tying the ducts of the lacrymal gland, as recommended by Sedillot, or by the removal of the lacrymal gland, an operation that has been recommended and practised by P. Bernard, Z. Laurence, and Tavignot. The method of performing it has already been described.

2. The proceedings for the obliteration of the lacrymal passages include the obliteration of the puncta, the excision of the lacrymal sac, the laying open and cauterisation of the sac.

3. The methods for restoring the patency of the lacrymal passages consist in the employment of injections, and the gradual or rapid dilatation of the ducts, with or without antecedent slitting up of one canaliculus.

4. The operations for making a new passage consist in perforating the os unguis with the object of allowing the tears to drain into the nose, or in establishing a communication with the maxillary sinus.

It may be laid down as a general rule in the treatment of chronic dacryocystitis and mucocele, that the simpler measures should be exhausted before resorting to cutting instruments and the passage of probes. These, especially in unskilful hands, and sometimes even in the hands of those who have had considerable experience, do infinite harm. It is exceedingly difficult to make the finer probes pass down the lacrymal sac and nasal duct, even in the perfectly normal eye. They can readily be made to traverse the whole length of the canaliculi, but beyond this point they are apt to become entangled in the folds of the mucous membrane, and the slightest pressure makes blood appear—a sure proof that the membrane has been perforated and a false passage made; and if this be true of the normal eye, how much more difficult is it likely to be when the membrane is swollen, congested, and softened from disease? In such cases bleeding invariably occurs, and sometimes, it is to be feared, the bone is perforated and broken in the vain attempt to pass a probe in a wrong direction. Then, again, the operation of slitting up the canaliculus, whilst allowing the passage of larger probes with ease, and enabling strictures of the nasal duct to be dilated, is yet by no means always successful, and gives but small assistance when dead bone can be felt. In making the section, it is certain that parts of great importance from a physiological point of view are divided, since it not infrequently happens that, although probes of large size can be passed with the utmost facility through the aperture thus made into the sac and down the nasal duct, the flow of tears is as troublesome as before; apparently because the exhausting or compressive action of the fibres of Horner's muscle or of the orbicularis muscle upon the fluid in the lacus lacrymalis has been destroyed.

It is well, therefore, to commence the treatment of mucocele, especially if the sac can be emptied and its contents discharged into the nose by moderate pressure with the finger, by resolvent local and general remedies. The surgeon may assure himself of the patency of the puncta and canaliculi by the careful and slow passage of a No. 1 or 2 of Bowman's probes, injury to the parietes being avoided as far as possible, since it is certain to increase the evil and perhaps to induce an attack of acute inflammation of the lacrymal sac.

Hot poultices, and especially the application of dry warmth in the form of bags of heated chamomile flowers, hops, or bran, are often of great service. The injection of water or of some medicated solution, by means of a fine Anel's syringe introduced a little way into the canaliculus, may then be tried. The best collyria to be injected are a 5 per cent. solution of boracic acid, and weak solutions of

iodine, alum, copper sulphate, and potassium iodide; or a small quantity of an ointment composed of one grain of atropine sulphate, five grains of mercury binoxide, and one ounce of vaseline, may be inserted between the lids. Good results are stated to have been obtained by blowing iodoform into the canaliculus and lacrymal sac. An examination should, in every case, be made into the conditions of the mucous membrane of the nose, as it is not improbable that some cases of chronic dacryocystitis proceed from extension of inflammation in that region, and that, by the cure of the primary affection, the state of the lacrymo-nasal passage may be improved or at least rendered more amenable to treatment. At the same time attention should be paid to the health. The general and dietetic regimen for struma and scrofula, with which the disease is so often associated, should be insisted on; and cod-liver oil, quinine, iron, warm or cold salt-water baths, country air and the removal of the depressing influences of late hours, excessive smoking, and the abuse of alcohol, are important points in the treatment.

When these measures fail, and it is clear that some obstruction exists in the lower part of the lacrymal sac or nasal duct, the passage of a probe must be attempted and dilatation effected.

With this object in view, fine probes may be passed down the canaliculi and the lacrymal sac, the diameter of the probes being gradually increased until the largest that can be made to enter the puncta have been introduced. If still no passage can be obtained, the canaliculus of the upper or lower lid may be divided for a part of its length, which allows the entrance of a larger probe and the more easy application of injections. In the event of this proceeding failing, it is expedient at once to proceed to perform the operation of slitting up the canaliculus along its whole length, which was originally proposed by Sir William Bowman. Since the inferior canaliculus is the most important in the process of draining off the tears, it is prudent to attack the superior canaliculus, which has the advantage of being in a more direct line with the sac, and thus permitting the passage of a probe, after its division, more easily.

The Method of Bowman.—This plan of treatment has the great advantage of enabling the surgeon to deal directly by means of large probes with strictures of the nasal duct or lower part of the lacrymal sac, without making any unsightly wound in the face. It consists in introducing through the superior or inferior punctum lacrymale and along the corresponding canaliculus a sharp-pointed small probe, which is grooved for about half an inch from the extremity. As soon as the point has entered the lacrymal sac, and is felt to touch its inner wall, it is withdrawn for a short distance, and either a probe-pointed knife or a Graefe's linear or other narrow-bladed knife is placed in the groove of the probe, which is turned towards the free surface, and is made to traverse a part or the whole of its length. By this means the canaliculus is slit up and converted into a groove or channel, and a straight or slightly bent probe can now be often at once passed down the nasal duct, breaking down or distending any obstruction that may have prevented the passage of the tears. The quantity of blood lost is sometimes very small, but occasionally the hæmorrhage is sharp for so small an operation, in consequence of the division of the angular artery. It is requisite to separate the lips of the little wound with a probe for one or two mornings after the operation, to prevent union from occurring. Some operators, with the same object in view, remove a small strip of the posterior edge of the wound with scissors, or touch the wound with oil or glycerine for a day or two.

In cases of simple obstruction, the passage of a moderate-sized probe through the nasal duct is sufficient to effect a cure; but when the bone is carious or necrosed, it is advisable to introduce a style, which is a straight piece of silver of the thickness of an ordinary dressing probe, and about an inch and a half in length. One end is smoothly rounded off, the other is enlarged into a head, or is sometimes bent like the handle of a walking-stick, to prevent its slipping into the dilated sac, an accident that has not infrequently occurred, though without serious consequences. The style may be worn for several days, being removed each morning in order to be cleansed. Weber has recommended the employment of elastic bougies as a means of dilatation of the duct. These have a diameter of one and a half millimètres at their extremity, but increase to a diameter of four millimètres, and on being introduced forcibly dilate the passage. Laminaria bougies have also been employed, which being introduced in the dry state absorb water, swell, and thus forcibly dilate a stricture. The objection is that they are brittle, and have been known to break off at the point where they were compressed by

the stricture, the lower fragment blocking up the canal below this point, and being then exceedingly difficult to remove.

The Method of Weber.—In this method of treatment, reliance is placed on the action of a conical sound to break down or forcibly dilate the stricture. Weber employs a very small probe-pointed knife, with a cutting edge of about one-third of an inch in length and a breadth of blade of one-twelfth of an inch. The lower lid being drawn outwards, and thus put on the stretch, the small button at the end of the knife is introduced into the punctum, and the canaliculus slit up for the greater part or the whole of its length; the conical sound is now gently pressed down the lacrymal sac and nasal duct.

The Method of Stilling.—This is founded on the supposition that the obstruction to the flow of tears is due to the presence of valve-like folds and rugæ in the sac and nasal duct, the free division of which leads to the formation of cicatrices. The contraction of the cicatrices obliterates the folds, and the patency of the passage is restored. Stilling first slits up the canaliculus with a probe-pointed Weber's knife, and then introduces, through the wound thus made into the sac, a peculiarly shaped knife, which has a triangular blade about half an inch in length and with a width of one-eighth of an inch. It is strong and substantial, with a thick back, sharp cutting edge, and blunt point. This is made to pass down the nasal duct, and is then partially withdrawn so as to incise the mucous membrane. The blade is then turned about a quarter round, again pressed down and withdrawn, and, by a repetition of this manœuvre, a series of vertical incisions is made in the mucous membrane of the lacrymal sac and nasal duct. This method is sometimes termed stricturotomy, or better, stenositomy. The method may, of course, be combined with the injection of medicated solutions and with the employment of probes.

A different mode of performing stenositomy is, after previous slitting up of the canaliculus, to introduce a knife with a concealed blade or lacrymotome down the nasal duct; pressure on a spring causes the blade to protrude, and the section can be made in any desired direction.

When, after slitting up the canaliculus, dead bone can be felt on the introduction of a probe, the sac should be washed out with some disinfecting solution, as a 3 per cent. solution of resorcin, and then a fluid injected, consisting of equal parts of glycerine and iodoform, with a little water, two or three times daily. The dead bone sometimes slowly disintegrates, whilst, at others, a fragment may become detached, and if felt to be loose may be cut down upon and removed.

In a paper read before the Chicago Society of Ophthalmology, Dr. Hotz recommends that the treatment of lesions of the lacrymal sac should be effected by means of medicated gelatine bougies, having the thickness of Bowman's probes numbered from 2 to 6. The materials with which the gelatine is impregnated are iodoform or carbolic acid (*Journ. of the Amer. Med. Assoc.*, January 26, 1884). Such means would probably be serviceable where there was only disease of the mucous membrane; but in a considerable number of cases, especially when the patient has suffered from lacrymal abscess which has been allowed to maturate and burst spontaneously, the lacrymal bone, or ascending process of the superior maxillary bone, is necrosed, and in such cases the free slitting up of the canaliculus seems to be the only means of cure.

Dr. Gorecki has quite recently recommended and practised an operation to which he has applied the term dacryocautery. In the performance of this operation, he first slits up the superior or inferior canaliculus, then introduces into the nose, through the nostril, a canula, made of silver or platinum, resembling a tracheotomy canula, which is connected with the positive or carbon pole of a battery. A Bowman's probe is then passed down the canaliculus, lacrymal sac, and nasal duct, and a pair of spring forceps in connection with the negative or zinc pole is attached to it. A galvanometer is introduced into the circuit in order that the completion of the current may be recognised. The current, which proceeds from a Grenet's battery, having an electro-motive force of 2,028 volts, is then passed; a luminous shock is felt, followed by tickling in the nose and the formation of a few bubbles of gas. A small mass of inspissated mucus forms round the sound at the inner angle of the eye, but scarcely any pain is felt. In a very short time the sound can be felt to be less tightly grasped, and a larger probe can be immediately passed.

Acute Inflammation of the Lacrymal Sac, Dacryo-cystitis Phlegmonosa.—In a large proportion of cases this disease is preceded either by epiphora or by mucocele, but occasionally, as in some forms of eruptive fever, it occurs when the lacrymal passages have previously been healthy. It commences with a sensation of heat at the inner angle of the eye and dryness of the

corresponding nostril. A swelling soon appears in the region of the lacrymal sac, which is exceedingly tender to the touch: red and hard at first, it quickly presents the characters of an abscess, and in the course of three or four days matures. At this time the swelling and redness may extend over the cheek and nose. The conjunctiva is inflamed, the lids become puffy and œdematous, there is severe throbbing pain, and, if seen for the first time at this period, the affection is often mistaken for erysipelas. In old and weakly patients, and especially in women during lactation, there may be considerable constitutional disturbance; rigors, foul tongue, nausea, frequent pulse, and sleeplessness being common symptoms. The matter now approaches the surface, the skin becomes purple at the most prominent part, and if left to itself at length gives way at one or more points, allowing the discharge of thick pus, sometimes mingled with membranous shreds of dead tissue. The symptoms now recede, the area of redness diminishes, the pain subsides, the lids resume their normal volume, and vision, prevented by their swelling, again becomes possible.

A *lacrymal fistula* may remain, opening either on the cheek or in the sac of the conjunctiva, though in general the wound heals and a scar alone remains to show where the abscess broke. In most cases that have been allowed to run their course unchecked, some part of the bony parietes of the lacrymal sac becomes necrosed, and in some instances still more serious results have been observed, such for example as orbital abscess, and even meningitis. The treatment is identical with that of an abscess in any other region. In the first instance, hot bread and water or linseed-meal poultices should be applied, and an emetic of thirty grains of ipecacuanha, with or without a grain or two of potassio-tartrate of antimony. Active emesis, with the administration of full doses of quinine, will often arrest the progress of the disease, and will in all instances facilitate the subsequent treatment. If pus be evidently present, and fluctuation can be perceived, a free opening should be made into the sac, and this may either be accomplished by entering the point of a Graefe's linear knife opposite the inner canthus of the eye and cutting in a curved direction downwards and outwards, or a grooved probe may be introduced into the canaliculus, and the sac opened by slitting up this passage. A Weber's probe may then be passed down the nasal duct, and the original cause of the disease may thus in some instances be removed. Finally, an injection of solution of carbolic acid containing 1 to 2 per cent. of the acid may be injected, and a tent, wetted with the same fluid, may be inserted.

Injuries of the Lacrymal Sac and Nasal Duct are occasionally met with as the result of direct violence. In such cases the bones adjoining the canal are often fractured, and in the first instance hæmorrhage and emphysema, and subsequently epiphora, are observed. The emphysema may cause considerable swelling of the lids, and is recognisable by its doughy feeling and its crepitation. The occlusion of the lacrymo-nasal canal, which results from fracture and leads to epiphora, is difficult to treat. The course of the canal is altered, its diameter is diminished by projecting portions of bone, and callus may be thrown out to an extent which completely obliterates the passage. The introduction of a probe then becomes extremely difficult or impossible, and if undue force be used, sharp hæmorrhage may occur from laceration of the mucous membrane, and the bone may even be penetrated. Henry Power.

LACTATION, Disorders of. *See* Breast, Diseases of the.

LAPARO-ELYTROTOMY.—This is an operation proposed as a substitute for Cæsarean section, and for the delivery of the child when this is impossible by the natural passages, either from contraction or deformity of the pelvic bones, from obstruction due to some pelvic tumour, or to disease of the cervix uteri.

In 1806, Jörg suggested cutting through the abdominal wall by an incision extending from the spine of the pubes to the anterior spine of the ilium, then cutting through the vagina, and delivering through the os uteri. In 1820, Ritgen proposed the same operation, but whereas Jörg proposed to cut through the peritoneum, Ritgen advised lifting it out of the way. Ritgen is said to have performed the operation with a fatal result. In 1822, Physick of Philadelphia again proposed the operation, and in 1823, A. Baudelocque, jun., attempted to perform it, but abandoned it and performed the Cæsarean section.

In 1870, Dr. Gaillard Thomas, of New York, performed the operation upon the dead subject several times, and believed that the idea had originated with himself, until his attention was called to the literature of the subject. In the same year he performed the operation, and delivered a

living child, but both mother and child died in a few hours. Dr. A. J. C. Skene, of Brooklyn, then operated three times; in the first case the child's head had been already perforated, and the mother died in seven hours; in the second case both mother and child survived, but the former had a small vesico-vaginal fistula as the result of the operation; this was afterwards closed by operation, and she was well in 1876; in the third case both mother and child survived, but again there was a vesico-vaginal fistula, which healed spontaneously. Eight years later Dr. Thomas operated successfully; but again the bladder was injured, and a fistula resulted, which healed without operation.

Operation.— Dr. Thomas advises the operator to be provided with a pocket case of instruments, an anæsthetic, Barnes's dilators, and Paquelin's cautery, or the ordinary cautery-irons.

The patient is laid upon her back upon a firm table, and the os is fully dilated with Barnes's dilators. The abdominal parietes are incised on the right side, from the spine of the pubes, along the upper edge of Poupart's ligament, to the anterior superior spine of the ilium. When the peritoneum is reached it is lifted out of the way. The operator or an assistant passes his finger from the vagina through the dilated os, and pushes up the vagina, which is incised from above at its junction with the uterus. The opening in the vagina is then enlarged by tearing it downwards, and the child delivered through the abdominal wound; by version, if the head or arm present, by extraction, if the breech do so. The placenta is then delivered, and the uterus made to contract firmly. The wound is cleansed by a stream of carbolised water poured through it, and escaping by the vagina. Hæmorrhage is checked by ligatures, by the cautery, or by tampon. The abdominal wound may be left open or closed by sutures, a track being left for drainage. Antiseptic syringing of the wound and vagina is employed afterwards, if necessary. The application of Listerism to the whole procedure, with a light antiseptic packing of the vagina during the early days after the operation, would certainly decrease the risk.

The advantages claimed for the operation are that it avoids opening the peritoneum and incising the uterus, and is easy and rapid; but it does not seem, so far, to have made much way with obstetricians, and has been rarely performed.

J. Knowsley Thornton.

LAPAROTOMY FOR INTESTINAL OBSTRUCTION.—This operation consists, essentially, in making an opening into the cavity of the abdomen. In cases of intestinal obstruction it has been performed as an exploratory operation; it has been used as a means of treatment in strangulation by bands, &c., and through slits and apertures; in strangulation by the true diverticulum or an adherent appendix, &c., in all forms of internal hernia, in reduction *en masse* after external hernia, in all forms of volvulus and of intussusception. By its means, obstruction due to impacted foreign bodies has been relieved, and also that due to compression of the bowel by tumours &c. situate without the intestine. It is made a preliminary to such other operations as enterotomy and resection of the intestine.

The operation of laparotomy should always be performed with antiseptic precautions. The incision should be made in the middle line between the umbilicus and the pubes, and should be large enough to allow the whole hand to be at once introduced into the abdomen. The median incision is better than an incision made over the supposed seat of the obstruction. The former incision is simple, involves no large planes of connective tissue, cuts through no vessels of any magnitude, disturbs no muscular tissue, and is readily adjusted. Through it, the whole abdomen can be explored and the intestine well examined. It can be made, moreover, independently of a very precise diagnosis. The bladder should be emptied before the incision is made, and, in cases where firm pelvic adhesions exist, it is well to make out its position with a sound. When the abdomen is opened, the intestines must on no account be allowed to protrude. They must be retained by flat sponges wrung out of warm carbolised water. If the distension of the bowels is so extreme that there is difficulty even in introducing the hand, the distended loops may be punctured in many places with a capillary trocar. When the hand has been introduced, the first part to be sought for in an obscure case is the cæcum. If the cæcum is flaccid and empty, then the obstruction must be in the small; if it is greatly distended, then it will be in the large intestine. In the latter instance, the fingers must be carefully passed along the whole length of the colon, from the cæcum to the rectum, in search of the obstruction. In the former instance, the fingers should be passed into the pelvis to make search for flaccid loops of small intestine which are *below* the obstruction. If such be found, they must be

followed up until the obstruction is reached. In any obscure case every hernial orifice should be examined from within.

If a slender band is found, it may be torn through with the finger. Larger bands and most omental cords should be secured with a double ligature, and then divided between the two threads. A narrow pipe-like diverticulum may be treated in the same way. Large diverticula, especially when disposed to gangrene, should be excised near their point of origin from the bowel, and the wound closed by many points of Lembert's suture. In cases where the appendix vermiformis has to be divided, its cut end may be secured by a single ligature or by several points of suture. If an intussusception be found, it should be, when possible, reduced. This is effected partly by traction and partly by squeezing the lower end of the invaginated mass, so as to press the intussusception out of the sheath.

After the operation, the peritoneal cavity should be carefully sponged out and the wound in the parietes united in the same manner as the wound after ovariotomy. In laparotomy for intestinal obstruction exclusive of intussusception, the mortality, as estimated from 122 recorded cases, is 63·1 per cent. The fatal result would appear to depend, not so much upon the cause or site of the obstruction or the age of the patient, as upon the time at which the operation is performed and the state of the bowel when relief is attempted. The most serious factors in the procedure are delay, and the evil practice of regarding laparotomy as a last resource. In many cases it should be the first, since it is really the only resource. The mortality of laparotomy performed for intussusception is 72·7 per cent., as estimated from 33 recorded cases. Here, the fatal issue depends very conspicuously upon the time at which the operation is performed and the state in which the invagination is found. Thus, the mortality, in cases where the reduction of the intussusception had been easy, was 30 per cent., while the mortality, in cases where the reduction had been difficult or impossible, was no less than 91·3 per cent.

FREDERICK TREVES.

LARDACEOUS DISEASE. *See* ALBUMINOID DEGENERATION.

LARYNGEAL CARTILAGES, Fractures of the, are produced by direct violence, such as an attempt to strangulate, a blow, or a fall against some projecting object. The thyroid cartilage is most frequently broken, and usually in the median line. Adults are more liable to the injury, on account of the rigidity of their cartilages. Repair may follow either by bone or by fibrous tissue, but the injury is often fatal, especially when the cricoid has been fractured.

The *symptoms* are pain in the seat of injury, swelling, ecchymosis, and some alteration of the natural shape of the parts. The voice is husky, or altogether lost. There may be coughing, hæmoptysis, and dyspnœa. The patient is sometimes unable to swallow. Upon manipulation, abnormal projections or depressions may be felt, with mobility of parts of the cartilages, and crepitus may sometimes be detected. The surgeon, however, should remember that a crackling sensation may be conveyed to the fingers when the healthy larynx is rubbed against the vertebræ. In some cases, the dyspnœa does not occur until the submucous tissues have become inflamed.

Treatment.—The patient should be kept lying down, and he should not be allowed to speak. Liquid food should be given, and, if swallowing is painful or disturbs the fragments, it may be necessary to use the œsophageal tube or nutrient enemata. An attempt should be made, if there is any displacement of the fragments, to reduce them, and to maintain them in position by pads of lint and strapping. An ice-bag may be applied to check hæmorrhage and diminish inflammation. When there is dyspnœa, and especially if this should be accompanied by hæmoptysis, laryngotomy or tracheotomy should be immediately performed. After the air-passages have been opened, and before the tube is tied in, the opportunity should be taken to explore with a probe the condition of the parts above, and as far as possible to restore them to their normal relations. In many cases, laryngotomy would be the preferable operation, as, if there was any difficulty in retaining the cartilages in their proper position, it would be easy to extend the incision upwards, and, after exposing the fragments, to fix them in their place by a few sutures.

N. DAVIES-COLLEY.

LARYNGITIS, including *acute laryngeal catarrh, acute laryngitis, hæmorrhagic laryngitis, œdematous laryngitis, traumatic laryngitis, abscess of the larynx.*

Causes.—Acute inflammatory affections of the larynx may be produced by the influence of the weather, especially in persons of sedentary habits and indoor occupations; excessive use of the vocal organs; extension

of a similar affection from neighbouring parts, notably from the pharynx; inhalation of hot and irritating vapours; entrance of foreign bodies into the larynx; scalds, corrosive poisons. They often accompany the acute exanthemata, especially measles. Acute œdematous laryngitis may either represent a most violent type of acute catarrhal inflammation of the larynx (though this is extremely rare) or be due to blood-poisoning (erysipelas); or be propagated from neighbouring parts, especially from the pharynx; or occur in the course of syphilitic and tubercular inflammations, carcinoma, perichondritis and diseases of the cartilages of the larynx; of renal affections, typhoid fever, smallpox, &c.

Pathology.—In slight cases, there is merely injection of the vessels, increased succulence of the epithelial layer, and some swelling of the mucous membrane. With the intensity of the inflammatory process the exudation increases, and in the œdematous form sometimes assumes extraordinary proportions. In laryngitis resulting from corrosive poisons even gangrene may supervene. Abscess of the larynx consists in a circumscribed collection of pus in the submucous tissue of the part.

Symptoms and Diagnosis.—The subjective symptoms of acute laryngitis, in adults, vary from slight soreness in the throat, with hoarseness or aphonia, cough and expectoration (which is at first simply mucous, and only towards the end of the attack becoming somewhat purulent), to severe and even fatal dyspnœa, accompanied by stridulous respiration and cyanosis, in cases of œdematous and traumatic laryngitis, and of abscess of the larynx. In hæmorrhagic laryngitis there is sometimes sanguinolent expectoration. In children, even in comparatively slight cases, the dyspnœa is often very marked, especially at night, and the prominent respiratory difficulty, in these cases, often leads to the disease being confounded with spasm of the larynx or with laryngeal diphtheria. Whether this form of dyspnœa be due to spasm of the adductors of the vocal cords from inflammatory irritation or to collection of inspissated mucus in the narrow rima glottidis of the child, is somewhat uncertain.

The objective symptoms—i.e. the laryngoscopic signs—of acute laryngitis are the following: There is general hyperæmia of the mucous membrane; the vocal cords are more or less congested, and more or less covered by the swollen ventricular bands. Sometimes, the mobility of the cords on attempted phonation is deficient, this being due either to the swelling of the soft parts, or to slight inflammatory changes within the laryngeal nerves and muscles. In hæmorrhagic laryngitis, the bleeding spot may sometimes be detected. In œdematous laryngitis, either the whole organ or a part of it may be affected. The looser the tissue, the more readily is it infiltrated; hence, acute œdema of the larynx affects most often the lax arytæno-epiglottidean folds; after these the submucosa of the epiglottis, the mucous membrane of the arytænoid cartilages and the arytænoid fold, and, least frequently of all, the vocal cords. The appearance of the œdematous parts is most characteristic. Their colour is either of a bright or of a pale transparent red—sometimes grey; the epiglottis is changed into a round, sausage-like body, the two halves of which sometimes appear to be squeezed the one against the other; the arytænoepiglottidean folds and ventricular bands sometimes attain such enormous dimensions as to meet in the middle line, and, with the swollen epiglottis, prevent inspection of the lower parts. Similar changes obtain in those rare cases in which the vocal cords are affected. The changes in laryngitis from scalds and from impaction of foreign bodies are very similar to those of simple œdematous laryngitis. In abscess of the larynx it will sometimes be possible, when it points, to see the yellow colour of the pus shining through the swelling, and the want of symmetry in the swollen parts may, even earlier, be of assistance in forming a correct diagnosis, but generally it will be difficult to diagnose this form with certainty.

In simple cases of laryngeal catarrh, in adults, the subjective symptoms will generally suffice to enable the practitioner to arrive at a correct diagnosis without the aid of the laryngoscope, though its use is of course always to be recommended. Matters are entirely different in the more serious, especially in the œdematous, forms. All the symptoms present in such cases (violent dyspnœa, aphonia, dysphagia, pain, &c.) are neither sufficient to make the diagnosis conclusive nor to indicate the proper moment for surgical interference. All or most of these symptoms might be produced by the impaction of a foreign body in the larynx, by a retropharyngeal abscess, by laryngeal diphtheria—in fact, by anything leading to narrowing of the upper air-passages; whilst in other cases, in which the acute œdema is secondary to another laryngeal disease (syphilis, tuberculosis, perichondritis, carcinoma, &c.), it will be of the greatest importance to make out the

nature of the primary affection. In most cases, therefore, of this sort, laryngoscopic examination will be indispensable in order to arrive at a precise diagnosis. In children, even in simple laryngeal catarrh, there will be occasionally considerable difficulty in differentiating this affection from spasm of the glottis (laryngismus stridulus) and from laryngeal diphtheria. The most satisfactory solution of the problem will also, in these cases, be afforded by laryngoscopic examination. If this, however, be impossible, it ought to be remembered that in catarrhal laryngitis there is often slight fever, with impairment of the voice and cough, even during the intervals of the spasmodic attacks; that in laryngismus stridulus the intervals between the attacks are quite free, that there is no fever, and that there are sometimes carpo-pedal contractions; that in laryngeal diphtheria there is often a corresponding affection in the pharynx, and that occasionally fragments of false membrane are coughed out.

The differential diagnosis between laryngitis and laryngeal diphtheria in children, however, is sometimes excessively difficult during the earlier stages, the graver disease often beginning with simple catarrhal symptoms. It will, therefore, be advisable in such cases to wait a while before giving a positive diagnosis.

Treatment.—Simple laryngeal catarrh tends to resolution, and it is only necessary to enjoin *complete rest* of the inflamed organ. This is of greater importance than any medical treatment. Cold water applications to the neck and sucking small pieces of ice will often, if used at the very onset of the affection, check its further progress. At a later period warm steam inhalations, to which some compound tincture of benzoin, lupulin, or coniin, may advantageously be added, are sometimes useful. If the catarrh affect the nose, pharynx, larynx, and bronchial tubes simultaneously, general diaphoresis often shortens its duration. No local applications of any kind ought to be made during the acute stages. They only come into play when the catarrh, instead of tending to resolution, passes into a subacute or chronic state. See *Chronic Laryngitis.* Gargles and lozenges are of exceedingly little use in laryngeal affections. Children suffering from acute laryngeal catarrh ought to be kept indoors, and in an atmosphere rendered moist by means of a bronchitis kettle. If there be much cough, the mistura scillæ composita of the Throat Hospital Pharmacopœia [Oxymel scill. ℥xv., vin. ipecac. ℥v., tinct. camph. comp. ℥xx., aq. ad f℥j., one or two teaspoonfuls for a dose] will prove a good remedy. In hæmorrhagic laryngitis, the direct application to the bleeding spot—if this can be laryngoscopically detected—of a solution of tannic acid or perchloride of iron will often at once arrest the hæmorrhage. If the exact source of the bleeding cannot be detected, inhalations of a cold perchloride of iron spray (gr. iij.–x. ad aq. f℥j.), cold water compresses round the neck, sucking pieces of ice, and absolute rest of body and larynx are recommended.

In all forms of acute œdematous laryngitis very active treatment is required. The diagnosis having been established by laryngoscopic inspection, but little time should be lost with internal remedies and external applications. If the administration of an emetic, ice internally and externally, leeches to or blisters and mustard poultices around the neck, fail to give relief within a short time; and if, on the contrary, the symptoms of stenosis and carbonic acid poisoning increase, an energetic scarification of the œdematous parts, especially of the arytænoepiglottidean folds, ought to be made by means of Mackenzie's laryngeal lancet, or of a long sharp-pointed bistoury enveloped, except at its point, in adhesive plaster. The writer has in several cases seen the progress of acute œdema of the larynx checked and the necessity for tracheotomy avoided by this operation, which is not difficult of execution. Should the practitioner, however, be unable to perform it, or should it not soon be followed by considerable abatement of the symptoms, tracheotomy ought to be undertaken without delay, and if promptly performed it will save the patient's life. (As to the after-treatment of that operation, *see* Tracheotomy.)

Abscess of the larynx ought to be opened as soon as possible from within, under the guidance of the mirror, by means of the laryngeal lancet. If it be very large and there be the danger of the patient being suffocated by the escape of pus into the lower air-passages, it might be necessary to perform tracheotomy as a prophylactic measure, and to insert a tampon-canula into the trachea before the abscess is opened from above.

Chronic Laryngitis.—*Causes.*—Many of the causes leading to acute inflammatory affections of the vocal organ produce, when continually acting, or when the acute stage is neglected and no rest be given to the inflamed part, chronic laryngitis. The most frequent causes are, exposure to influences

of temperature, persistent use of the voice when the larynx is acutely inflamed, excessive use of stimulants, extension of a similar affection from the pharynx.

Pathology.—Tumefaction of the affected parts, due to hyperplasia or dermoid metamorphosis of the mucous and submucous tissue, increase of the connective tissue, enlargement and tortuosity of the small vessels, in much developed cases occasionally denudation of epithelium, very rarely amounting to superficial ulceration. A particular form, in which swelling of the mucous follicles is said to be the prominent feature, has been described as granular, glandular, or follicular laryngitis. In another rare class of cases, hypertrophic indurative changes are most pronounced in the subglottic region.

Symptoms and Diagnosis.—The symptoms are hoarseness, rarely amounting to complete aphonia and varying in intensity, early fatigue of the voice; sometimes cough with a little tenacious expectoration, sometimes absence of all subjective sensations, sometimes sensations of dryness, heat, pricking, soreness, &c. In the subglottic form aphonia is often complete, and there is, corresponding to the amount of hypertrophy and to the degree of the narrowing of the glottis, more or less urgent dyspnœa. The laryngoscope shows either a general or a more partial thickening and congestion of the mucous membrane. The colour of the congested parts, however, is not so bright and uniform as in acute laryngitis, but darker and more irregular. Sometimes the ventricular bands are so much swollen as to entirely conceal the vocal cords; sometimes the latter appear irregularly thickened, showing ecchymotic patches or swellings. In other cases, the mucous membrane in the inter-arytænoid space is thickened, and, being squeezed on attempted phonation between the inner surfaces of the arytænoid cartilages, mechanically prevents the complete juxtaposition of the vocal cords.

In subglottic laryngitis, the tumefaction sometimes appears in the form of a second whitish, greyish, or reddish vocal cord underneath the true vocal cord; sometimes, an almost complete sphincter-like projection below the cords is perceived; sometimes, several projections underneath different parts of the cords or under the anterior commissure are seen.

For a correct diagnosis, laryngoscopic examination is indispensable for almost all chronic laryngeal affections: neoplasms, perichondritis, syphilis, phthisis, nervous disorders, &c., being accompanied by symptoms closely resembling those of chronic laryngitis. On the other hand, the laryngoscopic appearances described above are quite characteristic of chronic laryngitis, and the only point not to be lost sight of is that chronic laryngitis does not necessarily occur as an independent disease, but also in the course of other affections (typhoid fever, acute exanthemata, syphilis, &c.).

Treatment.—It is the writer's firm conviction that neither gargles, nor lozenges, nor inhalations, nor internal treatment, nor visits to watering-places, &c., alone will ever cure chronic laryngitis. There being actual changes in the histological conformation of the parts, the only rational treatment consists in changing the torpid inflammation into a reactive one by the local application of strong astringent remedies, and to watch the course of this until its natural termination in resolution has been achieved. With this view, in more recent cases applications of a solution of chloride of zinc (15–30 grains to the ounce) ought, under the guidance of the mirror, to be made to the larynx by means of a suitably curved camel-hair brush, or of a small sponge safely attached to a properly bent probe. Instead of the zinc, perchloride of iron, alum, or tannin solutions may be used. The best remedy, however, in these cases, especially in long-standing ones, is nitrate of silver, which may be employed in solutions of 16, 24, 48 grains to the ounce. In very severe cases still stronger solutions (96 grains to the ounce), or even the solid stick, may be required. It is, however advisable, in every case, to begin with the milder solutions, and only gradually to pass on to the strength which is deemed necessary in the individual case. The initial irritability becomes soon diminished, and stronger solutions may then be safely applied. To prevent spasm of the glottis following the introduction of the brush, the patient is to be advised, before the application is made, to stop breathing for a second or two altogether, and then to begin again to breathe quite superficially through his nose. His attention being thus diverted, the spasm is almost always avoided. Drinking a little cold water relieves in all instances the spasm, if it should occur. The application should be made daily, if necessary in increasing strength, until a lively reactive inflammation is produced. The intervals are gradually to be made longer, and weaker solutions must be applied, according to the individual case. If there be a corresponding pharyngeal affection

(granular pharyngitis), it is essential that this should be simultaneously treated. The treatment leads as a rule to speedy improvement even in old-standing cases, but ought to be continued until the last trace of the thickening and congestion of the parts has disappeared, there being a great tendency to recurrence unless the affection has been entirely stamped out. Sometimes, the improvement proceeds to a certain point and then becomes arrested. In such cases, it is well to combine the astringent applications with the use of electricity in both its forms —the constant and the faradic—to the sides of the larynx. If, on the other hand, the hyperplastic process should already have resulted in the formation of a well-defined neoplasm, astringent treatment is perfectly useless; the attempt to treat the growth by caustics is even injurious to the neighbouring parts, and the case belongs to the sphere of surgical interference. *See* Larynx, Growths in the.

During the whole of the often lengthy treatment, rest of the voice, discontinuance of excess in spirits, tobacco, &c., must be strongly insisted upon; disobedience in these respects leading almost invariably to its failure. It is, however, neither advisable nor necessary to altogether interdict moderate smoking and use of alcohol. Only in cases of general plethora is the regular use of some aperient (Friedrichshall water) indicated; otherwise no constitutional treatment is required. Inhalations may be looked upon as merely an aid to the rest of the treatment; the writer has little faith in them in these cases. If ordered at all, soothing steam inhalations, with the addition of some compound tincture of benzoin, lupulin, coniin, or oleum pini sylvestris are to be used. The patient is to wash his neck and chest in the morning with cold water, to wear flannel underclothing, but not to wrap up the neck. A good aid towards a lasting cure is a visit to a suitable watering-place (Ems, Reichenhall, Ischl, Royat, Mont Dore, &c.) after the conclusion of the local treatment.

In the subglottic form of disease, the treatment is more difficult than in common chronic laryngitis, and the prognosis much more unfavourable. Unless the measures recommended in the common form—which must in these cases be pushed still more assiduously—be successful, methodical dilatation by means of Schrötter's hollow vulcanite tubes, scarification, or galvano-caustic reduction of the hypertrophic parts will have to be resorted to; if, in spite of all these measures, the dyspnœa increases to an alarming degree, tracheotomy must be performed, after which operation the attempts at dilating the strictured portion may be resumed either from above or from the tracheal opening.

Felix Semon.

LARYNGOSCOPY.—To examine the interior of the larynx, a small mirror attached to a long handle must be introduced into the patient's throat. The reflecting surface of the mirror is to be directed obliquely downward, and a powerful light is to be thrown upon it, when the light will be reflected into the larynx and the laryngeal image will be visible on the mirror.

The light used may be either natural (sunlight, diffused daylight), or artificial (electric, lime, gas, lamp, candle-light). The stronger it is the better, especially for the examination of the more minute pathological changes and of the lower parts of the air-passages (sub-glottic cavity, trachea). The examiner should, however, acquire facility in examining with diffused daylight, which is preferable to the poor artificial illumination often offered to him in the private residences of patients. For use in the consulting-room, Mackenzie's rack-movement lamp, in which a plano-convex lens is placed in front of the flame, thus increasing the intensity of the light, is to be recommended.

The rays of light are thrown into the throat by means of a circular, slightly concave mirror, the so-called 'reflector,' about 3½ inches in diameter and of a focal length of 14 inches. This is attached by means of a ball-and-socket joint either to a spectacle frame, or to a frontal band which the operator affixes to his forehead. The spectacle frame possesses the additional advantage that myopic or hypermetropic practitioners can have their glasses fastened to it. The reflector should be perforated in its centre by a small oval opening, and, when in position, the long diameter of the perforation should correspond to the long axis of the observer's eye. The small mirror, attached at an angle of about 120° to a long shank and handle, is made in several sizes, of which the practitioner should have at least three (½, 1, 1½ inches in diameter); the largest size possible should always be used. Strict attention to the following mode of procedure is advised. The patient is to sit on a common chair opposite the observer, the lamp used for illumination being placed at the patient's left side on a table (or held by an assistant) near to the patient's left ear. For a satis-

factory illumination it is essential that the centre of the source of light, the centre of the patient's mouth when opened, and the centre of the reflector should be as nearly as possible on one and the same level. Neglect of this fundamental rule is one of the most fertile sources of failure among beginners.

The patient is now told to open his mouth, and the practitioner throws a disc of light from the reflector into the throat, so that the centre of the disc falls upon the uvula. The patient is then directed to put out his tongue, and the anterior part of the organ is enveloped in a small soft towel, and held between the thumb (above) and the forefinger (below) of the practitioner's left hand, the forefinger and other fingers resting on the patient's chin. The mirror is warmed over the lamp previous to its introduction, to prevent the expired air condensing on it. The proper temperature is obtained as soon as the film, which at first forms on its reflecting surface, is seen to disappear. To obviate, however, applying the mirror when too hot, the practitioner should never introduce it without having tested its temperature by applying it to the back of his hand. The patient is now instructed to breathe quite naturally, and the mirror—its handle being held like a pen—is introduced in the mesial line of the patient's mouth, and quickly moved forward until its upper border touches the base of the uvula. During the act of introduction the mirror is to be held horizontally, the reflecting surface looking downwards, and the shank of the instrument being close to the left angle of the patient's mouth. Touching the tongue or the faucial pillars should be carefully avoided. As soon as the mirror is beneath the uvula, it ought to be turned upwards until its reflecting surface forms an angle of 90° with the horizon. In this position it is gently but firmly raised, until its upper border is at the same height as the base of the uvula, that organ resting on the posterior surface of the mirror. According to the optical law that, when rays of light fall on a plane surface, the angle of reflection is equal to the angle of incidence, the horizontal rays of light falling from the frontal reflector at an angle of 90° are reflected in an equal angle—i.e. vertically downwards; the larynx, which is just beneath the mirror, is illuminated, and its image, in turn, appears in the mirror, where it is seen by the observer. The use of the writer's electric laryngoscope (see *Lancet*, March 1885), in which the source of light, a small incandescent lamp, is close to the little mirror, and is actually introduced into the patient's throat, does away with the difficulty of double reflection.

It ought to be noted that the only inversion which takes place, under these circumstances, is one in the antero-posterior direction; the parts in reality in front of the larynx (e.g. the epiglottis, the anterior commissure of the vocal cords, &c.) appear in the upper part of the mirror, whilst its posterior constituents (e.g. the arytænoid cartilages) are visible in the lower part of the mirror. But there is no lateral inversion—that is to say, the vocal cord which appears in the left side of the mirror (reckoned from the *observer*)—i.e. on the *patient's right* side—is in reality the patient's *right* vocal cord, and *vice versâ*. In cases in which the whole larynx comes into view, the image thus obtained comprises, in the upper part of the mirror, the epiglottis, of which generally the free border and the upper surface are seen, further down the vocal cords (their white colour vividly contrasting with the other parts of the larynx), between them the subglottic cavity, and a part, varying in length, of the anterior wall of the trachea. At the sides of the vocal cords, the ventricular bands (false vocal cords) are seen; between the vocal cords and ventricular bands a small rim, the opening of the ventricle of Morgagni. The ventricular bands are continuous externally with two projecting folds of mucous membrane, the arytæno-epiglottidean folds, and outside these a cavity becomes visible between them and the lateral wall of the pharynx. This is the hyoid fossa or the sinus pyriformis, a part surgically important, because it is one of the seats of predilection for the lodgment of foreign bodies finding their way into the air-passages. Posteriorly, —i.e. in the lower part of the mirror—the arytæno-epiglottidean folds end in the arytænoid cartilages, and often the cartilages of Wrisberg and Santorini can be recognised in the outline of these folds.

The laryngeal image seen in the mirror is, however, by no means always so complete as that just described. It will be often necessary to move the mirror slightly, or to let the patient draw his head further back, or to let him produce the sounds, *ah*, *eh*, *e*, in order to obtain a satisfactory view. The following faults should be avoided: undue haste, attempts at examination without having concentrated the light properly, violent pulling of the patient's tongue, clumsy introduction of the mirror (at times insufficiently warmed, at others overheated), inducing irritation of the tongue and fauces,

omitting to tell the patient that he must breathe quietly, holding the mirror too long in the patient's throat, neglect of the little manœuvres sometimes necessary to make a pendent epiglottis rise. This list does not exhaust all the causes of failure due to the fault of the operator, but only includes those which, in the experience of the writer, occur most frequently and are especially to be avoided. On the side of the patient the most common difficulties are: nervousness, over-sensibility of the pharynx, unruliness of the tongue, enlarged tonsils, an elongated uvula, and—most serious of all—a pendent epiglottis. All these difficulties can, however, be overcome by tact, gentleness, perseverance, the application of suitable instruments, and above all by continuous practice. In cases of exceptional irritability, and especially when intra-laryngeal operations are to be performed in nervous persons, the patient may suck little pieces of ice from fifteen to twenty minutes before the examination takes place. Recently, the local application of hydrochlorate of cocaine (in 10 or 20 per cent. solution) by means of a brush to the palate and pharynx has been found to be an excellent aid, in cases of hyperæsthesia of these parts. Local anæsthesia comes on a few minutes after the application, and lasts ten to fifteen minutes.

In conclusion, it is recommended that the signs offered by the inspection of the larynx be taken in the following order: (*a*) colour, (*b*) structural changes, (*c*) functional changes (mobility of the parts). As regards (*a*), it may be remarked that the vaso-motor changes in the larynx are very rapid, so that anæmia present on the first introduction of the mirror may, on its second, have given way to normal coloration, and to hyperæmia on its third introduction. Isolated laryngeal anæmia being a valuable diagnostic sign, it is advisable to make it a rule to devote the first glance into the larynx to the ascertainment of this inconstant factor, whilst the lasting features of the image—i.e. questions appertaining to structural and functional changes—may be safely left to a repetition of the inspection.

As regards (*b*). Under this head we shall have to look for swelling, thickening, abscess, œdema, ulceration, dislocations, malformations, new growths, foreign bodies, &c.

As regards (*c*). No definite conclusion concerning the mobility of the parts—i.e. the functions of the larynx—can, as a rule, be gained unless the larynx has been examined during phonation as well as during respiration. Failure to comply with this fundamental rule will lead to the overlooking of laryngeal paralysis, in many cases.

FELIX SEMON.

LARYNGOTOMY.—The term is used, in this country at least, to describe the artificial opening of the larynx through the crico-thyroid membrane. The Germans speak of this as 'partial laryngotomy,' to distinguish it from 'complete laryngotomy,' which we call thyrotomy (*see* THYROTOMY). Certain advantages were formerly claimed for this procedure, the chief of these being the facility and rapidity with which the operation could be performed. The limited space, the proximity of the vocal apparatus, the difficulty in fitting a suitable tube, detract, however, from the value of this operation. In children under twelve years of age, owing to the smallness of the larynx, and especially of the crico-thyroid space, it is quite inapplicable; while, in adults, the circumstances which call for it in preference to any other operation are but rarely met with.

Laryngotomy may be indicated when a ready and convenient access to the larynx is required; but there are few occasions when this operation is specially called for. The impaction of a foreign body, some cases of polypus and of localised morbid growths at or about the upper orifice of the cricoid cartilage, cases of laryngeal spasm (as in epilepsy or tetanus), some cases of drowning (to facilitate emptying of the lungs and subsequent artificial respiration), would, among other cases and causes, suggest and justify its adoption.

The Operation.—Unless the dyspnœa is very urgent and the patient partially insensible, an anæsthetic should be given. Ether causes increased bronchial secretion, which in many cases would be a serious drawback; chloroform should therefore be used. In administering it, especially in children, the surgeon should proceed very slowly at first, and allow the patient to sit up or lie down, as most agreeable to himself; a constrained position leads to a greater sense of suffocation, to struggling, and so to venous engorgement of the neck. A feeling of drowsiness quickly supervenes when a few drops of chloroform are slowly inhaled on a handkerchief; the dose may be gradually increased until narcosis is complete. The patient should then be placed in the recumbent position, with the shoulders resting on a cushion and the head thrown back. The thyroid cartilage is felt for

with the left index finger; from its lower margin a vertical median incision, about one and a half to two inches long, is made through the skin and fascia, which are then to be retracted with blunt hooks; the crico-thyroid membrane now comes into view in the middle line, covered on each side by the crico-thyroid muscle, and must next be incised. Some surgeons make a horizontal, while others prefer to make a vertical incision through the membrane; this incision may even include the cricoid cartilage, the term 'laryngotomy' being still strictly applicable to the operation. If the vertical incision be adopted, the crico-thyroid artery, which crosses the membrane, is sure to be cut, and may possibly give rise to troublesome hæmorrhage; it should be taken up with forceps and be either twisted or tied. The advantage of this incision is that it can be prolonged either upwards or downwards, should circumstances render such a proceeding desirable. In this manner, a 'partial' laryngotomy can be converted into a 'complete' one, or into a laryngo-tracheotomy; moreover, a vertical incision interferes with the integrity of the larynx less than a transverse one, which almost necessarily includes the crico-thyroid, and possibly the lateral crico-arytænoid muscles. Especially in cases where a tube must be subsequently worn, do the advantages of laryngo-tracheotomy become obvious; for a tube can be worn more comfortably in the trachea than in the larynx.

After-treatment, &c.—The reader may refer to what has been said under this heading in the article on TRACHEOTOMY. It will suffice to state here that the after-treatment, in any given case, is determined by the lesion calling for the operation, rather than by the operation itself. After the removal of foreign bodies, for instance, the wound will probably heal without any trouble within a few days. *Complications* may occur as after tracheotomy. As regards the voice and the vocal apparatus, they are more likely to be interfered with after section of the crico-thyroid membrane than after a simple tracheotomy, by reason of their greater proximity.

ROBERT WILLIAM PARKER.

LARYNGO-TRACHEOTOMY. *See* LARYNGOTOMY.

LARYNX, Extirpation of the (Laryngectomy).—Extirpation of the larynx is sometimes practised in cases of malignant disease. The operation was first carried out on the human subject by Dr. P. H. Watson in 1866, on account of cicatricial narrowing of the larynx. Subsequently, Billroth of Vienna removed the larynx and upper rings of the trachea for carcinoma; the man lived seven months, dying from recurrence of the growth, which commenced about four months after the operation. Bottini operated very successfully for sarcoma of the larynx; the man recovered and resumed work. Foulis successfully operated on a man with a soft papilloma; this patient lived two years. One of Thiersch's cases lived three years and seven months. A few others have lived for two months and upwards. When death has not actually occurred from the effects of the operation itself, recurrence or spread of the disease has always taken place sooner or later. Thus, it may be said that, unless the disease is strictly localised, little is gained by extirpating the larynx; whereas death may occur directly from it. On the whole, tracheotomy is a more hopeful palliative measure than laryngectomy.

The Operation.—The patient being anæsthetised, and in a reclining position, a vertical incision should be made in the median line of the neck from the hyoid bone to the isthmus of the thyroid gland; the soft structures are then to be carefully dissected from the larynx. When exposed, the trachea may be cut across and raised up out of the wound; into its distal extremity a suitable canula is to be introduced and so fixed that, while it prevents the entrance of blood, respiration can go on undisturbed. The larynx is then gradually detached from its connections, beginning *from below*; this greatly facilitates the operation, for, as the hæmorrhage gravitates away from the part actually being operated upon, the surgeon can see what he is about. It is very desirable to take up all the bleeding vessels one by one as they come into sight, and tie them with carbolised or sublimated silk. Care must be taken not to button-hole the œsophagus. In some of the recorded cases, owing to unexpected implication of the pharynx, portions of the latter have had to be removed with the larynx. After the operation is completed, the hole may be plugged with absorbent antiseptic wool or gauze; this must be changed twice, or oftener, daily, and such lotions or other applications used as each individual case seems to call for. Should recovery take place, an artificial larynx may be fitted. Liquid nourishment must alone be given at first; this is best administered through a soft œsophageal tube, provided with a funnel-shaped extremity.

The *prognosis* in all these cases must be very guarded. Apart from the fact that the operation is most frequently undertaken for carcinoma, there are grave risks attending it; should these be got over, there is considerable risk from the onset of septic pneumonia during the subsequent two or three weeks; while, later, the fear of relapse, of recurrence, or of secondary growths, can never be quite banished.

ROBERT WILLIAM PARKER.

LARYNX, Growths in the.—A. NON-MALIGNANT GROWTHS.

Causes.—All the causes leading to chronic inflammation of the mucous membrane of the larynx (see *Chronic Laryngitis* under LARYNGITIS) appear to favour the development of neoplasms in that part. This explains the fact that the male sex is, according to all experience, more liable to the disease than the female. Sometimes, no doubt, the disease is congenital, in other cases the etiology is quite obscure. Whilst some forms (especially papillomata) are met with in early infancy, and no period of life is exempt from such affections, benign growths in the larynx are probably most commonly met with in middle life—i.e. between the ages of thirty and fifty. Although, even in much more advanced periods of life, benign neoplasms occur, yet, if the history of the patient shows that the disease *commenced* after the fiftieth year of life, the surgeon will do well to remember the probability of the growth being malignant.

Pathology.—The benign neoplasms met with in the larynx are: papillomata, fibromata, cysts, myxomata, angiomata, adenomata, lipomata, and enchondromata. Of these the first two are by far the most commonly met with; cysts, though by no means so rare as believed up to recent date, following at a very long interval, and the remaining forms being excessively rare.

1. PAPILLOMATA.—Papillomata of the larynx consist of papillæ occurring singly or in groups. Their colour is white, grey, or pink, their form mostly cauliflower-like or warty. After extirpation they tend to recur. They may be solitary or multiple, pedunculated or sessile, unilateral or bilateral. Sometimes, multiple papillomata fill almost the whole larynx. The favourite seats of the growth are the vocal cords—in the experience of the writer especially their anterior commissure—the ventricular bands, and the ventricles of Morgagni. They often spring from the lower surface of the true cord, but never from the interarytænoid fold.

2. FIBROMATA.—Laryngeal fibromata consist of bundles of white, closely interwoven fibres, covered generally with squamous epithelium, and supplied more or less richly with blood-vessels. Their consistence is much harder than that of papillomata; their form round, oval, or multilobular, and their surface generally smooth; their colour white, pink, scarlet, or, in rare cases, bluish red; their size varies from that of a pin's head to that of a hazel-nut. They may be either pedunculated or sessile. They are almost always solitary, spring usually from one of the vocal cords, grow very slowly, and sometimes become arrested in growth after having attained a certain size. When extirpated they do not recur.

3. CYSTS of the larynx are almost always of the nature of follicular retention cysts. They grow most frequently from the back of the epiglottis, the laryngeal ventricles, and from the free borders of the vocal cords, and are generally filled with either serous or colloid material. Their walls are in most cases thin, so that they can be easily pricked. Occasionally, however, the walls are firm, and offer considerable resistance to cutting instruments. Their appearance is generally that of a greyish, somewhat transparent bladder; their size usually varies from that of a pin's head to that of a small cherry; but the writer has lately seen an epiglottidean cyst — the largest, he believes, ever observed—which was of the size of a bantam's egg. After pricking they either at once collapse or slowly give exit to a tenacious colloid fluid. Sometimes they fill again after having been emptied, and in such cases they not rarely change into blood-cysts.

The remaining forms of benign laryngeal neoplasms occur so rarely, that it must suffice to mention that, in quite exceptional cases, new formations of mucoid, vascular, fatty, glandular, and cartilaginous tissue have been observed.

Symptoms.—The symptoms caused by non-malignant laryngeal tumours depend upon their seat, their size, and their mode of attachment. The vocal cords and their neighbourhood being most frequently the seat of origin of these neoplasms, hoarseness or aphonia is the most frequent symptom. In cases of pedunculated neoplasms, which are swung to and fro by the respiratory current of air, these vocal symptoms are often of a surprisingly varied character, the natural or only slightly altered voice of the patient being present

whilst he speaks one sentence, and the next sentence being produced in a toneless whisper, because the neoplasm has in the meantime been thrown upon or between the vocal cords. If a neoplasm situated within the glottis be at all large, or if there be numerous small growths (papillomata) encroaching upon the air-passages, there will, in addition, be more or less considerable dyspnœa, sometimes to a dangerous extent. Again, in cases of pedunculated growth, even if not very large, the neoplasm may, especially during sleep, be suddenly impacted in the rima glottidis and produce a dangerous attack of suffocation. Dysphagia is only present when a growth (cyst) springs from the epiglottis or—in excessively rare cases—extends from the larynx into the œsophagus. Cough is by no means a frequent symptom of laryngeal growths; it is only troublesome in cases of pedunculated tumours, which are thrown about and irritate the mucous membrane after the manner of foreign bodies. Pain is not produced by benign growths.

Diagnosis. — Hoarseness, dysphonia, aphonia, dyspnœa, being concomitants of many chronic affections of the larynx, a certain diagnosis can in most cases only be arrived at by a laryngoscopic examination. Occasionally, a small piece of a papilloma may be coughed out and settle the nature of the ailment; again, the character of the dyspnœa or of the vocal disturbance may vary so much as to lead to a suspicion of its cause, or the patient himself may feel the movements of a pedunculated growth in his throat. But such cases are exceptional, and generally the discovery of a growth will come as a surprise upon both medical attendant and patient.

It is essential, in these cases, that the laryngoscopic examination be not limited to the observation of the larynx during phonation and respiration, but that it be repeated immediately after the patient has been directed to cough, because there are cases of subglottic pedunculated growths, in which the neoplasm can only in this manner be brought into view.

As to the aspect of the different forms of the more common benign neoplasms in the laryngeal mirror, sufficient information has been given in the paragraph dealing with their pathology.

The differential diagnosis between benign and malignant tumours (epitheliomata, sarcomata) of the larynx occasionally offers very serious difficulties. Epithelioma in its early stages—i.e. before the commencement of ulceration—sometimes looks strikingly like papilloma. The presence or absence of a distinct line of demarcation between the neoplasm and the neighbouring tissue; the degree of mobility of the vocal cord, if to this the growth be attached (see *Malignant Growths*, Symptoms); the age of the patient; the presence or absence of spontaneous pain, of tenderness of the larynx on handling, of tumefaction of the neighbouring lymphatic glands, of dysphagia, of hæmorrhages, of cachexia will, in such cases, sometimes give valuable information as to the true character of the neoplasm. Removal of a small fragment of the growth by means of the laryngeal forceps and its microscopic examination will, in most cases, at once settle all doubts. If this measure be impracticable, it will be wiser to leave the diagnosis for some time in suspense.

The laryngeal excrescences of syphilis and of phthisis can hardly be mistaken for non-malignant new formations. The existence of condylomata of the larynx is still doubted by many competent observers. The submucous origin of gummata, which are also very rare, and which occur in the form of smooth, roundish, yellowish, or pinkish elevations, is very obvious even on casual observation. The so-called 'false excrescences' of laryngeal syphilis, which, it is true, resemble in form some genuine neoplasms, but which in reality only represent ragged borders of ulcers seen *en profile*, are distinguished by being almost always situated in the interarytænoid fold — a situation in which, as stated above, according to the experiences of the most trustworthy observers, genuine neoplasms are never found. Moreover, in such cases there will be either concomitant lesions in other parts, or scars pointing to old mischief of a specific nature, and the history as well as the use of antisyphilitic remedies will soon clear up the diagnosis.

The general tumefaction, soon followed by ulceration, of laryngeal tuberculosis, coupled, as it almost always is in such a stage, with evidence of pulmonary disease and constitutional symptoms, will hardly lead the most inexperienced observer to mistake it for a benign growth.

Treatment.—There are cases of laryngeal growths, in which small neoplasms (especially fibromata) are so situated as to cause very little or no inconvenience. In such cases, operative removal may certainly be dispensed with, and the patient ought only to submit himself periodically to inspection, in order that the progress of the growth may be kept under notice.

In the much more numerous cases, in which neoplasms cause greater inconvenience or even danger, operative interference is indispensable. It has already been mentioned (see *Chronic Laryngitis*, under Laryngitis) that treatment of well-defined neoplasms by astringent or caustic applications is not only useless, so far as the destruction of the growth is concerned, but even injurious to the healthy parts in their neighbourhood. Moreover, the introduction of strong caustics into the larynx always implies a certain risk, leading, as it often does, to spasm of the glottis, and sometimes to violent inflammation of the adjacent parts.

Thus, removal of the growth is left as the only efficient mode of treatment. Such removal can either be effected from within under the guidance of the laryngeal mirror, or from without—i.e. by opening the laryngeal cavity; or, in rare cases, by a combination of these two methods—viz. tracheotomy, followed by intralaryngeal removal. The question which of the two methods, the intralaryngeal or the extralaryngeal, is the preferable one has been hotly discussed for years, and even now no general consensus of opinion has been obtained, though undoubtedly the intralaryngeal method is in the ascendant. It is impossible in the limited space at the writer's disposal to discuss the merits of both methods at any length. He unhesitatingly gives the preference to the intralaryngeal removal in all cases in which its execution is feasible, and his experience has taught him that this is possible in most cases. It has been contended that some qualities of certain growths, such as broad bases, vascularity, hard consistence, subglottic position when large, multiplicity and tendency towards recurrence, formed so many contra-indications to the adoption of the intralaryngeal method. The writer's personal experience has convinced him, that even the joint occurrence of several of these conditions in one case, often presents no insuperable obstacle to successful intralaryngeal extirpation. Of course, if there be urgent dyspnœa, and immediate intralaryngeal relief be unobtainable from whatsoever cause, palliative tracheotomy ought to be performed; but the writer would strongly advise that the division of the thyroid cartilages in such cases be not proceeded with at once, on account of the serious danger of lasting impairment of the voice which, in the majority of cases, follows the performance of that operation. *See* Thyrotomy.

Here comes in the vexed question of the recurrence of multiple papillomata. It has been maintained that thyrotomy offered, apart from being a quicker method of treatment than intralaryngeal evulsion of the growths, a better chance of thoroughly removing all of them, and of effectually cauterising their bases, thus giving a greater protection against recurrence. To this it must be replied that the uncontroverted statistics of Professor Bruns of Tübingen have shown these statements to be altogether unfounded on fact, and that they have brought out, in addition, most clearly the important fact that thyrotomy is in itself an operation seriously jeopardising the voice. The writer would add that frequently, in this question, two very different conditions are confounded under the one name 'recurrence.' It is an altogether different thing whether, from the same place from which a papilloma has just been removed, a fresh one springs up; or whether, after the removal of a papilloma from the anterior commissure of the vocal cords, another one begins to grow from one of the laryngeal ventricles. The latter event is evidently no 'recurrence' in the proper sense of the word, though often wrongly thus denominated, but evidence of a tendency to general papillomatous degeneration. It is obvious that unless, under such circumstances, all the contents of the laryngeal box be cut out or the larynx be entirely extirpated—two proceedings against the performance of which in such cases the writer would emphatically protest — no operation can give a guarantee against the appearance of fresh growths in the larynx. But it is equally obvious that, under such circumstances, the performance of an operation ought to be avoided, which, like thyrotomy, carries with it a grave danger of lasting impairment to the voice. The writer has found that if, in cases of multiple recurring papillomata, the intralaryngeal removal be perseveringly proceeded with, almost always, finally, a time arrives when the tendency to a fresh formation of these growths appears to become exhausted. The statement, that protracted intralaryngeal operations have been instrumental in converting a benign into a malignant tumour, has never been supported by valid evidence.

As to the practice of intra-laryngeal operations, the writer considers it neither necessary nor even desirable to give detailed directions. The method can only be learned by continued practice on the living subject, not from mere descriptions; its very essence—viz. that the operator must

constantly transfer, in his mind's eye, the parts seen in the antero-posteriorly *inverted* image to their real position—demanding quite a special education. The recent introduction of hydrochlorate of cocaine as a local anæsthetic of the laryngeal mucous membrane—a 20 per cent. solution being applied by means of a camel-hair brush to the larynx five minutes before the operation, and this application, if necessary, being repeated once or oftener during the sitting—will no doubt greatly facilitate the more general adoption of the intralaryngeal method. Removal of growths may be effected by cutting, by crushing, by evulsion, and by galvano-cauterisation, but it is impossible to lay down any general rule as to the method to be employed. The writer has found, in the great majority of his cases, that evulsion by means of Mackenzie's cutting laryngeal forceps did all that was necessary; in certain difficult cases, the galvano-caustic loop and burner had to be resorted to. Voltolini's method—viz. of running a little sponge firmly attached to a laryngeal probe up and down the larynx, by which process soft growths are supposed to be torn off their attachments—has not proved very satisfactory in his hands.

B. Malignant Growths.—*Causes.*—The causes of the origin of malignant growths in the larynx are as obscure as those of such growths in general. It is generally believed that hereditary influences, traumatic lesions, and long-continued irritation of the vocal organ may play a *rôle* in their production; the writer, who has had the opportunity of seeing an unusually large number of these neoplasms, has not been able, in a single case, to trace the origin to a distinct cause. It is doubtful whether papillomata ever degenerate into cancroids. Malignant tumours of the larynx almost always belong to the period of life after forty; the writer has seen two cases in men over eighty. The male sex is more liable to the disease than the female.

Pathology.—The malignant neoplasms met with in the larynx are carcinomata and sarcomata. Of these, the latter are very rare, the former considerably more frequent than is generally supposed. Carcinoma of the larynx is almost always primary or contiguous, never—so far as the writer knows—metastatic or infectious. This is due to the peculiar arrangement of the lymphatics of the larynx. They are very richly developed, but form quite a network of their own, and without anastomosing with the lymphatics of the neighbouring parts—as do the pharyngeal lymphatics so amply—empty themselves into four small lymphatic glands, two of which are situated underneath the greater horns of the hyoid bone, the two others at the sides of the trachea. This is practically very important, for it explains, on the one hand, why the larynx enjoys a practical immunity from infection in cases of carcinoma elsewhere in the body; on the other, why, in cases of primary intrinsic carcinoma of the larynx, the disease so long remains a purely local one, and does not infest the neighbouring lymphatics of the neck. Similar conditions obtain in laryngeal diphtheria. Hence, also the marked absence of general cachexia in the first stages of intrinsic laryngeal carcinoma.

Cancer of the larynx appears by far most frequently in the form of epithelioma, much more rarely as medullary carcinoma, still more rarely as scirrhus; the histological characteristics of these forms being the same in the larynx as those seen elsewhere in the body. The seats of predilection of laryngeal carcinoma are the ventricular bands and vocal cords. Sarcoma occurs in the round-celled, less frequently in the spindle-celled form.

Symptoms.—It is often very difficult, in the early stages of malignant neoplasms of the larynx, to differentiate them from benign ones or even from other laryngeal affections, neither the subjective nor the objective symptoms being of a pathognomonic character. Hoarseness is usually the earliest and altogether the most constant symptom. Its degree in the earliest stages—i.e. when only a small projection is seen on one of the vocal cords—is often out of proportion to the size of the neoplasm; and the writer considers it as a sign of great importance if already, at this early period, the mobility of the affected cord is considerably impaired. The latter phenomenon, which is no doubt due to the infiltrating character of the tumour, is entirely absent in cases of benign growths of similar size. With the progress of the tumefaction, the hoarseness soon changes into complete aphonia; but, on the other hand, the voice, which was already entirely lost, sometimes returns to some extent at the time when the tumour begins to break down—i.e. when a better juxtaposition of the cords is again rendered possible. Pain in the larynx may occur either at an early or at a later period, but the writer has observed cases in which this symptom was almost entirely absent throughout the

course of the disease. If present, it may radiate from the throat to the ear, the irritated fibres of the superior laryngeal nerve transmitting the irritation to the auricular branch of the pneumogastric nerve; but this variation of pain is not pathognomic of laryngeal cancer. The laryngeal region is not infrequently tender on external pressure. Dysphagia is always present when the epiglottis and the arytæno-epiglottidean folds are the seat of the disease; in intrinsic carcinoma it often is absent or slight. There is nearly always a considerable increase of secretion. This is generally at first frothy, later on tenacious and semipurulent, not rarely streaked with blood; in later stages —i.e. when the perichondrium has become affected—often fetid, as is also the patient's breath. More or less considerable hæmorrhages not infrequently take place, when vessels have been laid open in the progress of the disease. As soon as the tumefaction considerably narrows the air-passages, dyspnœa makes its appearance, the degree of which depends upon the amount of obstruction caused. Cachexia is not rarely absent throughout until the patient's death, and the lymphatics of the neck often remain unattacked so long as the growth remains within the larynx proper; when, however, the cancer dips into the pharynx, tumefaction of the lymphatics underneath the sterno-cleido-mastoid muscles and of the posterior cervical lymphatics sometimes takes place. In late stages of the intrinsic variety, the larynx is sometimes found considerably broadened, in consequence of the pressure from within.

In those cases in which the disease attacks the larynx only by contiguity—i.e. in which it starts from the tongue, the pharynx, the œsophagus, the thyroid gland, the branchial fissures of the neck, &c.—the symptoms just enumerated will of course vary according to the primary seat of the cancer, and will be, moreover, complicated by symptoms peculiar to the affection of the part primarily infested. Not rarely, acute œdema of the parts in the immediate vicinity of the new growth sets in; more frequently there is some degree of chronic œdema around the tumour. In other cases the perichondrium and the cartilages themselves are attacked, necrosis of the cartilages takes place, abscesses are formed, parts of the cartilages become separated and may be expectorated, fistulous communications between the air and food passages are established, or between the larynx and the external neck, &c.

The laryngoscopic appearances in the early stages are not very characteristic, and it will be often found very difficult to differentiate commencing carcinoma or sarcoma from papilloma, fibroma, syphilitic or tubercular infiltration. Generally, malignant growths appear as cauliflower-like, semiglobular, mamillated or warty distinct protuberances; in some cases there is from the beginning more extensive infiltration, with but little projection above the surface. Later on, the extensive irregular tumefaction, which sometimes fills half or even the whole laryngeal cavity and invades all the laryngeal structures, and above all the ulceration of the tumour itself, make the appearances much more characteristic. If the disease starts from the epiglottis, that part may either be found immensely thickened or, in other cases on the contrary, almost entirely eaten away. The parts are almost always found covered by white, yellowish, or greenish slimy or muco-purulent, often fetid, secretion.

Diagnosis.—Malignant growths of the larynx may be mistaken—(*a*) for benign ones; with regard to the differential diagnosis between the two, see *Non-Malignant Growths*, Diagnosis; (*b*) for syphilitic affections. The differential diagnosis is often difficult. The previous history of the patient, the simultaneous existence of other syphilitic affections, or evidence of old syphilitic lesions in other parts of the body, will of course aid in the decision, but neither is absolutely reliable. The carcinomatous ulcer, as well as the syphilitic, is irregular, and in the neighbourhood of both there is a zone of inflammation. But the syphilitic ulcer in the larynx is generally developed very acutely, often within a few days, whilst the cancerous takes some weeks for its development. The former is almost always solitary, unilateral, and not very large; the latter is preceded by tumefaction, the traces of which remain round the ulcer. Frequently, it is covered with small excrescences, and often attains a very large size.

There are, however, cases in which all these diagnostic signs are of little value, and in these the use of iodide of potassium will often solve the doubt. The writer would propose it as a general rule, that the treatment of every case of suspected laryngeal cancer ought to begin with the administration of large doses of iodide of potassium. (Ten-grain doses three times daily, to be rapidly increased up to thirty-grain doses three times daily.) No conclusions as to the nature of the affection

ought to be drawn from the patient's statements, but only from the occurrence of actual changes for the better in the laryngeal appearances; for the writer has found that, even in cases of undoubted cancer of the larynx, the patients often state, after having taken iodide of potassium for a week's time, that they feel better. In such cases, however, the progress of the growth is of course not arrested, and the drug soon loses its effect upon the subjective sensations.

(*c*) Malignant disease of the larynx may also be mistaken for tubercular affections. Here, generally, the differential diagnosis is much easier. The patient's age, the concomitance of pulmonary affections, the characteristic pallor of the laryngeal tissues, the bilateral infiltration usual in laryngeal phthisis, the slow development of the ulcers, their small size and great number, will easily differentiate this affection from malignant growth in the larynx. Examples have, however, been recorded by good observers, in which mistakes have been committed.

Treatment.—The treatment of malignant growths of the larynx is very unsatisfactory. Medical treatment is of course useless. Pain may be temporarily relieved by insufflations of morphia (gr. $\frac{1}{8}$—$\frac{1}{4}$ twice daily or more frequently). It is probable that applications of strong cocaine solutions (20 per cent. or more) to the affected parts, or the use of cocaine-sprays and tablets will also, in this disease, relieve pain and dysphagia, but up to the moment when this was written no experiences regarding this point had been recorded. If there be complete impossibility of swallowing, the patient must be fed by the stomach-pump or by nutrient enemata, unless gastrostomy be preferred. Dyspnœa being almost always present, the writer would advise the performance of tracheotomy, as far as possible from the seat of the disease, at an early period—i.e. before the general health has already suffered from insufficient air supply. The operation affords great relief to the patient, and life is prolonged on an average for a year, and not infrequently for longer. If its performance be left until the patient is almost suffocated, the results are not nearly so satisfactory.

Regarding radical extirpation of the growth, the following modes of procedure have to be considered: (1) intralaryngeal extirpation; (2) thyrotomy; (3) subhyoid pharyngotomy; (4) total—(5) partial extirpation of the larynx.

(1) Intralaryngeal extirpation is out of the question in cases of carcinoma, and in sarcoma may only be attempted in those cases in which the neoplasm forms a well-defined tumour.

(2) Thyrotomy, with subsequent extirpation through the wound, yields very bad results in cases of malignant growth, and should not be attempted.

(3) Subhyoid pharyngotomy may be thought of, in cases in which the growth is limited to the epiglottis and the parts in the laryngeal vestibule.

(4) Total extirpation of the larynx for carcinoma is at present still on its trial. According to the latest statistics, out of sixty patients operated upon for carcinoma, forty-two died, fifteen recovered, and the end of three cases is unknown. This result is certainly not very encouraging; and the question of how long the patients who recovered survived the operation, and the proportion between the length of life after simple tracheotomy and that after successful extirpation of the larynx, have still to be determined. Until these questions have been fully answered by large and reliable statistics, the propriety of extirpating the larynx as soon as the diagnosis of laryngeal cancer has been established is, in the writer's opinion, still *sub judice*. On the other hand, it is only in cases in which the tumour is absolutely limited to the laryngeal cavity, and in which no affection of the neighbouring parts is as yet present, that an early operation appears to have any chance. For, in those cases in which the lymphatic glands, the pharynx, œsophagus, thyroid gland, &c., are simultaneously or even primarily attacked, it will be almost impossible to eradicate all traces of the malignant disease, and recurrences within the next few months are almost certain. The kind of life which the patient will have to lead even after successful operation, and even with an artificial larynx, must of course be fully explained to him before the operation is undertaken. In sarcoma, the chances of complete extirpation appear to be much better. One patient has certainly survived the operation for more than six years.

(5) Partial extirpation of the larynx has of late years repeatedly been performed, especially by German surgeons, in cases in which the disease only involved one half of the larynx. It is stated to be much less serious than the total excision, not to be followed more frequently by recurrence of the disease than after complete removal of the organ, to give rise to less functional disturbance with regard to swallowing and speaking, and, in some instances, even to

enable the patient to dispense later on with the tracheal tube. Further experience, however, will have to show how far these statements can be supported. In the present state of our knowledge, the best policy would appear to be to explain to the patient or to his friends, on the one hand, the chances of the palliative treatment (tracheotomy if necessary, accompanied or followed by gastrostomy); and, on the other, those of the radical (partial or total extirpation of the larynx), and to let them decide. *See* Larynx, Extirpation of the.

Felix Semon.

LARYNX, Neuroses of the.—A. Motor Neuroses.

I. Paralyses. — *Causes.* — Diminished or abolished action of the vocal cords may be the consequence of either a neuropathic or a myopathic impairment. Myopathic impairments may be due to muscular degeneration (in phthisis), to infiltration of the muscles (in inflammatory processes), or to their direct destruction (in cases of injury, malignant growth in the larynx or œsophagus, &c.); otherwise they are exceedingly rare. Neuropathic impairments may be either of an organic or of a functional nature. The latter class of cases includes functional weakness (in cases of phthisis, chlorosis, general anæmia, loss of blood after injuries, exhausting diseases, &c.), hysterical affections; and—at least in the initial stages—also the *reflex* paralyses, although, in the case of the latter, probably later on actual organic changes take place. Examples of such reflex paralyses would be: the paralysis resulting on the *opposite* side from pressure on one pneumogastric nerve, probably some instances of diphtheritic and possibly some of the forms of toxic paralysis. The reflex paralysis in the first-named class of cases has been ingeniously explained by Dr. George Johnson as the result of a centripetal irritation of the trunk of the vagus acting on the nervous centre, and through it upon the nerve-supply to the laryngeal muscles on the opposite side.

With the exception of some of these reflex paralyses, in the great majority of cases of functional paralysis the adductor fibres of the recurrent laryngeal nerves are concerned, very rarely the abductor fibres. The organic paralyses may be of a central, peripheral, perhaps also (*see* above) of reflex origin. These paralyses may be either complete or incomplete—i.e. they may either involve the whole of the motor centres or single motor nerves of the larynx, or they may be limited to parts of centres or nerve-trunks. Thus, in cases belonging to the last-named category, there may be either paralysis of the motor branch of the superior laryngeal nerve, or incomplete paralysis of the centres or trunks of the recurrent laryngeal nerves, or paralysis of individual twigs of the recurrent from local causes. In cases of incomplete organic lesion of the centres or trunks of the spinal accessory, pneumogastric, and recurrent laryngeal nerves, there is, as the writer has shown, a distinct proclivity of the abductor fibres of the recurrent laryngeal nerve to succumb sooner than the adductor fibres, or even exclusively; whilst the occurrence of an analogous isolated affection of the adductor fibres, in cases of organic disease, has never yet been verified.

Pathology.—In the purely functional cases, no changes are to be detected in either nerves or muscles; in the myopathic cases, the changes vary according to the fundamental cause. Thus, in cases of acute inflammation of the mucous membrane, a serous infiltration of the muscles may take place, in phthisis, fatty degeneration of the muscles may be found, whilst in a case of œsophageal carcinoma occupying the plate of the cricoid cartilage, one or both posterior crico-arytænoid cartilages may have partially or entirely perished by a process of invasion and ulcerative destruction. In cases of neuropathic paralysis due to organic lesion or disease of the motor laryngeal nerves, the atrophic and degenerative changes usually met with under such circumstances will be found in the nerves and in the muscles supplied by them, their intensity varying in proportion to the amount of the lesion. If the lesion be equivalent to a transverse section of the nerve affected, all the nerve-fibres and all the muscles supplied by the nerve will, of course, suffer in an equal degree. But it is a most remarkable fact that, even in cases of grave and long-standing implication of the recurrent laryngeal nerves in tumours or dense connective tissue, or of serious central disease involving the roots of the laryngeal motor nerves, a number of normal, well-preserved nerve-fibres has been found; and that, in such cases as stated above, the abductors of the vocal cords (posterior crico-arytænoid muscles) have invariably been found to have undergone considerable or even almost complete atrophy and fatty degeneration, whilst the adductors have either suffered to a much less degree or even entirely escaped degenerative changes.

Symptoms. — The larynx serves two functions, respiration and phonation. For

the former it is necessary that the glottis should be open to a certain extent during inspiration and expiration, for the latter that it should be closed during the act of speaking, and that there should be a certain amount of tension of the vocal cords. If, in consequence of impaired abductive power, the cords cannot separate so far as to allow of a sufficient entry of air during inspiration, dyspnœa will arise; if, on the other hand, in consequence of complete paralysis of one or both recurrent laryngeal nerves, or of their adductor or tensor twigs, the vocal cords cannot be brought fully together or are not in a sufficient degree of tension when brought together, aphonia or dysphonia will arise.

The symptoms of laryngeal paralysis, therefore—apart from the symptoms of the fundamental disease which causes the paralysis—will vary very considerably according to the set of fibres attacked, and also according to whether the paralysis is unilateral or bilateral.

In *unilateral complete paralysis of one recurrent laryngeal nerve* the corresponding vocal cord stands immovably in the so-called cadaveric position—i.e. according to the measurements of the writer, about two to three millimètres from the mesial line. The other cord moves freely, and often, on attempted phonation, even crosses the middle line to join its fellow, the position of the glottis under such circumstances being oblique. The voice may be entirely lost, or impaired, squeaking, and with a peculiar tendency to breaking into falsetto on the slightest phonatory effort. There is no dyspnœa.

In *bilateral complete paralysis of the recurrent laryngeal nerves* both vocal cords stand immovably in the positions they occupy after death (cadaveric position), the voice is entirely lost, on attempted phonation the air rushes through the open glottis, and the patient soon gets exhausted if he attempts to speak, cough, or expectorate. There is no dyspnœa during repose; shortness of breath only occurs on exertion.

It has been stated above that, in case of incomplete organic unilateral paralysis of a recurrent nerve, those of its fibres which supply the abductor muscle are always first or pre-eminently paralysed. In such cases, there is at first of course only impaired abduction on the affected side; later on, however, the unopposed antagonists of the paralysed muscle fall into a state of paralytic contraction, and draw the vocal cord into the position of phonation, where it becomes immovably fixed. Under such circumstances—i.e. in the initial stages of all the severe lesions (enumerated under 'Causes') which may implicate the laryngeal nerves, and indeed not rarely up to the patient's death—in adults *neither vocal nor respiratory symptoms occur*; and the important laryngeal lesion present, which may be of the greatest importance for the correct diagnosis of the whole case, will entirely escape notice, unless a rule be made to examine the larynx in all cases in which lesions of the laryngeal nerves could occur, whether there be symptoms pointing to the larynx or not. In children, in consequence of the smallness of the glottis, even in unilateral paralysis of an abductor, fatal dyspnœa may arise.

If the conditions named in the last paragraph obtain on both sides—i.e. if there be either a bilateral incomplete lesion of the centres (e.g. in cerebral syphilis, or in tabes, or in a case of tumour of the brain); or a similar incomplete lesion of the trunks of both recurrent laryngeal nerves (e.g. in cases of goitre, aneurism of the aorta, carcinoma of the œsophagus); or if there be pressure upon the trunk of one pneumogastric nerve only (*see* under 'Causes'), the result will be *bilateral paralysis of the abductors of the vocal cords.* In such a case both vocal cords will, in the manner above described, be gradually drawn towards, and finally be fixed near, the middle line. Laryngoscopically, this looks similar to a continuous position of phonation. On inspiration, the cords separate to the extent of a small rim between their inner borders, or are, in much developed cases, even drawn nearer each other by the rarefaction of air below the stenosed opening; on expiration they separate a very little as in inspiration; on phonation they come together as under normal circumstances. The result of this state of things is loud, often sonorous, inspiratory stridor, free and noiseless expiration, and normal voice. There is always in advanced cases dyspnœa, but its intensity greatly depends upon whether the stenosis has been produced gradually or more suddenly. In the former cases, it is often surprising how little subjective dyspnœa is experienced by a patient whose glottis is reduced to a diameter of not more than two to three millimètres it is obvious that, in such patients, the least swelling of the abnormally approximated parts will suffice to close the opening, and may lead to immediate asphyxia.

Paralysis of the *adductors* is almost always bilateral and due to functional disorders, especially to weakness of the muscles

(as in phthisis, chlorosis, &c.), to infiltration of the muscles (as in violent catarrh or inflammation of the air-passages), to reflex causes (uterine disorders, &c.), and to hysteria. If unilateral, in which case one vocal cord would be seen not to approach the middle line on attempted phonation, whilst on deep inspiration it would be properly drawn to the side of the larynx, it is probably always the consequence of *local* injury to nerve-twigs or muscles. The voice would probably be quite aphonic, or at least exceedingly hoarse. In the bilateral cases the paralysis is rarely complete, in which case the glottis will be seen to form, on attempted phonation, a widely open immobile triangle, more frequently incomplete—i.e. on attempted phonation the cords are seen to approach, without, however, completely closing the glottis, or, if they do so, they at once recede from their juxtaposition. Thus this form is, more correctly speaking, a paresis. The result of the deficient closure of the glottis is more or less complete aphonia. Sometimes the patient is able to produce a few sounds with resonant voice; more often this is impossible; but even if the voice has been lost for months or years, coughing, sneezing, and the emotional voice-sounds (laughing, sighing) are often found to still possess their normal character. The onset of the affection is in the hysterical cases quite sudden, its duration most variable (from hours to years), its end sometimes quite as sudden as its beginning. In cases of catarrhal origin, both beginning and passing off are, in accordance with the nature of the lesion, more gradual.

Sometimes, in cases of catarrh or of hysteria, the *inter-arytænoid* muscle alone is affected. In such cases, the anterior three-fourths of the vocal cords are seen to come together on attempted phonation, but a triangular space remains open in the hindermost part of the glottis. In such cases there may be complete aphonia. The writer has never seen a case of isolated paralysis of a *crico-arytænoideus lateralis*; and though, of course, its occurrence in consequence of local lesion is theoretically quite possible, he must confess that he would be unable to distinguish it from paralysis of all the adductors on the same side.

Isolated paralysis of the *internal tensors* (thyro-arytænoid muscles) is laryngoscopically shown by an elliptic cleft remaining between the inner borders of the vocal cords on attempted phonation, and may be accompanied by more or less loss of voice. It is often associated with, or quickly follows upon, paralysis of the glottis-openers. It is, however, important to know that some elliptic gaping of the vocal cords, during phonation, is by no means rarely seen in persons who are in full possession of their voice.

Isolated paralysis of the *external tensors* (crico-thyroid muscles) may occur after diphtheria, and is, according to Mackenzie, characterised by the glottis having a wavy outline. There is, the same author states, a slight depression of the central portion of the vocal cords in inspiration, and a corresponding elevation in expiration and vocalisation. In unilateral paralysis of a crico-thyroid muscle, the corresponding vocal cord stands on a higher level than its fellow. The symptoms met with under such circumstances are more on the side of the sensory fibres of the superior laryngeal nerve (see *Neuroses of Sensation*) than of its motor fibres; but probably a deep, gruff, monotonous voice would be present.

Finally, it may be remarked that combinations of paralyses of individual muscles, with corresponding variations of the laryngoscopic image, are sometimes met with.

Diagnosis.—A certain diagnosis of laryngeal paralysis can only be made by means of the laryngoscope. Although, in cases of hysterical paralysis of the adductors or of bilateral paralysis of the abductors, the symptoms are so characteristic as to leave little doubt as to the nature of the loss of voice in the one and of the inspiratory dyspnœa in the other; yet the conditions in the former case may be simulated by general respiratory weakness, laryngeal polypi, and other forms of mechanical impediment to the closure of the glottis, in the latter by spasm of the glottis, perverse action of the vocal cords, cicatricial contraction in the inter-arytænoid fold (*see* Larynx, Syphilis of the), and, to a certain degree, by gummatous infiltration and stenosis of the trachea. Serious errors in these respects are known to have been made. In all forms of laryngeal paralysis, the laryngoscope will therefore be well-nigh indispensable for diagnosis. The mere discovery of an immobility of one or both vocal cords, however, is not sufficient to at once establish the diagnosis of a 'paralysis;' and the surgeon must bear in mind the possibility of a mechanical fixation by cicatricial contraction of the mucous membrane, after ulcerative diseases or injuries. A very unusual position of the arytænoid cartilage and corresponding vocal cord, with absolute immobility, signs of previous ulcerative diseases, abnormal distortion of the mucous folds, and above all, tumefaction at the

base of the immobile arytænoid cartilage, will favour the idea of a mechanical fixation. Several affections may lead to either mechanical fixation or to nervous paralysis, and the possibility of the combination of both forms of impairment must not be lost sight of. If the diagnosis of nervous paralysis have been established, its fundamental cause must of course be sought for.

Treatment.—In any form of *organic* laryngeal paralysis, the only indication is to remove, if possible, the *cause* of the mischief. Thus, in cases of cerebral syphilis a most energetic anti-specific treatment will have to be instituted; in cases of pressure by glands or tumours, these will, if possible, have to be removed, &c. Direct treatment of the paralysis itself, by electricity or otherwise, is, so long as the exciting cause continues to act, perfectly useless, though faradisation of the paralysed nerves and muscles, coupled with hypodermic injections of sulphate of strychnia (dose gr. $\frac{1}{30}$ gradually increasing to gr. $\frac{1}{10}$), may with advantage be adopted after its removal, in the hope that the conductivity of the nerve has not yet been wholly destroyed. In cases of bilateral paralysis of the abductors, in which considerable stenosis of the glottis has taken place and marked dyspnœa is present, unless not only subjective relief but an actual enlargement of the glottic opening has been speedily obtained by whatever method is employed, tracheotomy ought to be performed without delay; not as a curative but as a prophylactic measure, with a view to the subsequent removal of the tube in case any later therapeutical efforts should produce a real cure of the affection. Here, however, one caution is necessary. In all cases in which there is bilateral paralysis of the glottis-openers, certainly or probably due to pressure upon the nerves by tumours of the neck or thorax, it will often be impossible, with the means at present at our command, to exclude with certainty the existence of *a second stenosis lower down*, due to direct compression of the trachea or of the bronchi by the same tumour which causes the paralysis. If the laryngeal narrowing be considerable enough to give a sufficient explanation of the patient's dyspnœa, the surgeon will be warranted in operating, but he should always beforehand fully explain the situation to the patient or to his friends, to prevent disappointment in case there be a second stenosis lower down. Under such circumstances the low operation should always, if possible, be chosen, so that in case of a second stenosis lower down the tube could either be inserted below the compressing tumour—in cases of tumour of the neck—or that a long, flexible tube might be cautiously passed down, if possible, through the narrowed part of the windpipe, especially in cases of intra-thoracic tumours.

In cases of functional paralysis of the adductors, through overwork of the part or general or local weakness, tonic treatment (iron, phosphorus, strychnia, arsenic) coupled with gentle galvanisation or faradisation over the region of the pneumogastric nerves is indicated. Rest of the voice should be enjoined. In cases of inflammatory origin the usual treatment of catarrh might be instituted. *See* Laryngitis. In reflex paralysis the distant cause (e.g. uterine trouble) ought to be looked for and appropriately treated. In hysterical paralysis of the adductors, emotional effects or anything that gives a shock to the system often produce a cure, and the same result is frequently obtained by any remedy that stimulates the laryngeal mucous membrane —e.g. by inhalation of ammonia. The most reliable and quickest method, however, consists in intra-laryngeal faradisation by means of Mackenzie's laryngeal electrode. Generally, even in long-standing cases, the voice can be restored in the first sitting. The shock given ought not to be too great, nor, on the other hand, too feeble. By timid handling of the method its effects are often spoiled, and its subsequent adoption rendered difficult. If necessary, the faradisation ought to be repeated; in the writer's experience, however, one strong application generally suffices.

In post-diphtheritic paralysis of the crico-thyroid muscles, faradisation to the muscles and hypodermic injections of sulphate of strychnia into the sides of the neck are recommended.

II. Spasms.—*Causes.*—Excessive action of the laryngeal nerves may be due either to affections of the nerve-centres, nerve-trunks, or of single nerve-twigs. With regard to the nerve-trunk affections, it may be stated that, it having been shown that stimulation of the peripheral end of the cut recurrent laryngeal nerve—i.e. of *all* its fibres—results in adduction of the corresponding vocal cord, it is quite possible that, in cases of so-called 'spasm of the glottis' of peripheral origin, not only the adductors, but also the abductors may be in a state of spasmodic contraction, the former, however, preponderating. In spasms due to affection of single nerve-twigs, either the abductors, or

the tensors, or the adductors alone may be concerned. In the case of the latter, the spasm may either occur independently of volition, and may then be (*a*) uninterrupted during the attack (common 'spasmus glottidis'); (*b*) occurring in separate contractions quickly following one another and associated with similar contractions of other expiratory muscles (nervous 'laryngeal cough'); or it may occur only on attempted phonation, when it is usually allied to spasm of the tensors ('aphonia spastica'—'speaker's cramp').

Excessive action is always the result of irritation. Such irritation may be either direct or reflex—i.e. either acting upon the motor nerves themselves or affecting other centripetal nerves, and, being transferred to the laryngeal motor centres, radiate along their centrifugal tracts, causing spasmodic contraction of laryngeal muscles. To produce spasmodic motor phenomena, the irritation must possess a certain degree of suddenness and intensity. Any of the causes usually leading to progressive paralysis of the laryngeal nerves (see *Paralyses*, Causes), may therefore, if acting more suddenly and more intensely, produce laryngeal spasm. Thus, even in a case of slowly progressive primary paralysis of laryngeal nerves, provided that the conductivity of all the fibres has not yet been destroyed, spasm may suddenly supervene, if from any cause there be a sudden increase of irritation.

Pathology.—Laryngeal spasms are in the majority of cases pure neuroses, and, with the exception of those cases in which a direct pressure upon the laryngeal nerves is shown by the post-mortem examination to have existed, no changes either in the nerves or in the muscles are to be detected.

Symptoms.—The symptoms in cases of spasm due to affection of the nerve-trunks, and of the common form of the affection of the adductor twigs in which the contraction is uninterrupted during the attack (common spasm of the glottis), are identical, they may therefore be described together. The symptoms, however, differ to some extent in the cases of children, when the affection is also called 'laryngismus stridulus,' and in those of adults.

In children, often without any preliminary symptoms, a few at first short, gradually more prolonged, stridulous inspirations are followed by closure of the glottis, suspension of the respiratory movements of the chest, and complete cessation of respiration. This cessation, unless the child succumbs during the attack, lasts from a few seconds to about two minutes, and ends with a series of stridulous inspirations, after which regular respiration is gradually re-established. During the attack the aspect is a most painful one: the countenance is very anxious, the flush at first present on the face is soon replaced by pallor or even lividity, the eyes stare, the pupils are contracted, the nostrils are dilated, the head is thrown back, the neck forward, the face is covered with cold perspiration, its veins and those of the neck are swollen, and in severe cases these symptoms are accompanied by spastic, so-called 'carpo-pedal,' contractions of the muscles of the extremities. The thumbs are flexed on the palms and the other fingers closed round them or rigidly extended, the carpal joints are bent inwards, the feet somewhat flexed and rotated inwards. General convulsions are sometimes superadded to these phenomena. Attacks of this sort, but of variable severity, may follow one another at variable times. Sometimes they occur in most rapid succession, sometimes at intervals of twenty-four hours or more. The child may succumb in any of them, whilst in most cases, after a variable duration of the liability to such attacks, a complete cure is finally effected.

In adults the symptoms are similar to those just described, only generally less severe. The complete cessation of respiration witnessed in children only rarely occurs, and the attack is generally characterised by a series of stridulous inspirations. There is no doubt, however, that in cases of sudden considerable irritation of the laryngeal motor nerves, a laryngospastic attack may also end fatally in adults. In very rare cases there is, according to some authors, a slight but constant spasm. A laryngoscopic examination during the attack will, in most cases, be impossible. In the free interval, generally, no abnormality, except perhaps slight congestion, can be detected.

In the variety in which the spasmodic closure appears in the form of separate, sudden, short contractions of the adductors associated with similar contractions of other respiratory muscles, the only symptom is incessant cough of a particularly loud, sometimes barking, nature, which goes on without interruption whilst the patient is waking, and occasionally prevents him from sleeping. This nervous laryngeal cough, which is not associated with any demonstrable lesions, usually attacks young people between 16 and 20, may last for weeks, months, and even years, and finally almost always disappears spontaneously.

The last form of spasmodic contraction of the adductors, which is probably always allied to a similar contraction of the tensors, only occurs on attempted phonation, and is called 'spastic aphonia.' This form, like the preceding, is rare. There appears to be a certain proclivity to it on the part of highly strung male persons who have to use their vocal organs professionally (especially clergymen), but apparently robust males and females, whose occupation is of a silent kind, may also be attacked. It is characterised by a very peculiar alteration of the voice. Whenever the patient attempts to speak, he produces only a few sentences, words, or even syllables, in an audible voice, the rest of the sentence or word being completely lost in fruitless and distressing efforts to force a current of air through the spasmodically closed glottis. Laryngoscopically, under these circumstances the glottis may be seen to be so spasmodically closed, that it almost appears as if one vocal cord were overlapping the other. When the patient whispers, the difficulty is sometimes not so great, though not entirely absent. Respiration is free and noiseless.

Diagnosis.—Spasm of all the laryngeal muscles or of the adductors alone is so well characterised by its sudden commencement, the complete cessation of respiratory movements at the height of the attack, the absolutely free intervals, the absence of fever, cough, hoarseness, or aphonia, that these points considered together will, on the whole, suffice to prevent the practitioner from confusing it with acute laryngitis, &c.

Nervous laryngeal cough can only be confounded with cough from organic disease (phthisis). Careful examination of the chest, &c., will obviate such an error; moreover, cough from organic disease is hardly ever so continuous as the purely neurotic. Aphonia spastica is differentiated from common spasm of the glottis by its occurring only on attempts at phonation; from bilateral paralysis of the abductors by being associated with free and noiseless respiration.

Treatment.—In cases of spasmodic closure of the glottis threatening life, the first indication is to relieve the spasm, the second to remove if possible the cause of the abnormal irritability causing the spasm. During the attack, fresh air must be admitted to the room, the patient should be placed in a sitting posture, all tight clothing ought to be removed from him, cold water dashed into his face and upon his chest, strong smelling salts, ammonia, ether, acetic acid, should be held to his nostrils, and his fauces tickled with the finger or a feather until retching is produced. Inhalation of chloroform (which, of course, ought only to be administered by a medical man), or a subcutaneous injection of morphia often curtails the attack. During the interval, the exciting cause of the spasm ought to be ascertained if possible, in order to be avoided in future. The patient should be protected against all emotional disturbance; gastric and intestinal disorders should be promptly attended to; in cases of rachitis, the general hygiene and diet must be carefully regulated and cod-liver oil be given.

Nervous laryngeal cough and aphonia spastica are equally little amenable to treatment; but the best remedy, especially in nervous laryngeal cough, appears to consist in a long journey (if possible a sea voyage), or removal of the patient from his usual surroundings. In cases of nervous laryngeal cough due to irritability of the laryngeal mucous membrane, cocaine applications may possibly prove useful.

III. Troubles of Co-ordination.—Under this head it is only necessary to remark that, in some cases, a disorderly action of the vocal cords is observed. Thus choreic movements of these parts have been seen to accompany general chorea, and have even been noticed independently; a tremulous action of one or both cords, similar to the tremors of the limbs on intended movement, is sometimes seen in disseminated cerebro-spinal sclerosis, and finally, in some cases, a perverse action of the cords has been described. In this form (which has also been named functional inspiratory spasm, though it is more a trouble of co-ordination than of excessive action), the vocal cords, instead of separating on intended inspiration, approach each other, remain together during the inspiration, so that the air enters with difficulty and accompanied by stridor through the narrowed glottis, and only separate to some extent during expiration. The symptoms in such cases (variations appear to occur) will be very similar to those of bilateral paralysis of the abductors (see *Paralysis*); and it is only by watching the vocal cords with the laryngoscope during expiration, that a separation will be seen and a correct diagnosis arrived at. This affection appears to occur almost exclusively in nervous or hysterical persons, and a minor degree of the same is often witnessed in nervous people who are for the first time examined with the laryngoscope, the vocal cords being in such cases approached to one another,

instead of separated, on attempting a deep inspiration. Psychical treatment, bromide of potassium, and the cold douche will often effect a cure.

B. Neuroses of Sensation.

I. Anæsthesia.—Loss of sensibility of the mucous membrane occurs when the sensitive branch of the superior laryngeal nerve is paralysed. This may arise in cases of bulbar paralysis and other cerebral affections, in diphtheria, and to a minor degree in hysteria. It may be unilateral or bilateral, and vary from a slight diminution of sensibility and reflex irritability to complete anæsthesia and analgesia. If occurring in diphtheria or bulbar paralysis, it is always coupled with motor paralysis of the depressors of the epiglottis, and often with paralysis of the crico-thyroid muscles. *See* the motor phenomena caused by this paralysis, under *Paralyses*. The upper aperture of the larynx remaining open during the act of swallowing, and the mucous membrane of the larynx itself being insensitive, under these circumstances particles of food often enter the lower air-passages, and may either cause most violent cough (the tracheal mucous membrane having retained its reflex irritability); or obstruct the passage and produce dangerous attacks of suffocation; or become impacted in the bronchi and give rise to pneumonia. A certain diagnosis can only be arrived at by touching the laryngeal mucous membrane, under guidance of the mirror, with a probe. If anæsthesia be present, the patient neither feels the touch nor is reflex cough, &c., produced. Though post-diphtheritic anæsthesia tends to spontaneous disappearance in the course of five or six weeks, in all forms in which the anæsthesia is complete, the patient ought to be fed either by the œsophageal tube or by nutritive enemata, in order to prevent the very dangerous entry of food into the air-passages. The œsophageal tube ought, under these circumstances, to be introduced very cautiously, guided by the forefinger of the left hand, in order that it may not enter into the open and insensitive larynx. When it is in what is supposed to be the correct position, the patient, before the food is administered, should be requested to produce a sound, which will be impossible when the instrument is in the trachea. As to the treatment of the affection itself, in diphtheritic paralysis galvanic and faradic electricity applied to the anterior wall of the pyriform sinus, close to which the superior laryngeal nerve is running, and hypodermic injections of sulphate of strychnia (gr. $\frac{1}{30}$ to $\frac{1}{10}$) are recommended.

II. Hyperæsthesia, Paræsthesia, and Neuralgia.—All these forms of neurosis occur very rarely in the larynx, and are, if occurring, usually combined with similar affections in the pharynx. All of them are concomitants of hysteria, hypochondriasis, neurasthenia, anemia, chlorosis, and similar affections, and may be said to pass over into one another without very sharp outlines. The sensations complained of are of a very varying kind; pain, burning, pricking, constriction, dryness, rawness, sensation of a foreign body, pressure, irritation to cough, &c. The result of the laryngoscopic examination in such cases is negative. The treatment of these affections is often very difficult and unsatisfactory. In the first place, attention must be paid to the general health, nervine and tonic remedies be given, sea-bathing or a voyage advised, &c. If the pain be of an intermittent character, quinine should be tried. Locally, applications of astringent remedies or of morphia and chloroform may be instituted; cocaine may prove itself very useful in these cases.

Felix Semon.

LARYNX, Scalds of the, not infrequently occur in children from the attempt to drink from the spout of a boiling kettle. A similar effect is produced in adults and children by the swallowing of corrosive fluids, or by the inhalation of the heated vapours from flames or a gas explosion.

There is usually pallor and collapse, followed by restlessness and fever. The patient complains of severe pain about the mouth and fauces. The mucous membrane of these regions is swollen, white, and blistered. Swallowing is painful, and sometimes impossible. The voice is hoarse, or sinks to a whisper. In a short time respiration may be seriously affected from the extension of the swelling to the parts immediately above the rima glottidis, or from reflex contraction of the laryngeal muscles. This dyspnœa is subject to exacerbations, which may prove suddenly fatal. Generally, however, the breathing becomes more hurried, with stridulous inspiration and gradually increasing lividity, until the patient dies in a few hours from exhaustion or asphyxia. Where the injury is less severe, the symptoms may slowly subside, or they may be followed by those of broncho-pneumonia, even in cases in which the laryngeal disturbance has not been so severe as to necessitate tracheotomy.

When death occurs in a few hours, the mucous membrane of the mouth and pharynx, together with that part of the

larynx which lies above the true vocal cords, will be found to be sodden, wrinkled, and highly congested, while the œsophagus and the parts below the rima will usually have escaped injury. Should the patient succumb at a later period, the scalded parts will be covered with croupous exudation; partially separated sloughs will be seen about the fauces and epiglottis; the bronchi will be congested and full of viscid mucus or pus; and patches of hepatisation will be dotted over the substance of the lungs.

Treatment.—The child should be placed in a bed surrounded by screens in a warm and steamy atmosphere. Sponges wrung out of hot water should be applied to the front of the neck. Calomel in 1 or 2 grain doses should be given every hour. Antimonial wine, in doses of 1 or 2 minims, with ¼ to ½ minim of tincture of aconite, may also be given at first every quarter of an hour, and afterwards at longer intervals. If there should be any persistent dyspnœa, and especially if there should be spasmodic exacerbations, the parts about the fauces and epiglottis should be scarified with some pointed instrument, such as a needle in a handle. This gives exit to the serum of the blisters and to the submucous infiltrations in the upper part of the larynx, and in many cases the operation is followed by great relief. If, however, the symptoms still continue urgent, laryngotomy or tracheotomy should at once be performed. Should broncho-pneumonia supervene at a later period, a linseed-meal poultice should be wrapped round the chest, and expectorants be given, such as ipecacuanha wine with carbonate of ammonia. At first the child should be fed with small quantities of milk and beef-tea, and, if there is much collapse, some brandy must be added. Subsequently a more nourishing diet will be necessary. The treatment of adults will be similar to that of children. Where the patient is vigorous, leeches may be applied to the front of the neck, and, if lung-symptoms should arise, a blister to the upper part of the chest may be beneficial.

N. Davies-Colley.

LARYNX, Syphilis of the.—*Causes.* The larynx may be attacked by syphilis in its secondary, tertiary, and congenital forms. The secondary manifestations appear, usually, at the time of the corresponding skin-lesions or a little later; the tertiary symptoms, as a rule, a few years after the primary infection. Both forms, however, are subjected to most striking variations; whilst in some patients a form of superficial ulcerative laryngitis will return year after year, without ever passing into the more serious forms of deep destructive ulceration, on the other hand, lesions belonging to the most severe forms of the tertiary period occasionally appear in the larynx and in the trachea a few months after the primary infection. Again, there may be an outbreak of tertiary syphilis in the larynx five, ten, twenty, even thirty and forty years after the primary infection. The congenital lesions of laryngeal syphilis were considered as excessively rare up to very recent date; lately, however, it has been shown that they are much more common than had been supposed. They usually manifest themselves either shortly after birth, or in the first years of life, or at the time of puberty.

Pathology.—Secondary syphilis of the larynx shows itself usually in the form of a very obstinate catarrh, which has nothing specific in its character, but which is looked upon by some as an erythema. The occurrence of condylomata (mucous patches) is a hotly contested point. If occurring at all, they must be rare and of a very transitory nature. Superficial ulceration, often of a relapsing character, is also met with. The phenomena of tertiary laryngeal syphilis are gummata, deep destructive ulceration, perichondritis of a suppurative or an adhesive character, caries of the cartilages, fibroid thickening and degeneration of the mucous membrane, cicatricial contraction. All these may occur separately or combined, or one following another. Gummata in the larynx are rare. They are generally developed in the submucous tissue, and appear either in the form of multiple, small, sharply defined, often nearly coalescent nodules, or in that of a diffuse infiltration, or as larger, well-defined, smooth nodes. The mucous membrane over them is at first normally coloured, but assumes later on a yellowish tint. They show a great tendency to break down and to change into deep irregular ulcers, which often penetrate very deeply, extend to the perichondrium and the cartilages, and lead to purulent perichondritis, formation of abscesses, fistulous communications with the neighbouring parts, caries, necrosis, and exfoliation of the cartilages. Apart from this form of ulceration, there is another more frequent one, and not preceded by the formation of gummata, which shows a greater tendency to extend in surface than in depth.

Again, there is a form of primary perichondritis in syphilis, in which the mucous membrane is either not at all affected or only secondarily. This perichondritis

may either be of an adhesive type, or it may be of a suppurative character, and, in such cases, the mucous membrane only becomes affected at the time when the abscess breaks internally. The further consequences may be, of course, the same as in the cases in which the ulceration extends from the surface to the deeper structures. Often, there is œdema, acute or chronic, in the neighbourhood of the ulcers of both periods and of the gummata; sometimes, fungoid excrescences are found on the borders of the ulcers. These excrescences, which often look like papillomata, are especially seen in the inter-arytænoid fold, a locality in which, as elsewhere stated, genuine non-malignant neoplasms never occur, but in which isolated longitudinal syphilitic ulcers are not rarely found. On the whole, it may be said that syphilitic phenomena may show themselves anywhere in the larynx. The epiglottis, however, is perhaps more frequently attacked than any other part.

Common to all syphilitic ulcerations, whatever their particular form of origin may have been, is the extraordinary tendency to cicatricial contraction on healing and the formation of callous connective tissue. This peculiarity often leads not only to fibroid thickening and to very curious deformities of the individual parts, but also to their coalescence with each other, to the formation of membranous bridges or even of complete diaphragms between the cords or ventricular bands, to adhesion between the epiglottis and the adjacent pharyngeal structures, to extreme stenosis of the laryngeal cavity, &c.

Symptoms.—From a glance at the pathology of the possible changes in laryngeal syphilis, it will be evident that the symptoms may show almost every shade of variation peculiar to the larynx, according to the nature and the gravity of the lesions. Thus, in the secondary affection, with the exception of some hoarseness there are usually no laryngeal symptoms. There may be slight sensations of irritation or of soreness in the throat, but laryngeal syphilis, even in its most serious ulcerating forms, is characterised by complete or nearly complete *absence of pain*. Cough is but rarely present, and hardly ever very troublesome.

In the tertiary stage more definite symptoms are met with. When the vocal cords are either ulcerated or infiltrated by œdema, or fixed in an abnormal position by disease of the crico-arytænoid joints, more or less complete aphonia may be present; when there is stenosis of the larynx, from whatever cause, there will be dyspnœa, often of a dangerous degree; when the epiglottis is partly destroyed by ulceration, and if there be in addition ulceration in the pharynx or œsophagus, there may be some dysphagia, though this rarely forms a very prominent feature.

The laryngoscopical appearances will necessarily vary, almost indefinitely, according to the nature of the lesions in the individual case. The catarrhal congestion of secondary laryngeal syphilis is not very characteristic, and is only distinguished by its obstinacy. Mucous patches are described as smooth yellow projections sometimes 'round, but more often oval, varying in diameter from three to seven millimètres, but in rare cases attaining a breadth of a centimètre' (Mackenzie). The writer has never seen them. The superficial ulceration, which is most frequently intermediate between the secondary and the tertiary changes, is of a decidedly inflammatory character, and often surrounded by a more or less œdematous zone of congestion. The ulcers of the tertiary period show this inflammatory character in even a more decided manner. They are deep, with irregular infiltrated borders and an unhealthy-looking base. Sometimes, when they penetrate to the cartilages and exfoliation of sequestra has taken place, they have an almost crater-like appearance. Gummata have already been described. The congenital lesions of laryngeal syphilis may present themselves in any of the forms under which the acquired disease, in its secondary and tertiary stages, appears.

Diagnosis.—The catarrh of secondary laryngeal syphilis having nothing characteristic in its appearance, the diagnosis of its specific nature will have to be made only from the concomitant existence of undoubted syphilitic affections of the skin, the mucous membranes of the mouth, tongue, pharynx, &c. As stated before, it is distinguished by great obstinacy and resistance to purely anti-catarrhal treatment. It yields, however, quickly to anti-syphilitic measures. On the other hand, it must not be forgotten that a person suffering from secondary syphilis may acquire a common catarrh.

The hoarse voice of children suffering from 'snuffles,' broad condylomata about the anus, &c., will often lead to the inference that the larynx is also attacked, and not rarely laryngoscopic examination will verify the suspicion.

There will not, usually, be much difficulty in rightly interpreting the ulcerative and gummatous manifestations of syphilis. To begin with, in the majority of cases there

will be lesions, corresponding to the stage of the constitutional disorder, in other parts of the body, the skin, other mucous membranes, the eyes, bones, abdominal organs, brain, &c., which will at once point to the nature of the laryngeal affection. Even if the latter should occur alone, the patient's history and the discovery of old scars in other parts, notably in the pharynx, will give valuable information. Again, though the laryngeal ulcer of syphilis has nothing absolutely pathognomonic about it, yet there are usually signs sufficient to render it easily distinguishable from tubercular and malignant affections, the only ones—except lupus, which is very rare in the larynx—with which it could be confounded.

The syphilitic ulcer is produced very rapidly—i.e. within a few days; it is evidently of an inflammatory origin, and has an area of more or less active inflammation around it; it is irregular, often large, often deep, usually solitary and unilateral; there are rarely more than two or three ulcers.

The tubercular ulcer, on the other hand, is usually preceded by a long period of pseudo-œdematous infiltration, the parts are usually excessively pale, semi-transparent, the ulcers are very numerous, very small, and only later on confluent; they hardly ever lead to so much destruction as syphilitic ulcers. Moreover, the concomitant pulmonary and constitutional affections will afford valuable diagnostic help. The diagnosis, however, will be sometimes excessively difficult in cases in which phthisis and syphilis are simultaneously present, or in cases in which, besides the laryngeal affection, syphilitic lung-troubles exist. As regards the latter class of cases, it will be useful to remember that syphilitic lung-affections are generally localised, not in the apices but in the middle region of the lungs. Should there be any doubt, it is better to give under all circumstances antisyphilitic remedies.

The scars, thickenings, distortions, webs, &c., left after the healing up of syphilitic ulcers as a rule tell their own tale; occasionally, however, there will be great difficulty in deciding whether immobility of one or both vocal cords is due to previous syphilitic disease and ankylosis of the crico-arytænoid articulations, or to paralysis of the motor laryngeal nerves.

Treatment.—In all syphilitic affections of the larynx, constitutional treatment is of fundamental importance. In the secondary stage, mercurial preparations (hydrargyrum cum cretâ, 1–2 grains, two or three times daily, or a mercurial pill of two grains with opium—gr. ⅛—twice or three times daily) may be given; or a regular mercurial inunction treatment (half a drachm of mercurial ointment to be used daily) may be instituted. The inhalation of atomised solutions of bichloride of mercury (1 in 500 or in 1,000) has been warmly recommended. Local applications are rarely required. If such be made, solutions of sulphate of copper (15 grains to an ounce of distilled water) or of nitrate of silver (30–60 grains to one ounce of distilled water) may be used.

In the tertiary forms, in which every day unexpected and serious complications may arise, a vigorous iodide of potassium treatment is indicated. It almost always achieves brilliant results, even in cases in which from œdema, or from gummatous infiltration of the larynx and trachea, immediate danger appears to be present. It will, in such apparently hopeless cases, be sometimes possible to avoid scarification and performance of tracheotomy, when they seem to be urgently indicated, if, beginning with the administration of 10-grain doses of iodide of potassium three times daily, one gradually but quickly pushes the dose up to thirty grains three times daily, combining this internal medication with mercurial inunction.

Should there be so much acute œdema of the upper parts of the larynx and such dyspnœa, that the action of internal remedies cannot be waited for, scarification ought to be practised, and if in spite of this the difficulty of breathing continues, tracheotomy must be performed. The latter operation may also be required in cases of subglottic œdema, of chronic stenosis of the air-passages from fibroid thickening of the parts, and in cases of bilateral ankylosis of the arytænoid cartilages in the position of phonation, whereby the glottis is reduced to a narrow slit. In cases of narrowing of the larynx from cicatricial contraction, methodical dilatation by means of Schrötter's hollow vulcanite tubes may be tried; but the writer must confess that he has never been lucky enough, though he has followed this plan very perseveringly in several instances, to either avoid tracheotomy in cases in which this operation appeared to be indicated, or to enable patients, in whom that operation had been performed, and in whom dilatation was practised subsequently, to dispense with the canula. Moreover, the method is not quite free from the risk of setting up active inflammation and even suppurative perichondritis. In cases of cicatricial webs, it

may be either attempted to remove them with cutting-forceps, or to divide them by means of Dr. Whistler's cutting-dilator, or to destroy them by means of the galvano-cautery. If the web, however, be very tough, no method can boast of much success, and even removal from without—i.e. after the performance of thyrotomy, with subsequent dilatation, does not protect against a sphincter-like recicatrisation. The patient will, therefore, in such cases most probably have to wear his canula for the rest of his life. FELIX SEMON.

LARYNX, Tuberculosis of the.—*Causes.*—Laryngeal phthisis is due to the deposit of tubercle in the larynx, and occurs in about 30 per cent. of all cases of pulmonary phthisis. Tubercular disease of the larynx is almost always secondary to the pulmonary affection, though it often occurs at a time when there are no definite physical signs of lung-mischief; quite recently some cases have been put on record, in which the result of the post-mortem examination seems to establish the actual occurrence of primary laryngeal tuberculosis. As regards age and sex, the same conditions obtain as in pulmonary tuberculosis.

Pathology.—The stage of deposit of the tubercle is usually ushered in by infiltration and pseudo-œdematous thickening of the tissues, which is generally most marked in the epiglottis, the arytæno-epiglottidean folds, the mucous membrane covering the arytænoid cartilages, and in the inter-arytænoid fold. This stage is frequently preceded by marked isolated anæmia of the whole mucous membrane of the larynx, especially of the epiglottis. The tubercles themselves are said to have been seen in very rare cases as small greyish or yellowish nodules, but in the great majority of instances they break down so quickly that small ulcers are usually the first signs of their presence. These quickly coalesce, extend in surface and in depth, destroy epithelium and mucous membrane, and lead to perichondritis, caries, necrosis, and exfoliation of parts of the cartilages. In rare cases subepithelial tumours, consisting of an aggregation of miliary tubercles, and cellular infiltration of the mucosa and submucosa, have been found. Even in the stage of extensive ulceration, chronic œdema of the surrounding parts usually persists.

Symptoms.—The most common special symptoms of laryngeal phthisis are cough, with more or less expectoration, hoarseness, aphonia, and dysphagia, all of which may be due to the swollen and ulcerated state of the organ. Cough may, however, also depend upon the concomitant pulmonary affection; aphonia upon implication of the right recurrent nerve in thickening of the pleura of the apex of the right lung, or upon pressure of enlarged bronchial glands upon either or both recurrent laryngeal nerves, leading to paralysis of one or both vocal cords. Cough and dysphagia are generally the most troublesome symptoms of the malady; the latter is often so extreme that it materially hastens the fatal end.

Laryngeal dyspnœa is less common. The shortness of breath on slight exertion, so often observed in these cases, is to be attributed rather to the concomitant lung-affection than to the laryngeal disease. Serious and even fatal laryngeal dyspnœa, with stridulous breathing, may however, occur, either in consequence of extensive œdema, or of impaction of a piece of necrosed cartilage in the glottis, or of mechanical fixation of both vocal cords in the position of phonation. This last may be the result of perichondritis and subsequent ankylosis of the crico-arytænoid joints, or of bilateral paralysis of the glottis-openers, in consequence of implication of both recurrent nerves in lesions of the lungs or of the bronchial glands. *See* LARYNX, Neuroses of the.

Laryngoscopically, the pallor of the tissues is of great diagnostic value. Originating even before the stage of infiltration, it persists throughout the periods of thickening and ulceration. The discovery of such a pallor should always be followed by careful examination of the lungs. In rarer cases there is an obstinate chronic laryngeal catarrh, undistinguishable laryngoscopically, at the beginning, from common laryngitis. With the onset of the tubercular infiltration the appearances often become so pathognomonic, that the diagnosis of phthisis can be made from laryngoscopic inspection alone, though, of course, examination of the lungs, of the sputum for bacilli, &c., must never be neglected. In such cases, the infiltration gives to the eye of the observer the idea of a peculiarly dense, almost semi-solid, pale œdema; one or both of the arytænoid cartilages and arytæno-epiglottidean folds, which are sometimes for some length of time the only parts thus infiltrated, assume a pear-like appearance, the larger end of the pear being represented by the pale, swollen arytænoid cartilages. The epiglottis is often rolled backwards on itself,

and looks like a turban. If these pale swollen surfaces are, a little later on, seen studded with small ulcerations, the appearances are almost unmistakable. In other cases the first, and for some time the only, laryngeal symptom is infiltration or ulceration of the inter-arytænoid fold. If, in cases which otherwise warrant suspicion of phthisis, this part be seen to be swollen, velvety-looking, semi-transparent, superficially eroded, or even somewhat ulcerated, this is a sign of evil omen.

The vocal cords and ventricular bands are sometimes, but not often, the parts first affected. They appear sodden, rounded, the cords lose their lustre and become denuded of epithelium; later on, distinct ulcers are visible, their borders appear irregularly eroded, finally they may be partially or wholly destroyed. The superficial ulceration, wherever first seen, soon spreads in depth and extent. Often, the whole laryngeal mucous membrane forms a mass of ulceration covered with thick greenish-yellow secretion. The epiglottis may be, and not rarely is, almost wholly destroyed, or a small stump only is left, and one or both cords may be seen to be immovably fixed in any position, or their movements may be very defective.

Impairment of the mobility of one or both vocal cords may occur at different periods of laryngeal phthisis, and may be due—(*a*) to functional weakness of the (sometimes actually degenerated) laryngeal muscles; (*b*) to extensive infiltration of the tissues, notably of the inter-arytænoid fold, which may mechanically prevent the movements of the cords; (*c*) to actual disease of the crico-arytænoid joints; (*d*) to disease of the afferent motor nerves.

Diagnosis.—The diagnosis of laryngeal tuberculosis presents, as a rule, no great difficulty. In many cases the laryngoscopic examination will suffice; in more doubtful ones, examination of the lungs and of the sputum for bacilli will generally settle the question. In doubtful cases, especially if it be uncertain whether the laryngeal ulceration is syphilitic or tubercular, some of the secretion from the ulcerated surface withdrawn by means of a brush, under guidance of the laryngeal mirror, may be examined for bacilli, and their detection will clinch the diagnosis.

The diseases most likely to be mistaken for laryngeal phthisis are syphilis, carcinoma, chronic œdema, and simple chronic inflammation of the larynx. For the differential diagnosis from syphilis and carcinoma, *see* the articles treating of these affections. Chronic œdema occurs in the course of laryngeal phthisis, as well as in that of the diseases just named. Its greater transparency, and the absence of ulceration on the swollen parts, will usually differentiate it from tubercular infiltration. Whether an obstinate catarrh of the larynx, accompanying pulmonary phthisis, is of a tubercular or a non-tubercular nature, may for some time be doubtful. That non-tubercular catarrhal affections of the larynx may accompany tubercular disease of the lung, has been proven by post-mortem examination. The uselessness of the common treatment of chronic laryngitis, and the occurrence of more definite laryngeal lesions in such cases, may in time lead to a more accurate diagnosis of the true nature of the laryngeal affection.

Treatment.—The constitutional treatment—medical, climatic, hygienic—generally employed in pulmonary phthisis, is to be made use of in laryngeal tuberculosis. As to local medication, there are few diseases in which such a multitude of remedies has been recommended as in laryngeal phthisis. The writer will only mention those which he has found most useful. In the early stage—i.e. before ulceration occurs—he very rarely adopts any local measures. In cases of ulceration he has seen much benefit from the insufflation into the larynx once or twice daily, by means of the powder-blower, under the guidance of the laryngeal mirror, of a powder composed of iodoformi, acidi boracici, ana gr. j., morph. acet. gr. $\frac{1}{6}$–$\frac{1}{2}$, the patient having immediately before cleared the part as much as possible of mucus by coughing. In making the application the mirror must invariably be used, as unless the powder come in contact with the ulcerated surface the treatment is useless. If properly applied, however, the insufflation leads in most cases to diminution of the distressing cough, improvement of the dysphagia, and often to an actual improvement in the condition of the ulcers. In a very few cases, the writer has even seen them disappear for a time under the methodical employment of these insufflations. Quite lately, he has in a few cases of tubercular perichondritis with excessive dysphagia brushed over the whole of the affected parts with a 20 per cent. solution of hydrochlorate of cocaine, to enable the patients to swallow. The effects have been most encouraging. Cocaine may also be used in the form of spray or of pastiles. In cases of advanced œdema, energetic scarification is advised by some authors. Where there is much difficulty in swallow-

ing, the patient's diet ought to consist of liquids thickened by the addition of some arrowroot, cornflour, or isinglass, and drinks ought to be taken at a draught, and not sipped (Mackenzie). In cases of complete aphagia it may become necessary to feed the patient by means of an œsophageal tube.

Tracheotomy ought only be performed when there is direct danger of suffocation from any of the causes enumerated under 'symptoms,' but not otherwise. The experience of the most trustworthy observers shows that when it is performed simply to give the diseased larynx rest, it does not delay the tubercular process, whilst the wearing of the canula enhances the misery of the patient's existence.

FELIX SEMON.

LATERAL SPINAL CURVATURE.

SCOLIOSIS.—*Definition.*—A lateral deviation and contortion of the spinal column, nearly always accompanied by more or less exaggeration or diminution of the normal antero-posterior curves.

Causes.—Lateral curvature of the spine is predisposed to by weakness of the spinal muscles, combined with long-continued sitting or standing in stooping or careless positions, such as standing on one leg, sitting with the trunk leaning to one side, or with the thighs crossed. Another predisposing cause is inequality in the lengths of the lower extremities, the result of (1) congenital difference in size; (2) atrophy from infantile paralysis; (3) hip-joint disease; (4) congenital dislocation of the hip; (5) unequal muscular power, when one leg is partially paralysed, &c. Eliminating these causes of inequality in the legs, which are common to both sexes, there is no doubt that ordinary lateral curvature, induced by muscular weakness and injurious positions during years of growth and school life, is far more frequent in girls than in boys. This cannot be explained by girls being accustomed to sit in worse positions at school than boys, but by the fact that, as a rule, boys are allowed to correct the evil influence of stooping and lounging over lessons during long school hours, by daily physical exercise, such as cricket, football, &c., whereas girls enjoy far fewer opportunities of exercising their bodies. At the onset of puberty, the development of girls generally throws a greater strain on their health and strength than is the case with boys, and fully developed girls of twelve or fourteen years of age, suffering from lateral spinal curvature, are frequently met with in ordinary practice amongst all classes, but especially amongst the upper and middle.

It is still uncertain why the very large majority of cases of lateral spinal curvature have the upper or dorsal curve with the convexity to the right. Dismissing theories about the supposed influence of the arch of the aorta, it is very probable that the greater use of the right arm and hand is a predisposing cause; although, at the same time it must be admitted, that cases with the convexity of the upper or dorsal lateral curvature to the left are not at all limited to left-handed patients.

Weakness of the muscles is always accompanied by a corresponding weakness or softness of the bones to which they are attached. There is, besides, often an hereditary predisposition to lateral curvature, due either to inherited excessive softness of the bones, or weakness of the muscles, or to both combined. The writer knows of many cases where a mother and her daughters had more or less severe lateral curvature, and he has watched a family where father, daughter, and granddaughter by a son, had all marked lateral curvature, the father being much deformed.

Rickets is frequently associated with lateral curvature, and some of the worst deformities seen in museums are of this class, the curvature being induced either by unequal shortening of the legs from deformity, or by the excessive softness of the bones, or by these causes in combination, aided by the usual factor of weak muscles. As a general rule, anything which weakens the muscular system tends to produce lateral curvature, which often therefore follows convalescence from one of the acute zymotic diseases or a severe inflammation of the lungs. Too rapid a growth, or the too rapid laying on of fat at the time of puberty, is a frequent cause; the writer has observed that a large proportion of patients with lateral curvature are either too tall or too short, the latter condition occurring as the result of illness, which has not only weakened the muscles but also retarded a normal state of growth.

So far, ordinary lateral curvature only has been considered, but unilateral affections of the thoracic viscera, such as severe empyema in a stage of recovery with dragging down of the thoracic walls, or severe adhesions the result of old pleurisy, will also produce lateral curvature with concavity on the same side as the chest affection; in such cases, torsion of the lateral curvature is generally absent for a time.

Pathology.—Innumerable works have been written on the pathology of lateral curvature, and the most diverse views propounded as to whether it is caused by the weakness of the bones, ligaments, or muscles. Simple lateral curvature is hardly ever met with, except in cases due to empyema or severe disease of one lung. In the large majority of cases, the lateral curvature of the spine is accompanied by a rotation, on their axes, of the bodies of the vertebræ implicated in the given curvature, so that the transverse processes of the same side as the convexity of the curvature are directed backwards, while the transverse processes of the other side of the vertebral bodies, viz., towards the concavity of the curvature, are of necessity directed forwards. For example, in the common form of lateral curvature with dorsal or upper convexity to the right, and lumbar or lower convexity to the left, the right transverse processes of the dorsal vertebræ and the ribs attached to them are directed backwards. This torsion of the bodies of the vertebræ is probably caused by the muscles of the spine and trunk trying to recover the vertical position of the spine, and, failing in this, tending to partly restore equilibrium by twisting the portion of the trunk immediately above the convexity of the curvature, round to the same side.

It is difficult to say precisely whether the dorsal or lumbar lateral curvature is first established. No doubt as soon as one curvature is confirmed, a compensating curvature to the opposite side forms, and, in most cases, the head is flexed to the same side as the convexity of the dorsal curvature (cervical convexity to the left). In many cases when seen in the earliest stage, with scarcely any or no permanent osseous deformity, a distinct dorsal curvature with convexity to the right and a lumbar curvature with convexity to the left will be found, where it is but fair to conclude that the two curves began simultaneously. It is an important fact, that when once there is actual osseous deformity of the ribs and vertebræ, to that extent lateral curvature is incurable. Before a patient can become the subject of moderate or severe osseous lateral curvature, she must have passed through many intermediate stages from the first onset of the deformity, when she began to sit or stand with the spine slightly flexed to one side. At that time, if an anatomical examination could have been made, only some flabbiness or want of development of the muscles would have been found. As the curvature creeps insidiously on, the bodies of the vertebræ become gradually misshapen, so that they are more or less wedge-shaped transversely to the longitudinal axis of the spine, i.e. the vertical depth of a vertebral body will be one or more lines greater on the side corresponding to the convexity of a pathological curvature as compared with the side facing the concavity. The intervertebral fibro-cartilages also become wedge-shaped to the same or even to a greater degree. It is to be noted that the amount of lateral curvature observed by looking at the tips of the posterior spinous processes under the skin, always implies a much greater amount of actual lateral curvature of the bodies of the vertebræ. This can be easily understood by bearing in mind the rotation, on their axes, of the vertebral bodies during the formation of the lateral curvature, which tends to make the posterior spinous processes lie more and more in an imaginary vertical line, drawn through the arcs of the upper and lower lateral curves.

Lateral curvature may accompany spinal caries, or may directly result from caries of one lateral half of one or more vertebræ, but such cases are very exceptional. So also lateral curvature of congenital origin, the result of extra-lateral halves of vertebral bodies being inserted between the normal vertebræ, is extremely rare; according to Neugebauer, only thirteen such pathological specimens are on record. The osseous tissue of the spinal column, even in the severest cases of non-rickety deformity, generally appears to be quite normal; the chief pathological change, in addition to the actual deformation of the vertebræ, intervertebral cartilages, and ribs, is the frequent presence, in severe cases, of buttresses of new osseous deposits within the concavity of each lateral curvature, as a compensation for the instability caused by the deviation from the vertical line. The descending aorta, and other soft tissues, follow the severest undulating curvatures of the spine. In lateral curvature with much osseous deformity, the ribs opposite the convexity of the dorsal curvature become extremely convex posteriorly, and so flattened anteriorly that the sternal and vertebral ends of the same rib become almost or quite parallel. The corresponding ribs opposite the concavity become much flattened behind and too convex in front, causing undue prominence, and at times pseudo-enlargement, of the mamma of that side. Adjacent ribs are sometimes welded together by osseous tissue in cases of extreme deformity.

Symptoms.—Cases of lateral curvature may be divided, clinically, into two great

classes: (1) where pain in the back is the first symptom observed, and (2) where some deformity, as the undue prominence of a shoulder-blade, or of an iliac crest, or general stooping, first directs attention to the presence of lateral curvature. It may be stated generally that the amount of pain complained of is seldom in proportion to the amount of deformity. Cases of extreme lateral curvature are frequently seen, where there is not and never has been any pain felt by the patient, although the health may have been affected in other ways, by indigestion, headache, shortness of breath, &c. On the other hand, life may have become almost unbearable on account of constant backache, and the symptoms almost assume those of so-called 'spinal irritation,' in cases where the curvature is but slight.

Ordinary case of Lateral Curvature.—To take an average case of the ordinary type, that is, one not due to inequality of the lower extremities or paralysis. A school-girl of fifteen has stooped more or less for several years, especially during the last three; has complained of weakness and pain in the back for two years past, which became worse after measles, one and a half years ago. Her general health has always been good. She is a short, stoutish girl, with awkward gait, anæmic; complains of pain in the lower dorsal and lumbar regions whenever she has been sitting for an hour or so; generally has pain every evening before going to bed; half an hour's walk brings on the same pain. During the last three years at school the patient has written at a flat table, sitting on a bench without a back, with the trunk in an oblique position.

Mode of Examination.—Both boots should be taken off, and the clothes covering the trunk removed, a petticoat being fastened round the pelvis, well below the crista ilii, and sufficiently low to leave the upper end of the gluteal cleft visible; the latter is especially important in stout adult patients, as a guide to the middle line. The patient stands exactly in front of the surgeon with the back to him, the feet together and symmetrically placed, and the knees kept fully extended. The gluteal cleft is placed exactly in the middle line as compared with the feet and legs; in this way, any rotation of the pelvis, on its transverse axis, is corrected. With these exceptions, the patient is to stand in her habitual or most comfortable position.

In the case taken, there is decided irregularity in the lateral outlines of the trunk, the right side being too much hollowed, with undue prominence of the right iliac crest, while the left iliac crest is not visible as a prominence at all. The lower angle of the right scapula is rather higher and more prominent than that of the left. The posterior spinous process of each vertebra, beginning at the seventh cervical, and ending at the top of the sacrum, should now be carefully marked, and for this purpose one of the popular copying pencils, such as the soft 'automatic eagle,' is best, as the perspiration of the patient's skin facilitates the marking. Any special tenderness of one or more vertebræ will be at once recognised during the marking. This local hyperæsthesia is often present in lateral curvature, and does not indicate spinal caries in any way. The dorsal or upper lateral curvature with convexity to the right, and lower or lumbar lateral curvature with convexity to the left, are much more readily recognised after the marking. The right side, below the scapula, is decidedly fuller than the left. It should be noticed whether the two iliac crests are really on the same level, and this is done by the surgeon carefully and firmly pressing a forefinger of each hand into the soft tissues above each iliac bone; any apparent difference in level will disappear at once if the lower limbs are of equal length.

In the common form of lateral curvature, with dorsal convexity to the right, and lumbar convexity to the left, the *right* iliac crest is generally too prominent, as just stated. This increased prominence of the right iliac crest is produced by the lumbar lateral curvature carrying the trunk, immediately above the sacrum, at first to the left till the centre of the convexity is reached. The soft tissues, above the right iliac crest, are thus carried over towards the left, and if there is much subcutaneous fat, this often makes the right iliac crest appear too high, as if the pelvis were tilted transversely. The prominence of the left iliac crest at the same time becomes less than usual, or is lost altogether, because the skin, fat, &c., are carried more over it than usual. Sometimes, however, the *left* iliac crest appears too prominent, even in cases of ordinary lateral curvature with dorsal convexity to the right, when the dorsal curvature implicates a larger number of vertebræ than usual, while the lumbar lateral curvature is but slight. In these cases, the lower half of the dorsal curvature carries the whole trunk over to the right, leaving the left iliac crest uncovered, and hence apparently too high.

If there is any doubt about the lengths of the legs being equal, accurate measure-

ments must be taken before the conclusion of the examination. Allowing the petticoats to slip below the gluteal folds will often settle the point; for if the buttocks are perfectly symmetrical, there cannot be much, if any, difference. A practical method of ascertaining this at once, and one which does not entail any further undressing than the baring of the knees, is to make the patient lie on the ground, perfectly straight on her back, with the hips and knees fully flexed, and the feet placed symmetrically close together on the ground, with the knees touching each other. The slightest difference in length, of the two lower extremities, will be indicated either by a higher level or by a greater projection forwards of one knee. If such difference be present, the ordinary measurements, between the antero-superior iliac spinous process and the internal malleolus are to be taken, to obtain the actual amount of shortening.

To return to the examination of the trunk; the patient, still in her natural or habitual position, but with the knees straight and the feet close together, is now looked at *sideways*; a considerable exaggeration of the usual cervico-dorsal antero-posterior curve is generally observed; the middle dorsal vertebræ may, in some cases, have their posterior spinous processes projecting backwards beyond the vertical plane of the sacrum. At the same time the abdomen is too prominent, even when the patient is emaciated, and the thorax anteriorly is flattened, frequently with much hollowing of the infra-mammary regions. The head pokes, and the neck is directed forwards in front of, instead of being at the top of, the trunk. The patient should now be inspected *anteriorly* in the same position as before; generally the two lateral halves of the trunk appear more unsymmetrical than from behind; the mammæ, if at all developed, will exaggerate any deformity of the surfaces on which they lie. In the usual form of lateral curvature, with upper dorsal convexity to the right, the left mamma is generally more prominent, and considerably lower than the right; this undue prominence of the left mamma is due to the greater convexity of the left ribs anteriorly. The right iliac crest will also appear more prominent than when seen from behind.

The patient should now be again examined from behind, and, while the knees are kept well extended, requested to flex the trunk fully forwards, the arms hanging loosely downwards. In the case described, the left erector spinæ muscle, between the iliac crest and the last rib, is considerably broader and more prominent as compared with the corresponding right muscle, which was unduly depressed; the lumbar lateral curve being convex to the left, the left transverse processes of the lumbar vertebræ have been rotated backwards, raising up the large mass of the erector spinæ muscle, while the right transverse processes are rotated forwards, causing the overlying muscle to be less prominent than usual. In this flexed position of the trunk, the ribs posteriorly are left uncovered by the elevation and falling forwards of the scapulæ; the right ribs have their posterior angles and adjacent portions too convex, and on a higher level than the corresponding left ribs. This is due to exactly the same cause as the want of symmetry of the erectores spinæ muscles; the dorsal curvature being convex to the right, the right transverse processes of the dorsal vertebræ, with the ribs attached, have been rotated backwards, while the left transverse processes and corresponding ribs have been rotated forwards. The whole prognosis, as will be seen later, depends upon the greater or lesser want of symmetry of the two lateral halves of the trunk, examined thus while the spine is flexed.

To obtain an accurate record, for future reference, of the want of symmetry of the patient's back, the writer employs a malleable strip of lead applied *transversely* to the ribs posteriorly, and extending from the lower angle of the right scapula to the corresponding portion of the left scapula, while the patient's spine is well flexed with the arms hanging feebly down; from this a tracing can be readily taken on a sheet of paper. Another transverse tracing can then be made of the loins opposite the third lumbar spine, and extending on each side to where the muscular walls of the abdomen commence. In each tracing the position of the spine should be carefully marked.

The patient should next be directed to place herself in what she considers the most erect position; if there is any curvature, she will only aggravate the deformity by throwing the trunk too far backwards, by unequally raising the scapulæ, and putting the head to one side, or by assuming some equally unnatural position. The surgeon should now place the patient in the *best possible position*; in slight cases, where there is very little or no osseous deformity, he will succeed in obtaining a perfectly normal posture with the scapulæ and

iliac crests symmetrical, the thorax well thrown out, the abdomen withdrawn from undue prominence, and the head erect. The patient should be observed in this improved position, not only posteriorly, but also laterally and anteriorly. The patient is only able to maintain this position by a great effort for a few seconds, and she will feel as if she were more crooked than before. The muscular sense has become so perverted, that the habitual crooked position appears to her to be far more natural and straighter than the really erect or improved posture; the latter gives her, at first, the impression of an exaggeration of the deformity. In severer cases, it is necessary to ascertain the position of the arms which gives the best average improvement of the whole spine and trunk, e.g. the right arm directed upwards, the left outwards at right angles to the trunk, is a position which, in a large number of cases, effects this improvement, and to this the writer refers as the '*key-note*' position while describing the treatment. It is advisable, before concluding the examination, to let the patient stand erect with her back against the door, heels, sacrum, dorsum and occiput touching it, and with the shoulders well thrown back. While in this position, her mother or friend should try to fasten the stays and clothes in front. In most cases these will not meet for one or more inches, such great alteration and enlargement of the thorax anteriorly being effected by this simple device. This applies not only to females, but also to males, the waistcoat, coat, and overcoat, and frequently even the shirt collar, not meeting for an inch or more when the patient is placed thus with his back against the door. Finally, the stockings being removed, notice should be taken whether the patient is flat-footed or not. One out of every three cases of lateral spinal curvature has marked flat-foot (*see* Flat-Foot).

The *prognosis* depends altogether on the presence or absence of permanent osseous deformity of the ribs and vertebral column. If there is no osseous deformity found when the patient's trunk is flexed, it is possible in all cases to restore the patient's figure to the normal, and to prognosticate a more or less complete cure; the only exception being where the curvature is due to paralysis of the spinal muscles, when the prognosis is doubtful and difficult. Again, patients with deficient intellect, or who take no interest in their treatment, are difficult to benefit, and the prognosis is unfavourable.

Any case of 'confirmed' lateral curvature, i.e. where the patient has lost the muscular sense of a really straight position of the spine, and where his unaided attempts to rectify the deformity only tend instead to increase it, if left untreated is bound to become worse during a series of either months or years; some cases become much more rapidly worse than others. The popular and prevalent opinion that 'the patient will grow out of it in time,' without any special treatment being employed, is to be combated; cases of lateral curvature of the spine, which might have been thoroughly cured when first observed, are hence often neglected till too late, when a cure, i.e. complete restoration of form as well as of function, is out of the question.

Lateral curvature without any osseous deformity can, generally, be practically cured by one month's daily treatment; but strict attention to position, and perseverance with prescribed exercises for about a year afterwards, are needful to prevent relapse.

Where there is more or less permanent osseous deformity, the amount of improvement possible can be roughly judged of at the first examination. As a rule, the patient can be sufficiently strengthened, and the muscular sense thoroughly re-educated so that the best possible position becomes an habitual one, by three months' daily treatment.

The presence of much *pain* may sometimes prolong the time required; but, even in these cases, one month's daily treatment generally effects a decided improvement, with more or less relief to the pain; and three months' a complete disappearance of the pain, and a greatly improved figure, i.e. the best possible habitual posture which the osseous deformity admits of.

In cases of extreme osseous deformity, the steel or other spinal support, if worn even for years, should be discontinued at once; and if the treatment advised below is followed, complete, or almost complete, relief from pain, and a greater or less improvement in the figure and straightness of the spine will be obtained in three months; but the actual osseous deformity of the ribs and vertebræ cannot be much, if at all, altered.

Treatment.— Common sense suggests that any inequality, in the potential or actual lengths of the lower extremities, is to be corrected by wearing a thicker sole on the shorter leg, whatever other treatment may appear to be indicated.

Of late years, the implicit faith formerly placed in the treatment of lateral curvature

of the spine by steel and other supports has been gradually undermined, and even those who still adhere to the mechanical treatment of spinal deformities not due to caries, attach more and more importance to its association with suitably prescribed gymnastics. Lateral spinal curvatures, due to paralysis of the erectores spinæ muscles, when the patient is unable, by a voluntary effort, to maintain himself in an improved position, are the only cases in which spinal supports are of any real benefit. In these paralysed backs, it is necessary to prevent further increase of deformity by wearing some sort of spinal support, either the ordinary steel one with pelvic band and uprights, with or without crutches to fit into the axillæ; or, which is far better, a well-applied Sayre's plaster-jacket, which should be worn till the muscles have sufficiently recovered from their paralysis to enable the patient to hold the spine in an improved position. It is understood that the support is worn with the sole idea of being preventive, and not of being curative, and should be left off at night in bed.

Lying on the back for several hours daily, still frequently prescribed, is perfectly useless, as far as cure is concerned. If a limb with weak muscles were put into splints, and kept at rest for several hours daily, the muscles would surely become still weaker; and this is equally true of the spinal muscles. The patient may rest prone or supine for fifteen or thirty minutes at a time, for the relief of pain or when fatigued by exercise, but lying for longer periods does more harm than good.

The *treatment* advocated by the writer is based upon the following principles, and may be taken under the following heads:—

(*a*) Re-education of the patient's muscular sense as to an erect or improved position.

(*b*) Improved position to be maintained at all times, while sitting or standing.

(*c*) Attention to dress.

(*d*) Systematic training of the spinal and other muscles, including the development of the thorax.

(*e*) Attention to general health.

a. Re-education of the patient's muscular sense as to an erect or improved position.—A patient, with confirmed lateral spinal curvature, is so habituated to the crooked position, that considerable patience and perseverance are required to convince him or her that an erect or improved posture is really such, and not an exaggeration of the deformity. The best way of commencing this re-education is for the patient to lie on the back in the best possible position, and then to practise slow breathing, the shoulders being kept well pressed back, and prevented from rising by the patient trying to push the hands down towards the feet as much as possible. All the simple movements of the head (neck), arms, and legs can be practised in this position. A hand looking-glass, as well as an ordinary wall-mirror, is required, so that the patient may see and be convinced of the improved position.

As a home prescription, it is useful to direct the patient to stand frequently (e.g. before and after each meal), in front of a looking-glass, with the eyes closed until she believes she has placed herself in an erect position; generally, on first attempting this experiment, she opens her eyes to find that the head is inclined to one side or one shoulder unduly raised. Usually by the end of a week, and, in very persevering and intelligent patients, even at the end of two or three days, the muscular sense is sufficiently improved to enable the patient to place herself at once in a decidedly improved posture by a voluntary effort at any moment, whether lying, sitting, standing, or walking.

b. Improved position to be maintained at all times, while sitting or standing.—This best possible posture is always to be maintained while sitting, whatever the occupation of the moment may be, at meals, at the piano, while reading, writing, &c. It is most readily obtained by sitting with the sacrum, loins, dorsum, and shoulders well supported against the back of the chair, which should be moulded to the normal shape of the spine, with a slight prominence to fill the lumbar hollow. Almost any ordinary chair can be made to answer the purpose, if a suitable cushion is used. In writing, the patient's trunk is required to be more vertical than for reading, and it is essential that not only the trunk but the arms should remain perfectly symmetrical. A sloping desk is absolutely required, and the paper should be oblique, sloping upwards from right to left, but exactly in front of the patient. The Glendinning adjustable modern school-desk and seat, manufactured by the North of England School Furnishing Company, Darlington, will be found most beneficial for patients of school age, and even for adults. In reading, an inclined back to the chair is more restful to the patient, and an easel-table should support the book. For music the same rules apply, the ordinary music-stool being discarded and a high-backed chair em-

ployed, which will also come in useful for meals. In all cases, the seat of the chair or couch should be horizontal, and not tilted up in front, as is frequently seen in so-called spinal couches, and the patients feet should always be supported either by the ground or by a footstool. The thighs should never be crossed, as this throws the spine as much on one side as standing on one leg does.

Short-sight, or any other deficiency of the eyes, must be at once attended to, by suitable spectacles, &c., as it would be useless to urge a patient to hold himself erect who had always to poke the head forward for reading or looking at any object.

The patient may walk, run, and join in games, even lawn-tennis, if sufficiently strong, provided any fatigue thus induced disappears after resting for a quarter or half an hour; any walk or exercise that induces fatigue or pain lasting hours, only does harm. In such cases the duration of the walk, &c., must be curtailed. Standing still should be avoided at all times; when inevitable, the patient should stand equally on both legs, with the feet slightly apart. Standing on one leg is most injurious, as it at once throws the spine into a serpentine position, increasing the lateral curvature.

A horsehair mattress with a low pillow for the head, is all that can be advised for the night.

c. Attention to Dress.—It is essential that no article of clothing should interfere with the resumption of an improved or perfectly normal position of the patients' spine and trunk. This can be tested by making the patient stand with the back to the wall and with the clothes opened in front, as already mentioned (see *Mode of Examination*). In women, there should be no red zone of pressure on the skin of the thorax or abdomen produced by stays or injudiciously placed petticoat-bands; the latter should be shaped and made to fit round the pelvis, so as not to compress the lower ribs above the iliac crests. Stays with very little whalebone or steel, and with a vertical slip of elastic webbing, expanding transversely, inserted on each side, are strongly advised. Such stays admit of the full expansion of the lower ribs.

d. Systematic training of the spinal and other muscles, including the development of the thorax.—At first, attention is to be directed to correcting the antero-posterior curves of the spine; when these are improved, then only is it possible to carry out special exercises for correcting the dorsal and lumbar lateral curves.

The following is a prescription of twelve exercises which are recommended to be used at the commencement of the treatment of all cases of lateral curvature of the spine. The patient should rest for a minute or two between each exercise, on a couch with movable back fixed at an angle of 45°, or an ordinary chair if properly arranged.

First prescription of exercises.

1. Lying on back, arms by the sides of the body, hands supinated, slow full inspiration by the nose; slow expiration by the mouth (repeated four times).

2. Similar exercise with the arms extended upwards by the sides of the head (repeat four times).

3. Same position as 1, head-rotation on axis to right and left alternately; also lateral flexion of head to right and left alternately (four times).

4. Lying on back, slow simultaneous circumduction of both shoulder-joints from before backwards, elbows and wrists extended (twelve times).

5. Same position as 1; hip-circumduction both ways slowly; knees kept extended (ten times).

6. Lying on back, simultaneous extension of arms upwards, outwards, and downwards from a position with the elbows flexed and close to the trunk (four times).

7. Lying prone; hip-circumduction both ways; knee kept extended (ten times).

8. Sitting on couch with back at an angle of 45°: ankle-circumduction down, in, up, out, the toes being directed inwards the whole time (twenty times); also foot adduction (patient resisting); abduction (surgeon resisting), (eight times). [This may be omitted if there is no tendency to flat-foot.]

9. Lying on back, arms extended upwards by the sides of the head; slow flexion of both arms (surgeon resisting by grasping the hands), followed by extension (patient resisting), (six to eight times). The patient's knees, flexed over the end of the couch or table, fix the trunk.

10. Patient sitting astride a narrow table or chair without back, with arms down and hands supinated, trunk-flexion at the lumbar vertebræ (patient resisting slightly), followed by trunk-extension (surgeon resisting by his hand against back of patient's head), (six to ten times).

11. Patient with arms extended upwards, leans against a vertical post or door fitted with pegs on each side, which he grasps; the surgeon gently pulls the patient's pelvis forwards by his hands on the

sacrum (patient resisting), and the patient then moves back the pelvis to the post or door (surgeon resisting), (six to eight times). At no time are the patient's heels to be raised from the floor. Also pelvis-rotation on its axis to right and left alternately (surgeon resisting with his hands on each side of the pelvis), (six to eight times).

12. Lying on back with head and neck projecting beyond the end of the table, arms by the sides of the body, hands supinated; the head is gently flexed by the surgeon's hand on the occiput (patient resisting), followed by head-extension (surgeon resisting), (eight times).

It is important, while doing these exercises, that respiration should not be interfered with by involuntary fixation of the walls of the thorax. The patient should therefore always go on counting aloud (e.g. 1 to 10) during the execution of all exercises except those of respiration. From six to twelve longitudinal 'strokings' from above down of the patient's back by the assistant's palms, generally remove any aching caused by the exercises. These strokings are also usefully employed at home to relieve back-ache. All the exercises should be done slowly, and great care taken that the head and trunk remain the whole time in the best position. The above twelve exercises require about an hour's time, and should be followed by a short rest in a good position, with the back supported. In ordinary general practice, an intelligent mother or nurse can be readily trained to superintend all the simple movements.

These exercises are repeated daily, and as the patient gradually gains more power, and begins to assume the improved position more readily and with less exertion, other more severe exercises may be prescribed. In a few days, if there is no increase of back-ache, the following *standing* exercise is done; the patient, with the feet slightly apart and the heels fixed against a ledge or wall, rests with the front of the thighs against a low padded horizontal bar, while holding herself as erect as possible; the surgeon then gently flexes the patient's trunk by pressing his hand against the back of her head (patient resisting), and then the patient slowly recovers the vertical position against the surgeon's resistance, this being in fact exercise 10, in a standing instead of a sitting posture.

In about three weeks or a month, the following much more severe exercise can be tried, known as '*Forwards lying, heels fixed, trunk extension and flexion.*' This is done as follows:—the patient lies prone, with the pelvis and legs supported, and the heels fixed (the latter best by someone sitting on them), on a padded table, while the head and trunk to the level of the iliac crests project beyond the edge of the table. The patient slowly raises the trunk into the same horizontal position as the legs and pelvis, and slightly higher, and then as slowly allows the trunk to be again flexed by its own weight. The surgeon easily increases the severity of the exercise, if required, by more or less pressure with one hand at the back of the patient's head. During this exercise, the arms may be in any position required. By the time the patient is able to perform this exercise without pain, the antero-posterior curves will be sufficiently improved, and more attention can be paid to her being exercised in the 'key-note' position, i.e. that position of the trunk and arms in which the greatest improvement in the position of the spine is obtained. (See *Mode of Examination.*)

Another good exercise is one shortly described as '*Long sitting, trunk extension and flexion.*' Here the patient sits on a table, with the legs together and the knees extended; an assistant sits on the tibiæ, just above the feet, to fix the legs, and the patient slowly extends the spine against the surgeon's resistance (applied by his hand against the back of the patient's head) till the trunk is in the same horizontal plane as the legs; the patient then gently resists, while the surgeon slowly raises her trunk into a vertical position.

Female patients continue the daily repetition of these exercises during the menses, except that the hip-circumductions are omitted for three or four days, as these movements tend to increase the menstrual flow. Where menorrhagia or dysmenorrhœa is present, it is sometimes necessary to leave off the exercises altogether for a day or two. As a general rule, it is better to accustom the patient to practise the exercises all through the period of menstruation. While on the subject, it may be stated that flexions of the uterus are no hindrance to the treatment, as none of the exercises described are violent or jerky in their execution, and from the fact that respiration is never allowed to be impeded by the previously mentioned simple device of making the patient constantly count aloud, any over-exertion can always be prevented with ordinary care.

The patient's spine should be examined every fortnight or month in order to observe

how it is affected by the treatment, and whether any alteration of details is required. As already mentioned, one month's daily perseverance in the treatment will effect a very decided improvement in all cases, except those due to paralysis; some with no osseous deformity will even be quite cured, and others at the end of two months. To keep up the improvement, or to prevent any relapse in a cured case, it is very important to enlist the patient's co-operation and interest in her own case on ceasing treatment, and for some months she should continue the habit of practising the movements already described.

BERNARD ROTH.

LEECH, Artificial, an ingenious contrivance, obtainable at any surgical instrument maker's, consisting of two parts—1st, *the knife*, arranged in the form of a small rotating trephine, with a cutting edge which projects from a flat surface and can be adjusted at any depth thought sufficient to cut through the *cutis vera* only; 2nd, *the sucker*, a hollow glass cylinder, about three-quarters of an inch in diameter, fitted with a piston worked by a fine screw.

The part having been sponged with warm water, an incision is made with the knife, the open end of the sucker placed firmly over the wound, and the blood extracted by slowly withdrawing the piston. Two or three drachms can readily be taken by this process, which is, in fact, merely a modification of wet cupping. *See* CUPPING.

The method is of use when a leech is objected to by an over-sensitive patient, and is particularly suited for application to the temple or behind the ear.

WILLIAM H. BENNETT.

LEECHES.—Leeching is a convenient method of *local blood-letting*, in which an approximate idea of the amount of blood taken can be formed. It is applicable to any part of the external surface of the body (with the exception of the eyelids), and to any mucous cavity which is freely accessible from without, such as the mouth, the vagina, and the margins of the os uteri. Leeches should not be applied to acutely inflamed skin, to the anus if extensive piles exist, nor immediately over varicose veins. An ordinary fresh leech will abstract about f℥ij. of blood, which may be increased by about half by fomenting or poulticing the bite.

Leeches should be taken from the water in which they have been kept, and dried on a soft towel, about half an hour before use. It is desirable that a leech should be used once only.

Method of Application.—When the external surface of the body is to be operated on, the part should, if necessary, be shaved and then sponged with warm water, or, what is better, rubbed over with milk. If a single leech is to be applied, it may be taken between the finger and thumb and held with its *small end* in contact with the part until it attaches itself. A preferable plan, however, especially if it is necessary that the bite should be exactly localised, is to place the leech in a leech-glass or roll of cardboard, either of which may be made to accurately determine the point of fixation. If more than one is to be used, the simplest plan is to place two, three, or more leeches in a large pill-box or small tea-cup, which is then inverted and held on the part; other devices of a similar kind may suggest themselves—e.g. a folded handkerchief, a cone of cardboard, or a nest of cotton-wool.

The application of a leech inside a cavity should be effected by means of a 'leech-glass,' the part having been exposed to view as freely as possible; for instance, in the case of the os uteri, a vaginal speculum should be passed and retained *in situ* until the leech has relaxed its hold. In leeching the immediate vicinity of the orifice of any canal, it is a wise precaution to plug the opening, when possible, with cotton-wool.

In the event of an obstinate refusal to bite, a drop of blood drawn by the prick of a needle will afford an irresistible bait. When fully distended, the leech usually relaxes its hold and falls off; if it does not, a little salt sprinkled over it will effect the separation. The bleeding from the bites as a rule ceases upon exposure to the air, or can be stopped by the pressure of a finger or pad of lint; should it persist, a drop of perchloride of iron or the touch of a red-hot needle is sufficient, excepting in very rare cases, when it may be necessary to encircle the bite with a ligature tied beneath a needle, which has been passed under its base.

In delicate persons, in whom a leech often creates great disgust, if one only is necessary, an efficient substitute will be found in the artificial leech, *see* LEECH, Artificial. The scar of a leech-bite, although small, is indelible.

WILLIAM H. BENNETT.

LEG, Amputations of the, are performed in its lower, middle, and upper thirds by the following methods:—

In the Lower Third by (*a*) the circular method; (*b*) modified circular (Syme, Liston, Lenoir); (*c*) long anterior flap (Bell, Teale); (*d*) elliptic posterior flap (Guyon).

In the Middle Third by (*a*) long anterior curved flap (Bell); (*b*) Hey's amputation by short anterior and long posterior flap; (*c*) rectangular (Teale); (*d*) long posterior rectangular (Lee); (*e*) single posterior flap.

In the Upper Third at 'the place of election,' a hand's breadth below the lower edge of the patella, by (*a*) the circular method; (*b*) short anterior and long posterior flaps (Liston, Syme, Skey); (*c*) unilateral external flap (Sedillot, Guérin); (*d*) rectangular (Teale); (*e*) modifications of rectangular (Wharton, Lee); (*f*) antero-external and postero-internal semilunar flaps (Bell); and (*g*) *above* the place of election, the circular amputation (Larrey), in which the tibia is divided through, but not above the tubercle, and the head of the fibula disarticulated. The alleged advantages of this last procedure are, its being easier than at the 'place of election' from the absence of an interosseous space, and only a single artery—the popliteal—requiring deligation; but the frequency of communication between the superior tibio-fibular articulation and the knee-joint is sufficient to render the operation one attended with considerable risk.

The situation best adapted to the *circular* method and its modifications is the lower third, in which, owing to the large number of tendons, the 'flap' methods are not as a rule indicated. In performing the circular amputation immediately above the ankle, difficulty, consequent on the increasing size of the limb, is sometimes experienced, in reflecting the flaps, and hence the modifications recommended by Lenoir and Syme. The former made, in addition to the circular, a vertical incision about an inch and a half in length, corresponding to the crest of the tibia, and dissected back the skin-flaps right and left. Syme, with the same object, made two lunated incisions, one anterior and the other posterior; but, at the 'place of election' and immediately above it, the circular method can be carried out without these modifications.

In the lower third some authorities consider Teale's *rectangular flap* operation to be indicated; but having regard to the thinness of the anterior flap, there is, in the writer's opinion, a danger of sloughing, although, doubtless, the risk is diminished by taking care to include the anterior tibial artery in the flap. To avoid wounding this vessel, it is recommended that the handle of the scalpel should be used in raising the vessels from the interosseous membrane; and, in operating high up in the leg, the surgeon must be careful not to cut the origin of the anterior tibial artery when dissecting the short flap. Half the circumference of the limb at the point where the bone is divided will be the length and the breadth of the anterior flap; the breadth of the posterior flap will be the same as that of the anterior, and its length one-fourth of that flap. Having divided the integumentary structures at the outset, to allow for contraction, the deeper incisions are made, following closely the line of the contracted integument, and the danger of muscular protrusion is in this way avoided. To obviate the risk already mentioned—namely of sloughing—care must be observed in dissecting up the anterior flap to include the anterior tibial artery. The posterior flap is formed by a circular sweep of the knife, and is dissected back to a point corresponding to the situation of the osseous section. The rest of the operation is performed as already described. The inferior angles of both flaps should first be united, and then their remaining edges brought into accurate apposition with numerous points of interrupted suture. The advantages of this method are that the cicatrix is drawn well behind the point of pressure, the wound is dependent, so that in the event of matter forming, it gravitates through it; the principal vessels and nerves in the posterior flap are removed from pressure, the flap affords ample covering for the bones, and the risk of conical or sugar-loaf stump is greatly diminished.

The other *flap* operations are done at the place of election and at the middle third. For amputation at the middle of the leg Hey's method, which has not, in the writer's opinion, received sufficient recognition, is, of the 'flap' methods, decidedly the best. It consists in obtaining a short but broad anterior flap and a long posterior one. The circumference of the limb being taken, two-thirds of it will be the breadth, and one inch the length of the anterior flap, while one-third will be the breadth and one-third the length of the posterior. Hey divided the posterior flap by transfixion with a catlin seven inches in length, and separated the integuments in the anterior part of the limb along the course of the circular incision. In this procedure, the desirability

of dividing the interosseous structures at least half an inch below the point of section of the bone, so that the arteries may not retract beyond reach, should not be forgotten.

Liston's operation is done at the place of election, and consists in a short anterior and a long posterior flap taken from the calf of the leg. Having determined the position of the fibula, to avoid the danger of passing the knife between the bones, the surgeon, standing to the right of the limb, which is elevated by an assistant, places his left index finger on the inner edge of the tibia and his thumb on the posterior edge of the fibula. Then, taking a long catlin and placing its heel immediately in front of the index finger, he makes a semilunar sweep across the front of the leg between the selected points—namely, the inner edge of the tibia and the posterior margin of the fibula—penetrating the posterior tissues of the leg, and transfixing it close behind the fibula, and cutting from behind forwards a posterior flap somewhat longer than the anterior. The anterior flap, consisting mainly of integument and fat, is dissected back, and, the interosseous structures being divided, the saw is applied to the tibia. When the bone has been sawn to at least half its thickness, the handle of the saw should be depressed, to bring the instrument into contact with the fibula, and then both bones are simultaneously divided. The sharp projecting angle of the tibia is removed either by a small oblique section with the saw, or by dividing it with a pair of bone-forceps. The tibial, peroneal, interosseous, and muscular arteries having been secured, the edges of the flap are brought together by numerous points of interrupted suture and the wound is dressed antiseptically.

In estimating the comparative value of the various methods of amputation of the leg in each of the three situations already indicated—viz. the lower, middle, and upper third—the writer is disposed to consider that in the first the 'circular,' or the modifications of it which have been mentioned, notably that of Prof. Syme, will be found most suitable; in the second, the antero-posterior flap methods of Teale or that of Hey must be considered preferable; and in the last situation, or upper third, the amputation by short anterior and long posterior flaps—Liston's or Skey's modification of it, which consists in diminishing the thickness of the posterior flap by not including the tissues in their entirety in it—will give the best results. WILLIAM STOKES.

LEG, Diagnosis of Affections of the. *See* THIGH AND LEG, Diagnosis of Affections of.

LEG, Fractures of the, include fractures of the two bones together or of either the tibia or the fibula alone. Of these injuries fracture of both bones is the most frequent, while fracture of the fibula is more frequent than fracture of the tibia; the relative numbers stated approximately being of both bones eight, of the fibula alone five, of the tibia alone three. Probably, in many cases regarded as fracture of the tibia only, undetected fracture of the fibula has also been present. In infancy fracture of the leg is very rare, while fracture of the thigh is of comparatively frequent occurrence. The explanation probably is that young children, who have learnt to walk only imperfectly, fall with the limbs drawn up so that the force comes chiefly on the femur rather than on the bones of the leg.

FRACTURE OF THE TIBIA most commonly occurs in the lower third, where the bone is smallest. The injury is often caused by indirect violence, such as a fall on the feet, or a sudden wrench of the leg when the foot is fixed; or it may be produced by direct violence—a kick, a blow, the passage of a wheel, &c., in which case any part of the shaft, even its more massive upper end, may be broken. The fracture is generally oblique; most frequently perhaps from above downwards and from without inwards. It may, however, take any other direction. When due to direct violence it is often transverse. Sometimes, the bone is extensively split in a longitudinal direction, the fracture extending into either the knee or the ankle-joint. Owing to the fact that the bone lies so close beneath the surface, and that the break is oblique, so that the upper fragment presents a sharp end, the fracture is frequently either compound at the time, or is rendered so by subsequent movement. Great care should be used to avoid this occurrence during the lifting or undressing of the patient. In falls upon the heel, from a height of even not more than two or three feet, the tibia is sometimes much comminuted and the ankle-joint extensively involved; in other instances, although the fibula remains entire, there is great deformity from displacement of the foot.

Diagnosis.—Fracture of the tibia generally declares itself by displacement, irregularity of the outline of the bone, shortening, mobility of the fragments, and crepitus. In children, and in cases in which the

fracture is unattended with displacement, the nature of the injury may very easily be overlooked, especially as the patient can sometimes bear considerable weight upon the limb. In cases of doubt, the bone should be grasped above and below the part at which it is painful or tender on firm pressure, and attempts, but with no undue violence, should be made to move one part on another, first in a transverse and then in an antero-posterior direction, when, if there is fracture, yielding and crepitus will be detected. The knee-joint may be involved either by longitudinal splitting of the shaft, or by separation of one of the tuberosities. A mere fissure of the bone will probably escape notice; but fracture through the tuberosities will be indicated by widening of the head of the bone, irregularity, and crepitus. The joint, in either case, becomes distended with blood and serous effusion, and acute synovitis is often present. After this injury, movement of the joint may be more or less impaired, especially where the fragments cannot be accurately adjusted; or when acute synovitis with much plastic effusion has occurred.

Treatment is the same as that prescribed below for fracture of both *Tibia and Fibula*. When the knee-joint is involved, synovitis must be controlled by the use of ice or cold lotions, and by the maintenance of complete rest; it usually soon subsides. If distension is extreme the joint may be aspirated; but this proceeding is not without risk, and as a rule had better not be resorted to.

Fibula.—This bone may be fractured in any part of its length, but the great majority of the cases involve the inferior third of the shaft, within four or five inches of the tip of the malleolus. The injury may result from direct violence, but it is much more commonly produced by falls in which the foot is twisted upon the leg, sometimes with inversion, but more often with eversion.

Fractures of the shaft may take any direction, and may be multiple or comminuted; they are rarely compound. Fracture through the malleolus, due to sudden inversion of the foot, is generally transverse. In Pott's fracture, the fibula is broken from two to five inches above its lower end, the foot is dislocated outwards, and either the internal malleolus is wholly or in part torn off, or the internal lateral ligament is ruptured. When the fibula alone is broken, displacement of the fragments is usually slight. Cases are on record in which, either by direct violence or by the action of the biceps, the head of the fibula has been detached and the peroneal nerve injured, so that the anterior muscles of the limb below have remained paralysed.

Diagnosis.—The detection of fracture of the fibula is often very difficult, especially in a stout limb, and no doubt many cases are regarded as merely severe sprains. The best method of examination is to make firm pressure with the tips of the fingers along the course of the bone, when sharp pain will be produced as the site of the fracture is reached; and at the same time crepitus or a sharp click may perhaps be noticed. Or, when the fingers are placed on the lower end of the bone, an inch or two above the malleolus, and firm pressure is made upon the shaft higher up, if the bone is entire it may be felt to yield and recoil like a spring, while, if fracture is present, this transmitted movement and elastic recoil will not be observed.

Treatment.—When there is no displacement, the limb may be kept at rest on a pillow and be covered with cold lotion till swelling has subsided, and may then be enclosed in a light case of plaster of Paris or in carefully moulded leather or other splints. At the end of a month the apparatus may be removed, and the patient may begin to use the limb.

In Pott's fracture, or whenever there has been marked deformity at the time of the injury, great care must be taken to correct the displacement, and the limb should be placed in the apparatus recommended for fracture of both bones; or Dupuytren's inside splint may be employed. At the end of a month a plaster case may be applied, so that the patient may be on crutches, but he should not bear on the limb for another fortnight or three weeks. If weight is thrown upon the part earlier than the sixth or seventh week, the torn structures on the inside of the foot are apt to yield, so that aggravated valgus, very difficult to correct, is gradually developed. Another method of treatment is that by the immediate application of plaster of Paris.

Tibia and Fibula.—Fracture of both bones is produced, in almost equal proportions, by direct violence, as by a kick or the passage of a heavy wheel, and indirectly, as in jumps from a height, or by falls in which the leg is suddenly bent. Sometimes a fracture, which may be extensively comminuted, is produced merely by a slip off a step not more than a foot from the ground, or even off the kerb-stone. Fracture of both bones is most common

at about the junction of the middle and the inferior thirds of the leg, where the tibia is smallest. It is rare and generally produced only by great direct violence, in the upper third, where the tibia is large and massive. In a few instances, fracture seems to have resulted from muscular action. The two bones may be broken at the same spot, but more commonly the fibula gives way at a higher level than the tibia. The fracture, though usually single, may be multiple or comminuted. Instances have been recorded, in which the tibia has been reduced to four distinct pieces by three lines of fracture. The fracture may extend either into the ankle or, more rarely, into the knee-joint. This complication is alluded to under *Tibia*. The direction of the fracture of the tibia, though sometimes transverse, is generally oblique from above downwards, and either inwards or with an inclination forwards; so that, even where the injury is not at first compound, the sharp end of the upper fragment is very apt to be driven through the skin during the subsequent movement and transference of the patient to bed—an occurrence which should be very carefully guarded against. The relative position of the fragments varies; but along with displacement of the lower fragment upwards, and generally outwards behind the upper, there is often also rotation of the lower fragment outwards by the weight of the foot.

A V-shaped or spiral fracture has been described by M. Gosselin. It is produced by rotation of the leg when the foot is fixed, so that the bones are subject to a violent twist or torsion movement. In this injury, the main fracture is in the shape of a V with its apex pointing downwards; while, from the receding angle presented by the lower fragment, another line of fracture passes in a spiral direction downwards into the ankle-joint, and, after traversing the articular surface of the tibia, ascends along the posterior aspect of the bone, so as to detach a considerable fragment from the lower part of the shaft. This spiral fracture is believed by Gosselin to be due to the wedge-like action of the upper upon the lower fragment, at the moment the bone is undergoing rotation. The injury deserves attention, not only because the ankle is involved, so that more or less stiffness of the joint may result, but because the extensive laceration of the medullary tissue which occurs may be followed, especially when the fracture is compound, by osteo-myelitis. This fracture is difficult of recognition, but the V-shaped outline of the fragments may suggest its presence, while careful examination shows that the ankle-joint is the seat of effusion, and the splintering of the lower end of the tibia may sometimes be made out.

Treatment.—This is best conducted by means of (*a*) a well-padded, iron, back splint extending three or four inches above the knee, curved to fit the limb, furnished with a rectangular foot-piece and with lateral bars for swinging the leg, and having an oval aperture at the lower end so that the heel may be free from pressure; and (*b*) straight side-splints. After the fragments have been adjusted, all shortening having been removed by extension, and care taken to place the ball of the great toe in a line with the inner edge of the patella, the foot is securely fastened to the foot-piece by wide strips of plaster and a bandage, a thin layer of cotton wool being used to protect the skin. Extension being continued, wide bands of strapping are placed spirally round the limb and splint above the level of the fracture, and covered with a bandage which should not be put on tightly. The side-splints are now applied to the inner and outer aspects of the leg from the sole to a little above the knee, and fastened with webbing straps and buckles; they should be a little deeper than the antero-posterior diameter of the limb, so as to project slightly beyond the anterior aspect of the tibia, in order that the webbing straps may stand clear of and not constrict the leg. The limb is then swung beneath a cradle, which should be large enough to prevent pressure of the bedclothes on the foot. This method is so comfortable, that it is advisable to use it even in the simplest cases so long as the patient is to remain in bed; while in complicated, and especially in compound, fractures—in the latter case the side-splints are interrupted opposite the injury—it is the best with which the writer is acquainted. The swinging of the limb enables the patient to change his position in bed without disturbing the fracture; all pressure over the seat of injury is avoided, and, as the seat of fracture is left uncovered, the position of the fragments can at any moment be observed. In the course of three to six weeks, in uncomplicated fractures, the limb may be enclosed in the ordinary plaster of Paris bandage, and the patient allowed to move about a little on crutches.

A plan that was formerly much in favour, and which may still be sometimes used with advantage if the fragments show a tendency to displacement when the leg is placed in the straight position, is to put the patient on the injured side, the leg being flexed on the

thigh to relax the muscles and enclosed in lateral splints. It is advisable in all cases to put up the fracture as soon as possible in order to arrest muscular spasm and relieve pain; while the support to the tissues afforded by well-adapted bandages tends to limit effusion and swelling in the parts around the fracture. For a description of Mr. Croft's excellent method, *see* IMMOVABLE BANDAGES. The difficulty sometimes met with in fracture of the leg, of restoring the fragments to place, is best overcome by placing the patient under an anæsthetic and making extension when the leg is bent upon the thigh. Should this method fail, the tendo Achillis may be divided—a proceeding, however, which is seldom called for.

Compound fracture is more commonly met with in the leg than in any other part. The injury is generally the result of direct violence, though it is sometimes produced by falls upon the feet. The extent of the wound varies from a mere puncture of the skin by one of the fragments, or by some sharp body entering from without, to a wide rending open of all the soft parts down to the bone. In severe crushes, the amount of destruction of the soft parts is often out of all proportion to the size of the wound, all the muscles being reduced to a pulp. Sometimes the skin is stripped entirely off; in other cases, the tibial vessels or nerves are lacerated, or the injury extends into the ankle, or more rarely into the knee-joint. In compound fractures generally both bones are broken, though the tibia, or more rarely the fibula, alone may be involved.

Treatment.—By no other example could the improvements recently introduced in the treatment of wounds be more clearly shown, than by that of compound fracture of the leg. In a large proportion of cases, which would formerly have been treated by primary amputation, surgeons now venture on an attempt to save the limb, and the attempt is fully justified by the rarity with which secondary amputation is called for. Whether, in any case, primary amputation should be performed, can be determined only when all the circumstances that present themselves have been carefully considered, both singly and collectively. The following, however, are the main points: If the tibia is so extensively comminuted that, when the pieces which were entirely separated from the periosteum are removed, a very considerable gap exists between the fragments, the limb would be useless, even if the soft parts should be repaired. Again, if both the tibial arteries are ruptured, and the limb is pulseless and cold, its condition is generally hopeless. But it must not be forgotten that, sometimes, pulsation is arrested by pressure of the fragments or by contusion of the internal and middle coats of the vessel; and therefore, unless bleeding is free, the mere loss of pulsation should not lead us to immediate amputation. Should the anterior tibial be found ruptured, while the posterior still beats, it should be tied; but when the posterior is bleeding persistently from a wound high in the limb, where it can be reached only by a tedious dissection, amputation had better be performed. In children, however, hæmorrhage may, as a rule, be safely dealt with by a well-applied compress. If either of the chief nerves is seen to be lacerated, its ends should be joined by suture. When the muscles are, as is often the case, crushed and minced, they are past restoration; but their mere rupture, or the separation of adjacent muscles by laceration of their sheaths, may be repaired. When the skin has been widely stripped off, especially if the separation extends around the whole girth of the leg, amputation is called for. The condition of the skin should always be carefully investigated. Often, though the wound itself is small, the integuments will be found to be separated over a considerable area.

In practice, the various injuries just alluded to will be met with in all degrees and in all varieties of combination. They must be carefully weighed; but we shall be justified in trusting largely to the means we now possess for turning the balance in the direction of an attempt to save the limb.

HOWARD MARSH.

LEITER'S TUBES are made of flexible metal, with a fine bore through which hot or cold water may be made to circulate. The tubes are coiled up into spirals of various shapes and sizes, and the spirals are loosely connected with bands which allow of their being moulded to flat, hollow, or concave surfaces, and so form a metal surface which will rest evenly on the parts to which it is applied. They may be adapted evenly to the head in the form of a cap, to the throat, eye, chest, abdomen, joints, &c. One end of the tube is placed in a vessel containing water, hot or cold according to the requirements of the case, and the other dips into a receiver on the floor. If the supply vessel be raised and a little suction be applied to the terminal end of the tube, the water will be made to circulate through the coil and will continue to flow by syphon action. Before Leiter introduced metal tubes, coils of india-rubber tubing had been

introduced by Richardson and Thornton; but they had certain disadvantages, which do not apply to Leiter's tubes. India-rubber is a bad conductor of heat, and so the water used had to be iced in order to produce the required reduction of temperature; the india-rubber tubes are soft and unsuitable for parts on which the patient rests, as his weight flattens the tubing and arrests the circulation of the water through it; india-rubber has a disagreeable smell. Leiter's tubes are free from all these objections. The metal is a good conductor of heat, and so the water used need not, and in fact should not, be iced; it does not collapse under the weight of the body, and it is free from smell. The tubes may be used for making warm applications at an even or gradually increasing or decreasing temperature, and Leiter has constructed a warming apparatus, through which the water is made to flow before it enters the coils of tubing. BILTON POLLARD.

LEMBERT'S SUTURE is employed in closing wounds of the intestine. In such closure it is essential that the two serous surfaces about the wound should be brought in contact, and this is well effected by this particular suture. The needle is first made to pick up a little fold of peritoneum at a short distance (about 3 lines) from the edge of the wound. This fold would not be more than a line or so in width, being merely of sufficient size to afford a hold to the thread. In picking it up, the needle is passed at right angles to the long axis of the wound. A similar fold is now picked up at a corresponding point on the other side of the wound, and when the thread has been drawn through the two folds, and thus carried across the incision, the knot may be tied in the ordinary way. By this suture, the serous surfaces that immediately bound the margins of the wound are turned in towards the lumen of the gut, and are brought into close contact. The needle employed should be curved to the extent of half a circle, should be round on section, and of uniform thickness from the eye to within a short distance of the point. It must be held in a needle-holder.

Hagedorn's flat intestinal needle, and his ingenious needle-holder, are very well adapted for this form of suture. The best material for the ligature is, without doubt, the finest size of 'Chinese twist.'

CZERNY-LEMBERT SUTURE.—By means of this suture for intestinal wounds much greater security is afforded. The sutures are applied in two rows. The first or inner row includes the mucous membrane only, and is applied in the form of a series of simple suture points. The second or outer row includes the peritoneum only, and is applied in the form of Lembert's suture. As, in wounds of the bowel, the mucous membrane, as a rule, projects conspicuously into the incision, the introduction of the first row of sutures is easy. It is almost needless to say that when the outer series of sutures is applied, the inner set is entirely covered in. FREDERICK TREVES.

LENS. *See* CRYSTALLINE LENS.

LENTIGO (*Synon.* Ephelis, Freckles). An increase of the normal pigment of the epidermis in small spots varying from a pin's-head to a hemp-seed or more in size. Freckles are acquired in consequence of hereditary predisposition, and are rare before the age of six and after that of forty, disappearing completely in old age. They occur in persons of both sexes equally, and are met with chiefly, but not exclusively, in persons of fair complexion, especially those who have red hair. They appear chiefly on the face and backs of the hands, and are most strongly marked during the summer and after exposure to the sun; that they are not actually caused by the sun, however, is shown by their occurrence on parts of the body which are covered by clothing, as the buttocks, genitals, and abdomen. During the winter they become much less marked, but do not disappear completely. They consist of a circumscribed hypertrophy of the normal epidermic pigment. They are seen as rounded, oval, or irregularly polygonal spots, neither prominent nor depressed, of a dull yellow to orange or brownish tint. The larger spots (lentigo) have usually a rounded outline, while the smaller ones (ephelis) are more or less angular.

Freckles do not usually call for treatment; but, where they are so copious as to cause disfigurement to any serious extent, a weak lotion of corrosive sublimate may be recommended. JOHN CAVAFY.

LEONTIASIS OSSEA is a name given to a form of hyperostosis affecting the facial bones. The disease frequently commences in early life, and gradually encroaches upon the cavities of the skull and face, producing the most hideous deformity. It only very slowly causes the death of the victim, if by pressure it should interfere with any vital function. The osseous masses that are slowly developed about the superior maxillæ and orbits are formed of exceedingly hard compact bone, and are

very irregular and nodular. They thus differ from osteoporosis, which has a more uniform outline and is composed of finely reticulated porous bone. They seem to be more of the nature of exostoses. In addition to this fact, the osteoporotic condition which is so well displayed in ostitis deformans does not, so far as we are at present able to judge from the records of cases, affect the bones of the face, but is entirely confined to the calvaria if the head shows any evidence of the disease. *See* Jaws, Diseases of the. H. H. Clutton.

LEPRA. *See* Elephantiasis Græcorum.

LEPROSY. *See* Elephantiasis Græcorum.

LEUCASMUS. *See* Leucoderma.

LEUCODERMA (*Synon.* Leucasmus, Leucopathia acquisita, Vitiligo).—An affection of the skin characterised by the appearance of white or nearly white patches, more or less symmetrically disposed, and due to loss of the normal epidermic pigment. The skin, in the immediate neighbourhood of the white patches, is usually pigmented in excess.

The causes of the affection are obscure; it is commonest in negroes and dark races generally, but not very infrequent in Europeans; it occurs in both sexes, perhaps most frequently in females, and chiefly between the ages of ten and thirty, though earlier and later instances are occasionally met with. A certain number of cases have been observed to follow acute febrile diseases (ague, typhoid fever, scarlatina); in others, pruritus, neuralgia, and various nervous affections and injuries have preceded the pigmentary change, which is most probably directly dependent on the nervous system, in some hitherto unexplained manner.

Pathological examination shows no other abnormality than deficiency or absence of the normal epidermic pigment in the white patches, and excess in the surrounding dark skin; there is, therefore, a simultaneous atrophy and hypertrophy of pigment; in some cases the hypertrophy is generally diffused, and precedes the atrophy by a considerable interval—that is, a diffused chloasma may gradually develop into leucoderma.

The symptoms of leucoderma are entirely limited to the appearance of white rounded or oval spots, neither raised nor depressed, having a convex border, and surrounded by a zone of hyperpigmented skin; they grow slowly, and by their coalescence give rise to large gyrate and irregular figures, the hyperpigmented skin being thus constantly invaded by the leucodermic patches, which ultimately predominate. The process may attack any part of the skin, but is usually most strongly marked over the trunk, especially the loins and abdomen, and the arms and thighs; the forearms and hands, legs and feet, and the face are commonly affected in a lesser degree. When the scalp is attacked, the hair of the affected part becomes white, and the same loss of pigment is found, as a rule, on hairy leucodermic parts of the skin (genitals, axilla); but occasionally the hair retains its colour. Sensation and secretion are perfectly normal. The process is very chronic, often lasting the whole of life; spontaneous improvement has been rarely noticed.

Diagnosis is not difficult. From true leprosy it may be distinguished by the history, the absence of anæsthesia and of other signs of leprosy, and by the sharp outline of the patches and normal texture of the skin; what is called 'white leprosy' in India is, doubtless, only severe leucoderma. Morphœa is followed by loss of pigment, but the affected parts are also generally atrophied and scar-like, and hence depressed beneath the level of the surrounding skin. From chloasma, leucoderma may be distinguished by the concave borders of the pigmented parts; they are convex in circumscribed chloasma.

Treatment is unsatisfactory. No internal remedy is of use, although arsenic has been suggested; locally, all that can be done is to promote removal of excess of pigment by weak lotions of corrosive sublimate, if this should be thought worth while. Any irritation of the white patches, as by mustard for example, may be followed by a return of pigmentation, but this is temporary and irregular, and does not influence the process in the least. John Cavafy.

LEUCOMA. *See* Cornea, Ulceration of the.

LEVIS' APPARATUS for the reduction of dislocations of the fingers or thumb consists of a strip of wood, about ten inches long and one inch wide, which is perforated towards one extremity by six or eight holes arranged in two parallel series, and at the other is abruptly narrowed, so as to form a projecting peg around which the tapes completing the apparatus may be secured. The tapes, two in number, are passed through the holes at the end of the piece

of wood in such a way that a loop arches across between a pair of holes. One loop should always project from the first pair, and the next may project from the second, third, or fourth pair of holes, according to the length of the digit for which the apparatus is required. To use it, the dislocated finger is placed on the splint and beneath the loops of tape; the loops are then tightened, and the ends of the tape carried along the under surface of the handle of the splint and firmly secured to the projecting peg. The advantages of this apparatus are that the finger is securely and rigidly fixed to a handle, by which extension and leverage can be brought to bear directly on the dislocated joint.

BILTON POLLARD.

LICE. *See* PEDICULI.

LICHEN.—There are five distinct diseases of the skin to which the name lichen is applied, but it cannot be said that these diseases form a satisfactory group, or that they have any close relationship to each other. They are—(1) lichen planus or ruber; (2) lichen circinatus; (3) lichen urticatus; (4) lichen scrofulosus; (5) lichen pilaris.

LICHEN PLANUS OR RUBER.—*Definition.*—An inflammatory disease of the skin characterised by an eruption of large, flat, shining papules of a purplish-red colour, which have a tendency to unite and form raised and scaly patches. The disease is attended with much itching and pigmentation, and with more or less constitutional disturbance.

Symptoms and Pathology.—A well-marked example of lichen planus has very characteristic features; some varieties of the disease are, however, met with in which these typical characters are wanting. The most important of these varieties has been called lichen ruber acuminatus, because the flat top of the papule is absent. In a typical example of lichen planus, the papules are considerably raised above the skin, and vary in size from a pin's head to a split pea; they are often quadrangular or polygonal in form; this is, however, by no means a constant feature, for in many instances they are well rounded. In the centre of each well-formed papule there is a slight depression or umbilication, which in some of the larger papules becomes a crater-like excavation, giving to the eruption a very peculiar and characteristic appearance. With the exception of the central depression, which is not always present, the surface of the papule is flat and glistening until a late stage of the disease, when the shining appearance is generally lost. The colour of the papules is a dull or purplish red, often standing out in marked contrast to the white skin around. In many instances the papules remain discrete throughout, but, in not a few cases, they coalesce so as to form raised and scaly patches closely resembling psoriasis. In very severe cases of this kind, nearly the whole body may be covered with raised scaly patches, and thus many of the distinctive features of the disease may be lost. Severe cases of this kind were first described by Hebra, and named by him lichen ruber; they differ from cases of lichen planus only in the greater extent of skin involved in the disease. Lichen planus is usually distributed symmetrically and most commonly on the flexor sides of the forearms, especially at the wrists; it is, however, seldom confined to that region. The course of the disease is most tedious, so much so that Hebra described the severer forms of the malady as incurable. The itching is usually very great, especially when the papules first appear; as the eruption fades it leaves behind dark pigmented stains, which often last long after the original papules have disappeared. On the whole it may be said that, with the exception of some forms of syphilis, lichen planus produces more pigmentation than any other disease of the skin. In severe types of the disease the constitutional disturbance is great, in which respect it presents a marked contrast to psoriasis.

Etiology.—The causes of lichen planus are quite unknown. It is very rare in young children, and is equally common in males and females. It is true that some observers have thought it more common in men, and others in women; the explanation of this is that they have not drawn their conclusions from a sufficient number of cases. The disease is comparatively rare.

Diagnosis.—There are only two diseases with which lichen planus can be confounded—viz. dermato-syphilis and psoriasis. In its discrete form it may be distinguished from any syphilitic eruption—(1) by the umbilicated form, peculiar colour, and arrangement of the papules; (2) the intense itching; (3) its distribution and symmetry; (4) the absence of any symptoms of syphilis; in short, the only point in which it closely resembles a syphilide is in the dark pigmentation produced. In the confluent form it certainly bears a close resemblance to psoriasis or a scaly syphilitic

eruption; the great irritation and the history serve to distinguish it from the latter disease, while the out-lying papules, dark pigmentation, distribution, and constitutional disturbance help to distinguish it from the former.

Treatment. — Of internal remedies, arsenic and perchloride of mercury are the only two which have any distinct or definite value; of local remedies, weak alkaline baths are often very useful in relieving the intense itching. The baths may be followed up by sponging with liquor carbonis detergens lotion. A useful lotion of this kind is ℞ Liq. carbonis detergent. f℥ss., Glycerini, f℥ss., Liq. plumbi subacetatis dil. Oj. A nitrate of silver lotion (gr. iij. ad f℥j.) often relieves the irritation when the tar lotions fail. A perchloride of mercury lotion is also sometimes useful for the same purpose.

Lichen Circinatus is a fairly well defined though not very important affection of the skin. The eruption is met with chiefly on the chest and back, where it is apt to form a triangular patch, the base of which is directed upwards towards the shoulders and the apex towards the lumbar region. The eruption consists of minute reddish papules, some of which are discrete, while others are arranged in small rings or parts of circles; these rings spread centrifugally, leaving a central space of smooth slightly pigmented skin, the yellowish pigmentation giving the disease a superficial resemblance to pityriasis versicolor. Although the disease is most common on the chest and back, it is not strictly confined to those regions; it is attended with itching, which is not usually excessive. It is easily cured by the internal administration of arsenic and the local application of boracic acid or borax lotion.

Lichen Urticatus (*Synon.* Urticaria papulosa).—This disease has, in the opinion of the writer, more marked affinities with urticaria than with lichen; nevertheless, the large size and persistent character of the papules separate it very distinctly from ordinary urticaria. The older writers describe it as a mixed eruption of urticaria and lichen. The disease is met with almost entirely in children, and is very obstinate, usually lasting for several years, but with intervals of comparative subsidence; the itching and irritation are very great, especially at night, and this is always aggravated by the scratching of the patient, which can hardly be prevented. The disease is common amongst the poor, and not uncommon amongst the well-to-do classes in England. It is often mistaken by beginners for scabies, for the reason that in both the superficial characters are greatly due to scratching; for the same reason, the eruption set up in some children by pediculi and other insects may be easily mistaken for lichen urticatus. The difference, however, is soon evident, for, when the insects are removed the eruption disappears, and in this respect it differs, of course, entirely from true lichen urticatus, which is one of the most obstinate affections of the skin. The treatment of the disease consists—(1) in the removal of all local causes of irritation, such as flannel and stimulating soap; (2) in carefully regulating the diet, which should be of a highly nutritious but simple kind; (3) the administration of small doses of arsenic with alkalies and mild purgatives; (4) the local application of lotions and powders to relieve the itching.

Lichen Scrofulosus cannot be regarded as an important disease of the skin. It was first described by Hebra as almost exclusively met with in scrofulous people; it may, however, be fairly doubted whether he did not lay too much stress on this feature of the disease. The eruption has the following characters: (1) the papules are of a very pale colour, and about the size of small pins' heads; (2) they are arranged in patches more or less circular or ringed; (3) the eruption is most common on the trunk, less common on the limbs; (4) it is unattended with itching, and this is its most characteristic feature; (5) it is chiefly met with in children and young people; (6) it is sometimes followed by slight pigmentation and desquamation. The absence of all itching and irritation, and the pale and superficial character of the eruption make it easily overlooked, which is not a matter of much importance. In general appearance it resembles a superficial papular eczema, but can easily be distinguished by the absence of all subjective sensations. Its affinities are rather with lichen (keratosis) pilaris. Besides the above described form of lichen scrofulosus, there is also another variety in which the papules are larger, more discrete, and of a much brighter colour, but in which the *characteristic* feature of not itching is present. In the treatment of this disease, the internal use of cod-liver oil has been strongly recommended by Hebra. Arsenic is also very useful.

Lichen Pilaris, or Keratosis Pilaris as it is now usually called, is a hypertrophic affection of the hair-follicles rather than a true inflammation. The general

appearance of this disease is that of a persistent cutis anserina. It is due to an over-distension and sometimes hypertrophy of the hair-follicles; this distension is caused by an accumulation of epidermic structures and sebaceous matter which collects around the hairs, and forms pale, firm papules about the size of small pins'-heads, or sometimes larger. In well-developed cases the papules are very numerous, and when the hand is passed over the surface of the skin it feels like a fine nutmeg-grater. The usual seat of this affection is the trunk, and the extensor surface of the limbs. It occasionally happens that the papules become a little inflamed, and then assume a red appearance which is attended by some itching; otherwise the patient is free from subjective sensations, and the papules are of the same colour as the skin. It is probable that this inflammation is simply accidental, and not an essential part of the malady.

Diagnosis.—There are two affections of the skin with which keratosis pilaris may easily be confounded—namely, lichen scrofulosus and the papular or follicular form of ichthyosis. From the former it may be distinguished—(1) by the hardness of the papule, and its obvious formation from over-distension of the follicle; (2) the arrangement of the papules, there being no tendency to form round or ringed patches; (3) the history of the case. From follicular ichthyosis it may be distinguished by the fact that keratosis pilaris is an acquired disease; but the two affections bear a very close superficial resemblance to each other. The treatment consists in the use of warm alkaline baths and the free inunction of glycerine. ROBERT LIVEING.

LIGATURES.—Hæmorrhage is best arrested by a simple ligature of the cut ends of the vessels. Large veins, when divided, occasionally require ligature. It is best to include as little of the surrounding tissue as possible, except when the arterial coats are diseased. Occasionally, as with the pedicle in ovariotomy, or the stump after hysterotomy, the vessels are best secured *en masse*. Growths such as nævus or hæmorrhoids may be treated by ligature.

Materials innumerable have been employed for the ligature of arteries. The best are silk and hemp, catgut, tendon, or ox aorta. Those ligatures are best which are most easily prepared. All ligatures should be perfectly aseptic; silk can be kept constantly in carbolic solution; the catgut in common use (from the intestines of the sheep) can be prepared best in carbolic or chromic acid. For the cut ends of arteries, catgut, when properly prepared, is the best material. The carbolised catgut should be removed from the oil and soaked for at least twelve hours in an antiseptic solution, but chromicised catgut may be kept dry, and only requires soaking in carbolic lotion for half an hour before use. The ligature then ceases to be slippery or brittle, and the knot will not yield. Animal ligatures disappear in the course of time, leaving the artery occluded, without setting up irritation. Silk ligatures, if really aseptic, may do the same, but frequently fail in this respect. Whatever the material employed, the inner coats of the vessel are usually ruptured; the flatter the ligature the less likely is this to happen. Secondary hæmorrhage is more likely to follow the use of silk than of animal ligatures. For the ligature of arteries in their continuity, animal substances are best. A single thread should always be used.

Method of Tying.—A reef-knot should always be used, and the knot made firmly without any jerk. In tying arteries in their continuity, the dissection should be carried down till the white coat of the vessel is exposed, and the ligature applied with a minimum of disturbance to the sheath. The artery should not be separated from its vascular connections for more than the width of the aneurism needle. By pressing the tips of the fingers down on the vessel in tying the knots, the danger of lifting up the artery from its bed will be obviated. The ends can be cut off short, and the cut sheath should meet over the knot when the wound is closed. Often, the internal coats can be felt to give way as the first knot is made, and when this happens, it is a proof that sufficient force has been exerted. The internal coats are ruptured with far greater ease than might be supposed. In a healthy artery, the absolute cessation of the pulsation below indicates that the vessel has been tied sufficiently tightly. The swelling of the ligature which follows when an animal material is employed, is more likely to increase the constriction than to diminish it, as usually supposed; for the knot, if properly tied, does not yield with the swelling of the ligature. The more diseased the vessel, the more deliberately should the first knot be made.

In dense, fibrous tissues, it is often very difficult to secure a bleeding point with the ligature. A good plan then is to pass a needle, threaded with a double ligature, through

a portion of tissue near the vessel, as in acupressure. The loop is cut and both ligatures are tied, one on each side of the bleeding point. They are thus prevented from slipping off, and one or other will certainly include the vessel. For tying thick ovarian pedicles, and, still more, in tying the stump after removal of the uterus, silk ligatures are best. Spencer Wells's twisted silk is far the strongest and most reliable. Here, the first knot should be made with a double hitch, and tied very slowly and firmly; if the loose ends are pulled across each other the knot will not slip. After a few minutes the loop will be found loose as the fluids are pressed out; the knot is then again tightened. This process may require to be repeated several times before the reef-knot is completed; if this be not done, hæmorrhage is apt to follow. C. T. Dent.

LIGHTNING, Accidents from. — These injuries seldom come under the notice of surgeons in this country, and most of our knowledge of the subject has been derived from the records of cases collected, from several sources, by Sestier and Boudin, and from the results of experiments made by Dr. Richardson in 1869. These injuries vary much, in different cases, in their character, intensity and extent, and though due in most instances to the action, more or less direct, of lightning, are at times the results merely of alarm and mental shock. In the most severe and fatal instances, the proportion of which to all the cases of injury from lightning is about one to four, the patient is killed at once, the body either falling suddenly to the ground, or becoming rigid and remaining fixed in a more or less erect attitude. In the more severe cases of the non-fatal injuries, the most marked general symptom is sudden and very profound collapse with unconsciousness, which condition is followed by drowsiness, fever, much prostration, and occasionally delirium and convulsions. A very frequent result of the injury is temporary paralysis of one or more limbs, associated in some instances with severe neuralgic pains, in others with complete anæsthesia of the paralysed region. Impairment of vision, and even blindness, have frequently been observed in cases of lightning injury, and these sequelæ, unlike the other results of lightning injuries, have in many cases a tendency to persist, especially when due not to nervous shock, but to progressive inflammatory changes in the choroid and retina. The long list of affections, that have been recorded as remote sequelæ of accidents from lightning, includes general debility, muscular weakness, vague fugitive pains, loss of memory, impairment of smell and taste, feeble circulation, coldness of the extremities, and the other well-known subjects of complaint common in those who have recovered from severe shock.

The external lesions caused by lightning also vary to a considerable extent, even in fatal cases. A person killed on the spot may present hardly any visible mark of injury, whilst, in some instances, the body may be much mutilated, and the bones of a limb or of the cranium widely comminuted and exposed. The clothes, in fatal as in less severe cases, may be left untouched, but are usually burnt and perforated at scattered points or along extended lines; or are reduced to shreds and torn away, leaving more or less of the patient's body quite bare. The most frequent superficial injuries from lightning are patches of cutaneous ecchymosis, burns varying in extent and severity, and dusky patches on the surface of the skin caused by the deposition of fused portions of metallic bodies—chains, coins, studs—carried by the patient at the time of the injury. Much attention has been directed to the so-called *keraunographic* images or arborescent impressions, that have been occasionally observed in cases of injury from lightning. These patches, presenting deep red lines, having a decided arborescent arrangement, correspond to the distribution of one or more subcutaneous veins, and are probably due, like similar appearances in the decomposing cadaver, to effusion of fluid blood along the course of the venous trunk and its branches. Arrest of the growth of the hair, followed by complete general or localised epilation, is another frequent result of these injuries.

In fatal cases of lightning injury, rigor mortis comes on rapidly, but the coagulation of the blood is usually much retarded. The most frequently observed post-mortem appearances have been: circumscribed effusions of blood under the serous membrane of the large cavities, extreme vascular injection of the coats of the intestines, and distension of the cerebral veins and sinuses. Instances of rupture of the heart, and also of the stomach, have been recorded.

In the *treatment* of severe lightning injuries, the surgeon has to deal at first with the condition of shock by applying warmth to the surface of the body, by administering stimulants by the mouth, rectum, or under

the skin, and, in very severe cases, by artificially inflating the lungs. Each of the secondary and local affections requires the usual treatment of such condition. Under the influence of a proper and regular course of galvanism, the localised paralysis in most instances very soon yields. The progress of healing of the burns caused by lightning is often very slow, and in such instances, it has been stated, the action of the ordinary local remedies will be much assisted by the occasional application of electric currents to the injured region. W. Johnson Smith.

LINGUAL ARTERY, The, arises opposite the greater cornu of the hyoid bone, and, passing inwards parallel to the greater cornu and a quarter of an inch above it, finally ascends to the tongue.

The artery is divided into three stages by the hyo-glossus muscle, which crosses it—viz. a part posterior to, a part beneath, and, finally, a part anterior to the muscle. The second stage is the important surgical one. The digastric and stylo-hyoid muscles cross the artery obliquely, and divide it into two regions; the one below belongs to the superior carotid triangle, the one above to the submaxillary. The artery rests at first upon the middle constrictor, afterwards upon the genio-hyo-glossus.

Ligation.— Make a straight incision along the upper border of the hyoid bone for an inch and a half, dividing the cutaneous structures. When the deep fascia is opened, the posterior belly of the digastric is to be plainly made out; the hyo-glossus is then seen, with the hypo-glossal nerve and the lingual vein lying on it. Pull upwards the digastric and stylo-hyoid muscles, the submaxillary gland, the hypoglossal nerve, and the lingual vein. The hyo-glossus muscle being freely exposed, cut it lengthwise on a director immediately above the hyoid bone, where, beneath the muscle, the artery is found and secured. It is best to fix the hyoid bone by a tenaculum or forceps whilst the director is being passed beneath the muscle. Pass the needle from above downwards.

James Cantlie.

LINHART'S CHISEL. *See* Osteotomy.

LIPOMA (Fatty Tumour).—Three varieties of fatty tumour are recognised: The diffused. The single (fatty tumour proper). The multiple.

The *diffused* form is comparatively rare, unless the common 'double chin' be regarded as a growth; yet certainly in this region, as well as in those of the parotid, the sub-occipital, and in many others, usually near to the mesial line of the trunk, are to be found occasionally such definite masses of subcutaneous fat that the name of 'tumour' must be applied to them. Beneath the chin and in the perineum these swellings may seem single, but, otherwise, it is usual to find these lumps of fat placed symmetrically, and often there are many of them; and as the double chin is generally seen in men, so are these diffused fatty growths almost always found in men, and almost as constantly in young men.

The *single* variety is the well-known 'fatty tumour,' whose *locus* is always the areolar tissue, and which most frequently is subcutaneous; but lipomata may be found occupying inter-muscular spaces or forming an omental mass, occurring usually as a single tumour, though two placed symmetrically or more may exist in the same patient. Women appear to produce this form of lipoma more frequently than do men; certainly women seek advice for their removal in greater numbers than men, and although commonly seen in well-nourished subjects, this is by no means universally the case.

Fatty tumours occur most frequently upon the posterior plane of the body, and as a rule nearer the lateral borders than the spine; thus, favourite sites are the nape of the neck, the shoulders, and the scapular area generally, as also lower down the trunk, over the loins, the nates, and the region of the great trochanters. Sometimes, these fatty tumours shift their position by a process of gradual downward displacement, caused by their own weight acting on loose connections, and thus pendulous or even pedunculated fatty tumours are produced. They are at first usually of slow growth, but at any time are liable to increase rapidly. The largest the writer has seen grew from between the scapulæ, and weighed thirty-seven pounds.

The *multiple* variety, where three or more may exist in the same person, are usually found upon the extremities, the upper more often than the lower, and rarely grow larger than a filbert.

Causes.—A possible cause for the occurrence of diffused lipomata appears, by recent observations, to have been found in the fact that subjects of this affection are large consumers of ardent spirits. In the case of the common fatty tumour, taking into consideration the situations where these tumours are wont to be found, and that not infrequently such parts are sub-

jected to pressure—as for instance the points of the shoulders in lying—it would not seem unreasonable to suppose that local irritation, inducing hyperplasia, may be regarded as a frequent exciting cause, whilst a general disposition to the over-production of fatty tissue is usually the predisposing cause. Family predisposition is often the cause assigned by the subjects of multiple lipomata.

Pathology.—As regards minute structure and arrangement, the microscopic appearances of the lipomata do not differ from those of normal fatty tissue. On inspection, after removal, a fatty tumour is seen to be made up of a series of lobes, with a very varying amount of fibrous tissue which radiates through the tumour, and also forms its capsule. This capsule is complete in the *single* and *multiple* forms, but, as its name infers, is wanting either altogether or in part in the *diffuse*. Lipomata are feebly vascular. They stretch the skin covering them and attenuate it, so that, either from friction or neglect, it may ulcerate and allow the tumour to herniate. The only form of degeneration that is common in fatty tumours is calcification.

Diagnosis.—The diffused lipomata vary in consistency, being either soft and doughy, or very hard and dense. They have indefinite borders, which fade off into the normal subcutaneous fat at some one aspect or in all directions; the skin is generally so closely blended with the fatty mass that it cannot be raised off the tumour, nor this from off the subjacent tissue. Lobulation may be very imperfect in this variety.

In a typical fatty tumour of the single class there is a well-defined roundish or oval swelling, the skin is commonly puckered over the tumour and loosely adherent to it, whilst the growth can be lifted up from off the subjacent structures. The tumour is easily displaced; it is soft and lobulated, and the softness and elasticity of these tumours is often so marked as to give rise to a most deceptive sense of fluctuation. Often fatty tumours are flattened out, and, as has been stated, they may be almost pedunculated, and this is likely to be the case when they are connected with the axilla or perineum. A fatty tumour has in the first place to be diagnosed from a sebaceous cyst, to which the skin is more closely adherent, and on the surface of which a black spot marking the obstructed orifice of the duct can often be seen; in the second place, from a chronic abscess or other fluid swelling, in which case, if doubt exists, aspiration will clear it up. Almost the only inconvenience which a fatty tumour produces is from its size. It is very seldom that patients make complaint of pain.

In the multiple variety, the little fatty masses are firmer, but still lobed, and often one or more are very painful on pressure; this form drifts into and can hardly be separated from the painful subcutaneous fibroma, the relative amount of fatty and fibrous tissue, and the more or less definite evidence of nerve-filaments forming a part of the growth, determining the point.

Treatment.—For the diffused lipomata, operative procedure is, as a rule, contra-indicated. A reform of the tippling habits, and the use of medicines which tend to cause absorption of the masses of fat, seem the more suitable plan of treatment, although, if very large and disfiguring, free cutting out of the overgrown structure may be performed.

Ordinary single lipomata should be removed by a free incision and enucleation of the growth; and, as the writer has seen recurrence follow an operation, a word of caution may be added, to remove the tumour thoroughly, for a small outlying lobe may very easily escape observation.

Multiple lipomata, it is clear, cannot be all excised; if one or two are the cause of much pain, they may be taken out; but here again the internal administration of such drugs as liq. potassæ in large doses, arsenic, iron, and iodine, forms the most appropriate treatment, together with strict regimen. ALFRED WILLETT.

LIPS, Diseases of the.—*Malformations* of the lips are described under CHEEK, Fissure of the; HARE-LIP; NÆVUS.

I. *Cracked lip*, though usually the result of dyspepsia or local irritation, may owe its origin to scrofula or syphilis. The simple variety is generally seated in the centre of the lower lip. There is little, if any, induration; the mucous membrane around may be more or less chapped. In slight cases no treatment is required, but if the fissure is obstinate it should be touched with lunar caustic, or anointed with some mild mercurial preparation. Healing may be hastened by checking the action of the labial muscles, by means of a piece of strapping passed below the lip from cheek to cheek.

II. *Ulcers of the Lip.*—(*a*) *Simple follicular ulcers* are frequently associated with disordered digestion. They are rarely larger than grape-seeds. Their edges are steep and sharply cut. They give rise to

smarting pain, which is increased by mechanical or chemical irritation.

Treatment.—Any digestive errors are to be corrected by a saline purge and an alkaline-bitter tonic; and the ulcers touched with some mineral astringent.

(*b*) *Syphilitic* ulcers are of three kinds: (1) the primary sore or chancre; (2) secondary fissures and mucous tubercles; and (3) tertiary serpiginous sores.

Hard chancre may be acquired in various ways—e.g. the virus may be conveyed by the saliva, or by the secretion from mucous tubercles on the lips of another person, in the act of kissing; or it may be carried by a pipe, drinking-glass, or tooth-brush. Occasionally, inoculation is the consequence of lascivious practices. Infants may be infected from the cracked nipples of wet nurses the subjects of syphilis. As a rule, the chancre is less indurated than when seated on the genitals; its base may be purulent, sloughy, or even hæmorrhagic. On the other hand, the local signs may be so slight that the patient may not notice them. The lymphatic glands beneath the jaw, which are the seat of indolent bubo, are affected quite early. The other constitutional symptoms are not long in making their appearance. It is difficult, and it may be impossible in the early stages, to distinguish an infective from a non-infective chancre.

Treatment.–The ulcer should be covered with crystalline iodoform until it begins to heal, and the red oxide of mercury ointment then be applied.

Mucous tubercles are situated at the angles of the mouth and on the inner surface of the lips. The *cracks* or *fissures* of congenital syphilis often leave indelible scars, radiating from the corners of the mouth.

Treatment.—The broken surfaces should be brushed over with a solution of bichloride of mercury, $\frac{1}{4}$ to 2 grains to the ounce.

Tertiary syphilitic ulcers begin on the cutaneous surface, generally of the upper lip. They are often coated with thick foul scabs. The local *treatment* is the same as for the primary ulcerated chancre.

In each of the foregoing varieties of syphilitic ulcer the constitutional affection requires systematic treatment. Strict injunctions should be given to the patient to guard against conveying infection to others.

(*c*) *Scrofulous ulcers* consist of cracks or fissures: not rarely the muco-cutaneous surface is the seat of eczema. In addition to or even without ulceration, the upper lip may be permanently swollen from solid œdema, the result of chronic inflammation. The lip is prominent and carried away from the teeth. This is known as *Strumous lip.*

Treatment.—The digestive organs must be attended to, and cod-liver oil and iron administered. The fissures and eczematous patches may be painted with a mixture of equal parts of castor oil and oxide of zinc, or touched lightly with nitrate of silver.

(*d*) *Epithelioma* in its early stages resembles simple warty proliferation. On section, however, it will be found that in papilloma there is no invasion of the cutis vera, whereas in epithelioma the cutaneous and subcutaneous tissues are involved quite early, and at the same time there is induration of the base of the growth. The disease is infinitely rare in females. It is seldom met with under thirty, and, like other forms of cancer, it occurs with increasing frequency as age advances. With very few exceptions the lower lip is the part attacked. The rate of growth and ulceration varies within wide limits. At first the surface is merely cracked, or irregular from papillary hypertrophy. A little later it is covered with a scab, which on being removed leaves a granular-looking sore. On squeezing the part it may be possible to express some plugs of epithelium. As the destructive process advances, the part assumes a ragged, ulcerated appearance. The submaxillary glands become involved, and the gum or even the jaw may be implicated in the growth.

Diagnosis.—It is only in the initial stages that a doubt can arise as to the nature of the lesion.

From papilloma it is told by its tendency to ulcerate; by the induration of its base; by the possibility of dislodging epithelial-cell cylinders; by the enlargement, if any, of the submaxillary lymphatic glands; and lastly, in many cases, by the duration of the disease.

Epithelioma is more commonly mistaken for a hard chancre, and *vice versâ*; but a chancre is less warty or otherwise irregular, and the induration is more uniform and circumscribed. Again, the lymphatic glands are affected at an earlier date in chancre, forming indolent bubo. In the majority of cases, epithelioma is met with later in life than labial chancres, which are not infrequent in women. Corroborative evidence will be furnished by the absence or presence of other symptoms of syphilis, taken together with the known duration of the affection. When once the skin or

mucous membrane has been destroyed by a syphilitic ulcer, no epithelium is found in its base, whereas in epithelioma it is quite plentiful.

The writer's experience leads him to conclude that no great reliance can be placed on the results of microscopical examination of scrapings from the surface. It is quite possible to mistake the tips of hypertrophied papillæ for cell-globes.

Treatment.—Nothing short of complete removal is of the least avail. The usual plan of operation is to excise the growth with the entire thickness of the lip, by means of a V-shaped incision. Care must be taken that the cuts are made quite clear of the diseased tissues, otherwise recurrence will be certain and speedy. There can be no doubt that, when practised early, this plan of treatment suffices to effect a permanent cure in some cases. Even when the gum or jaw is deeply invaded, the surgeon should advise an operation if the whole of the tumour can be got away, and the condition of any infiltrated cervical glands is such as to allow of their complete extirpation. If the disease is left to itself there is but one termination—death, and that in a horribly distressing form; the patient being worn out by absorption of septic matter from the ulcerated gangrenous tissues; by repeated attacks of hæmorrhage, which it may be difficult to arrest, and by the passage of decomposing discharge into the stomach and lungs. For the more serious operations, no rule can be laid down with regard to the incisions suitable to all cases. It may be expedient to close the gap left after removal of the mass by means of a plastic operation. The directions for such a procedure will be found under CHEILOPLASTY. It may be added that these extensive operations are the more justifiable, since it is quite exceptional for the viscera to be affected with secondary growths. It is surprising what little deformity is left, even when the greater part of the lip has been excised.

III. *Adenoma of the lip* commences in proliferation of the glandular epithelium. It is composed of tubes and acini, the latter predominating. It is a rare affection, and generally slow in its march. The inner surface of the tumour, which is covered with mucous membrane, may be flattened by pressure against the teeth and gums, whilst the outer surface presents a uniform swelling under the skin. In addition to the glandular structure there may be a considerable quantity of fibrous and mucous tissue; in fact, these growths bear a strong resemblance to the mixed tumours of the parotid. In one case the growth contained a nodule of bone. Occasionally they are cystic.

Treatment. — If possible the tumour should be enucleated without dividing the lip. The best plan is to make a free incision over the inner surface of the swelling.

IV. *Labial cysts* arise for the most part from distension of mucous follicles, but there may be free cyst-formation, possibly from dilatation of lymphatic spaces. They can generally be seen projecting beneath the mucous membrane as semi-transparent vesicles, as if a white grape were embedded in the tissues of the lip. The contents are usually viscid, and are either colourless or yellowish.

Treatment.—If small, the entire cyst may be removed; but, rather than damage the surrounding structures, it is better to excise a portion of the cyst-wall. In the latter case to prevent refilling, the inner surface should then be rubbed with solid silver nitrate or brushed over with strong nitric acid.

V. *Herpes labialis* is commonly seen as a crop of vesicles at the junction of the skin and mucous membrane. *See* HERPES.

VI. *Pigmentation* of the mucous membrane of the lip occurs as patches in Addison's disease. It is of no surgical import.

VII. *Aneurism by anastomosis* of the facial artery and its branches may involve the lip. *See* CIRSOID ANEURISM.

AUGUSTUS J. PEPPER.

LISTER'S SPLINT for excision of the wrist is an anterior forearm splint, with a cork pad at one end for the hand to rest upon with the wrist extended and the fingers slightly bent, and a cork ledge projecting on the radial side for the thumb to rest upon.

LISTON'S LONG SPLINT is a wooden splint, reaching from the axilla to six inches beyond the sole of the foot. It has two notches at the distal end so as to give the ankle bandage a firmer grip of the splint, and two holes at the other end for the perineal band to be attached to. The middle of the band should be accurately adjusted over the ischial tuberosity, and its two ends should be carried, one in front of the groin and the other behind the buttock, to the holes in the axillary end of the splint. Extension should be made by pulling on the foot and the lower end of the splint, and then the ends of the perineal band should be tied together to maintain the extension. BILTON POLLARD.

LITHOTOMY. — This and the next article deal simply with the surgical treatment of stone in the bladder by operation —the varieties, the obstacles and dangers met with, the results, and the applicability of each method of proceeding. For the symptoms, diagnosis, and medical treatment of stone, *see* STONE IN THE BLADDER. The writer has not attempted to treat the subject exhaustively; he has been compelled to omit many references to authorities, and even to leave unnoticed varieties of instruments and operative measures which are now but seldom used or adopted. He has rather aimed at giving, in a concise and practical manner, his own reflections on lithotomy and lithotrity, formed after a fairly long and full experience extending to just 300 cases of operation in his own practice, and probably as many more in that of his colleagues and friends.

Not all patients who have stone in the bladder should be advised to submit to operation. Some suffer so little from the presence of even a very large stone, that it would be wrong to place their lives in danger by resorting to lithotomy; while some others are unfit for any operation because of the presence of serious organic disease, urinary or otherwise. Let it now, however, be assumed that, after due consideration, a patient is about to undergo an operation.

LATERAL LITHOTOMY IN THE ADULT.— The instruments required are, or ought to be, few. Staffs, a knife, Prichard's anklets, forceps, scoops, a sound or searcher, possibly a blunt gorget, a drainage-tube, a tampon, and a syringe, are all that can be required.

The staff should be of moderate rather than of full size (the former is just as easy to find, and does not oppose the introduction of the finger so much as a large one), with not too long a curve or too sharp a point, for fear of injuring or even perforating the posterior wall of a contracted bladder; the lateral groove should be wide rather than deep, and extend to and end abruptly at a quarter of an inch from the end. The knife usually sold as Liston's is the best shape, with the back nearly straight, of a good width, the cutting edge terminating an inch and a quarter from its point; the blade three, and the handle four, inches in length. The forceps should be always straight— curved are unnecessary and inefficient—the blades sufficiently hollowed that they will hold a stone fairly by their surfaces and not merely by two points, and yet not so hollowed as that the tips of the blades would be likely to break the stone if only half-grasped; the inside of the blades should be roughened, or, what is better, lined with linen, which diminishes the risk of breaking the stone. The scoops usually sold are of little use; they should not be double-ended, but firmly fixed in a good-sized bone or wood handle, of various sizes, and well curved, so that if a stone or piece of stone is fairly engaged in one, it can be withdrawn by a combination of traction and leverage. The gorget can seldom be needed; for upwards of thirty years it has scarcely ever been used in Norwich, and now the hospital does not possess one. Cases frequently occur in which the finger cannot reach the bladder; but the forceps will always readily enter it and will act as the best dilator. A tube of some kind to secure, after the operation, perfect drainage and repose of the bladder is of infinite advantage. It is usually made of gum-elastic material, but many years ago the writer suggested the use of a double silver canula, sheathed so that it can be drawn out according to the distance of the bladder from the surface; it should be about the size of No. 18 catheter, with a well-bevelled end and numerous small holes for about an inch. These small apertures are better than one or two larger ones, because if the tube has to be retained several days, the swelling of the wound's surface may cause the granulations to bulge into these apertures and make its withdrawal painful, and even cause a little bleeding.

No special preparation of the patient is called for beyond a judicious diet for a few days, a mild laxative if necessary, and an enema shortly before the hour of operation. The table for the patient and the chair for the surgeon should be of such relative heights, that the latter can easily proceed without having to raise his hand and arm uncomfortably.

While the anæsthetic is being administered, the anklets may be adjusted. The two assistants who support the legs must be mindful of their duties, which are, to keep the patient in a straight and immovable position, with his thighs well flexed on the body and the knees symmetrically separated. This is best done by folding one arm over the patient's knee, with the forearm and hand along the inner side of the leg, the other hand supporting the foot, but ready at any moment to assist the operator if required. The staff may be introduced either before or after the anklets are locked; if before, care must be taken that it is not driven in upon the bladder during the rough movements of flexing the legs. The presence of a stone will be verified by the staff; if any

doubt on this point is felt, a sound should be substituted and a proper search made, and if still the stone cannot be detected, the operation must be postponed. This, however, will very seldom happen; in several hundred operations the writer has only once known it occur, and that was in the practice of Mr. Liston. The patient, a fat, elderly man, with an enlarged prostate, had twice been removed from the table; on the third attempt, although the stone had been felt the day before with the sound, the staff did not strike it at the time of operation. When the bladder was opened and the forceps were introduced, still no stone could be felt; there was free bleeding, and a clot was entangled in the blades of the forceps, and in this clot were two small stones which had been unconsciously removed. The position of the staff is a matter of importance: instead of keeping its handle perpendicular, the staff-holder should incline his hand considerably towards the patient's abdomen, and gently push the convexity of the staff towards the perineum. The effect of this, as verified by dissection, is to bring the membranous urethra slightly nearer to and almost parallel with the surface of the perineum; the groove is more easily reached, the operator has no inducement to open the urethra too far forwards, and the bulb and its artery will probably escape being cut. The end of the staff need not, by this plan, be withdrawn from the bladder; but if it were, it would be immediately replaced when the staff is brought into the perpendicular position and hooked firmly under the pubic arch, before the deep incisions are made.

Before commencing the operation, the finger is passed into the rectum to ascertain that it is empty, to note the size of the prostate, and to secure the proper position of the staff. The first incision should be about three inches in length or more, according to the estimated size of the stone and of the prostate; the freer the incision, the easier it is to bury the knuckles in it and reach a deeply-placed bladder. The knife is entered perpendicularly rather more than an inch above the anus, and a little to the proper left of the middle line; this first puncture should be of some depth, but not deep enough to touch the staff: should it do so, it may be assumed that the urethra has been opened too far forward, and free bleeding may be the needless result. The direction of the incision should be well towards the tuberosity of the ischium—nearer, that is, to it than to the anus. The left forefinger is then pressed deeply along the upper angle of the wound, and the staff felt for; it can always be found, but it is not easy to place the finger-nail on the edge of the groove. This would require a good deal of rotation of the hand, and the uncut tissues prevent it; it will suffice if it rests fairly on the staff. The surgeon, keeping his eye on the latter, will slip the knife along the back of the finger and will easily find the groove; if there is any difficulty, the knife is not to be at once carried deeper, but its point should be moved laterally, without cutting, when it will probably be found to touch the staff on one side or other, and the groove will be quickly entered. This being done, the staff is raised into the perpendicular position and hooked firmly up against the pubic arch, as before mentioned, the knife following it, and then being pushed cautiously along quite to the end of the groove in the bladder. Young operators sometimes find this a little awkward; they are so strongly cautioned against allowing the knife to leave the staff that they direct it upwards, and its point, impinging against the metal, will not readily glide along; it is only necessary to raise the hand a little to make it slip forwards. The beginner should practise this before operating, and the proper adaptation of the knife and staff will soon be acquired.

The next step is one of delicacy and importance. It is useless to withdraw the knife in the same line as it entered, unless the stone is very small; some division of the prostate and neck of the bladder is necessary, and it is now to be made by a draw-cut. The knife, with its edge well lateralised, is to be pressed gently but steadily downwards and outwards as it is withdrawn, the pressure diminishing by degrees to nothing as the external wound is reached. Only experience can guide one aright at this stage. Those who prefer a free incision, with its risks of hæmorrhage and extravasation of blood or urine, will use more pressure; and those who prefer a small incision, with the certainty of laceration, will use less: the safe course is the medium one.

The left index finger is now passed along the groove into the bladder, and the staff is withdrawn. The depth of the bladder, the size and position of the stone, and the extent of the deeper part of the wound are ascertained. The finger is to be used to dilate the neck of the bladder in all directions, employing pretty strong pressure in doing it, and so making a smooth path for the entry of the forceps and for the further dilatation of the vesical orifice. Martineau and Liston laid great stress on this dilata-

tion by the finger. Having ascertained the size of the stone, the surgeon selects the forceps, taking care not to fall into the mistake of using too small a pair; he passes them along the upper or dorsal surface of the finger, withdrawing the latter as the forceps enter. The blades should be fully introduced before opening them—this is done slowly and in a lateral direction—then, by giving a quarter turn to the handles, one blade is made to sweep round to the lower fundus of the bladder, and by this manœuvre the stone will almost certainly be caught. If it is not, the process will be repeated, and, if there is still a difficulty, the surgeon will ascertain if he has not passed over the stone, which is not infrequently found close behind the prostate and beneath the forceps; if this be so, he will withdraw them slightly, elevate the handles, and repeat the rotatory movement. Sometimes, though rarely, the stone is entangled or held by irregular contraction of the bladder at the upper fundus, in which case the handles should be lowered and the blades directed upwards, while an assistant makes firm pressure above the pubes. The large size of the stone sometimes makes it difficult to grasp it; in this case the operator will withdraw the forceps, perhaps take a larger pair, and having ascertained with his finger the exact position of the stone, he will introduce them so that the tips of the blades impinge on it; then by slowly opening them they will be found to glide over each side of the stone, and a good hold is obtained.

All these manœuvres are to be slowly and gently conducted, and there should be no wild 'digs' at the stone or sudden alterations of method. The extraction should be deliberate and steady, the direction somewhat downwards, the blades and handles of the forceps kept in a vertical position, and no rotation made as the stone advances, for fear of injuring the prostate and neck of the bladder. Should there be much resistance and no sense of gradual yielding, the surgeon will ask himself the question whether this is due to an insufficient opening, or to the projection of the ends of an oval stone laterally beyond the blades. This latter may be known by observing that the bladder is brought bodily down, so that the prostate, which is probably large, is visible near the external wound; in this case, the stone must be liberated, the finger again introduced, and a fresh hold taken. If the obstruction is due to a large stone and too small a wound, the latter is to be enlarged in the direction of the first incision; this, in the opinion of the writer, is preferable to making a division of the neck of the bladder on the opposite side, and preferable, too, to using undue traction force. The stone being removed, the bladder is again fully examined with the finger, and if necessary with a searcher, to see if another calculus or piece of one remains; any bleeding vessels are to be tied, or the wound plugged, as will presently be described. The silver tube is introduced and secured by tapes and a bandage round the body, a morphia suppository put into the rectum, and the patient placed in bed with hot bottles to his feet.

The after-treatment is very simple. The bed should be a firm hair-mattress, protected by a waterproof, and plenty of old sheets cut into squares for frequent removal; a rope and cross-bar should be arranged above, so that with his hands the patient can raise his hips without undue exertion. His knees are to be supported by separate pillows, with an interval between them, so that the light is not obstructed and the tube can easily be got at. This must be kept free, by a feather or a small sponge on a wire, so that the urine shall easily pass, and clots be removed if necessary. The secretion of urine is often scanty for the first twelve or twenty-four hours, and then it flows freely; if it ceases, and the patient is in pain, the tube should be gently pushed a little further in, or a flexible catheter may be passed through it into the bladder. In ordinary cases the tube may be withdrawn in thirty-six hours, but if the prostate is large or if the patient had been compelled to use the catheter previously, it will be right to retain it three or four days or more; and even then it will, in the cases just mentioned, be requisite for the nurse or surgeon to draw off the urine by passing a catheter through the wound as often as may be necessary, until its use by the urethra is resumed. If the urine is alkaline and acrid, the skin of the perineum and nates is apt to be excoriated, especially in the aged and feeble; and this is to be guarded against by frequent washing and change of bed linen, and by the free application of zinc ointment. In these cases, much benefit will accrue from washing out the bladder with Condy and water or boracic water, twice or thrice daily; the deposit of phosphates, which coats the surface of the wound and may lead even to phosphatic concretion and recurrent stone, is thereby lessened, and the cystitis is greatly alleviated. The diet should be simple and good; a mild aperient may be taken on the third day, and, if requisite, it

should be aided by a simple enema. The urine generally begins to flow by the urethra between the end of the first and second week, depending somewhat on the size of the stone and the condition of the patient; and the external wound is generally healed, and the cure complete, within the month.

The Obstacles met with in lithotomy are chiefly due to—1, the large size of the stone; 2, enlarged prostate; 3, breakage of the stone; 4, encysted stone. (1) The mode of dealing with large stones has already been briefly described. In these days of anæsthetics, stones of such magnitude as are described in the *Medico-Chirurgical Transactions*, vol. xi., are not likely to be met with. The largest in the Norwich Hospital weighed nearly thirteen ounces, and the surgeon failed to extract it. There is, however, a stone in the hospital museum which weighed nearly fifteen ounces; it was successfully removed by Mr. Harmer in 1746, assisted by Benjamin Gooch, who, in describing the operation, says: 'I divided the parts occasionally as he continued to make a gentle extraction.' This sentence describes pithily the best mode of removing stones of large size; it means practically a judicious combination of dilatation and cutting, and probably some rupture of tissues. It is far better than attempting to break a hard compact stone, by which serious injury to and sloughing of the soft parts are likely to be produced. In the present day, however, it is probable that stones weighing upwards of three ounces will be dealt with by the improved method of supra-pubic lithotomy.

(2) Enlarged prostate, undoubtedly, is sometimes a serious obstacle in lithotomy, and if it is combined with a full-sized stone the difficulty is very considerable. The bladder is probably beyond reach, and the size and position of the stone cannot be accurately known. Still, the finger will reach well into the prostatic urethra; the knife has already made a free incision, and the forceps will readily pass in. It is in the extraction that the trouble lies; the rigid prostate will not easily dilate, and if the stone is of any magnitude, there is certain to be some yielding of tissue. This rupture always takes place below, at the thinnest part, so that, when the wound is examined after the extraction of the stone, the gland seems to be, and indeed is, separated into two lateral lobes. If the median portion projects prominently into the bladder, it may get entangled in the forceps and be torn off, or a fibrous tumour in one or other lobe may be forced out by the stone as it passes. This accident has been deemed by some surgeons as of no disadvantage, but it is probable that a careful examination of the subsequent condition of such patients would show that, although it may not have endangered life, it has not infrequently been followed by partial inability to retain urine.

(3) The breaking of the stone in the forceps has two disadvantages: it makes the repeated use of instruments necessary, and, what is of more importance, it entails the risk of leaving a fragment behind. The same may be said when there are a number of small stones. Nothing requires more deliberate care and perseverance on the part of the surgeon than the entire clearance of the bladder under these circumstances: small fragments, or small stones, are apt to be surrounded by clots or viscid mucus, or to get into the recesses of the mucous membrane, and are not easily detected by the searcher or even by the finger. Frequent syringing with a Higginson's enema and a small flexible tube, so as to search every part of the bladder and allow of a free return stream, and the careful exploration with the sound and finger, are all that can be done; but the case should be narrowly watched after the operation, and if, within two or three weeks, the patient should complain of pain when the bladder contracts, a sound should be used. If a small piece of stone is detected, an attempt may be made to extract it by means of long slender forceps through the wound; or the latter may be dilated with the finger, and forceps of adequate size used; or, what perhaps is a better plan, the wound may be allowed almost to heal, and a lithotrite be applied to complete the cure. Recurrence of stone within two years almost always means that a fragment has been left after the operation. No greater disappointment than this, both to the surgeon and the patient, can happen. No one, probably, has cut fifty patients without having to admit and lament its occurrence, but it is especially liable to occur to the inexperienced.

(4) The stone may be encysted, and this constitutes a very dangerous and puzzling obstacle. Fortunately it is rare, but the writer has met with at least six or eight instances. Each case will present peculiar features; no rule for general adoption can be laid down, and the surgeon must decide, at the moment, how to attempt to remove the stone, and how far to persist in such attempts and when to desist. Sometimes, one or more stones are lying free in the bladder and can be easily removed, and then the finger, in making a thorough exploration,

feels the point of one that is hidden in a sac or cyst. Possibly, the surgeon may succeed in dilating the mouth of the sac with his finger, and possibly, also, he may be able with forceps or, more likely, with a long narrow scoop curved almost to a right angle, to dislodge and remove it. This manœuvre will only occasionally succeed, however, and it will be prudent to leave the stone embedded, in which case all that can be done will be to remove, with the lithotrite, from time to time projecting masses of phosphates, which are sure to grow up into the cavity of the bladder. In this way the patient's comfort may be promoted for a time, but ultimately he will sink from cystitis.

The Dangers of Lithotomy are—1, hæmorrhage; 2, wound of the rectum; 3, perforation of the bladder. (1) Hæmorrhage is either primary or secondary; that which comes from the transverse artery of the perineum or any other, in the first incisions, may be disregarded at the moment; it generally ceases as the further steps of the operation proceed, and the vessel can be tied when it is concluded. The artery of the bulb should not be cut, but it frequently is, especially by beginners, who are naturally anxious to reach the staff, and who make their incisions too far forward; it is not easy to place a ligature on it, but pressure-forceps will control it, and may be left on for a day or two. Deeper sources of arterial hæmorrhage, and that which comes from enlarged hæmorrhoidal or prostatic veins, must be dealt with by the plug, either the air-tampon of Buckston Browne fully introduced and moderately distended, or by long strips of dry lint pushed with a blunt instrument deeply all round the silver tube. The end of each piece is left hanging from the wound, and so placed and noted that, when the time comes for removing the plug, the last piece which was put in may be the first withdrawn. The wound, however, should be plugged with reluctance, it is always an evil; it offers some obstacle to the free escape of urine and serous discharge, leads to ecchymosis around the base of the bladder and in the pelvic cellular tissue, and presses, sometimes injuriously, on the neighbouring soft parts. Before resorting to it, ice may be applied to the perineum and cold water injected into the bladder, and the case watched for a short time. Should, however, the loss of blood continue actively, and particularly if it should recommence after an hour or two, when the patient is warm in bed with reaction fully established, and if it be accompanied by vesical tenesmus and the forcible expulsion of clots, the case must be resolutely dealt with at once. The patient should be brought to the edge of the bed in a good light, the tube removed and cleansed, the finger introduced into the bladder and coagula removed as far as possible; and then the tube is to be replaced and a fresh plug or tampon introduced. Secondary hæmorrhage is a much more serious danger; it may come on in three or four days from the softening of restraining clots, or in one or two weeks from the separation of sloughs. It sometimes occurs without pain or the knowledge of the patient; sometimes, it begins with a rigor and the expulsion of coagula, with straining. At first, ice-bags to the perineum and above the pubes, or the injection of cold water, may be tried; but if the bleeding recurs to a serious amount, the re-insertion of the tube and plug, thoroughly and firmly applied, is chiefly to be depended on. Happily, it is very rare to meet with a death from hæmorrhage, however near to it apparently the patient may be brought.

(2) Wound of the rectum may occur in various ways. Above the internal sphincter the ampulla of the bowel approaches very near to the membranous urethra, and it may easily be injured if the knife is not sufficiently lateralised while making the deeper incisions; or sloughing may follow the extraction of a large stone some time after the operation. In any case it will be right to do nothing for a time; nature is often competent to bring about a complete cure as the healing goes on. If not, the perineal wound may close and a recto-urethral fistula will remain, and, so remaining, a slight exchange of the fluid contents of either canal may take place with but little attending inconvenience. Should the perineal wound not heal, and there is a free communication with the bowel close above the sphincter, the latter should be divided; but this will seldom be required. Caustics or Paquelin's cautery carefully used will lead to contraction, and time will aid much.

The perineal wound may be slow to heal, either through injury done by the forcible extraction of a large stone, or through the feeble condition of the patient leading to the deposit of phosphatic matter on the entire surface of the wound. By degrees this coating comes away, but it sometimes happens that little cavities may be formed in or near the prostate, and so the complete and firm healing of the wound is delayed. It may even happen that some

particles of this phosphatic covering may pass into the bladder or remain in the prostate, and so give rise to future trouble and recurring stone. This condition of things should be carefully watched; frequent syringing through the wound with boracic or acidulated water early in the case will tend to obviate it, and remove the incrustation and prevent the consequences named. The insertion of probes coated with nitrate of silver or the wire cautery will expedite the healing of a clean sinus, but, here again, time and the restoration of the patient's strength are important aids to full recovery.

(3) Perforation of the bladder is an accident which can rarely happen. It may occur in a contracted bladder with a staff having too long a curve and too pointed an end, and especially if the surgeon, taking the staff in his left hand, pulls it somewhat towards himself as some surgeons do who use the gorget; the knife can never injure the bladder if its point is carefully kept within the groove. The accident is probably not suspected at the time, but rapid and overwhelming peritonitis quickly sets in, and the misfortune is only discovered at the autopsy.

The Causes of Death after Lithotomy are various—shock and exhaustion; suppression of urine and kidney disease; phlebitis and pyæmia; and extravasation of urine. The last was considered, by the older surgeons, to be by far the most frequent of the fatal effects of lithotomy. At the present time this is by no means admitted to be the case; it is probable that, with the advance of pathological knowledge, the causes of death which used to be attributed to infiltration of urine are now recognised to be due to other conditions. When it does occur it may be looked for about the third or fourth day or later; it is often insidious in its approach; there may or may not be a rigor, little or no pain, probably some tenderness of the lower abdomen; dry tongue, fever, anorexia, hiccup, exhaustion, and death. Sometimes it is accompanied by tympanitic distension and peritonitis, and sometimes, too, its progress is milder and the condition ends, not necessarily in death, but in pelvic abscess, which may find an escape through the wound or bowel, or be reached by incision of the abdominal wall. The treatment of these various conditions is not materially modified by their connection with lithotomy, and need not be specially described here.

Lithotomy in Children is modified by the anatomical conditions that the bladder is situated high in the pelvis, the prostate is wholly undeveloped, and the urethra very small; this last fact alone constitutes the chief difficulty and risk of failure. The incisions, although they will properly be made more freely in proportion than in the adult, must still be limited, and the attempt to pass the finger along the staff—which already fills the urethra—is fraught with the risk of separating the bladder from its anterior connections, pushing it back away from the staff, and failing to reach it altogether. In a young child, the least force used at this stage of the operation will end in this failure, and gorgets, dilators, and other contrivances have been designed to obviate the difficulty; but these instruments themselves require very careful handling, and have sometimes, in the hands of inexperienced operators, led to disaster. The writer has never used them, but has proceeded in one or other of the following ways:—The staff being exposed and the resistance to the finger recognised, the surgeon will consider the position, and, if he has the least doubt as to the sufficiency of his incision, he will again use the scalpel or a probe-ended bistoury and extend it, and again try his finger; should its passage be still resisted, he may introduce easily a pair of ordinary polypus-forceps along the groove, and dilate the neck of the bladder by opening the blades; he may even carefully seize and remove the stone with them, or, having stretched the parts open, he may introduce his finger and the lithotomy-forceps or scoop in the usual manner. Another method the writer has frequently adopted is this: when the staff is well exposed and the deep incision made, the tip of the left forefinger is placed on it, but no attempt is made to pass it into the bladder until the staff is withdrawn; then the finger is gently wormed along the empty urethra, dilating it as it goes. With an empty urethra and a proper incision, he has never met with any real obstacle to the passage of the finger; there is no other route open to it, and it is only a question of sufficient or insufficient room. But here, as always, the golden rule of avoiding undue force must be remembered, and, if resistance is met with, the staff should be reintroduced and the knife again applied. With this exception, the other steps in the operation in children are similar to and more easily carried out than in the adult. Urinary infiltration is so little to be dreaded in children that it is not necessary to use a tube; moreover, it is difficult to restrain the sudden movements of a child during

sleep or even when awake, and on this account a tube is objectionable.

Median Lithotomy is performed as follows:—The staff, of moderate size with a central wide groove, is held as in the lateral operation, with its handle inclined towards the umbilicus. The left forefinger is passed into the rectum, with its tip resting against the apex of the prostate. Keeping it steadily there as a guide to the membranous urethra, a long narrow bistoury, double-edged near its point, is passed, with its back towards the bowel, through the raphé of the perineum straight into the staff. Having reached the groove, and the handle of the staff being replaced in the perpendicular position and hooked well up against the arch of the pubes, the knife is pushed slightly towards the bladder so as just to nick the apex of the prostate; then a forward cut is made along the groove for nearly an inch, in order to divide the membranous urethra, and as the bistoury is removed a draw-cut upwards is carried through the central line of the perineum to the requisite extent. The operation is then completed as in lateral lithotomy. Some operators prefer to reach the staff by dissecting down to it; but the plan advocated above is simpler, and is perhaps less likely to wound either the bulb or the rectum.

The advantages of the median over the lateral operation are: the somewhat smaller amount of cutting, the rapid recovery in favourable cases, and the slight injury done to the neck of the bladder, but these advantages are only obtained when the stone is small; when it is large the difficulty of extraction is considerable, and laceration of tissue is unavoidable. The disadvantages are: the liability to wound the bowel, which lies in immediate and dangerous proximity to the wound; the frequent occurrence of troublesome bleeding, which can only be arrested by the tampon or the plug, and the general want of room and space for dealing with stones of some magnitude. It is true that the writer has removed a stone by this method which weighed nearly five ounces, but he believes that, with the lateral operation, the manipulation would have been easier and the recovery of the patient quicker. Some years ago, the surgeons of the Norwich Hospital gave median lithotomy a fair and extensive trial, the writer alone having had upwards of fifty cases, and the result was that he and his colleagues have all but relinquished it both for children and for adults. The advantages seemed to them to be on the whole less than the disadvantages, and the results were not more favourable than in the lateral operation, if so good. It is suitable only for small stones, and these, for the most part, are best dealt with by lithotrity.

Supra-pubic Lithotomy, since its first introduction by Peter Franco in 1541, has experienced many vicissitudes. In its first century it awakened great hopes of success, which, however, owing to repeated failures gradually faded away, and it fell into disrepute until about the beginning of the last century, when it was revived and adopted amongst others by Cheselden, who practised it with such success that surprise may be felt that he ever relinquished it. He was, however, induced to do so, not by any dissatisfaction with it, but by the hope of even greater success from the adoption and modification of the perineal operation of Raw. The lateral method, when it became stamped by the sanction and success of Cheselden, took its place firmly, and again the high operation became obsolete. During the last thirty years it has been practised some forty or fifty times in America, as may be seen in a good paper on the whole subject by Dulles in the *American Journal of Medical Sciences*, July 1875; but its success was not sufficient to recommend it to English surgeons, who have been content to adopt it, unwillingly, only in cases of unusually large stones.

In 1880, however, a fresh impulse was given by the improved method of operating suggested by Professor Petersen of Kiel. He noticed the effect of fully distending the rectum in causing the bladder to project above the pubes, so as to bring it within easy reach and to remove the anterior fold of the peritoneum well above the risk of injury by an incision. This indeed was fully demonstrated by Dr. Garson in a paper published in the *Edin. Med. Journ.* for October 1878. He distended the rectum by introducing a rubber bag and filling it with water. The bladder having been also distended, the body was frozen, and a vertical section of the pelvis made and accurate observations and measurements taken. These observations made by Garson, when under Professor Braune of Leipsic, may be said to have laid the foundation of the present mode of conducting the high operation.

Operation.—The patient rests on his back near the end of the table, with the knees elevated and separated. The surgeon first introduces a catheter, washes out the bladder with boracic water, and fills it slowly and carefully with the same as full as it can easily bear. The catheter is with-

drawn and the water retained by a ligature on the penis. The india-rubber bottle is next introduced into the rectum. This bottle is made of thin rubber; it is pear-shaped, with a long tube at one end through which to fill it. It is introduced empty by folding it longitudinally and dipping it into carbolic oil. Warm water is slowly injected by a common enema syringe through the long tube. The water is contained in a pint-glass graduated measure, so that the exact quantity used can be watched; this is a matter of some moment, for, if an excessive quantity be introduced, there will be risk of rupturing the coats of the rectum. Petersen says as much as 21 oz. (avoir.) may be used; but this would probably be seldom required, and from 12 to 16 oz. will be found sufficient. The writer in one case used 18 oz., and it was noticed that when, after the stone had been removed, the bag was emptied and withdrawn, a teaspoonful of blood escaped. The patient died of kidney disease and suppression of urine, and it was found, on post-mortem examination, that the mucous membrane, and even the circular muscular fibres, of the bowel had been ruptured at the upper or bladder side, and that there was some ecchymosis and sloughy tissue around the injured part.

The patient's legs are now lowered, and an incision about three inches long is made in the median line, the lower end of which comes well over the upper border of the symphysis pubis. The operator works his way between the recti and pyramidales muscles, nicking them on each side if necessary, until he comes to the loose fat which covers the bladder wall; this is scratched through by the finger-nail or handle of the knife. The peritoneum will probably not be seen, for the fold of it will be an inch or two above the knife. The bladder being exposed, a tenaculum or hook is used to steady it, and the knife is dipped into it on a level with the upper border of the pubes, and the wound is extended a little upwards and downwards. The water immediately gushes out, and the stone is felt with the finger close at hand. In some cases, when it is small, it can be removed with the finger alone or aided by a scoop; but with large stones, for which alone English surgeons are likely to resort to the high operation, forceps of adequate size must be used. The edges of the bladder-wound may require to be held up and steadied by delicate hooks, during this manipulation. Extraction should be slow, and very little force used, for it is better to extend the incision upwards rather than bruise the wound by over-stretching. The wall of the bladder is apt to bleed rather freely, but it soon ceases, and any little vessel may be secured by ligature if necessary. A full-sized, long drainage-tube is passed fully into the bladder, and secured by a thread to the margin of the external wound. The upper part of the bladder wound is closed by two or three fine catgut or silk sutures: the upper part of the external wound, too, may be closed, the lower part being left open for the escape of blood or other fluid. Oiled lint and absorbent bags are secured around the tube, and the patient is placed in bed on his side, with the free end of the tube in a basin by the side of the bed. When this position becomes irksome, he may turn on the other side, care being taken that the tube is properly placed and the dressings not disturbed.

Some surgeons recommend that, in addition to the tube, a catheter should be retained in the bladder through the urethra; others that no tube should be used, but the aperture in the bladder wholly closed and the bladder drained, either by a catheter tied in, or by a tube introduced through a perineal opening. On this point, and in several details of the operation, further experience is wanted for trustworthy guidance. So also, it is too early to speak of results. Petersen, and Guyon of Paris, have had fair success, but the number of cases is at present too small to admit of comparison with lateral lithotomy. The chief danger to be apprehended is from extravasation of urine behind the pubes, in the loose cellulo-adipose tissue around the bladder. Peritonitis, which used to be the too frequent result of the high operation, was due to direct wound of the peritoneum; now, however, this can scarcely happen, and peritonitis will only occur as a secondary consequence of urinary extravasation. From shock, from hæmorrhage, from possible impotence, from wounds of the rectum and perineal fistula, which are the occasional results of perineal lithotomy, the supra-pubic method will be free. The operation is easy to do, and unless it turns out to have a heavy mortality, it is almost certain to take a high place in professional esteem, and to supplant all other methods for the removal of large stones.

Lithotomy in the Female, whether adult or child, is still surrounded by several undecided questions. Stones, of small or even of moderate size, may safely be removed by dilating the urethra with the three-branched screw instrument so as to admit one or two fingers; this is followed by small lithotomy-forceps, and the stone is slowly extracted. Some laceration of the

mucous membrane of the urethra is almost sure to occur, but the result of this proceeding is most satisfactory; the patient will experience no incontinence of urine or other ill-effect, and will probably be convalescent in a few days. But when the stone is of considerable magnitude, the surgeon has a choice of several methods of removal. He may adopt lithotrity with immediate removal of fragments by Bigelow's plan, if the stone is not larger than a strong ordinary lithotrite can deal with, say up to an ounce and a half or two ounces. In favour of this proceeding is the fact, that the largest evacuating tube may be readily used with a little dilatation. Or the stone may be broken and removed piecemeal by small forceps: or he may make an incision upwards laterally on a grooved staff, dilate the neck of the bladder with his finger, and extract the stone entire.

Should the stone be still larger, say three ounces or more, the choice will lie between vaginal and supra-pubic incision. The former is certainly to be preferred to any plan of cutting the urethra, whether upwards or laterally, and dragging the stone through that passage; such a proceeding would almost certainly, with a stone of considerable size, lead to permanent incontinence and future misery; but it must be admitted that a vaginal incision, combined with the force necessary to extract a large stone, may lead either to permanent vesico-vaginal fistula or to the necessity of repeated operations for its closure. The supra-pubic operation conducted after Petersen's method offers the most tempting inducement; it is not difficult of execution, it entails no liability to incontinence, and the free drainage of the bladder by the urethra is easy. The one cause for hesitation is the possible risk to life from peritonitis or urinary infiltration which this operation may entail, and this risk there are, at present, no means of accurately estimating. Experience alone can decide the question. In children, however, when the stone is full-sized, the supra-pubic operation should surely be preferred; the small and undeveloped urethra and vagina, the abdominal position of the bladder in the young, and the comparative immunity of children from urinary infiltration, are considerations which may well lead to its adoption.

It should be borne in mind that, in young women, the presence of stone in the bladder is generally due to incrustation on some foreign body introduced by the patient, and this may produce some difficulty in, and require some special method for, its removal. Another point connected with stone in the female may be mentioned—viz. the spontaneous expulsion of even large calculi from the bladder. This has been quoted to prove how dilatable the urethra must be (*see* paper by Bryant, *Medico-Chir. Trans.*, vol. xlvii. p. 151). In the Norwich Hospital Museum is a large stone which dropped from a woman without any operation or effort on her part: it weighed six ounces. There is no history of the case, but there is reason to believe that in this, and in some of the instances given by Mr. Bryant, there was first a prolapse of the vesical wall into the vagina, then the continued straining efforts of the bladder increased the prolapse, and that, finally, ulceration and liberation of the stone took place. The writer saw one such case many years ago, in which a full-sized stone had caused such a falling of the bladder and upper wall of the vagina that it presented as a round mass at the os externum, and had been mistaken for prolapsus uteri.

The Results of Lithotomy may and should be regarded from two points of view—1, the mortality; 2, the tendency to recurrence of stone.

(1) *Mortality after Lithotomy.* — The value of mere statistics is small, but they may justify approximate estimates on some points which will serve for guidance in practice. Those of the Norwich Hospital only will be used, partly because they consist of a compact body of cases of large number and done on some uniform system; and also because there exists in the hospital museum, not only a record of the chief facts of every case of lithotomy and lithotrity from the commencement of the hospital up to the end of 1884, just a hundred years, but the calculi also are there, cut and labelled, and well displayed to prove the accuracy of the record.

The whole number of operations amounts to 1,245. Of these, 1,124 were by lithotomy and 121 by lithotrity.

Of the 1,124 lithotomy cases, 1,074 were males and 50 were females.

Of the 1,074 males, 927 recovered and 147 died, being about 1 in $7\frac{1}{4}$, or $13\frac{1}{2}$ per cent. Of the 50 females, 46 recovered and 4 died, being about 1 in 12, or 8 per cent.

Age, of course, influenced greatly the results. Thus, there were 513 cases under twenty, of which 475 recovered and 38 died, being about 1 in 14, or 8 per cent.; and 562

were over twenty, of which 456 recovered and 106 died, being 1 in 5·3, or about 19 per cent.

Of the adult males it may be further said, there were 465 over forty, of whom 349 recovered and 116 died, being 1 in 4, or 25 per cent.; while there were 169 over fifty, of whom 123 recovered and 46 died, being 1 in 3·67, or 27·4 per cent.

Weight of stone, again, affected results; thus, there were 794 cases in which the weight was 1 oz. and under, of which 723 recovered and 71 died, being 1 in 11·2, or 9 per cent.; of 1 oz. to 2 oz., 193, of which 159 recovered and 34 died, being 1 in 5·6, or 17·6 per cent.; of 2 oz. to 3 oz., 55, of which 35 recovered and 20 died; of 3 oz. to 4 oz., 14, of which 5 recovered and 9 died; of 4 oz. to 5 oz., 9, of which 6 recovered and 3 died; of 5 oz. to 6 oz., 3, of which 1 recovered and 2 died; of 6 oz. to 7 oz., 2, of which both died; of 7 oz. to 8 oz., 2, of which 1 recovered and 1 died.

Of the 151 fatal cases, males and females, the average age was forty-six, and the average weight of stone 840 grains. Of the 151 cases, 38 were under twenty, with an average weight of stone of 424 grains, and 113 were over twenty, with an average weight of stone of 1,122 grains, or 2½ oz.

(2) *Recurrence of Stone after Lithotomy* is comparatively rare. During the century of work at the Norwich Hospital, and out of about 1,030 individuals who were cut, only 40 were operated on a second time, and 5 a third time. It may be said that 150 of this number died, and could not, therefore, have had recurrence, and that many who had once experienced the agony of lithotomy would not have had courage enough to face it again; this would, however, only apply to pre-anæsthetic times, whereas since the use of ether recurrence is still rare. The causes of recurrence are (1) the descent of a fresh renal stone, and (2) the leaving of stones or fragments of stones at the first operation. A careful examination in the museum shows that, of the 45 individuals who had recurrence, in 21 the stone was broken at the operation, and in 14 there were multiple stones; and, further, that the interval between the first and second operation was far less in these 35 cases of multiple or broken stone than in the other 10 cases, where only one unbroken stone was removed. The inference is strong, almost amounting to proof, that, in a large majority of instances, recurrence of stone after lithotomy is due to stones or portions of stone having been left at the first operation.

WILLIAM CADGE.

LITHOTRITY.—Since the first introduction of lithotrity sixty years ago, its progress and development have been steady and continuous. Civiale and Leroy-d'Etiolles in France, and Brodie in England, were mainly instrumental in establishing it as the proper rule of practice for stones of moderate size. Brodie's article in the *Medico-Chirurgical Trans.*, vol. xxxviii., is a model of lucid treatment of the whole subject; in it he reports the results of upwards of a hundred cases, setting forth with admirable candour his failures even more prominently than his successes; indeed, his clear exposition has left but little for his followers to do, except in the way of slight modifications of instruments and details of procedure. In both these particulars, however, improvement has gone on, and it has been illustrated in the work and writings of the Coulsons, and especially of Sir H. Thompson, whose name and fame are bound up with recent lithotrity. Five years ago it seemed as if, both as to its principles and method, the operation might be considered almost perfect; but in 1878 Professor Bigelow, of Harvard University, recognising the importance of the full dilatability of the urethra as demonstrated by Otis, and recognising, too, the value of Sir P. Crampton's and Clover's plans of extracting calculous débris from the bladder by suction, applied these observations to lithotrity, with the result that in his hands the operation has taken a new departure, based on principles wholly different from those which all surgeons up to that time had advised and adopted.

Thus, the old rules of practice were: repeated short sittings, the smallest possible use of instruments, and leaving the extrusion of débris as much as practicable to nature. Bigelow, on the other hand, maintains that the bladder is less hurt by the prolonged use of smooth metallic instruments than by the presence of sharp, angular fragments of stone; he therefore removes the entire calculus at one long sitting, even of one, two, or three hours' duration, if necessary, by suction through a large evacuating tube. He, aided by Otis, Keyes, Van Buren, and others in the United States, has proved the value and correctness of these principles by successful practice; he has demonstrated the method of operating in Europe, and after a short period of hesitating and somewhat reluctant assent, the plan has been almost universally adopted, and the old mode by repeated sittings is becoming obsolete. 'Litholapaxy,' as the new method is termed, has been applied to larger

and larger stones, and its capability in this direction is not yet determined.

The instruments required are: (1) lithotrites of various sizes; (2) evacuating tubes; (3) an aspirator. Lithotrites are of two kinds, fenestrated and non-fenestrated. The female blade of the former should be somewhat flattened, and the prehensile surface slightly grooved or roughened, so as to hold the stone when seized. The male blade should be serrated and fit accurately. In the non-fenestrated instrument the female blade should also have its edges roughened, and there should be an opening in it for the lower half of its length, into which a projection on the male blade will fit. The object of this is to diminish the risk of over-impaction, but it will not prevent it altogether, for the upper half of the female blade may be over-packed with débris, and there are no means of freeing that part. Still, it is at the heel or junction of the blade and shaft that impaction is most likely to occur, and the larger opening mentioned will to a certain extent prevent it. The male blade should be serrated, wedge-shaped, and of less width than the female blade, so that the mucous membrane may not be easily caught. The handles of all lithotrites should be cylindrical or hexagonal in shape, with a sliding button to put the screw into immediate action. Sometimes the screw will not easily adapt itself, but will catch on the edge of the worm; this, however, is obviated by giving a slight turn to the ring on the male blade, when the screw will slip home and adapt itself instantly.

The evacuating catheters or tubes are slightly curved or straight: the curved are easiest to introduce, the straight are the best evacuators. Bigelow prefers the straight ones, and Otis has suggested that the extreme end beyond the aperture should be slightly turned up, so as to facilitate its passage. These tubes are usually made in three sizes, equal to 14, 16, and 18 English scale. Each should be fitted with a gum-elastic bougie, which passes the whole length of the tube and partially fills up the lower aperture, thus rendering its journey to the bladder easier, and serving also to clear it of impacted fragments when necessary. Aspirators, made of stout india-rubber, are of various shapes; they all have a funnel and stopcock at the top. Some have a glass trap or receiver at the lower end, into which the fragments fall, and the evacuating tube fits into the centre of the bottle; in others, the glass receiver is separate from the bottle and intermediately placed between it and the evacuator. The latter is provided with a hanging wire valve, which is necessary to prevent the regurgitation of débris into the bladder. The evacuator is connected with the receiver or aspirator by a short tube fitted with a stopcock, or simply by a piece of rubber tube three or four inches long, which has the advantage, by its flexibility, of preventing any disturbance of the catheter in the bladder by slight movements of the aspirator. Bigelow has contrived a frame to sustain the apparatus and stand on the bed, and Otis has lately introduced an aspirator, by which the water is forced into the bladder by air-pressure from a separate rubber bottle. It is probable that, as time goes on, other modifications and improvements will be made; at present none of the aspirators are perfect.

Before proceeding to the operation, it is important to ascertain, as far as possible, that the patient is in the most favourable condition; that by rest and careful preparation the whole urinary tract and organs are in a quiet and satisfactory state. It is not necessary or desirable to accustom the urethra to the repeated passage of instruments. A clear estimate of the size and nature of the stone and of the prostate will have been ascertained by the sound, or possibly by the lithotrite. Also, the surgeon will have informed himself of the kind of bladder he has to deal with, as to its irritability, its capacity, its shape, hardness, or roughness, and any feature of peculiarity about it. It is not necessary at the time of operation to inject water into the bladder, as used to be done; but it is well that there should be some urine in it, say the secretion of an hour or two, or as much as can comfortably be borne. The patient should lie on a firm mattress with a cushion beneath the buttocks, and the head low; the knees slightly raised, well separated, and each leg steadied by a nurse or assistant; the chest, body, and limbs should be well covered with blankets, so as to prevent exposure to chill during a proceeding which may be long. An anæsthetic is absolutely necessary in one-sitting lithotrity: in all cases it facilitates the use and manipulation of instruments, and especially in the deliberate and careful search for final fragments.

Operation.—The surgeon, standing on the patient's right side so close that he has not to reach or stoop much, and with his instruments within easy reach, insinuates the lithotrite along the urethra; it matters little how this is done, so far as the penile portion is concerned. Generally the instrument should be parallel with one groin or the abdomen; but when the triangular liga-

ment is reached the hand must be raised to the perpendicular, and the point of the blades coaxed through this part by a manœuvre, difficult to describe in words and not always easy to execute. If any hesitation should occur, no force is to be applied, and it is useless to lower the handle prematurely as if the prostate had been reached; rather, the hand should be dropped towards the abdomen, and fresh gentle attempts made, varying the direction slightly. When this point is passed, the handle is gradually lowered towards the bed, and the instrument will slip on into the bladder almost by its own weight. If the prostate is enlarged, some little pressure and a very slight rotatory movement of the lithotrite may be required to carry it on, and the handle still further lowered so as to lift the blades over any obstacle at the vesical orifice.

When fairly in the bladder, the handle of the lithotrite should be somewhat raised, and the blades made to depress slightly the lower and back part of the bladder, and opened fully. By this simple manœuvre the stone will generally fall towards the instrument, and will be caught when the male blade is pushed down, care being taken not to raise the female blade out of its position. If the stone be not seized, the instrument may be turned to one or other side, or it may be wholly reversed and the stone picked out from behind the prostate. In doing this, care is required to avoid pinching the mucous membrane, and the closing of the blades should be slow and gentle. It is not always easy to distinguish between a piece of soft stone, enveloped in concrete mucus, and the lining membrane of the bladder. In this and in any case, before applying pressure either with the hand or screw, the blades with the stone should be turned up into the centre of the bladder. When once the stone is fairly seized and broken, the operator will have little difficulty in rapidly picking up pieces, and he should endeavour to attack the larger ones so as in a short time to produce good fragmentation.

This being done, the evacuating tube is substituted for the lithotrite, the same precautions in its introduction being required as for the lithotrite. If the stone is of small or moderate size, No. 14 or 16 tube will suffice, but if it be large, No. 18 possesses great advantages in the rapidity of removing débris. It is not necessary at each pressure of the aspirator to introduce much water; short and quick strokes give the best results. If the rubber bottle will not expand readily, a fragment of stone or clot of blood is probably impacted, and may be returned to the bladder by a sharp pressure of the bottle, or, if necessary, by disconnecting it, and freeing the tube by the gum-elastic plug. Sometimes, while the aspirator is extracting the water, the bladder may be felt to strike the end of the catheter with a vibratile thud. This should not be; it is a sign that the bladder is too empty; it is apt to be injured in its lining membrane, and it interferes with the free escape of detritus. It is easy to introduce a little more water, and then proceed. Care should be taken, when the instruments are changed, to leave four or five ounces of water, and not to use the lithotrite in an empty bladder. The thud, just mentioned, will easily be distinguished from the sharp click of fragments of stone, as they are drawn against the opening in the catheter by the out-rushing stream; this sound will cease as the fragments diminish. When débris cease to fall into the trap, the lithotrite is again used, the fragments reduced in size and evacuated as before, and so on alternately until no more stone can be felt or obtained.

In all these proceedings gentleness and care are necessary; the operator will change his lithotrites from a large and fenestrated one at first to a smaller and non-fenestrated one as the stone diminishes in bulk. The former never clogs; the latter pulverises fragments best, and renders their extraction easy and swift. Should the orifice of the urethra be too small to admit the evacuating tube which the size of the stone renders it proper to use, say 16 or 18, it may rightly be divided by a straight, narrow probe-ended knife for about half an inch alongside the preputial frænum. No other part of the urethra will oppose its passage, unless the prostate is awkwardly enlarged, and this will seldom obstruct it. It is desirable to remove the last fragment; and every experienced lithotritist knows how difficult this may be, for, after operating for some little time, these final small pieces are prone to get hidden in the recesses of the bladder, or to be enveloped in small clots of blood or thick mucus, and so escape detection. It is not right, however, to persevere or prolong the manipulation too much in searching for them. They will probably be expelled in a day or two, or they can easily be removed at a second sitting. So, too, although this method is called 'one sitting,' circumstances connected with the general condition of the patient or the state of the bladder may oblige the surgeon, however unwilling he may be, to desist and divide the treatment into two or more sittings.

At the termination of the operation the patient is warmly covered; hot dry flannels are applied to the perineum and above the pubes, and a morphia suppository placed in the rectum. Warm diluent drinks, such as barley-water or lemonade, are freely supplied, and a milk diet prescribed for a few days. Many patients are almost well at once and have no after-trouble whatever; others experience cystitis, more or less acute, and some require the catheter for a time to deal with retention. If much mucopurulent secretion accompanies this condition, or is present without retention and does not speedily abate, the bladder should be carefully washed out twice a day, or oftener, with warm boracic water or a weak solution of nitrate of silver. The strength of this solution will vary with each case; it is well to begin with a grain to three ounces of distilled water, but not infrequently as much as four to six grains to the ounce is beneficial. Rigors are proverbially common in all bladder cases requiring the use of instruments; frequently they simply mean a slight nervous shock, are evanescent, and do no harm. Sometimes they usher in cystitis; sometimes, too, they are the forerunners of grave, continued, and even fatal nephritis. Not infrequently, however, kidney-inflammation comes on without rigor, pain, or any bladder-complication. The patient becomes mildly febrile, complains of no pain, but he loses appetite and strength, fades away, and dies in the course of two or three weeks. The necropsy reveals pyelitis, dilated ureters, and hyperæmia, with or without scattered abscesses of the kidney.

Another complication, usually fatal, but happily rare after lithotrity, is suppression of urine. This may be looked for when the patient is known to have been subject to ordinary albuminuria; also in cases of chronic kidney-disease, the result of slow and slight inflammatory conditions. These cases are very difficult to diagnose beforehand. The urine probably contains no blood, albumen, or casts; there is no anæmia, and the patient looks, probably, in fair health. Suspicion may, however, be entertained if there be a large secretion of limpid urine, non-albuminous, but of low specific gravity. Should death from suppression occur after lithotrity or lithotomy, the necropsy may display no hyperæmia, but simply a contracted kidney, with atrophy of the tubular and cortical structure, or possibly a dilated pelvis, but still with wasting of the secreting tissue. Calculus in the kidney not very infrequently coexists with stone in the bladder; its presence would be suspected if there were persistent aching over one kidney, but as often as not there are no diagnostic signs, and its presence is only revealed after death, when it has led to some of the fatal symptoms above described.

Treatment has but little control over these formidable renal complications, when they arise after lithotrity. The prompt removal of all remains of stone, frequent washing of the bladder with antiseptic fluids if there be fœtid urine and mucopurulent deposit, perfect rest, good sustaining diet, rubefacient applications to the loins, quinine, and moderate use of opium in some form if absolutely requisite: these means may sometimes ward off the worst symptoms, and facilitate recovery.

The Old Method of Lithotrity may still be preferred in certain cases; it requires perhaps less skill than the new, and the young surgeon may therefore be well justified in preferring it. In ordinary cases there is but little difference in the results. Even in the most experienced hands, the mortality of the one-sitting method would appear to be only one to two per cent. less than the old method, and in inexperienced hands it would very likely be greater. The old plan is gentler, milder, less formidable altogether; no anæsthetic probably is required, no extra assistance; the surgeon calls by himself and makes a short sitting, just as much as the patient is willing to bear, or it may be that the patient even calls on the surgeon when only a fragment or two have to be dealt with. A nervous, timid patient may prefer this to the more heroic and rougher, if more expeditious, proceeding. The writer, although fully admitting the many advantages of the new operation for the large majority of cases, has yet allowed himself to follow the old lines occasionally, and he is not dissatisfied with the result.

The first sitting should be conducted with great care, the stone being taken up and broken only four or five times. The patient should remain in bed for at least a day or two, during which time he will void water while recumbent. Some little cystitis will probably ensue, but frequently the sharp pains of stone abate at once and before any of it is passed. In a few days the sitting will be repeated, and the surgeon will soon form an opinion as to how much instrumentation his patient can bear. If the expelling power of the bladder be deficient, or the prostate be enlarged, in all probability the passage of débris will be slow, and

only the finest will escape. Under these circumstances, its removal should be secured either by the repeated use of the non-fenestrated lithotrite, sometimes six or eight, or even ten times, in as many minutes, at each sitting, by which a large quantity is soon withdrawn; or by the application of the evacuating catheter and aspirator at once. The number of sittings required will vary according to the size of the stone, and the facility and rapidity with which the fragments are voided. From three to six is the average; but the writer observes in his list of cases one of seventeen sittings for 360 grains, and another of twenty sittings for 384 grains of dried débris. Both these cases, however, would now undoubtedly be treated by the new method. The last fragment is still the difficulty, and it should be the surgeon's most anxious care, by searching and re-searching, with sound, or lithotrite, or evacuator, to secure its removal; he will narrowly watch the patient's sensations, and if any, the least, of the old feeling at the glans penis or at the prostate should persist, he will not allow him to return home so long as a doubt exists.

The after-treatment is the same in both kinds of operation, but this may be added. Sitting should follow sitting without unnecessary delay, probably within three or four days. After the first crushing, however, should mild cystitis occur, a few days or a week of rest and treatment may elapse; but if the condition shows a tendency to run on, especially if it be associated with fetid urine and febrile persistence, the sitting should be promptly repeated, and if possible the entire stone removed at once by the evacuator. Should the use of the lithotrite at or after the first sitting prove to be very difficult or ineffective, and the vesical tenesmus and constitutional disturbance very severe and unsafe, the surgeon will be justified in at once clearing the bladder and putting it at rest by lithotomy. The writer has never yet thought it necessary to adopt this alternative, but he is inclined to admit, on reflection, that, in a few cases, the patients might possibly have been saved by its timely performance.

Foreign bodies have occasionally to be removed from the bladder; they are of great variety, and may require either lithotomy or lithotrity. *See* Foreign Bodies in the Bladder.

The Obstacles met with in lithotrity may be due (1) to the size and nature of the stone; (2) to stricture of the urethra; (3) to enlarged prostate; (4) to atony of the bladder; (5) to sacculation of and other changes in the bladder.

(1) The mere weight and bulk of stone are no test of the difficulty of crushing. A stone weighing an ounce, composed of pure lithic acid, will, from its intense hardness, test the quality of the instrument and the strength of wrist more than one of double the weight, composed of phosphates or some of the salts of uric acid. The writer has sometimes trembled for his instruments when dealing with these pure red lithic stones; they break into sharp, angular pieces, very different from the laminated, smaller, fawn-coloured, and often multiple stones, composed of lithate of ammonia, which are, perhaps, in Norfolk at all events, the most common variety after the pure lithic. The oxalate of lime stone is also very hard, but it breaks into less angular pieces than the lithic. Litholapaxy, however, has accomplished the removal of lithic acid and oxalate of lime stones of two and even three ounces and upwards, and it may perhaps be said that, given a healthy bladder and prostate, a capacious urethra, and an experienced hand, the only limit as to size of stone is the power of the lithotrite.

(2) Stricture of the urethra, if slight and capable of full dilatation, need be no bar to lithotrity for stones of moderate dimensions; but in old stricture, with great surrounding induration and fistulæ, lithotomy will obtain the surest and most permanent cure. Sometimes a stone is detected in the urethra behind the stricture, as well as one or more in the bladder, or it may be partly in the bladder and partly in the urethra, and in these cases median lithotomy will not only remove the stone, but may go far to remedy the stricture by external division.

(3) Hypertrophy of the prostate gland is not necessarily a serious impediment to lithotrity; but, if it is considerable, it may impede the easy introduction of instruments, make the seizure of the stone difficult, the expulsion of débris slow and tedious, and in the one-sitting method obstruct the free and efficient action of the evacuator. Prostatic enlargement, also, leads to alterations in the shape and condition of the bladder, which deserve more attention with reference to lithotrity than they have hitherto received. Coming on as it usually does about or after the age of sixty, when the vital power begins to wane, it induces, by the obstacle it offers to the free escape of urine, dilatation and hypertrophy of the muscular walls of the bladder, and leads to imperfect contraction, residual urine, and,

worse than all, to sacculation of the mucous membrane in all its degrees. Enlargement of the median lobe, when it is considerable, projects backwards into the cavity of the bladder in such a manner as to form pouches or cornua on each side of it, and even below it, into which portions of stone may and do get, and where it is almost impossible for any instrument to follow and seize, or even detect them. Injections will not always wash them out of these recesses, especially when they are immersed in viscid adhesive mucus or blood-clot; they are probably overlooked, and may account for some of those numerous recurrences of stone which lithotritists have to lament.

(4) Atony of the bladder, from whatever cause, is a serious drawback to lithotrity, chiefly because, as the natural expulsive power is lost, the surgeon must trust to his instruments to remove the final, minute atoms of stone; and this is a matter of no small difficulty in flabby, reticulated, and irregularly-shaped bladders.

(5) Sacculation of the bladder is also an enemy to complete and permanent cure by lithotrity. The formation of these sacculi, from the slight honeycomb recesses between the hypertrophied columns to the complete sac, in which the mucous membrane is forced gradually between and through the muscular fibres and may equal the bladder in size, is well understood. The aperture of communication with these complete sacs is usually closed by the contraction of the muscular columns, so that a stone may be broken and none of the fragments may enter them; but, on the other hand, débris does sometimes find its way into them or one of them. The surgeon is unaware of it, and the patient, being relieved of nearly all his suffering, is probably declared to be cured. But trouble is in store for him: gradually an encysted stone is formed; it enlarges and grows up into the bladder; pain and cystitis return, and all the surgeon can do is, from time to time to break off and remove the projecting portion; or he may do lithotomy, with the slight hope of being able to dislodge the whole stone from its bed. Sacculation, too, may lead to another serious danger in lithotrity—viz. to peritonitis. In two fatal cases, the writer found after death acute peritonitis, apparently originating in large sacs, the walls of which consisted of mucous membrane only covered by peritoneum, and were in a sloughy condition; the inflammation was probably due to decomposing urine imprisoned in the sacs; the fœtid character of the urine was perhaps increased by the slight cystitis set up by the operation. In all cases of sacculation and stone, it is certain that the danger now pointed out would be diminished by the prompt and immediate removal of all the débris, and this constitutes another advantage of the one-sitting method.

The Dangers of Lithotrity are—(1) bleeding; (2) clogging of the lithotrite; (3) impaction of fragments in the urethra; (4) rupture of the bladder or urethra; (5) cystitis and nephritis.

(1) Bleeding is seldom a cause of trouble, but in a few recorded cases the bladder has become filled with clot and unable to relieve itself, and the patient has been brought into danger by both local and constitutional symptoms of a serious kind. In such a condition two courses are open for adoption—either to draw off the urine as it is secreted, by the frequent use of a full-sized catheter with a large eye, soothing the part and system, and leaving the clot to soften and come away by degrees; or the clot may be sucked out of the bladder by a strong syringe and a large catheter, alternately washing and exhausting until all is removed. The first method is generally preferable, but in either case troublesome cystitis is apt to follow.

(2) Extreme impaction of the lithotrite with débris can only occur with the non-fenestrated instrument; when it does happen, the operator should endeavour, by opening and closing the blades, and moving them about in the urine, to free them to some extent. Then he will try to withdraw the lithotrite: it will probably pass along the prostatic and membranous urethra, but it may be arrested either just behind or in front of the scrotum, and if by fair traction force it will not come away, it will be right to cut down on it in the perineum, turn out the blades and unload them, and then withdraw the instrument. If the opening in the urethra is far down in the perineum, it would be good practice to slip the finger back into the bladder, dilating the passage as it goes, and clear out all the stone as in a median lithotomy; or, if this is not done, a full-sized catheter should be introduced and retained in or near the bladder for a time, so that no fragments may pass until the wound is more or less closed, and if possible no urine should be allowed to irritate it. This accident has only once occurred to the writer, with one of Charrière's instruments. It was withdrawn with some force, causing slight laceration of the mucous membrane; swelling followed, fragments of stone accumulated at the part injured, and led to a sloughy abscess, which

was opened, and allowed all the stone to escape. The patient recovered, but a permanent fistula, close in front of the scrotum, remained. Even when the instrument is not over full, it is apt to scratch the urethral membrane with sharp fragments which project from the blades; it is seldom that this causes harm, but it is to be borne in mind as one of the disadvantages of the non-fenestrated lithotrite.

(3) Rupture of the bladder or urethra has undoubtedly occurred since the introduction of litholapaxy—of the bladder, presumably, by sudden over-distension, or by the point of the evacuating catheter; of the urethra, by the rough use of too large an instrument. Peritonitis in the one case, and urinary extravasation in the other, will befall the patient, and discredit will come upon the surgeon. It may be expected, however, that these mishaps will not be repeated now that the novelty of the operation has passed by.

(4) Arrest of fragments in the urethra occasionally occurs, and may produce total or partial retention of urine, pain, spasm, and distress. Very often, the natural efforts and pressure of the urine will accomplish the removal of the obstacle in a short time; if they do not, and the fragment is far back, it should be pushed into the bladder by a large catheter, open at the end so that it may better engage and hold the offending piece. When arrested nearer the meatus, it should be seized and withdrawn by long slender forceps or Civiale's urethral lithotrite. It is very seldom, indeed, that a fragment will require to be removed by external incision, but this may be called for.

(5) Ordinary cystitis and nephritis have been referred to already in describing the after-treatment; but there is a form of persistent chronic cystitis, accompanied with vesical irritability, decomposing urine, and phosphatic deposit, which all lithotritists admit to be not infrequently the sequence or consequence of the operation. It generally occurs in old and feeble persons in whom the prostate is hypertrophied, the bladder dilated and unable to empty itself, and therefore unable to expel all the débris of a broken stone. Hence, although by clearing out the main bulk of the stone the patient is greatly improved, some few atoms probably elude detection, and these, acting as nuclei, form the basis of future phosphatic concretions, and in a few months, or perhaps a year or two, the patient presents himself again and is again more or less cured. Sometimes the bladder, at this second intervention of the surgeon, is entirely freed of calculous matter, and by the careful use of the catheter and diligent washing out of the bladder no further recurrence takes place; but this happy result is rather the exception than the rule, and the surgeon must either go on repeatedly removing phosphatic matter with the lithotrite, or he must do lithotomy with the hope—the somewhat forlorn hope—that by entire clearance of stone, and by drainage and repose of the bladder for a time, a permanent cure may result. Some surgeons attribute this persistent chronic cystitis to the rough use of instruments, or to some inherent tendency to phosphatic deposit; but the writer believes that, in the great majority of such cases, it is due to leaving some trifling piece of stone undetected. The difficulty of finding and removing the last atom in some bladders has been alluded to. The hope has been expressed that by the aspirator and the large evacuating tube of the new method this may be more certainly accomplished than by the old method; but at present it is only a hope, and it is yet to be proved that recurrence of stone is less frequent now than it used to be. Stones of purely bladder origin and formation are rarely met with. In ordinary cases of atony and chronic cystitis, with decomposing urine loaded with muco-purulent deposit, stone will seldom occur unless there is a nucleus of some kind; and, when stone does occur in these cases, it will be found that they are almost always of renal origin, although the bulk of the stone may probably be composed of phosphates.

The Results of Lithotrity may, like those of lithotomy, be considered—(1) as to the mortality; (2) as to recurrence.

Taking again the experience of the Norwich Hospital, there have been 121 cases in 117 individuals with 13 deaths, being 1 in about 9½, or 10·7 per cent. The average age was just sixty, the average weight of stone preserved was 110 grains. In the 13 fatal cases the average weight of stone was 209 grains, showing that, as in lithotomy, the mortality increased with the increasing size of the stone.

The list of lithotrity cases recently reported by Sir H. Thompson affords, both from the large number and the brilliant success obtained, the best evidence of what lithotrity can achieve. He enumerates 672 cases in 576 adult males with 43 deaths, being 1 in 15½, or about 6 per cent. The average age was sixty; the weight of stone is not given, and this diminishes the interest and value of the record. He mentions, however, having crushed 100 stones

which were so small as to produce only slight symptoms, and of which cases only one was fatal. In a valuable paper read by Sir H. Thompson at the International Medical Congress in 1881, he gives the weight of 75 cases done by Bigelow's method, the average being 130 grains, and in others the stone is described as 'small.'

Dr. Freyer, of the Indian Civil Service, has recently published (*Lancet*, February 28, 1885) a remarkable series of 108 cases in males above puberty, done by litholapaxy, with only 4 deaths, being 1 in 27 only, or 3·7 per cent.; the average age of the patients was forty-seven, and the average weight of stone 317 grains. Thus there were more young and probably healthy, and fewer old and probably unhealthy, persons than English lithotritists are accustomed to meet with; but the average size and weight of stones in Dr. Freyer's practice was undoubtedly great. The record indeed is the most remarkable and successful yet published, and testifies strongly to the skill of the operator as well as to the endurance of the Indian constitution.

Recurrence of Stone after Lithotrity is undoubtedly common; it constitutes the greatest drawback of the operation, and requires from the practical surgeon the most candid statement and the fullest inquiry. An analysis of Sir H. Thompson's cases would seem to show that of 576 adult males treated by lithotrity, 61 were operated on a second time, 9 a third time, 3 a fourth, and 2 a fifth time; or 75 out of 576, being 1 in 7·6, or 13 per cent. It is probable that not all who suffered from recurrence applied to him again; they may have gone elsewhere or declined further treatment. Moreover, there were 43 fatal cases, in none of which could recurrence have taken place. Further, this list of 75 only includes those which, Sir H. Thompson considered, deserve to be called 'stone,' and does not include those numerous ones of so-called phosphatic 'concretions,' which are due either to phosphatic deposit from decomposing urine in an incompetent bladder or to undetected fragments. If, therefore, this frequent recurrence of stone has occurred in the practice of one so skilful and of such vast experience, it must be admitted that, so far as it can be shown to be incident to the operation of lithotrity, it must be considered a great and serious drawback.

The causes of it are, as in lithotomy—(1) the descent of a fresh renal stone; and (2) the leaving of stones or fragments of stone at the first operation. The descent of a fresh stone from the kidney is obviously as likely to follow one operation as the other; there are not a few persons who are in the habit of voiding small stones composed of lithic acid or lithate of ammonia, and this habit may persist after some of these have been removed by operation. But when it is remembered that in lithotomy recurrence is almost certainly caused, in more than half the cases, by leaving stones or portions of stone at the first operation, and when it is remembered too that recurrence is vastly more frequent after lithotrity than after lithotomy, it cannot be denied that, in by far the larger number of cases of recurrence after lithotrity, the real true cause is the leaving of calculous débris in minute quantity at the first operation. The difficulty of removing these final atoms from the recesses and pockets of the atonic, half-paralysed bladders of aged and feeble persons has been referred to; the difficulty may, and probably will be, much lessened by the large evacuating tubes of Bigelow, but hitherto this drawback has been regarded as the price paid for the vastly greater security to life from lithotrity, as compared with lithotomy.

Choice of Operation.—This is a matter not infrequently of great nicety and difficulty, even to the most experienced surgeon. Indeed, as Sir W. Fergusson has said, the greater his experience, the greater will sometimes be his doubt. He will, in certain cases, dread, if he cannot clearly diagnose, those kidney-changes which may mar his best endeavours, and which the young surgeon is apt to think but little of; he will know, too, that even with a measuring sound it is not always safe to infer the exact size of a stone, for, in large, flattened stones, a small diameter may mislead him into the belief that he has one of a moderate size to deal with. There are some points, however, on which all surgeons are agreed. In children under puberty, unless the stone is very small indeed, lithotomy should be the rule; its good results in the young, and the small size of the urethra, which precludes the use of the evacuating tube, combine to favour the method of cure by one complete operation. On the other hand, in the healthy adult, lithotrity should undoubtedly be adopted in all cases where the stone is of moderate size; but it may be asked what is meant by the word 'moderate.' A different answer will be given now to that which used to be offered, for it is certain that litholapaxy is competent to deal with stones of considerable magnitude,

even up to 2, 3, and 4 ounces. It should, however, be borne in mind that a single hard uric acid or oxalate of lime stone of 1½ or 2 oz. will be far more difficult to break and extract, and be more trying to the patient, than double that weight of small multiple or friable and laminated stones. Up to an ounce and a half in weight, there can be no doubt of the immense superiority of lithotrity over lithotomy, so far as mortality is concerned. Above that weight, say from 1½ to 3 ounces, it yet remains to be seen whether lithotrity by any method can be applied with more safety and success than lithotomy.

In the Norwich Hospital there have been 193 cases, chiefly adults, treated by lithotomy, in which the stones weighed 1 ounce and under 2, with 159 cures and 34 deaths, being 1 in 5·6, or 17·6 per cent.; and 55 cases of 2 ounces and under 3, with 35 cures and 20 deaths, being 1 in 2·75, or 36 per cent. These figures will serve as a basis for future comparison. In stones weighing more than three ounces the choice will rest between lateral and supra-pubic lithotomy; and here, again, experience, not at present forthcoming, is required to assist in deciding. In the same hospital there have been 50 cases, almost all done by the lateral method, of stones above 3 ounces, with 31 cures and 19 deaths, being 1 in 2·6, or 36 per cent. This list also will serve for future comparison. The writer has long felt that supra-pubic lithotomy deserves a full re-examination by the light of modern antiseptic surgery and the more perfect system of drainage; lately a fresh impetus has been given to this inquiry by the investigation of Professor Petersen. So that it would seem likely that in future, the time-honoured operation of lateral lithotomy will be shorn of its prestige and diminished in its supremacy by the extended domain of litholapaxy on the one hand, and of supra-pubic lithotomy on the other. In children of both sexes, with large stones, the high operation has been proved to have great advantages, and in adult females, when the stone is beyond the compass of lithotrity, the high operation will probably come to supplant the vaginal or any other method of cure.

These principles and rules dealing with stones of various sizes are applicable only or chiefly when the urinary organs are sound and the general health good; but what course should be adopted when these circumstances are adverse? The effect of stricture, of prostatic enlargement, of changes in the shape and walls of the bladder, have already been mentioned. Mere vesical irritability seldom impedes lithotrity, nor do atony and chronic cystitis; these bladders, as a rule, bear the contact of instruments well, and are frequently already accustomed to the constant use of the catheter. But what is to be said of stone, complicated with kidney disease, such as albuminuria, and chronic pyelitis, and atrophy? In these cases all operations are fraught with danger, but it is probable that the least risk will be met with from a carefully conducted one-sitting lithotrity. So, too, in those cases of constitutional disease combined with stone, such as diabetes, tabes, and other spinal diseases, it will be well to avoid the shock and hæmorrhage of lithotomy, and proceed, if any surgical proceeding is allowable, by lithotrity. This, however, can only be recommended in cases where the stone is of strictly moderate size; when it is of 1½ or 2 oz. and upwards, the lateral or high operation will probably afford the best of the bad chances of recovery. Some consideration in selecting the operation must be given to the tact and experience of the surgeon. A beginner will do well to adopt lithotomy in cases of full-sized stones in which his more experienced colleague would trust himself to do litholapaxy; but no one should adopt the latter without practising it well beforehand outside the bladder. Lastly, it may be said that by lithotomy there is greater danger to life, but a more perfect recovery for those who do recover; while by lithotrity the immediate security to life and the present recovery are not infrequently dearly purchased, and well-nigh counterbalanced, by the recurrence of the disease or the more or less permanent persistence of some form of vesical trouble.

WILLIAM CADGE.

LITTRE'S OPERATION for opening the colon in the groin. *See* ATRESIA ANI.

LIVER, Rupture of the.—From its size the liver is more frequently ruptured than any of the other abdominal viscera. Either surface of the organ may be torn, but the upper is more frequently so affected, and an organ that is diseased is more prone to suffer than one of normal texture. Several degrees of rupture are met with, varying from a slight superficial crack to a complete pulp. The parenchymatous tissue may sometimes be torn while the peritoneal covering of the organ is left intact.

Causes.—Blows, falls, spent shot taking effect in the hepatic region, wheels of

vehicles passing over the abdomen, fractured ribs perforating the diaphragm.

Symptoms.—As there are none that are strictly diagnostic, the presence of a communicating wound or the performance of laparotomy can alone lead to an accurate estimate. The precise nature of the injury and the region of the abdomen must be considered. Shock, if the rupture be of any extent, is well marked; the general surface of the body is pallid and cold; vomiting, thirst, general restlessness, sighing respirations and feeble pulse, are present; also pain and tenderness in the region of the liver; but this is likewise present when the organ is merely bruised. An increase in the faintness and feebleness of pulse denotes that the hæmorrhage is continuing, and that an accumulation is taking place in the peritoneal cavity, which will be recognised by a gradually widening area of dulness on percussion. If not speedily fatal, jaundice and itching of the skin may supervene. Should an external wound exist, bile may be discharged through it.

Prognosis.—This depends upon the size of the rupture. If it be of any magnitude, death takes place in a few hours from shock and hæmorrhage. Small ruptures may be recovered from, and very superficial cracks may pass undetected. If the immediate dangers be overcome, the subsequent ones that threaten are peritonitis and abscess due to the extravasation of blood and bile. When the serous covering of the organ is not torn, the chances of recovery are enhanced.

Treatment.—Rest in the horizontal position; warmth to the general surface of the body; hot fomentations or ice applied over the region of the liver. To relieve pain and tenderness, morphia should be administered subcutaneously or by suppository. Brandy, if it can be borne, should be administered by the mouth in frequent but small doses until the heat of the body is restored. To allay thirst, ice may be given to suck, and cold or warm water in teaspoonful doses.

If it be evident that the internal hæmorrhage is copious or continuing, the abdomen may be opened in the middle line between the ensiform cartilage and the umbilicus, the peritoneal cavity emptied of blood-clot or bile, and the wounded organ examined. Should exposure not restrain the hæmorrhage, the bleeding surface may be gently seared with the thermo-cautery; the abdominal cavity should then be washed out thoroughly with clean hot water and carefully dried with sponges. A glass drainage-tube having been inserted, the rest of the parietal wound should be closed and dry dressings applied, secured with strapping and a wide flannel bandage. The drainage-tube should be retained for at least twenty-four hours, and longer if the discharge be copious.

Peritonitis must be treated in the ordinary manner, and any abscess-formation should be evacuated by the aspirator or by incision. THOMAS F. CHAVASSE.

LOCAL ANÆSTHESIA.—When we consider the fatal cases which have resulted from general anæsthetics of all kinds, and call to mind the fact that very many of the deaths have occurred in operations of trifling magnitude; when also we think of the unpleasant and sometimes dangerous after-effects of such anæsthetics, it is obvious that local means for the prevention of pain would be of the greatest value.

Although by squeezing and rubbing the lobe of the ear jewellers render it insensitive to the passage of a needle, the use of compression of sensory nerves may be said to have failed to produce sufficient anæsthesia to render even small operations painless. Narcotic drugs—opium, morphia, belladonna, chloroform, carbonic and carbolic acids—applied to the unbroken skin or injected hypodermically, are either too weak in their action to prevent the pain of a cut, or they produce painful effects such as vesication. But lotions, ointments, and vapours of the above drugs are valuable when applied to painful ulcers, simple or malignant.

Until quite recently, the only local method of preventing the pain of an operation was that of freezing the part. This may be done by—(1) the application of a mixture of ice and salt to the part, or (2) by the ether spray.

Ice and Salt.—Finely powdered ice and salt, well mixed in the proportion of 2 to 1, and put into a gauze bag, are closely applied to the part. In five to ten minutes the skin becomes yellowish-white, firmer than natural, looks tallowy on section and does not bleed, and incisions into it are painless. After a somewhat longer application a nail may be painlessly removed; but it is impossible to freeze deeper tissues without great probability of inducing sloughing.

The *ether spray* is handier than ice and salt. The nozzle should be held one to two inches from the part. In from half to two minutes, a white firmish patch appears and rapidly spreads. Painless incisions may now be made in the skin; but the deeper parts are unaffected. It has been recommended to

play on the latter through the incision—to make the spray precede the knife; but this is a very slow process, and could not be carried out for large incisions. The knife, too, gets crusted with ice, and the operator's fingers numb. No cautery or light must ever be brought near the spray. *See* ETHER-SPRAY.

The first objection to both these methods is that their action is very superficial. But they cannot be recommended even for superficial operations, as the sensations in a part during freezing are painful; and, during thawing, the suffering may be so acute as considerably to exceed that which the operation itself would have caused. It is well, however, to bear in mind that a Cæsarean section has been done almost painlessly under the ether spray.

Hydrochlorate of Cocaine.—During the last few months this drug has been much used as a local anæsthetic. A solution of from 4 to 20 p.c. is either dropped or painted over the surface to be anæsthetised, two or three times at intervals of three to five minutes; sufficient anæsthesia is thus produced for the performance of small operations, and continues from ten to fifteen minutes. But the drug will not act through unbroken skin, and can, therefore, be used as above only upon mucous surfaces. Two cases have, however, been reported in which a hypodermic injection rendered the opening of an abscess painless. The new anæsthetic has been used chiefly in operations upon the eye, ear, nose, mouth, larynx, urethra, and rectum. Its capabilities are probably not yet fully determined.

STANLEY BOYD.

LOCK-JAW. *See* TETANUS.

LOOSE CARTILAGE.—This is the name given to certain movable bodies, of varying origin and constitution, which are found in the interior of joints, especially the knee, and whose presence gives rise to a characteristic train of symptoms.

The name 'loose cartilage' is, however, not always an accurate one; for these bodies are sometimes not loose, and frequently contain no cartilage. Most often they consist chiefly of fibrous tissue, in which is a small quantity of ill-formed cartilage containing some irregularly deposited calcareous material. They may, however, be formed of true cartilage, or of cartilage which has undergone a variable amount of ossification or calcification. Others consist of small masses of fibrinous lymph.

They may be single or multiple, and they vary in size from a quarter of an inch to an inch or more in diameter. The majority of these bodies lie loose in the joint, and can travel to any part of it; but occasionally they are attached by a pedicle which limits their range of movement. Their occurrence is almost confined to the knee, but they have occasionally been met with in the elbow, and rarely in some of the other joints. Their mode of origin is variable, though they are often traced to injury. Probably, many of them occur in the early stages of osteo-arthritis, in which cartilaginous or calcareous material is formed in a synovial fringe, and this, becoming pendulous, is eventually detached either by injury or the movements of the joint. Or, they may have their origin in the exudation of inflammatory lymph upon the surface or into the substance of the loose synovial tissue; and this, undergoing development into fibrous tissue or cartilage, is separated from its attachment by the pressure of the bones. In other cases, a piece of the articular cartilage is detached either by direct injury or by the process of necrosis.

The *symptoms*, caused by the presence of a loose body in a joint, are recurrent attacks of pain and synovitis. The pain comes on suddenly and is very acute; it is due to the body slipping between the ends of the bones. In the knee (which is the only joint that need be considered), when this occurs the joint becomes immediately fixed, and this, together with the severe pain, often causes the patient to fall. After a time, usually a few hours, or it may be in the first effort to move, the loose body again becomes displaced and the joint can be moved; but more or less synovitis ensues. These attacks of pain and synovitis recur whenever the loose body becomes caught between the bones, and, as every attack of synovitis leaves the joint a little looser, this occurrence is apt to become increasingly frequent.

Treatment.—This must depend upon the amount of inconvenience caused by the presence of the loose cartilage, and also upon the condition of the health of the sufferer. In some cases, a carefully contrived splint or bandage will keep the offending body in the upper pouch of the synovial cavity, where it may possibly become fixed by adhesions. Or, the same end may be attained by the use of strapping over it a piece of leather, with a hole cut in it to receive the loose body. But usually such measures are inefficient, and the patient requires something more radical to be done. The only curative treatment is the re-

moval of the loose body from the cavity of the joint. This, of course, can only be done by opening the joint, which, even with every precaution, is an operation of sufficient gravity to forbid its being undertaken till palliative measures have been tried. Moreover, it is to be remembered that any serious disturbance of the patient's health, and especially such as is indicated by the presence of albumen in the urine, should deter the surgeon from any avoidable operation upon a large joint. Nevertheless, if the local inconvenience renders the extraction of the loose cartilage desirable, and the patient be in good health, the operation may be undertaken with every prospect of success.

Two methods of operation are available: one in which an incision is made directly into the joint, and the loose body at once removed; the other in which, the capsule of the joint being opened subcutaneously by a long knife passed obliquely under the skin, the loose body is pressed out of the joint into the subcutaneous cellular tissue, and either left there or removed after the wound into the joint is healed. Whichever operation is adopted, the strictest antiseptic precautions should be observed; and, if due care be taken on this point, the removal of the loose body by direct incision is, in the writer's opinion, the preferable method.

If the loose body be freely movable, an incision a finger's breath in length should be made on the outer side of the joint, the loose body if possible being held in that position, and then squeezed through the opening. Should the substance slip away, as often happens, the finger may be introduced into the joint to bring it again towards the opening, through which it may be extracted by a small pair of lithotomy forceps. If there be any difficulty, it is much better to explore the joint with the finger than to search for it from the outside or by movements of the joint. The wound is to be closed by a fine catgut suture, antiseptic dressings applied, and the limb at once fixed on a splint.

Usually, there is no local or constitutional disturbance; the wound is healed in a few days, and after a fortnight's rest of the limb the patient may be considered well. Should there ensue any inflammation of the joint, it must at once be combated by decided antiphlogistic treatment.

J. Warrington Haward.

LORDOSIS. *See* Antero-posterior Spinal Curvature.

LUMBAR ABSCESS.—An abscess, usually chronic, situated in the loin or over the lower ribs near their angles.

Cause.—Generally due to caries either of the spine or ribs; may also come from deeper parts, as the kidney, or may have no evident source of origin; this last occurs usually in children, and is subcutaneous. In children, also, acute abscess in the erector spinæ, without bone-disease, is seen.

Pathology.—When from spinal caries, it may be a diverticulum in the course of a psoas abscess, starting at the upper or lower end of the primary abscess; and, when the former, it lies over the lower ribs, and may be mistaken for a localised empyema. Or pus may travel directly backwards from the spine to the outer edge of the erector spinæ; or, more rarely, may be over the spines themselves; or, passing between the laminæ, may get into the sheath of the erector spinæ; or a dorsal spinal abscess may travel down and become lumbar. Caries of the lower ribs or of the iliac crest may also cause lumbar abscess; and a pyonephrosis and perinephritic abscess may project in the loin, as well as in the abdomen.

Symptoms.—No special subjective symptom belongs to lumbar abscess; the tumour is generally the first thing remarked. Any source of origin, as above, must be sought for; the deep connection of the swelling is shown by a cough impulse.

Diagnosis.—The abscess is recognised by the usual physical signs; its origin must be discovered by history and examination. The possibility of its being part of a psoas abscess must not be forgotten. When over the lower ribs it may be an empyema, which an examination of the thorax will decide; or it may be from rib-caries. Until the abscess is opened, it is usually impossible to feel any carious or irregular surface. A local spot of pain under the abscess and in the rib suggests caries. The 'cold' subcutaneous abscess of children has only negative signs with regard to origin. Pyonephrosis and perinephritic abscess cause abdominal swelling as well, and probably pyuria. Renal cancer resembles lumbar abscess at times, but there is no true fluctuation; there are great pain and special renal symptoms—e.g. hæmaturia.

Treatment.—Whether due to caries or not, the abscess must be opened freely; this allows exploration and perhaps removal of sequestra. In the subcutaneous abscess of children, relief of tension by aspiration, followed by firm bandaging over bella-

donna plaster, with the internal use of iodide of iron, frequently causes resolution of the abscess.

C. Hilton Golding-Bird.

LUMBAR HERNIA.—In this variety of hernia, the protrusion presents itself externally in Petit's triangle. This triangle is bounded in front by the external oblique, and behind by the latissimus dorsi, while its base is formed by that part of the iliac crest which lies between the attachments of the two muscles. To reach the triangle, the hernial sac passes through the posterior aponeurosis of the transversalis muscle, and then through the fibres of the internal oblique. Its neck will be situated near the outer border of the quadratus lumborum. This rupture has occurred most usually after wounds, deep abscesses, and severe contusions. It is also said to have followed pregnancy and ascites. The sac may contain small intestine or omentum, or a portion of the ascending or of the descending colon. The hernial tumour is usually very small, but it may attain the size of an infant's head. It is reported to be usually oval in shape, with its long axis placed antero-posteriorly. Its orifice is large; and it is as a rule readily reduced. It may, however, become irreducible or inflamed. It has been the seat of strangulation, and in one reported case of strangulation herniotomy was performed, but with a fatal result. The hernia has been mistaken for lumbar abscess, for hæmatoma, and for a fatty or fibro-cellular growth.

Frederick Treves.

LUNG, Hernia of the. *See* Pneumocele.

LUNG, Inflammation of the. *See* Pneumonia, Traumatic.

LUNG, Wounds of the.—These may be produced in three ways—

(*a*) By an external agent, as in stabs.

(*β*) By the fractured end of a rib.

(*γ*) Certain rare cases occur in which the lung ruptures in compression of the chest, where no rib-fracture can be detected.

Wounds of the lung are also divided into punctured, lacerated, and incised wounds. Of these, the incised wounds are the most dangerous, being attended with the most copious hæmorrhage. A punctured wound is the least dangerous, as may be illustrated by the effect of an accidental puncture in exploration of the chest with the aspirating needle. A lacerated wound, such as that caused by a fractured bone, will be dangerous in proportion to the amount of tissue involved.

Diagnosis.—(*a*) Where there is an external wound, blood and bubbles of air may be seen in some cases escaping from the opening in the act of respiration, or even passing backwards and forwards by an efflux and reflux movement. If the wound in the chest be large, there may be a hernia of the wounded lung (pneumocele). In such cases (which are, however, rare), the diagnosis is easy, but in the majority a wounded lung must be diagnosed inferentially from the state of the chest and other symptoms. On account of its vascularity, hæmorrhage from a wound in the lung is one of its most common accompaniments. This takes place into the cavity of the pleura (hæmothorax), and into the lung-tissue about the site of the wound. Comparatively seldom does this hæmorrhage take place to any great extent externally, unless the wound be very large. The elasticity of the tissues, and consequent tendency of a small wound to close, will, as a rule, shut in the blood, and the hæmorrhage thus takes place internally. Internal hæmorrhage, whether into pleura or lung, gives rise to dulness about the affected side, more especially about the base of the lung, if the amount of extravasated blood be considerable. The area of dulness, however, depends a good deal upon the position which the patient assumes after the injury is inflicted. If, as is most common, it be the recumbent posture, the blood will not necessarily gravitate towards the base of the lung, and the area of dulness will be most marked about that part of the chest upon which the patient has principally lain.

The *amount* of blood extravasated is not generally great enough to cause any considerable compression of the lung, unless some very large vessel has been wounded; but it is often enough to separate completely the surfaces of the pleura. Fine crepitation is the auscultatory sound most commonly present. But if the amount of blood extravasated be large, the crepitation will disappear, and the breathing sounds become indistinct or inaudible from the lung-tissue having become compressed. The very rapid appearance of the dulness after the injury will enable the surgeon to distinguish it from acute pleuritic effusion.

Other signs of wounded lung consist in:—

1. A fixed, deep, and severe pain in the thorax about the region of the wound.

2. Much troublesome cough, with irritation of the larynx, causing constant desire to cough. The patient, however, is obliged to repress the tendency within the narrowest possible limits on account of the increase of pain so caused, and thus arises the peculiar, small, *suppressed* cough of thoracic injury.

3. Very considerable dyspnœa. This no doubt arises from, and is directly proportioned to, the amount of lung-tissue rendered inoperative by the injury.

4. Hæmoptysis. Frothy blood is coughed up from the chest into the mouth in this condition; at a later stage, as the pneumonic state supervenes, the frothy blood gradually gives place to rust-coloured sputum.

5. Pneumothorax. This condition is generally conjoined with more or less hæmothorax. Air passes, either from the wounded lung or from the external wound, into the cavity of the pleura; this causes resonance on percussion over the upper part of the pleural cavity, and dulness in the most dependent part; sometimes, but not invariably, the succussion sound is present. Comparatively seldom is there any general emphysema of the tissues, unless the external wound is very small, with a great tendency to close. As a rule, if there be extravasation of air beyond the bony parietes, it escapes from the wound, and does not accumulate in the subcutaneous tissues.

(β) When the wound in the lung is produced by the fractured end of a rib, the symptoms are more limited in number. In addition to those of the fracture, there will probably be expectoration of frothy pale-red blood at first, and after two or three days rust-coloured sputum. This will be accompanied by troublesome cough, deep-seated thoracic pain, some dyspnœa, and probably a considerable elevation of temperature. There may be more or less hæmothorax, or more rarely hæmopneumothorax. Pneumothorax is not, however, so frequent after this injury as when there is an external wound. On the other hand, its place is taken by the much more frequent occurrence of a general emphysema of the cellular tissue of the parietes, and this is more frequent in the young and healthy than in the aged. Its occurrence must definitely show that not only has there been some rent in the pulmonary surface, but that the pleura costalis has also been torn through. The air must therefore pass across the cavity of the pleura before it can extravasate into the areolar tissue of the parietes. It is a remarkable fact that, under these circumstances, the cavity of the pleura but rarely fills up with air and the explanation probably is that after the lung has been lacerated, swelling of its substance very rapidly takes place, on account of its great vascularity and the hæmorrhage which consequently takes place into its parenchyma, so that the lung fully occupies the cavity in which it is contained. Consequently, the wound in the lung becomes applied to the corresponding part in the pleura costalis in which the rent has occurred, and any air which may extravasate is forced out through the wound into the general areolar tissue of the parietes at each expiration, there being no room for it in the pleural cavity.

(γ) Wound of the lung or rupture of this viscus from simple compression of the thorax, without any fracture of the ribs, is of comparatively rare occurrence. It is only likely to take place in young persons, where the ribs and sternum are very elastic. In the case of a young lad under the writer's care, there was, in addition to bloody expectoration, a limited patch of emphysema towards the root of the neck, as if air had been forced out of the rent of the lung and through the dome of the pleura in the direction of least resistance, by the violent squeeze which the chest had sustained. In this case, also, was present the peculiar capillary venous ecchymosis which often accompanies violent compression of the chest. It principally affected the parts where the skin was thinnest and the capillary blood-supply most abundant. Thus, the whole of the conjunctivæ were suffused of a pinkish tint, the whole of the skin of the face was covered with minute bluish dots, which gave it *en masse* a livid tint. The skin of the neck was also deeply affected, but less than the conjunctivæ and face. This boy ultimately recovered, the emphysema disappearing in three or four days, the capillary ecchymosis not for nearly a fortnight.

Prognosis.—This must mainly depend upon the *depth* and *size* of the wound in the lung. Small wounds are rarely dangerous; large wounds, especially those involving a large vessel, are exceedingly so.

Treatment.—The patient should be placed in bed in the most easy position; this will generally be lying over on the injured side, so as to allow the escape of blood or discharge from the wound, and to permit the freest movements of the uninjured side in respiration. No attempt at any deep examination of the wound should be

made with the probe or the finger—though in cases where the hæmorrhage into the pleural cavity is considerable, a drainage-tube will be of some value. Nor is it wise to attempt the washing-out of the wound with any antiseptic lotion, when first seen. The *surface* of the wound may be washed over with some carbolic lotion (1 to 40), and then covered with protective and antiseptic gauze. The whole should then be surrounded with a bandage of moderate tightness. The tight bandaging formerly recommended is not generally borne well by patients in this state, on account of its interfering too much with the freedom of respiration. Nor is the object for which it was devised—viz. the checking of the bleeding and the prevention of extravasation of air—easily attained by this means. The bandage, then, should be of only moderate tightness, and applied more for the purpose of immobilising the wounded side of the thorax and supporting it, than for the purpose of compressing the chest. Although these wounds can rarely be rendered aseptic from the first, it is an advantage to dress them under the carbolic spray. The dressings should be changed every day or every other day in accordance with their condition. If the wound is healthily granulating, dressing on alternate days, or even less frequently, will suffice; but if there be any putridity, or much discharge, it should be made daily. If a drainage-tube has been used for very extensive pleural hæmorrhage and consequent threatened collapse of the lung, it should be withdrawn at the earliest practicable moment when equilibrium seems to have been re-established in the chest. If retained too long, it will tend to favour the entry of air and the formation of a pneumothorax.

As medicinal treatment, small doses of vinum antimoniale (ɱx.), with two or three drops of tinct. opii in some liq. ammon. acetatis, are useful for checking the tendency to pneumonia, and for allaying the cough. The amount of food given during the first two or three days should be very small. The tendency to hæmorrhage may be checked by reducing the amount within the narrowest possible limits, and the writer has several times kept these patients upon only half a pint of milk for the first three or four days, with the most excellent results. A very small quantity of ice may be allowed with it to check urgent thirst. After the first four days, the amount of fluid food may be slightly increased, but it is always better in such cases to err on the side of starvation than the reverse. H. G. Howse.

LUPUS ERYTHEMATOSUS.—*Definition.*—A hyperæmia of the skin, mainly affecting the sebaceous glands and hair-follicles, and accompanied by a cell-growth. It appears in the form of one or more red, slightly raised patches, chiefly on the face, is extremely chronic, and ends, without ulceration, in atrophy and superficial scar.

Etiology.—The cause is still obscure. In certain persons, with feeble circulation and a tendency to chilblains, it seems to be provoked by comparatively slight irritating causes, such as sunburn, exposure to cold, sea air, and wind. Rich and poor are equally liable to its attacks, but females more than males. It is a rare form of lupus, and neither hereditary nor contagious.

Symptoms.—The disease may begin at any age, but usually does so between fifteen and thirty, and often lasts for life. It commences with one or more well-defined oval or round erythematous patches on the face. These gradually spread and coalesce, forming, when fully developed, what is known as the butterfly outline, the body resting on the nose and a wing extended on either cheek. Occasionally it commences on the scalp, but it is constantly symmetrical wherever located. The usual order of appearance is primarily on the nose, extending thence first to one cheek and then to the other, then to the ears, scalp, backs of hands and fingers, feet and toes, and trunk, affecting each side to an equal extent. In colour it is either of a bright red, dull brick red, or violet tint. The crust that forms on the patch, and is an important feature of the disease, varies in colour, being sometimes grey, but often yellow; and the plugs of sebaceous matter extending into the follicles render it very adherent to the skin. As the patches extend, their centres become gradually converted into thin, superficial, silvery-tinted scars. If the active process be suspended, the scarring may spread over the whole of the patches. Sometimes, even after a long period of quiescence, from some slight or scarcely apparent cause, the patches may increase in size. The edge of a well-defined patch is raised, while the centre is depressed, and, when the crust is forcibly removed, the surface is found to be red and pitted, and covered with numerous bleeding points. The mucous membrane of the lips is occasionally involved; but, speaking generally, the mucous membranes are not attacked as they are by lupus vulgaris. The whole process terminates in absorption, and there is never any ulceration. Even in cases in which large tracts of skin are affected, the general health is not usually

interrupted, except in the acute and severe variety described by Kaposi, Hans Hebra, and others in Germany, in which the appearance of the eruption is accompanied by fever, often terminating in death. In ordinary cases, some smarting or burning is experienced on exposure to cold or heat, or from indigestion, but there is little or no pain.

Diagnosis.—In an early stage it is apt to be confounded with simple erythema; but, as erythema is a transitory disease, a little time will suffice to show its true nature. From eczema it can be distinguished by the absence of watery exudation, by its chronic course, and, in the later stages, by the scarring; and from acne rosacea by its raised and well-defined margin, and the absence of pustules and tubercles. Syphilis will at times imitate lupus erythematosus in such a way as to make the diagnosis far from easy, but it is of value to note that this manifestation of syphilis is usually a late one, more rapid in its course, and not so strictly symmetrical as lupus erythematosus; besides which there is the important test by anti-syphilitic drugs.

Morbid Anatomy.—At first there is dilatation of the capillary plexuses of the sebaceous glands and hair-follicles, followed by a gradual development of a small-celled growth in the surrounding connective tissue. The crusts are formed of sebaceous matter. The new growth is converted into scar-tissue by a process of fatty degeneration. According to some authorities, the sweat-glands may be primarily affected.

Treatment.—A. *Local.*—There are three distinct indications in the local treatment: (1) Soothing and astringent applications to allay smarting or burning; (2) stimulating applications to promote absorption; (3) mechanical or chemical means for the destruction of the new growth. (1) When the erythema is the chief symptom, much may be done by avoiding all sources of irritation, such as cold wind, sea air, or sun, and by the use of cooling and astringent applications, such as liq. plumbi in lotion or ointment, oleate of zinc in powder or mixed with spermaceti ointment in the proportion of ʒj. to ℥j.; calamine ʒj., oxide of zinc ʒss., glycerine fʒiss., in rose water fʒvj.; cod-liver oil, liquor carbonis deterg. fʒss. to vaseline ℥j. Complete removal of all crusts should be effected by oiling and washing with soap and water, or, better still, with soft soap and spirits of wine in equal parts. (2) Stimulating applications of various kinds may then be employed, with a view to the absorption of the new growth. Mercurial ointments, sulphur, carbolic acid, chromic acid, chrysophanic acid, pyrogallic acid, iodine, iodoform, tar, salicylic acid, chloride of zinc, in various combinations and proportions, are all recommended, and are often of service in individual cases. (3) For the destruction of the new growth there is no method so efficacious as multiple linear scarification, repeated at intervals of a week for a long period. It is successful in about half the cases, and leaves a white, soft, yielding scar. The other methods of destruction are electrolysis, galvano-cautery, scraping with a sharp spoon; or by the application of caustics, such as chloride of zinc, or Vienna paste, or the acid nitrate of mercury.

B. *Constitutional.*—Cases have been recorded, from time to time, in which benefit and even cure has resulted from the prolonged use of one of the following drugs: arsenic, iodine, iodide of potassium, iodide of starch, phosphorus, and cod-liver oil. It is difficult to give any rule for constitutional treatment further than that any deviation from health should be treated, and that one or more of the above-mentioned remedies should be tried.

MALCOLM MORRIS.

LUPUS VULGARIS.—*Definition.*—Lupus vulgaris is a chronic disease of the skin or mucous membrane, and consists of a cellular new growth in the substance of the corium, presenting the appearance of yellowish nodules of irregular size. After passing through various stages, it terminates in scars, the result of ulceration or atrophy.

Etiology.—Lupus vulgaris is less common in Great Britain and the United States than on the continent of Europe. It is said chiefly to attack people who live in cold, damp districts, and females rather than males. It is a disease of early life, making its appearance usually between the second and tenth year, but it is neither hereditary nor syphilitic. Until quite recent years, it was held by all authorities to be a manifestation of scrofula, but now that scrofula may fairly be considered to be a pathological process totally distinct from tuberculosis, the question arises whether lupus can be so classified. At the same time it is clear that certain changes in the skin resembling lupus are scrofulous in origin, but these, which should be classed under scrofuloderma, will be considered under the head of diagnosis. Whether lupus is or is not a local tuberculosis of the skin is a question of grave importance, bearing as it does directly

on prognosis and treatment. Upwards of twenty years ago Mr. Hutchinson pointed out its connection with the tubercular diathesis; yet we find that out of 209 cases carefully examined by Dr. Raudnitz of Prague, although 21 cases are recorded in which there was hereditary history of tuberculosis, only 2 of them had lung-tuberculosis themselves. More recently, numerous observers have examined lupus-nodules for micro-organisms. Before Koch's discovery of the tubercle bacillus, Schüller described a microbe in the smaller tubercles of lupus, and Friedländer, Pfeiffer, Doutrelepont, Demme, Krause, Martin, Besnier, have all discovered bacilli in lupus tissue, and each has asserted the identity of lupus and tuberculosis. Schüller injected lupus into the trachea of animals, making at the same time a wound in the knee-joint, and after a certain time found tuberculosis of the lungs and the joint. Martin, using the same method, was once unsuccessful and once successful. Besnier quotes cases in which death took place from tuberculosis of internal organs in people suffering from lupus, and argues therefrom that lupus is a local tuberculosis, and may become the focus of infection of the whole body.

On the other hand, Kaposi, Vidal, and Kiener have, by different modes, subcutaneously inoculated various animals with lupus products, with only negative results. Cornil and Leloir, also, examined skin from eleven lupus patients but found bacilli in one case only. With this evidence before us, therefore, the whole question of the relation of lupus to tuberculosis must be considered as still *sub judice*.

Symptoms.—Lupus first appears in the form of a small, light-brown, or amber-coloured patch on the skin, with more or less redness round it. When pressed with the finger the redness disappears, but the patch itself, though rendered paler, retains its characteristic yellow tint. This peculiar appearance has been compared to apple jelly, and very aptly, for were a small portion of skin gouged out, the cavity filled with apple jelly, and the surface pared even with the surrounding skin, the resemblance to a primary nodule of lupus vulgaris would be complete.

When first this amber-coloured or 'apple jelly'-like nodule makes its appearance on the surface of the skin, it may be no larger than a pin's head, in which condition it may remain stationary for months or years, and then either gradually disappear, leaving in its place a small scar, or slowly enlarge. Again, there may be several of these primary nodules, which may coalesce, forming patches of irregular shape, when the rapidity of the spread of the disease will be found to be in proportion to the number of the nodules, the centre of each of which becomes gradually converted into scar tissue. The whole process is destructive, but the amount of destruction depends on the position of the nodules. When superficially placed in the corium, the resulting scar is thin and oftentimes barely visible; but, if deeply situated, the ulceration is more extensive and the scar unsightly. Though lupus vulgaris is primarily a disease of the skin or mucous membrane, it may also attack the subcutaneous tissue, muscles, cartilage, and all tissues except bone. There is, as a rule, little or no pain, and the glands in the neighbourhood of the diseased skin are usually not affected. Occasionally there is much erythema or œdema.

The different varieties of lupus depend either on the shape of the patch or on the changes it undergoes, but it cannot be too strongly stated that these are stages merely, and not separate varieties; and, as some or all of them may occur at the same time in the same individual, it would be better if the term lupus vulgaris were employed to designate all stages of the disease.

Lupus *exedens* or lupus *exulcerans* are terms applied to the disease when there is distinct ulceration, a phase usually confined to the nose or cheeks; lupus *non-exedens* when there is no ulceration. When the nodules shrivel and disappear with more or less desquamation, but without ulceration, the variety is termed lupus *exfoliativus* or *exfoliaceus*; while the huddling together of the nodules, so that they project considerably above the level of the skin, is called lupus *hypertrophicus* or *tuberculatus*. Should a patch of irregular outline be formed by the fusion of two or more patches, lupus *serpiginosus* is produced; but if it present the appearance of numerous scattered isolated points it is called lupus *disseminatus*. McCall Anderson adds yet another variety which, because of certain warty growths appearing on the tubercles, he calls lupus *verrucosus*, but which Vidal designated lupus *scléreux*.

Lupus usually shows itself first on the skin of the nose, and the parts subject to attack next in frequency are the cheeks, and then the extremities. Next in order are the ears, mouth, gums, pharynx and larynx, eye, and female genital organs. The scalp is seldom attacked primarily. The disease on each part will now be briefly noticed, and

its differential diagnosis, distinguishing it from certain other diseases, given.

Lupus of the Nose.—At first, in most cases, one or more small yellowish-red spots appear on the skin near the tip or at the sides of the nose. When these early nodules occur in the first decade of life, they are easily distinguishable from simple inflammatory diseases; from eczema by the absence of moisture and persistence, and from psoriasis by the immunity of other parts of the body and by the absence of the silvery scales. Their resemblance to true scrofulous nodules renders the diagnosis in an early stage less easy. The scrofulous nodules are harder when pricked, paler, and more raised than lupus. They are usually more rapid in growth and tend to ulcerate more quickly, and, as a rule, the neighbouring lymphatics are involved. When the first appearance occurs during the second decade, at or soon after the age of puberty, the lupus nodules are apt to be mistaken for either acne vulgaris or a secondary manifestation of syphilis. The lupus nodules are, however, usually larger than acne, not limited to sebaceous glands, not pustular, soft when pricked, and are of longer standing. They are distinguished from syphilitic nodules by the absence of the cachexia, enlarged glands, sore-throat, and the mixed eruption usual in that disease. Lupus of the nose is sometimes difficult to diagnose from acne rosacea. The age at which the disease showed itself, the presence of apple-jelly nodules and scarring, are the guides.

Lupus of the Cheeks.—Lupus vulgaris is a non-symmetrical disease; it is, therefore, not uncommon to see on one cheek a single patch that has lasted for years, or both cheeks may be attacked by extension from one side, or as a result of several nodules scattered on the nose and cheeks. It is interesting to notice that, however much the disease may extend, the forehead and chin, as a rule, escape attack. Diagnosis of a single patch of lupus is not always easy, but it will be discernible from eczema, psoriasis, and acne rosacea for reasons already mentioned. Lupus may be distinguished from scrofuloderma by its hardness, and the frequency with which it appears in scars after abscesses. Enlargement of the glands and other signs of scrofula, such as catarrh, serve to distinguish scrofula from true lupus. Tertiary tubercular syphilide may be recognised by the age at which the disease first appeared, by the rate of its growth, by the shape and colour of the patch, and by the history and presence of old scars. When attacking both cheeks and nose and not ulcerating, lupus vulgaris may be confounded with lupus erythematosus, which may be distinguished from it by its symmetrical distribution, by the age at which it appears—usually after puberty—by its superficial character and its total freedom from ulceration, by the absence of apple-jelly tubercles, by the colour and nature of the crusts, and the plugs on the under surface when removed.

There is a variety of lupus vulgaris, occasionally seen on the face, which often ulcerates, leaving small pits, and which, from its resemblance to common acne, has been called *acne-lupus*. The chief features of chronic ulcerating lupus of the face, which may be mistaken for simple scrofulous ulceration, epithelioma, rodent ulcer, and tertiary syphilis, are the age of the patient, the mode of origin, the rate of growth, the character of the ulcer, and the constitutional effects. Both lupus and scrofula commence in early life, the latter in a hard tubercular nodule which breaks down speedily, forming an ulcer with a thin undermined edge; the surface is either devoid of granulations or covered with pale flabby granulations which bleed easily, and the surrounding skin purple or red. The lymphatic glands are enlarged, and there are usually other signs of scrofula. There are nodules of lupus around the lupus ulcer, the edges of which are not well defined. The discharge is yellowish but not offensive, forming thick scabs, and there is a tendency to heal in the centre. Epithelioma and rodent ulcer usually commence in middle or late life, and generally at the junction of skin and mucous membrane, as, for instance, the margin of nostril or eyelid; and usually from one point, and not several, as in lupus, and the process is very slow, as a rule lasting for years. They differ from lupus in their tendency to destroy deep tissues, including bone, and by showing no disposition to heal. The rodent ulcer is cavernous, the base smooth, and the edge firm and inelastic. The syphilitic ulcer spreads serpiginously, often with an outline of a horse-shoe shape, unlike lupus; in addition to which the edges are sharply defined, the discharge is foul, and there is a tendency to destroy deep tissues, including bone. Its rate of growth is usually more rapid than that of rodent ulcer or epithelioma, and the existence of early symptoms of syphilis and the presence of scars are important data.

Lupus of the face, by destruction of the skin and scar-contraction, may produce the

most terrible deformity. Ectropion and dragging of the mouth and nose are common results, as also loss of a great portion of the nose.

Lupus of the Ear.—The ear may be attacked either primarily or by extension from the face. The disease may commence on the membrana tympani and spread outwards, or on the outer ear and ultimately involve the membrane, from which cause deafness frequently results. The destruction and deformity are also at times very great, leaving the external meatus permanently contracted.

Lupus of the Trunk and Extremities.—Lupus may attack any part of the surface, and differs in appearance according to the part attacked. It may start and pursue its course in the same way as on the face, though as a rule the process is even slower. There is a variety, most severe in character, which has been described under the name of *lupus mutilans*, which attacks the fingers and toes, ulcerating greatly, and causing much destruction, contraction, and deformity.

Lupus of the Mucous Membranes.—This may either commence in the mucous membrane or may spread thereto from affected skin. When primarily affecting the mucous membrane it is difficult to recognise, and there is little doubt that it has often existed long prior to its discovery. The nasal mucous membrane is that most commonly attacked, next the mouth and pharynx, and occasionally the larynx, while the rarest parts are the genital organs, both male and female.

In the nose, the first indication is a scab or crust and a slight sensation of soreness. If the scab be removed the exposed surface bleeds easily, is sensitive to the touch, and soft when scraped. If not arrested at this stage deep ulceration may ensue, often causing the complete destruction of the cartilaginous septum. In the mouth, isolated patches may occur on the lips, which become swollen and everted, on the gums and on the hard and soft palate. The tongue is rarely affected. The conjunctiva is seldom attacked primarily, but occasionally by extension from the cheeks.

Morbid Anatomy.—Sections of skin affected with lupus vulgaris show under the microscope small scattered nodules, arranged like nests in the fibrous connective tissue, composed of young cells situated in a highly vascular network. The surrounding corium is at first free, but gradually the small-celled growth extends along the vessels, or the sweat-glands, or the hair-follicles and sebaceous glands, until the whole depth of the corium is involved. The epidermis, at first unaffected, becomes hypertrophied. Fatty degeneration and absorption may take place in the deeper nodules without destruction of the epidermis, or ulceration of the whole substance of skin and subcutaneous tissues may result, followed by cicatrisation.

Treatment.—A. *Local.*—Whatever method is used, the ultimate aim in the treatment of lupus is the total destruction of all the existing lupus tissue. This is not an easy matter, even when the parts are well within the surgeon's reach. Each method has its advantages and disadvantages, and care must be taken to select that most suitable to the individual case. When there is much erythema or œdema in the neighbourhood of the patch, soothing or astringent applications, such as lead or zinc, are for the time preferable to violent caustic or surgical treatment.

The points of most importance, in selecting a method to destroy the growth, are the thoroughness of the destruction and the kind of scar produced by the process.

The various means may be divided thus:—1. Mechanical. 2. Chemical.

1. *Mechanical.*—When the disease is situated on the face and is superficial, much improvement, and often cure, can be effected by free scarification. By this process only diseased tissue is destroyed. If the parts be more deeply involved, scraping, with one of the many kinds of curette or spoon, is often attended with the most satisfactory results. In all forms of ulcerating lupus, and in lupus of the mucous membranes, scraping is to be preferred to any other treatment. The scraping, to be effective, must be done thoroughly and repeated constantly, so as to destroy every vestige of the new growth. In disseminated lupus, a narrow curved spoon may be introduced into a nodule and pushed subcutaneously into a neighbouring one, when both nodules can be broken up by rotating the spoon. The writer has introduced a double screw for the complete destruction of small isolated nodules.

The actual cautery is strongly advocated by some, and at times excellent results are obtained by its use. For this purpose Paquelin's thermo-cautère is the best way of applying it. A fine point, heated to redness, should be firmly inserted into each nodule until the resistance of the sound tissue is felt. Care must be taken not to operate on too large an area at one time.

The ultimate scar is not so satisfactory as that attendant on scraping, as much thick

cicatricial tissue often results; but it is a suitable method of treatment for isolated nodules which have resisted other treatment. The galvanic cautery is strongly recommended by Dr. Besnier of Paris, because it destroys without blood-letting. Occasionally, it is useful to combine scraping and cautery, first scraping out as much of the diseased tissue as possible, and then lightly cauterising the raw surface. Weak solutions of perchloride of mercury, chloride of zinc, carbolic acid or boracic acid, or finely-powdered iodoform, are suitable dressings after either scraping or cautery.

2. *Chemical.*—The local treatment of lupus by chemical means alone must be looked upon as a somewhat obsolete method. Many have been recommended, but none are really satisfactory. In superficial cases, no doubt, some caustics are useful, but in consequence of the difficulty in regulating their action, they either destroy too much or too little. If strong acids are employed, such as nitric, more tissue may be destroyed than is necessary; or if weaker caustics are used, such as nitrate of silver, a solution of potassa fusa, carbolic acid, or arsenic paste, the diseased tissue may be only partly destroyed, and the remainder stimulated to renewed action. Injections into the nodules, by means of a small syringe, of a caustic solution, such as iodine 1 part, glycerine 20 parts, have been successful in the hands of Schiff of Vienna and others.

B. *Constitutional.*—It is difficult to lay down any rigid rules for guidance. It is doubtful whether there is a drug that has any specific power in preventing the formation or development of true lupus vulgaris. Lupus usually occurs in healthy people, but if there be any deviation from health it should, of course, receive attention.

Some authorities strongly advise the administration of such drugs as iodine, iodide of potassium, phosphorus, arsenic, iron, cod-liver oil; and, as no harm can accrue, it is wise to give the patient the benefit of a trial of one or more of them, at the same time impressing the opinion that without active local treatment the chance of cure is remote, if not impossible.

MALCOLM MORRIS.

LYMPHADENITIS or ADENITIS.

These terms are applied to inflammations of a lymphatic gland. There are many varieties of the process, and the cases may be divided into such as are acute, subacute, or chronic. The more useful and more usual division of adenitis, however, is based upon the nature of the morbid process involved, and is a division of the forms of the malady according to their kind rather than their degree. By this arrangement three principal varieties are separated: 1. The simple, 2. The scrofulous or tubercular, 3. The syphilitic. Besides these there are other specific forms, among which may be mentioned the adenitis met with in farcy, in the plague, in erysipelas, pyæmia, &c. The present article is concerned only with simple adenitis. The other forms will be found described under BUBO; GLANDERS; SCROFULA; SYPHILIS, &c.

SIMPLE ADENITIS, BUBO.—*Pathology.*—The inflammatory process when it involves a gland differs in no way from a like process attacking other parts of the body. It may assume an acute, subacute, or chronic character. In acute cases the gland is swollen, and is softer and moister than usual; on section it is red and often presents hæmorrhagic patches. The change is first observed and remains most marked in the cortex of the gland; all the blood-vessels are dilated, and the lymph-channels are blocked with leucocytes, among which will be found a few red blood-corpuscles. In the follicles also the number of lymphoid corpuscles is greatly increased; as the cells accumulate at any one part, that part becomes paler and the hyperæmia diminishes. The fibres of the reticulum become swollen and soften, and after a while break down, and the anatomical details of a large portion of the gland are lost. In the least severe cases resolution follows. The leucocytes undergo fatty degeneration and are absorbed, the congestion diminishes, and the gland becomes flaccid. In other cases—taking them in order of severity—suppuration takes place, either in isolated spots or throughout the substance of the disordered gland. This pus will probably be discharged, but, in cases that become chronic, its fluid parts may be absorbed and it may form a caseous mass in the centre of a disorganised and inactive gland. If the tension within the capsule has been considerable during the acute stage, the blood-vessels may become so compressed that the gland-tissue perishes, in whole or part, by necrosis. When the capsule is divided, it is found to be occupied by a sloughy mass. In another series of cases the inflammation becomes chronic. The congestion diminishes, and the gland becomes the seat of an extensive growth of new connective tissue. This tissue is of low organisation and ill-formed. It may develop into fibrous tissue and the gland be converted into an indurated mass composed mainly of this structure (cirrhosis or fibroid indura-

tion), or the newly formed material may break down here and there, and small collections of pus be formed, which will probably find their way to the surface from time to time.

Thus, an acutely inflamed gland may undergo resolution, or may suppurate or perish by necrosis, or may pass into the condition of chronic inflammation or long-abiding suppuration. It may become converted into a more or less permanent fibroid mass. It may caseate and in time become calcareous. It may undergo resolution, and after that may atrophy more or less completely. After having been once inflamed, it may at future times become again and again inflamed upon slight provocation, or, after having been quiescent for months or years, suppuration may be excited in it with singular ease. Such suppuration will take place about the residues of the primary inflammation, and will constitute the form of abscess termed by Paget 'residual.'

Causes.—Adenitis is nearly always secondary, and due to the absorption of morbid material from a focus of inflammation at the periphery. The lymphatics conveying that material to the gland may or may not be inflamed themselves. Adenitis may follow upon wounds, especially upon such as are septic or are irritated by the presence of a foreign substance. It occurs especially, also, in cases where pus has not a free vent, as in small sores covered with a scab. It is often seen after wounds exposed to continued irritation, as after abrasion of the heel from friction of a shoe. It would appear that, in rare cases, glands have been inflamed by the absorption of animal poisons through the skin, the integument presenting no breach of surface. Glands may be inflamed by direct violence; as an example of this, may be cited the case of a healthy man whose cervical glands became acutely inflamed after an accident in which the neck had been severely compressed. It is possible also that adenitis may sometimes be excited directly by exposure to cold. Inflammation in the vicinity of a gland may spread to that body by direct continuity of tissue, without of necessity reaching it by means of the lymphatics. Some individuals are more liable to adenitis than others. It is more common in the young; it is comparatively rare in the aged. It is often met with in those who are debilitated, as, for example, in children convalescent from fevers. The inflammation in the glands will partake of the character of the primary inflammation. It is indeed, a mere reproduction of it. The mischief in nearly every instance stops at the first chain of glands above the seat of the primary mischief. In some rare cases the inflammatory irritant is passed on, but always in a much modified and milder form, to the chain of glands next above those the seat of the adenitis.

Symptoms.—The gland becomes swollen, painful, and tender. It is at first movable, but soon becomes fixed. This latter symptom depends partly upon the increased size of the gland, partly upon inflammation which is usually excited in the connective tissue around the gland (peri-adenitis). The pain is lancinating and, as suppuration appears, throbbing. It is made worse by movement, and is somewhat relieved by relaxation of the part. As the disease advances, the skin becomes stretched, red, glazed, and frequently œdematous. Fluctuation appears in the centre of the indurated mass, and suppuration is evident. In time the pus finds an escape upon the surface. One gland alone may be affected, but, as a rule, others in the series become enlarged, not simultaneously but consecutively. In any case, one gland is usually more extensively involved than any other. Much of the pus is probably derived from the connective tissue around the gland. If this tissue be lax, the abscess may attain considerable size and the skin become in consequence greatly undermined. If many glands are involved, there may be lymph-œdema in the parts from whence their afferent vessels are derived.

The process, especially when suppuration occurs, is attended by a varying amount of constitutional disturbance. There may be a rigor, there is pyrexia with its accompanying symptoms, and sometimes much prostration. Adenitis of deeply seated glands, as a rule, causes more severe disturbance and more pain than adenitis of a superficial gland. This depends upon the confined position of the deeper gland and the tension that the inflammatory swelling produces. The writer has seen most severe symptoms attend adenitis of the small gland that lies in contact with the septum crurale. When the gland is surrounded by lax connective tissue, an extensive abscess may form without producing any marked constitutional disturbance. The possible modes of ending of a case of adenitis have been already indicated in speaking of the pathology.

In the *diagnosis* of the acute affection there can be little difficulty. The position of the swelling in the site of well-known

glands; the probable evidence of an exciting cause and of a connecting lymphangitis; the circumscribed nature of the swelling and the probable enlargement of other glands in its vicinity, all tend to point to a precise diagnosis. The indolent and chronic enlargements are not always so easy to recognise. In the inguinal region, for example, they have been mistaken for irreducible femoral epiploceles and for solid growths of various kinds. In the diagnosis the position of the swelling should be noted, its circumscribed character, the fact that it can be more or less isolated, the probable presence of slighter gland enlargements in the vicinity, the tenderness of the swelling, the history of an exciting cause and, possibly, of a subacute initial attack.

Treatment.—In the first place, the primary cause of the trouble (wound, abrasion, ulcer, abscess, &c.) should be sought for and so treated as to encourage its healthy healing. With regard to the adenitis, rest of the part must be at once secured, and the limb put in such a position as to relax all the fascial tissues about the seat of the disease. Thus, when the groin is involved the patient should seek the recumbent position, and keep the thigh a little flexed by placing a pillow beneath the knee. To the gland itself an ice-bag should be applied. If applied early, it gives relief and appears to prevent suppuration. A degree of cold less than that of the temperature of ice appears to do harm rather than good, and to increase the pain. In some cases, when ice cannot be borne, the local application of extract of belladonna with equal parts of glycerine will give immediate relief, with or without a fomentation or poultice. Warm applications relieve, probably by relaxing the parts and by lessening tension, but they certainly appear to encourage suppuration. When the presence of pus is evident, it should be evacuated at once. The incision should be free, in the long axis of the tumour, and almost as extensive as the abscess-cavity. On no account should the pus be squeezed out of the cut; it should be allowed to escape of itself. Squeezing the part merely damages the fine lining membrane of the abscess, where such exists, and breaks up the softened and inflamed gland-tissue. Immediately after the incision a poultice should be applied. In twenty-four hours, if all the pus has escaped, the cavity may be syringed out with a 1 in 20 solution of carbolic acid, and, after a few more days of poulticing, it may then be dressed from the bottom. The little sac should be gently filled with lint soaked in glycerine and carbolic acid (1 in 20), or with gauze well powdered with iodoform.

The method of treatment by a small incision and a drainage-tube often leads to very tardy healing. Sometimes the pus is mainly in the connective tissue about the gland, and when the abscess is opened the inflamed lymphatic body may be seen exposed at the bottom of it. Such a gland should be removed. It can be taken away by a few touches with the thermo-cautery. If left, it is apt to lead to serious trouble and to greatly retard the closing of the cavity. When the healing is sluggish the part may be dressed with carbolic acid and glycerine in the proportion of 1 in 10, or with a solution of nitrate of silver (15 grs. to the ounce), or touched daily with a solid piece of sulphate of copper. When the skin is much undermined about a sinus, the integument should be divided so far as the undermining extends, and the cavity thus exposed dressed from the bottom. If the purple skin at the edge of such a sinus be greatly thinned, it may be destroyed with the thermo-cautery. When extensive chronic sinuses result from adenitis, they require active treatment. When possible they should be slit up, the unhealthy granulations which line them should be scraped away with a Volkmann's spoon, and the resulting cavity dressed from the bottom with some stimulating application. Sinuses that are too deep to be slit up should be scraped, and then dilated fully by the use of a sea-tangle tent. When this has been done they may then be dressed from the bottom. Sometimes the sinus depends upon the presence, at the bottom of the wound, of a fragment of a degenerating gland. The softened tissue of such a gland should be scraped away with a Volkmann's spoon, or be destroyed with the cautery. After both proceedings a drainage-tube should be used for a while. *See* Sinuses.

In dealing with chronic and obstinate sinuses, it is most important that the part be kept at rest. This precaution is usually neglected in the case of cervical sinuses, and the chronicity of these depends, the writer thinks, largely upon the constant movements of the neck. In such cases the parts should be fixed by a simple stock of guttapercha, fashioned to the neck and taking its fixed points at the lower jaw and the upper part of the chest. The writer has used such stocks extensively, and has found them well borne by the patient and of extraordinary value in many obstinate cases.

In very chronic, indolent gland-enlargements without breach in the integument,

much can be done by attending to the general health, by change of air, by sea-bathing, and by the use of tonics, especially of iron. The simplest local treatment consists in the rubbing into the part, night and morning, of a little of the Ung. plumbi iodidi. This should be rubbed in for five minutes, and until the skin is a little red. This treatment is more certain and more efficacious than the painting of the part with iodine, which may, however, be tried if the ointment fails. In certain cases the gland resists all such treatment; it remains enlarged, is painless and perfectly quiescent. Such swellings may, for a while at least, be left alone. If, for any reason, their removal seems needed and they are solitary and well isolated, they may be excised, although the cases where excision is suitable are very few. If the indolent gland remains tender, and is still enlarging very slowly and is fixed in the tissues, it probably contains some suppurating foci in its interior. It is then best treated by thrusting the finest point of the thermo-cautery through the skin into the gland, and by passing the point in several directions through the gland without enlarging the skin-puncture. A drainage-tube should be finally introduced, and the part poulticed. By this means a gland which has long given trouble can often be got rid of, without leaving any but the slightest scar.

FREDERICK TREVES.

LYMPHADENOMA.—The primary non-inflammatory tumours of lymphatic glands have been subjected to many classifications, are still surrounded by an atmosphere of pathological doubt, and are burdened with a confused nomenclature. Under the term lymphadenoma may be comprised four kinds of new growth, viz.: 1. Simple Lymphoma; 2. Non-Leukæmic Lymphadenoma; 3. Leukæmic Lymphadenoma; 4. True Sarcoma. To each of these different tumours the term lymphadenoma has been applied by one author or another.

The above division includes all the primary non-inflammatory growths to which the lymph-glands are liable.

1. SIMPLE LYMPHOMA.—In this affection a gland enlarges without visible cause. By slow and gradual degrees it forms a tumour, that may be the size of a hen's egg or even larger. It is accompanied by no inflammatory symptoms, by no pain, by no tenderness. It contracts no adhesions. It is smooth and rounded, firm but elastic. It is usually found in the neck. As a rule only one gland is involved, but one or even two other glands in the vicinity may be affected. It does not affect the patient's health. It is a purely local affection, and does not recur after removal. It is associated with no constitutional defect. It shows, on section, a simple homogeneous aspect, and is composed of a new growth having precisely the structure of the follicles of a normal gland. It is difficult to decide whether the tumour is a neoplasm or a mere hypertrophy. In any case it is an innocent growth.

2. NON-LEUKÆMIC LYMPHADENOMA.—This disease is also known as Hodgkin's disease, adenia, pseudo-leukæmia, malignant lymphoma, and by the misleading term 'lympho-sarcoma.' In this form certain glands become enlarged without apparent cause, they increase in size, the disease spreads from gland to gland until a whole chain is involved. The tumours formed appear as large, round, smooth masses made up of clusters of enlarged glands. The disease usually begins in the neck, sometimes in the inguinal or axillary glands, and rarely in those in the interior of the body. In time, nearly all the more conspicuous glands in the body may be affected.

Etiology.—The causes of this disease are quite unknown. It is unconnected with scrofula, syphilis, or inflammation, It is somewhat more common in the delicate. It is three times more common in males than in females. Most of the cases occur between the ages of 25 and 35, and next in frequency between the ages of 5 and 12; it is rare after 45.

Symptoms.—The tumours increase without inflammatory symptoms, are not tender, and are not painful unless they grow quickly. They form smooth, prominent, bossy tumours which do not contract adhesions and which remain well encapsuled. Pyrexia is rare. The patients become debilitated and anæmic; they emaciate and lose their appetite. Profuse diarrhœa and dropsy are not infrequently observed, and the sufferer dies usually of exhaustion. Pressure symptoms may be produced. Gland-tumours in the neck may cause laryngeal troubles and dysphagia, sympathetic paralysis, and congestion of the great cervical veins. Tumours in the thorax may press on the trachea or lung or gullet, or may interfere with the action of the heart. Those in the abdomen may press upon the portal vein or bile-duct, and produce dropsy or jaundice. Masses in the groins or armpits may cause œdema of the corresponding limbs. Secondary deposits may develop in the alimentary canal, the liver, the kid-

neys, the medulla of the bones. The spleen is usually conspicuously affected, but it is important to note that there is no leukæmia. Death follows, on an average, in twelve months. The disease may end fatally in six months, or the patient may survive two or even three years.

The gland tumours are distinguished from those of scrofula by their wider distribution, their enlargement without visible cause, and the absence of inflammation. They form larger masses than are met with in struma, they do not suppurate nor become adherent to the skin, and they are usually not tender. They are not benefited by a treatment which would probably greatly influence scrofulous swellings.

Pathology.—The tumours are of two kinds, the soft and the hard. The former are quite soft and juicy, and homogeneous on section. The latter are firm, are also homogeneous, and yield but little juice. Transition forms between the two varieties are found. Microscopically, both kinds of tumour are composed of a tissue precisely resembling that of a normal lymph-follicle. The mass, indeed, is so like a gland that is composed wholly of follicles. The secondary deposits have the same character. The hard lymphadenoma differs from the soft in one particular only, its cell-elements are not so numerous, while the development of the reticulum and fibrous parts of the gland is peculiarly conspicuous. Clinically, the two forms are precisely alike and adopt the same course. The only differences consist in the different physical characters of the two forms of tumour, and in the fact that the hard lymphadenoma forms somewhat smaller masses.

3. Leukæmic Lymphadenoma. — This disease resembles in nearly all respects, both clinically and pathologically, the affection just described as soft non-leukæmic lymphadenoma. Microscopically the tumours have precisely the same structure, and the appearance of the growths and the characters of the secondary deposits are practically the same in the two affections. Indeed, it may be said that there are only two main points of difference between these closely allied disorders. In the present disease the spleen is more conspicuously affected, and is implicated at an earlier period, while the blood presents the evidences of leukæmia.

It will be seen that, microscopically, these three forms of lymphatic gland-tumour are almost identical. The differences which some pathologists have maintained to exist between them are ill-marked and questionable. Indeed, it would be very difficult to differentiate these three forms by the microscope alone, provided that the examination were limited to the tumours. All these growths would appear to represent grades or degrees of one common affection. Why in one case the disease should remain an innocent local affection, while in another it assumes malignant characters, and in a third produces leukæmia, must remain at present a pathological mystery.

4. True Sarcoma.—In rare instances sarcoma has appeared in a lymphatic gland as a primary tumour. Examples of round-celled, of spindle-celled, and of alveolar sarcoma have been met with in this situation. The growth commences in the connective-tissue reticulum or in the tissue around the vessels. The tumours differ in no way from sarcomatous growths appearing elsewhere. They may be distinguished from the other lymphadenomata by the following features:—Only one tumour is formed; it remains limited, for a long time at least, to one set of glands; it tends to invade the adjacent parts and to protrude through the skin. There is no leukæmia, nor the debility which is an early symptom in lymphadenoma.

Treatment.—1. In the treatment of simple lymphoma no measure is of any avail short of extirpation of the tumour with the knife. Medical treatment will neither retard the growth of the neoplasm, nor diminish its proportions when it is fully formed. Excision is easily performed, and the tumour has no tendency to recur.

2. In Hodgkin's disease surgical treatment is of little or no avail. Excision, to be of any service, must be performed at the very commencement of the malady, and, unfortunately, when the tumours first appear their precise nature is difficult to diagnose. By the time that the nature of the malady is beyond doubt, the case is probably beyond any surgical treatment. The benefit that has been obtained from a free extirpation of the growths has been temporary only, and has been purchased at a great immediate risk to life. When one definite tumour is causing troublesome symptoms from pressure, its removal may give the patient much relief. When the neck is involved and there is some risk of laryngeal stenosis from pressure, it is well to perform tracheotomy before the growth is so extensive as to hide the trachea. Local treatment of the growths by iodine, counter-irritants, setons, caustics, injections into the substance of the mass, electrolysis and subcutaneous crushing of the gland, is useless

when not actually harmful. The patient should be placed under the most favourable hygienic conditions. Cod-liver oil should be administered, and in every case iron. This may be given in the form of the sulphate or the perchloride, and, when these forms are not well borne, trial may be made of the hypophosphite or of Parrish's chemical food, or of Easton's syrup or Bravais' iron. Much good often attends the use of the syrup of the iodide of iron. The iron should be given with quinine or with nux vomica. In some cases, especially when the patient's health is still fairly good, benefit has followed the administration of iodide of potassium in increasing doses (from 5 grains three times a day to 20 or 30 grains). Many physicians strongly recommend arsenic. It should be given in increasing doses, until at last 20 or 30 minims of Fowler's solution are taken every day.

3. In leukæmic lymphadenoma any surgical interference is distinctly counter-indicated. The treatment of the case is the treatment of a case of leukæmia.

4. The treatment of sarcoma of lymphatic glands differs in no way from the treatment of that growth when attacking other superficial parts. *See* Sarcoma.

Frederick Treves.

LYMPHANGIECTASIS and LYMPHANGIOMA.—The lymphatic vessels are liable to the same species of dilatation and the same kind of varix that are met with in the blood-vessels. They may present conditions that have their counterpart in nævus, in varicose veins, and in arterial varix or cirsoid aneurism. To the lesser degrees the term 'lymphangiectasis' is applied, to the more pronounced the term 'lymphangioma.' In the milder forms—as seen in the surface lymphatics—the vessels are dilated and tortuous. The dilatation is usually unequal. Ampullæ are apt to form, especially in the vicinity of the valves, and to appear under the thinned integument as minute vesicles. The dilated vessels themselves, moreover, can be both seen and felt beneath the skin, which is apt to become atrophied over them.

When the smallest vessels are most involved, distinct networks of varicose lymphatics may be formed (Reticular L.), but when the larger trunks are attacked, a series of long tortuous tubes only is to be seen (Tubular L.). In some cases of tubular lymphangiectasis the varicosity may be considerable, and, in one reported instance, the inguinal lymphatics were so dilated as to be mistaken for a hernial protrusion.

In certain instances the lymphangiectasis is congenital. In others it has followed upon occlusion of some lymphatics after lymphangitis. In another series of cases one may assume that the dilatation has been produced by conditions resembling those that cause varicose veins. The condition is more common in tropical countries than in Europe or in colder climates. The parts most often attacked are the lower limb, the scrotum, and the lower half of the abdomen.

Lymphangiectasis is often associated with solid œdema of the parts concerned, and with some local malnutrition. The little vesicular ampullæ are apt to rupture, and to lead to a troublesome lymphorrhœa. These dilated vessels, moreover, are frequently the seat of lymphangitis.

The *treatment* of lymphangiectasis is purely palliative, The parts should be protected from pressure and injury, should be kept raised when possible, and should be supported by slight elastic pressure.

In lymphangioma vessels of good size are involved. They are extremely dilated, and form large ampullæ, and cavities of the most varied shapes. Adjacent cavities are apt to break into one another, until a mass of intercommunicating cavernous spaces and passages are formed, all lined with endothelium. The condition is identical with that known in the blood vascular system as cavernous angioma, and is therefore usually termed lymphangioma cavernosum. This condition is probably always congenital. It underlies many hypertrophic conditions, such as macroglossia, macrochelia, and certain forms of elephantiasis, and is said by some to be the actual cause of congenital hydrocele of the neck. It is, moreover, very generally acknowledged to be the anatomical basis of certain forms of 'giant growth' in the lower limb. In some instances the lymphangioma has assumed the form of an isolated cystic tumour, and has, when in this condition, been incised, under the impression that it was a chronic abscess.

Such isolated tumours have been excised with success. Omitting these exceptional tumours, the treatment of lymphangioma cannot be considered apart from the conditions of tissue to which it leads, such as macroglossia, giant-growth, and the like.

A lymphangioma may involve the channels of a lymph-gland, and a large cystic tumour be in consequence produced. To such growths the term lymphadenectasis has been applied. Frederick Treves.

LYMPHANGITIS, or ANGIOLEUCITIS.—These terms are applied to an inflammation of the lymphatic vessels. The inflammatory process is not necessarily limited to the lymphatics. Indeed, in nearly every instance of lymphangitis there is a visible implication of the corresponding glands. In the milder forms this implication may, however, be so slight that its effects may not be perceptible. The terms are conveniently applied to cases where the inflammation of the lymph-vessels is conspicuous, and is—for a time at least—predominant.

Causes.—Lymphangitis is in almost every instance secondary. Some irritative process is excited among certain lymph-radicles; an inflammation follows, which runs along the lymphatic vessels. The primary lesion is usually inflammatory, and depends upon a wound, stab, prick, or abrasion, or upon some ulceration or purulent collection. Lymphangitis has, however, followed upon simple sprain, and even upon long-continued or rough friction of the skin. Cases of sunburn—especially when involving the forearm—are often associated with quite an extensive lymphangitis of slight degree. The larger lymphatic vessels may be involved by the direct spreading to their walls of some inflammatory process in their vicinity. Some individuals are much more liable to lymphangitis than others, and especially those who are in feeble health, or who are the subjects of Bright's disease, or who have been debilitated by alcoholism. The disease is more common during youth and adult life than during childhood and in old age. The local exciting cause may be very trivial—a slight scratch, a minute puncture, the sting of an insect. In many cases it has probably been overlooked, and the lymphatic trouble regarded as primary. Lymphangitis is especially apt to occur when the body has been inoculated with decomposing animal matter (*see* POISONED WOUNDS). It is often met with, therefore, in medical men, in those engaged in dissecting, in butchers, cooks, &c. In suppurative affections, it is most commonly met with in cases where pus is closely retained. It is more likely to attend a minute abscess of the finger, where a bead of pus is retained, than the large suppurating surface of an amputation flap. There are certain forms of lymphangitis due to specific poisons, as illustrated by those attending erysipelas, malignant pustule, glanders, pyæmia, &c.

Pathology.—The inflammation most conspicuously involves the outer coat of the vessel, and the mischief is peculiarly apt to spread to the adjacent connective tissue. The intima becomes opaque, and its epithelium degenerates.

The contents of the inflamed vessel are no longer clear. They often appear fatty, or even puriform. Sometimes the contained lymph coagulates, and the vessel becomes plugged. In slight cases complete resolution follows, the vessels remaining a little dilated for a while. In a severer grade of the disease, the walls of the lymphatics remain greatly thickened, the adjacent connective tissue is sclerosed, and the lumen of the tubes is narrowed or obliterated. The coagula—when they exist—may become organised, or may break down into a pus-like matter. In the severest cases of lymphangitis, the walls of the lymph-vessels and the connective tissue outside those walls suppurate, pus fills the interior of the lymphatics, and the involved parts may slough, or at least undergo extensive destruction. Suppurative lymphangitis is often the starting-point for a severe and wide-spread inflammation of the cellular tissue. *See* CELLULITIS.

Symptoms.—To take a typical case. Let it be supposed that a man has an abrasion upon his knuckle, which becomes infected with some putrid matter. For one or two days nothing takes place, then about the wound an extensive red areola appears. This is due to implication of the primary lymphatic network (reticular lymphangitis). From this areola lines are soon to be seen running up the forearm to the gland above the inner condyle, and towards those in the axilla. These lines are of a faint pink, are sometimes straight, sometimes wavy, and always very narrow (tubular lymphangitis). They soon become painful on pressure, palpable to the touch, and usually in time form perceptible cords, while the redness over them becomes more diffused and less distinct. One or more glands will now be distinctly enlarged and tender, and, with the development of the glandular inflammation, the inflamed lymphatics will become less conspicuous. The affected parts of the limb are hot, and the seat of a burning or throbbing pain. If many lymph-vessels are involved, œdema will appear as a result of the blocking of the lymphatic channels. The disease may be ushered in with a rigor. There is a good deal of pyrexia, a feeling of malaise, and a certain amount of prostration. At the end of a few days or a week the inflammation subsides, and the parts are restored to their normal condition. As a rule, the œdema,

when it exists, is slow to disappear, and usually the adenitis persists for a while, and often runs on to suppuration. In other cases the areola around the wound may be very slight: there may be little reticular lymphangitis. There may be tracks of tissue free from all evidences of disease between the wound and the inflamed lymph-canals, or between this tubular lymphangitis and the enlarged glands. The trouble may pass on to suppuration. This may spread, and involve extensive tracts of the subcutaneous cellular tissue. More frequently the suppuration occurs in the glands, and in either case the condition may lead to septicæmia or pyæmia.

When the deep lymphatics of a part are involved, the redness may be absent or present only in patches. The pain will be very severe, and the part very tender. There will be much swelling, which will be more or less diffused. When suppuration occurs in these cases, a very grave cellulitis may ensue. In any case the lymph-vessels may become occluded, some lymph-œdema may persist, and the part become brawny and hypertrophied.

The prognosis in lymphangitis is good. The only risk to life depends upon the suppuration, and death may ensue from any of the fatal issues that may attend suppuration. Other things being equal, it may be said that the nearer the lymph-disturbance is to the periphery, the less grave is the morbid condition,

Treatment.—The primary cause of the lymphangitis should be sought for and carefully treated. Any collections of pus at the primary focus should be freely opened, and, after having been well washed with a solution of carbolic acid or corrosive sublimate, the part should be treated with a charcoal poultice. The freest vent must always be given to the pus. Unhealthy wounds should be cleansed in the same way, and then dressed with iodoform powder, or poulticed if they are sloughy and not suppurating freely. To simply abraded surfaces evaporating lead lotion may be applied. The affected part must be kept at rest. If a limb be involved it should be raised. No application seems to better suit the parts—the actual seat of a lymphangitis—than an evaporating lead and spirit lotion, or the free application of belladonna. Any severe tension, and any suppurative focus, should at once be relieved by free incision; and at some hospitals the practice obtains of still applying cold after the matter has been evacuated.

Quinine should be given, and to this drug perchloride of iron may be added in a few days. Any swellings that may persist will probably be relieved by position, by friction or *massage* of the parts, or by the continued application of the elastic bandage. FREDERICK TREVES.

LYMPHOMA. *See* LYMPHADENOMA.

LYMPHORRHŒA or LYMPHORRHAGIA.—These terms are employed to denote an escape of lymph upon the surface of the body through an abnormal opening in a lymphatic vessel. In almost every wound lymphatics must be cut and lymph escape. The fluid, however, being translucent and very trifling in amount, and mixed at the same time with blood, is not perceived. The flow of lymph from a wound, moreover, would appear to very soon cease. In wounds of large lymphatic trunks, as in a punctured wound of the groin, where no blood-vessel of any size has been pricked, the escape of lymph may be sufficiently copious and sufficiently long-continued to attract attention. Instances, however, of this occurrence are exceedingly rare. In lymphorrhœa the discharge of lymph is very copious. It comes away in drops, and many ounces, and even several pounds, may escape in the course of twenty-four hours. It is probable that in every case there is some abnormality or disease of the lymphatic system. The state of the lymph-vessels may be similar to that of the blood-vessels in hæmophilia, or there may be some obstruction in the tube above the seat of the fistulous opening. With regard to this latter point, it may be noted that lacteals have been found ruptured after closure of some of the main vessels by the pressure of a tumour; and immense quantities of chyle and lymph have been thus poured into the peritoneal cavity. In by far the greater number of the cases of lymphorrhœa the involved vessels are dilated or varicose (*see* LYMPHANGIECTASIS), and, indeed, comparatively few cases of lymphorrhœa have been reported where this condition of the vessels has not been apparent. Lymphorrhœa has occurred after wounds, after slight operations such as venesection, after the opening of abscesses, and after incisions into inflamed and enlarged glands. It has occurred also from the surface of an ulcer.

In many cases varicose lymph-vessels have ruptured spontaneously, or have been cut into—when very large—under an erroneous impression as to their nature. Lym-

phorrhœa has followed the spontaneous bursting of a gland-abscess, and of small purulent collections the result of suppurative lymphangitis. The condition has been most frequently met with in the lower limb, and especially in the groin or thigh. The lymph escapes drop by drop, in the form of a clear, colourless fluid, which may sometimes have a faint yellowish or reddish tint, and occasionally an opalescent appearance. It usually flows more freely during movement and when the patient is standing. It varies in quantity from time to time without apparent reason. In certain instances as much as five pounds is said to have escaped in twenty-four hours. More usually, the amount escaping in a day would be a matter of ounces. The fluid coagulates into a flimsy clot, and hangs from the wound like a whitish fungus. In one or two instances of lymphorrhœa from the scrotum or groin the escaping fluid has been milky, and in these cases some abnormal communication with the lacteals or the thoracic duct has been assumed.

Lymphorrhœa only affects the health when it is profuse and long-abiding. When due to wound and involving a normal vessel, the discharge very soon ceases. When, however, the vessels are dilated or varicose, and when the abnormal opening has formed spontaneously, a very troublesome fistula is apt to be left, which may become more or less permanent.

In *treating* these cases, the limb should be raised and the part placed at rest. The skin should be kept cool, and the extremity compressed by an elastic bandage lightly applied. The fistula may be induced to close by long-continued pressure, applied by means of a truss or a pad and bandage; or, failing this, its margin may be touched from time to time with the actual cautery. Beyond this little can be done, and any attempt at a plastic procedure would probably end in failure. The patient's strength should be supported by tonics and a liberal diet.

FREDERICK TREVES.

LYMPHO-SARCOMA. *See* LYMPHADENOMA.

LYMPH-SCROTUM. *See* ELEPHANTIASIS ARABUM.

END OF THE FIRST VOLUME.

DICTIONARY

OF

PRACTICAL SURGERY

M——Z

DICTIONARY

OF

PRACTICAL SURGERY

BY

VARIOUS BRITISH HOSPITAL SURGEONS

EDITED BY

CHRISTOPHER HEATH, F.R.C.S.

HOLME PROFESSOR OF CLINICAL SURGERY IN UNIVERSITY COLLEGE, LONDON
SURGEON TO UNIVERSITY COLLEGE HOSPITAL; MEMBER OF THE
COUNCIL AND COURT OF EXAMINERS OF THE ROYAL
COLLEGE OF SURGEONS OF ENGLAND

VOL. II.

MACROGLOSSIA—ZYGOMA

PHILADELPHIA:
J. B. LIPPINCOTT COMPANY.
1886.

DICTIONARY

OF

PRACTICAL SURGERY

MACROGLOSSIA is an enlargement of the tongue, which may be pronounced of congenital origins inasmuch as, although not always making itself evident in the earliest months of life, it is due to some innate defect of some of the tissues of which the tongue is composed, and is almost always noticed within the first two or three years after birth. It is not hereditary, and is generally symmetrical, though sometimes the hypertrophy is more pronounced upon one side than the other; and it occurs more frequently in females than in males. It does not interfere with the power of suction, and the children are not, therefore, necessarily debilitated. The rate of progress is not uniform, but the length, breadth, and thickness of the organ are involved, so that it has been known to measure as much as 6½ inches along the dorsum of the part protruding beyond the upper lip, and as much as 10 inches in circumference at the base. As a result of this enlargement, the teeth of the lower jaw may be rendered carious and fall out, or they may be thrust forward from a vertical into a horizontal position, while, so great is the result of the constant pressure, that the lower jaw may be actually dislocated. In consequence of the protrusion the saliva constantly dribbles from the mouth, and articulation is very defective. Sometimes the enlargement extending backwards causes interference with respiration. The subjects of macroglossia are not infrequently epileptic.

Cause.—When the condition is noticed at birth, it is due to congenital hypertrophy of all the tissues of which the tongue is composed, but the abnormal size of the organ is often not observed until after the first year or two of life, or even later (it has occurred in a patient at 40), and may then be aggravated, if it is not actually originated, by some irritation, such as that caused by the pressure of the lower incisors in the act of sucking, or by the presence of a ranula, or by a bite during a fit, or injury from a fall upon the chin. Under such circumstances inflammation, though it may be but slight, precedes the condition of hypertrophy which causes the protrusion, and the swelling is aggravated by a condition of chronic glossitis, which results from the irritation due to exposure and strangulation by the lips and teeth.

Pathology.—In those instances in which portions of the tongue have been removed from very young children on account of this condition, a simple hypertrophy of all the tissues, of the muscles, cellular tissue, mucous membrane, and papillæ has been found; but in those which have occurred as a result of any irritation, there exists a close analogy with the condition of elephantiasis of other parts of the body, a form of lymphangioma characterised by thrombosis and consequent dilatation of the lymphatic vessels. The connective as well as all other tissues is greatly increased and is infiltrated with numerous white cells, which are aggregated, and especially upon the under surface, in a delicate reticulum of lymphoid tissue, presenting saccular dilatations, which show themselves on the surface as small irregular conical elevations. Externally the upper surface is dry, brown, and covered with fissures or small ulcerations. The papillæ are elevated and coated with a crust of epithelial *débris*; the veins on the under surface are large, tortuous, and unevenly dilated.

Diagnosis and Symptoms.—The subject of this deformity has an imbecile expression, though the functional powers of the brain

may be healthy. The tongue hangs forward over the chin, and its surface is constantly dry and the papillæ are prominent. Small hæmorrhagic puncta are seen beneath the mucous membrane, and between the elevations are sores and fissures. The tongue can by an effort be drawn into the mouth, but, except when voluntarily retracted, it is habitually protruded. The oral passage being obstructed, breathing is performed chiefly through the nostrils, which are, therefore, dilated. The constant dribbling of saliva causes a rough, red, eczematous eruption on the skin covering the chin. If punctured, the exudation will appear more serous than bloody. This condition has first to be distinguished from that of acute glossitis, in which the history of some injury or cause, and the rapid onset of the swelling, together with the pain, the glazed appearance of the surface of the organ, which is observed to fill the cavity of the mouth but to protrude but little from it, point to the true nature of the affection. A condition for which true macroglossia has been mistaken, and for which amputation has been erroneously performed, is that which is seen in some idiotic children, particularly in those who are described as 'sporadic cretins,' in whom the mouth remains open, and the tongue lies between the gums or even is advanced beyond them; but the vacant look and absence of all expression, the small forehead and general dwarfed appearance, added to the fact that the size of the tongue does not undergo any increase, should obviate this mistake.

Treatment.—Compression has in many cases effected a cure, and should, at all events, be given a fair trial. This is best accomplished by strips of isinglass plaster placed round the organ, much in the manner of strapping a testicle. Beneath this, small strips of calico, which have been steeped in a solution of alum, tannin, or some other astringent, may be wound round the tongue; or a linen bag may be made to fit the protruded portion and be tied behind the head with tapes. When the tongue can be retained in the mouth, the chin should be supported by a bandage secured over the vertex, and the mouth thus kept constantly closed. All these means are, however, difficult of application, and the alternative of excision will in most cases have to be resorted to. This is best performed by excising a V-shaped portion, with scissors or a bistoury, from the end of the elongated member. The hæmorrhage is not severe, and the vessels are easily secured with catgut ligatures, when the edges of the wound thus made can be brought together by one or more silver wires passed deeply through the substance, thus drawing the parts firmly together, while the edges are superficially united by means of fine wire or horsehair. This is more likely to obtain primary union than any other method, but the écraseur or galvano-cautery may be used with the same purpose. The period at which operation is to be resorted to should, if possible, be before dentition has commenced, and the sutures should be removed before suppuration in their track has occurred. The introduction of setons or the injection of astringent fluids is worse than useless. As regards medicinal remedies, there is some advantage in putting the patient on cod-liver oil and some preparation of iron. JOHN H. MORGAN.

MADURA FOOT. *See* FUNGOUS DISEASE OF INDIA.

MALACOSTEON. *See* OSTEOMALACIA.

MALAR BONE, Fracture of the. *See* FACE, Fracture of Bones of the.

MALIGNANT PUSTULE (*Synon.* Anthrax Charbon, Woolsorters' Disease, Mycosis Intestinalis) is a specific affection caught from animals suffering from splenic fever, a disease which occurs sporadically in cattle in this country, but is endemic and very fatal in many other parts of the world. Graminivorous animals, and especially horned cattle, sheep, and horses, are liable to splenic fever, and the disease may spread to those who have to tend the beasts when alive, or to handle their hides and flesh after death. It is in the latter mode that the infection is usually conveyed in this country, where, of late years, the disease has occurred with some frequency among the tanners of foreign hides in Bermondsey, and the sorters of Van mohair in Bradford. It has also been observed in those who have eaten the flesh of infected animals, and instances are on record in which the disease has been communicated by butter or milk, or by the bites of flies. There are two forms of the disease, the external and internal.

1. The *external* form is the one which usually comes under the notice of surgeons. It is generally seen as a characteristic eschar, to which the name *malignant pustule* has been very incorrectly applied, for one of the peculiarities of the disease is an entire absence of pus-formation until the throwing off of the slough. From a few hours to several days, or even weeks, after the contagious material has come into contact with the skin, a small itching red

pimple appears upon some exposed part of the body, such as the face, neck, or arm. A vesicle soon forms upon the papule, containing serum and frequently a little blood. This is either opened by scratching or dries up. Meanwhile the papule grows and becomes an indurated red area, upon which other vesicles form around the first. As the disease progresses, the earlier vesicles sink down, and a slight central depression of a dark dingy purple colour appears, surrounded by a ring of closely set pearly vesicles, two or three deep. This indurated area may attain a diameter of more than an inch. It is usually elevated one-eighth of an inch above the healthy skin around, and the central depression is about one-twentieth of an inch below the level of the adjacent vesicles. Soon, the parts around become slightly flushed, swollen, and œdematous; and this swelling may be so great as to level them with the indurated area, which, however, can always be distinguished by its appearance and hardness. At the same time the lymphatic glands enlarge; but this may be in a great measure concealed by the brawny œdema of the subcutaneous tissues, which is often accompanied, as the disease progresses, by some livid discoloration of the part. There is a remarkable absence of pain in and around the eschar, pricking or a slight gnawing sensation being usually all that is felt.

Constitutional symptoms set in from a few hours to eight or ten days after the appearance of the papule. They bear no exact relation to the amount of local trouble. There is pallor, and in bad cases, cyanosis, with languor and a feeble pulse. Dyspnœa may be observed upon slight exertion, and occasionally there is a cough, or a sense of constriction of the chest. Vague pains and stiffness are complained of in various parts of the body, with chilliness or even rigors. There may be sleeplessness, restlessness, headache, giddiness, and more rarely delirium. In some cases the nervous symptoms are more severe. Convulsions or tetanic spasms occur, followed by coma. In others, the intellect is clear and the voice strong to the last. There is usually loss of appetite, and sometimes vomiting or diarrhœa, with abdominal pain. The temperature is often high, but it is subject to rapid variations. The patient may sink into a typhoid condition and die exhausted, but more often death is the result of sudden syncope, or, where some part of the neck has been the seat of local mischief, œdema glottidis supervenes and proves fatal by asphyxia. Death usually occurs within five or six days from the beginning of constitutional infection. In favourable cases the general health is not seriously affected. The vesicles may dry up in a few days, and form a black slough, which is separated and cast off by ordinary inflammatory processes.

In some patients, the ring of vesicles may be absent from the eschar, which then consists of a well-defined firm elevation, of a pellucid red colour, with a dingy purple central depression. Except that it is much harder, this form may bear rather a close resemblance to a nævus. A rare variety of the external form is *malignant œdema*, which is said to occur sometimes as a primary disease in those who have eaten the flesh of infected animals, or have inhaled the poisonous matter through their lungs. Beginning as a soft, doughy, pale swelling of moderate extent, it spreads rapidly at its circumference. Vesicles are not always present, and when they appear, are scattered irregularly over the surface. Constitutional symptoms rapidly follow the development of the swelling.

2. The *internal* form presents symptoms which are in most respects identical with those which indicate constitutional infection in the other variety. In this country the *woolsorters' disease* has usually assumed this form. According as the contagion has been received by the lungs or alimentary canal, the disease may take the form of a broncho-pneumonia or gastro-enteritis. In either case it is generally accompanied by great prostration and mental depression; frequently, also, there is lividity of the lips and nails, or more general cyanosis without any physical signs to account for its presence. The incubation may last from two to ten days or even several weeks, and the majority of the cases end fatally in a few days. Occasionally the internal variety is followed by the development of the malignant pustule or œdema upon the skin.

Pathology.—The essential feature of this disease is the presence of a micro-organism, the *bacillus anthracis*, in the tissues. Under the microscope this is easily seen as a well-defined cylindrical body, of a much larger size than the bacteria which are usually found in decomposing matter. The diameter is generally about $\frac{1}{18000}$th of an inch, while the length varies from $\frac{1}{2000}$th to $\frac{1}{1400}$th of an inch, and here and there much longer filaments may be observed. Most of them are straight, but a few are curved or bent at an acute angle. Upon careful examina-

tion some are seen to contain transverse markings, and they have a tendency to break up into segments at these points. Ovoid spores may sometimes be seen in their interior, and occasionally collections of these spores are found in the adjacent tissues. In the external form, the central parts of the eschar are dried up to a leathery substance, while the surrounding skin and the subjacent tissues are infiltrated with fibrinous exudation. Small patches of ecchymosis occur in the deeper layers of the corium, and sometimes in the muscles beneath, but nowhere is there any appearance of pus. The vessels are not affected. The adjacent glands are swollen, and sometimes ecchymosed. The characteristic bacilli, with their spores, abound in the fibrinous exudations beneath the Malpighian layer of the eschar. They are also found in the superficial strata of the corium, and outside the sheaths of the hair-follicles. Although they are probably conveyed by the blood to the other parts of the body, it is rare to find them in the vessels near the eschar or in the blood of the patient during life.

In the bodies of those who have died from either the *internal* or *external* form of the disease, the surface is generally cyanosed and there are signs of rapid decomposition, the blood is thick and dark and does not coagulate. Small hæmorrhages are found in the viscera, and under the mucous and serous membranes. Effusions of blood and serum are met with in the pleural, peritoneal, and other serous sacs. The lungs are congested or inflamed, with nodules of ecchymosis upon the surface or in their substance. In some cases there is œdema of the upper part of the larynx. Blackish raised patches, formed by extravasated and decomposing blood and somewhat resembling the external eschar, may be found studded over the internal surface of the stomach and intestines. They are surrounded by gelatinous infiltrations of the mucous membrane, and in many cases the process of separation by sloughing is already far advanced. The liver and spleen are often large, congested, and softened, and the mesenteric glands may be swollen and ecchymosed. Hæmorrhages may be found in the cerebral and spinal meninges. Upon microscopic examination, the bacilli are found abundantly in the patches of ecchymosis and the surrounding infiltrations. In cases which recover from the constitutional infection, the writer has seen the bacilli in the sputa, sweat, fæces, and urine.

Diagnosis.—In most cases, the characteristic eschar of the external form is easily recognised. The raised indurated area, with its central blackish depression surrounded by a ring of closely-packed vesicles, can hardly be mistaken for any other affection. Further confirmation may be obtained from the painlessness of the swelling, the occupation of the patient, and the finding of bacilli in the serum obtained by scraping the vesicles. The disease is sometimes confounded with a boil or carbuncle, and especially with the acute and very dangerous form of the latter which sometimes attacks the face. Both these affections, however, are from the first painful, and they soon show evidence of suppuration. In the same way, it will usually be easy to distinguish it from an ordinary poisoned wound. When the vesicles are drying up, it may somewhat resemble a chancre of the face, but the history of the case, the rapidity of development, and the absence of tenderness would usually suffice for the recognition of malignant pustule. When the soft parts are much affected, its appearance may approach that of erysipelas or cellulitis, especially where the eschar is small, or, in the case of malignant œdema, where it is absent. Here, however, the occupation of the patient would afford a clue, and a microscopic examination of the serum would probably show the presence of bacilli. There is also a peculiar pallor and a tendency to the formation of cyanotic patches, which is not observed in ordinary cellulitis. In the internal form the diagnosis of isolated cases is very difficult, and they may easily be mistaken for ordinary pneumonia when the lungs are primarily affected, and for enteritis or typhoid fever when the intestines are chiefly attacked. But when several cases have occurred, or where the occupation of the sufferers makes it probable that they have been exposed to the contagion, the peculiar and sudden prostration, together with the tendency to a cyanotic condition, for which the physical signs afford no satisfactory explanation, will be enough to suggest the true nature of the disease, and further evidence may be obtained by the microscopical examination of the blood and excretions.

Treatment.—In the *external* form, it is of the utmost importance to destroy or remove the whole of the indurated area which forms the primary eschar. This is most effectually done by the knife, and care should be taken to dissect away the whole thickness of the affected skin, together with about one-eighth of an inch of the, apparently healthy, adjacent tissue.

When the hæmorrhage has been checked by pressure or ligature, the exposed surface should be examined, and if it should present any appearance of discoloration or ecchymosis, some cauterising agent should be employed, such as chloride of zinc paste (i.e. one part of the chloride to three of flour), or potassa fusa, or the thermo-cautery. In Turkey, where the disease is frequent, the usual plan is to destroy the whole eschar with the actual cautery; and in France the use of potassa fusa, for this purpose, has been strongly recommended by Bourgeois. Success has also followed the subcutaneous injection of the liquefied crystals of carbolic acid. It is generally desirable to have ether or chloroform administered, but where the patient objects, or where his languid and cyanotic condition indicates that an anæsthetic would be dangerous, the operation can be performed without this assistance, and it is not attended with much pain. The wound should be dressed with carbolised oil, or boracic acid ointment spread on lint.

Recovery usually follows the removal of the primary lesion, even when the swollen state of the parts around and of the adjacent glands, together with severe constitutional disturbance, proves that the disease is no longer local. Probably, the eschar acts as a nursery from which the infective material passes into the system, and after excision the patient is in a better position to throw off that which has already passed into the circulation. In some cases, in which the surrounding œdema is already excessive, or in which after excision the swelling still spreads, it may be necessary to incise freely the swollen tissue, or resort may be had to the subcutaneous injection of some antiseptic fluid, such as an aqueous solution (1 in 20) of carbolic acid. The same treatment would be required in malignant œdema. Constitutional symptoms should be treated by absolute rest in bed, with a plentiful supply of animal food, such as beef-tea, milk, and eggs. If the heart's action is weak, ammonia and alcoholic stimulants should be freely given. Large doses of quinine are beneficial. The internal administration of sulphite of sodium in 10-grain doses has been recommended, on account of the success which has attended its use in the splenic fever of animals. Where there is evidence of obstruction to respiration from œdema glottidis, laryngotomy should be performed. The subcutaneous injection of morphia may be required in those cases in which sleeplessness is a distressing symptom, and opium may be called for to check the diarrhœa produced by the gastro-intestinal lesions. Where the lungs are affected, senega and other expectorants will be useful, and the patient may be made to inhale air charged with carbolic acid or some other antiseptic agent.

N. Davies-Colley.

MALIGNANT TUMOURS.—All malignant tumours are either Sarcomata or Carcinomata, and display their malignancy in similar ways, though to a very varying extent. For, whilst an innocent tumour may, by its weight, size, and position, become dangerous to the comfort and life of the patient, malignant tumours destroy by other means as well. Malignant tumours differ from innocent growths in the following particulars:—1. Mode of growth; 2. glandular affection; 3. dissemination; 4. interference with the general health; 5. local recurrence after removal.

1. Mode of Growth.—All malignant growths tend to *infiltrate* the tissues in which they grow, and it is in their growth by infiltration that they essentially differ from the innocent tumours. They may also be said to grow at their *periphery*, innocent tumours from their *centre*; and, although this is not absolutely true, perhaps, in all cases, still it is a broad fact which generally holds good. In consequence of this infiltration and peripheral growth, malignant tumours are practically never encapsuled, although to the naked eye they may sometimes appear to be so, but actually blend with, and are inseparable from, the tissues in which they develop. They never simply push aside the structures amongst which they grow. This infiltration is more marked in the carcinomas than in the sarcomas, and the latter are, at times, apparently encapsuled; whilst, at the growing edge of the former, the remains of the surrounding structures may be seen entangled in the tumour-growth. But, in addition to its infiltrating mode of growth, a malignant tumour increases with much greater rapidity than does an innocent one. Its blood-supply is large, its cell-multiplication rapid, and within three or four months it may attain a considerable size. The skin covering such a growth is at first simply stretched over it; then, especially in the carcinomas, it becomes dimpled and puckered by the inclusion of the subjacent tissues; and finally, becoming itself infiltrated and adherent, allows of the protrusion of a fungating mass. This protruding growth is often foul-smelling, very vascular, and readily bleeding; and the patient is worn out by the combination of septic conditions with profuse discharge of

blood and pus. Large fungoid masses occur, especially in connection with rapidly growing tumours; for, where the growth is slow, it ulcerates and disintegrates on its exposed surface almost as rapidly as it is produced. This is very evident if an encephaloid cancer be compared with an epithelioma.

A malignant growth may become the seat of inflammatory changes; suppuration and the formation of a definite abscess within the tumour may occur. All the usual signs of inflammation may be present, and the abscess may point and burst, in just the same way as a similar collection of pus in an otherwise healthy tissue. This is especially common in the case of lymphatic glands the seat of new growth secondary to epithelioma.

2. Glandular Affection.—One of the best marked and most widely recognised evidences of malignancy is found in the affection of the neighbouring lymphatic glands. This glandular affection has nothing whatever to do with inflammatory processes, for, although the latter may be present, they in no way bear evidence to the malignancy of the growth. The glands are affected by the production in them of new growth, precisely and in all respects similar to, and identical in structure with, the original tumour; so that in the glands are reproduced, with the most perfect mimicry, all the little varieties of structure met with in the original cancer. Innocent tumours do not so affect the glands.

But although glandular affection may be said, in general terms, to be of common occurrence in the cancerous growths, the question whether the glands shall be so diseased in any given case depends upon two conditions—(*a*) the character, and (*b*) the locality of the growth.

(*a*) *Character.*—Speaking generally, it may be said that the carcinomata much more frequently cause glandular infection than do the sarcomata; but that, of the carcinomata, the rodent ulcers practically never infect the glands, and the adenoid carcinomata not nearly so frequently as the other groups of the same class. The epitheliomata and spheroidal-celled carcinomata most generally cause glandular affection. The sarcomata, on the other hand, do not as a rule affect the glands—i.e. when they occur in those situations in which they most generally come under the notice of the surgeon, as apart from the physician. But one variety, nevertheless—the melanotic sarcoma—does, almost invariably, cause glandular infection.

(*b*) *Locality.*—Carcinomas in certain localities rarely affect the glands. This is especially true of all the varieties that are found in the œsophagus, stomach, and intestines, as well as in the superior maxillary bone. Sarcomata of the testis, the tonsil, and of the mediastinum, always result in glandular affection, as do, more rarely, similar growths in other situations; whilst sarcomata of the breast, of the subcutaneous tissues, and those growing in or around the bones, almost never infect the glands.

3. Dissemination.—Although malignant tumours, as a whole, are prone to cause metastatic growths, this phenomenon, like glandular affection, is influenced by—(*a*) the character, and (*b*) the situation of the tumour.

(*a*) *Character.*—Rodent ulcers never tend to become disseminated. Epitheliomas and adenoid carcinomas do not become disseminated nearly so frequently as do the spheroidal-celled carcinomas, and, of these latter, the scirrhous growths are less liable to dissemination than are the encephaloid tumours. Of the sarcomas, the round and mixed-celled groups are those which are the most likely to be associated with metastatic growths, and the melanotic variety is in this respect of a very malignant nature. The spindle-celled sarcomas often become disseminated, but not so frequently as the above groups. And, still speaking of the sarcomata, it may be said that the more the tumour tends to become developed into one of the higher forms of adult tissue, the less likely is dissemination, so that the fibro-sarcomata often do not become disseminated at all.

(*b*) *Locality.*—But, whilst laying due stress on the influence which the structure of the growth exercises upon the question of its dissemination, it must clearly be borne in mind that its locality is also of great importance. Thus, epitheliomas of the lip and vulva are much less liable to become disseminated than are those of the tongue. Carcinomatous growths of all kinds, occurring in the œsophagus and stomach, often run their entire course without metastasis, whilst precisely similar growths, in the testis or in the breast, are extremely prone to become disseminated. So also with sarcomas. Thus, round-celled sarcoma of the testis tends to become most rapidly disseminated, and is altogether of a very malignant nature; whilst a similar tumour in the parotid gland is practically never followed by metastasis. Fibro-sarcomas of the skin and subcutaneous tissues often

run their entire course without occurring in distant organs. Similar tumours in the breast follow a like course, whilst those fibro-sarcomas which occur under the periosteum of the long bones tend to become widely disseminated, and run a very malignant course.

4. Affection of the General Health. There can be no doubt that, in the growth of malignant tumours, the general health does often become very markedly affected, and that, more particularly, the patient loses weight to a very considerable extent. This wasting and loss of health were formerly supposed to indicate a cachectic condition that was typical of cancer; and although this is no longer generally accepted, it is certainly a fact, that a patient with a malignant growth often wastes to an extent which is out of all proportion to the apparent demands made by the disease upon his vital resources. As the growth increases in size and the viscera become the seat of secondary tumours, the emaciation and weakness become more marked. Special symptoms will be developed according to the particular viscus diseased.

5. Local Recurrence. — Almost all tumours which show their malignancy in one of the ways already mentioned, are also prone to recur locally when removed; but many other growths which do not tend to become disseminated or to affect the health of the patient, do tend to recur locally and sometimes to affect the glands. Such growths as these are said to have a 'limited malignancy,' and the chief of them are the fibro-sarcomas or recurrent fibroids of the skin and subcutaneous tissues, the rodent ulcers, and, to a less extent, the epitheliomas of the skin surfaces of the body and of the lips. In the section on etiology this question of recurrence will be alluded to, and here the writers will merely say that the liability to recurrence is apparently more than can be accounted for by simply inefficient removal, though this is undoubtedly accountable for a return of disease in many instances. These recurrent growths, when sarcomata, appear to run one of two pretty definite courses—either the interval that elapses between removal and recurrence of each recurrent tumour steadily diminishes, or else it tends to increase. So that a growth may recur at intervals of six, three, and two years, then after a few months, and then in the wound before it is soundly healed. Or, on the other hand, after two, three, or more removals the tumour may never reappear. The former is unfortunately by far the more common of the two alternatives. When the period of time that elapses between each removal tends to diminish, it will often be found that the character of the tumour varies with each removal, so that whilst the first growth may have been a fibro-sarcoma, the others gradually become more and more cellular, and the last is perhaps composed of nothing but spindle and oval cells. Yet the tumour may never become disseminated.

Etiology of Malignant Tumours.—It must be owned at the outset that our knowledge of the causation of sarcomata and carcinomata is very defective—in fact, that it is almost entirely hypothetical. There are, nevertheless, several well-ascertained predisposing and exciting causes, which may be shortly discussed.

(1) *Inclusion Theory*, or embryonic hypothesis of Cohnheim.—This theory may be briefly stated as follows. At the time when the various tissues are becoming differentiated in the embryo, it is supposed that more cells may be produced than are required for the proper formation of the growing tissue or organ; that, not being utilised, they may remain in the locality in which they originally grew, and may become enclosed and surrounded by the fully-developed structures in which they are placed. This small mass of germinal embryonic cells may remain quiescent throughout the life of the patient, or may be lighted up into active growth either by the application of some artificial irritation, or by the normal physiological activity of the part excited in a natural manner.

With regard to this hypothesis, it is here enough to say that it is not sufficiently supported by either physiological or histological research to allow of its general acceptance, and that our knowledge of the life of the tissues renders it extremely improbable that masses of embryonic cells could remain in an unaltered condition—i.e. retain not only the formative, but also the vital and inherent properties of embryonic cells, whilst surrounded by tissues which are undergoing daily metamorphosis.

(2) Hereditary Influence.—It is a fact that, in a certain proportion of cases of 'cancer,' a history of similar disease in the same family may be obtained; and, considering that a very large number of patients are absolutely ignorant of the cause of death of even their near relations, it is quite certain that the ascertained proportion would be increased if accurate histories could be always elicited. It must be clearly borne in mind, however, that even if the hereditary nature of cancer were clearly proved,

this would in no way imply that cancer is therefore a constitutional or blood disease, for just as certain local affections, such as club-foot, hare-lip, multiplicity of digits, &c., may be transmitted from parent to offspring, so a purely local tendency to the development of cancer may be inherited. Such a mode of inheritance is clearly indicated in those cases where, not only is the tendency to cancer-development in general traceable, but even to development in the same situation in the offspring as in the ancestor.

(3) Effect of Injury or Irritation. Whilst the above theories relate to predisposing causes, the effect of injury or irritation may be considered as an *exciting* cause of tumour-formation. There can be no doubt, in the mind of any surgeon of experience, that the effect of injury or irritation in the causation of cancer is no mere hypothesis. How the injury acts is another affair altogether, and here it will suffice to point out merely some well-established examples of the effect of so-called *traumatism*. The occurrence of epithelioma of the lip or tongue is not infrequently preceded by the irritation of sharp teeth; of broken pipes, often very short, and consequently proportionately hot; of syphilitic or simple ulcers, or fissures, &c. Phimosis, and the consequent irritation of the glans and prepuce by retained secretion, may precede epithelioma of the penis. Sweeps' cancer results from irritation of the scrotum by soot; and other such instances will readily suggest themselves.

But, whilst long-continued irritation often precedes malignant growths, it should be especially borne in mind that it is the carcinomata that are specially likely to follow it. The occurrence of the sarcomata, on the other hand, possibly from their growing in the deeper tissues, is not materially influenced by irritations, but rather by direct and sudden injury, especially in the form of contusion. Thus, a blow on the testis may precede sarcoma of that organ, and a similar history is not uncommon in periosteal sarcomas of bone. Again, wrenches, sprains, and effusions of blood often precede the sarcomas of the soft tissues; and it is certainly to be noticed that, where the tumour is preceded by an injury, it is occasionally of a most malignant type. Further, the swelling caused by the injury in many cases does not entirely subside, but passes imperceptibly into the tumour-growth. With respect to this question of injury, it may here be pointed out that there is a definite form of tumour, allied to the sarcomata, which is always preceded by an injury and grows in a scar—namely, keloid. A keloid growth is composed of spindle cells and young connective tissue, and cannot be distinguished microscopically from a spindle-celled or fibro-sarcoma. It further resembles the sarcomata in the constancy of its recurrence after removal, and appears, on the whole, to be in the position of a connecting link between the sarcomata and the inflammatory new growths.

(4) Physiological Activity or Decline.—Both carcinomata and sarcomata frequently occur in places where active or degenerative processes are in progress. The sarcomata are found more particularly in connection with growing and developing, or functionally active, organs or tissues—e.g. at the epiphysial ends of the long bones, in the developing kidneys of infants, in the mammary gland during the years of its greatest activity, and in the parotid gland. The carcinomata, on the other hand, are more prone to develop in glands and tissues that are undergoing retrograde changes—e.g. in the breast and uterus towards the end of the child-bearing period, or later. Normally, in such organs there is a gradual disappearance of epithelial tissue, and if by any means its growth is again induced, the epithelium seems to be unable to grow in a natural manner.

So far the various causes which have been discussed are such as may be considered of a general character. But there are certain more definite conditions which influence greatly the *nature* of the malignant growth. The chief of these are—1. Age; 2. Sex; 3. Locality.

1. *Age.*—Speaking generally, it may be said that sarcomata occur in the young and middle-aged, carcinomata in the middle-aged and old.

2. *Sex.*—In addition to those peculiarities which are dependent upon differences in the sexual organs, certain malignant growths of parts, that might be called indifferent to either sex, are very differently predisposed to tumour-formation in the male and the female. Thus, epitheliomas of the lip and tongue are much more rare in women than in men.

3. *Locality.*—Whilst some organs and localities are frequently attacked by sarcomata, the occurrence in them of carcinomata is unknown. This difference may be dependent upon the absence of any epithelium from which an epithelial growth can start, and is well instanced in the case of the long bones, for, in these, sarcomatous growths are frequent and carcinomata never occur.

On the other hand, the tongue is very rarely attacked by sarcoma, but frequently by carcinoma, although the elements for the development of each are present. Again, in two glands so nearly identical in structure as the parotid and submaxillary, one —the parotid—is frequently the seat of new growths of a malignant nature, the other but rarely. In a similar way, some bones are never attacked by sarcomata, others frequently so. Some organs—e.g. the lungs and spleen—are practically never the seat of primary cancer; others—e.g. the liver and the testis—are liable to be attacked by each of the two great classes of the malignant tumours.

Although all the preceding causes may be recognised as resulting in the production of malignant tumours, it is, nevertheless, difficult to understand the exact manner in which they act. Various explanations have been offered, but none of them are entirely satisfactory. In considering this subject, it must clearly be kept in mind that the most marked character in which any tumour differs from a simple overgrowth of the tissue is, that it grows *independently of the mother-tissue* from which it originated. Under normal conditions, the influence of the mother-tissue in determining the fate of any newly-formed cells cannot be too highly estimated, and is most clearly evident in many pathological and physiological processes. Thus, in the union of a fracture, it is the influence of the bone-tissue that causes the inflammatory exudation of leucocytes to become organised into bone; in wounds of tendons, the same influence is at work, and out of precisely similar cells tendon is formed. In the ordinary every-day process of nutrition, it is the influence of the mother-tissue that causes all growth and development to take place on the exact type of the pre-existing structure. In the growth of any tumour, but more particularly of a malignant one, it is this influence that is most notably absent. And it is readily conceivable that any given tissue or organ may, by an inherent instability of its structure, be disposed to tumour-growth, or that this instability and deficiency in control over the processes of growth or development may also be induced by any of the causes just enumerated.

But, supposing such a theory as the foregoing to be true, does it satisfactorily account for the apparently independent life of the tumour-cells, when transplanted into different organs from those in which they originated? If the cells were capable of growing in any organ to which they may be transplanted, as they seem to be at first sight, then tumours would be certainly inoculable, either in the same animal in which they commenced to grow, or in any other into which they might be transplanted. This, however, is not the case. If a portion of a growing tumour be transplanted into another animal from that in which the original tumour grew, it never attains any appreciable size, and acts in a manner entirely different from the original growth. Further, in the case in which secondary deposits occur in one organ and not in another, when, so far as can be ascertained, each has been equally exposed, we are justified in supposing that the exemption of the one is due to the fact that its tissue yet exercises a controlling influence over all cells that may be brought into contact with it.

Are the causes, then, that excite cell-growth to be neglected? Certainly not. For had no undue cell-growth been excited, no greater strain would have been thrown on the mother-tissue than it could have borne, and it is conceivable that the very multiplicity of the cells may tend to emancipate some of them at least. In this way the effect of an injury or irritation in producing tumour-formation would be of a twofold nature. Firstly, more cells would be produced than could be controlled by a mother-tissue previously deficient in vital power; and secondly, the injury might itself inflict the necessary damage on a tissue already predisposed. In a similar manner, the development of tumours at the growing ends of bones, and in functionally active glands, may be brought about by a greater increase in the number of the cells than can be properly regulated by a mother-tissue inherently predisposed to tumour-growth.

It will thus be seen that this theory involves a predisposition to tumour-formation in any given organ or tissue. This tendency may, as already explained, be inherited or congenital, but not necessarily so; for it is conceivable that the condition of a tissue may vary from time to time, and that tumour-growth only occurs when all conditions, both exciting and predisposing, are favourable.

Moreover, this theory assists us in understanding the *recurrence* of growths. These have hitherto been explained by supposing that certain cells are left behind, and that these in the future take on active growth. Such a theory appears very difficult of belief, and is open to the same objection as Cohnheim's inclusion theory. It

is scarcely conceivable that tumour-cells should remain in any organ or tissue for five, ten, or more years—for such times may elapse between removal and recurrence—and yet maintain their own individuality; besides, it is noticeable, in the sarcomata, that the cells of the secondary growth often differ materially from those of the primary one. It is much more likely that a sufficient amount of the surrounding mother-tissue is not removed, and that the same or a similar process of emancipation of cells from its influence again takes place as that which resulted in the production of the original tumour. Thus, when a carcinoma of the breast is removed, if the whole of the gland be not taken away, we know that the growth is much more likely to recur than if the operation had been a thorough one. The explanation of this would be that the whole gland was predisposed, and it was the influence of the remaining diseased part that reproduced the tumour.

Treatment.—There is but one treatment for a malignant growth—namely, removal. When once the diagnosis has been made, all palliative treatment must be abandoned. As a rule, removal should not be attempted unless (*a*) the whole of the disease can be taken away, unless (*b*) the glands are not too extensively affected to admit of similar radical treatment, and unless (*c*) there is reason to believe that no metastatic growths are present in the viscera.

In speaking of treatment, it is well also to mention that in not a few cases the development of malignant tumours can be obviated. Thus, no ulcer of the tongue, caused by either a sharp tooth or by syphilis, should be permitted to remain unhealed; increase in size of a previously quiescent wart or mole should be met by immediate excision; and whenever any reasonable doubt exists as to whether any given swelling is inflammatory or due to malignant growth, an exploratory operation should be undertaken without unnecessary delay, and if the case still remain doubtful, removal should certainly be recommended.

Treatment of Growths in Lymphatic Glands.—In all cases where the glands are evidently affected, they should, if possible, be removed. Such operations are often difficult, and, in their performance, the surgeon is liable to be led into much deeper and more dangerous regions than he might expect from an external examination of the growth. The frequency with which carcinomas in some localities affect the glands (especially carcinomas in the breast and on the lip and tongue), has caused some surgeons to advise that in all cases of carcinoma in such regions the glands in the neighbourhood should be removed. It is certainly true that, even where no diseased gland can be detected by the most careful manipulation, there may be nevertheless considerable glandular disease. Thus cases are not infrequent in which glands, hardened and enlarged, have been detected only after incision of the superjacent skin and fascia. And, in other cases, glands which, before being cut open, when handled free from the surrounding tissues, appeared entirely normal, have on section been found to contain minute masses of epithelial cells. Indeed, it is evident that, where the cancerous deposit is yet microscopic in amount, it cannot be detected by the naked eye. It follows, therefore, that in no case can it be certainly stated that the glands are not the seat of secondary growth.

Excision of a malignant tumour with a knife or other cutting instrument is the most usually applicable method of removal, the advantages being that a clean-cut surface is left, that the amount of tissue to be removed can be readily regulated, and that the whole operation is completed at once and painlessly.

Removal by caustics is not now so much resorted to as formerly, but there are not a few patients who will submit to the use of these agents, yet who will not tolerate a cutting operation. For such, this method is often applied with benefit, although otherwise, except in rare instances, it has no advantage over excision with the knife.

Electrolysis is useful in cases similar to those in which caustics may be used.

Prognosis after Excision.—From what has been already written in an earlier part of this article, it may be gathered that the prognosis varies according to the nature and situation of the new growth. No general rules are applicable to all cases.

Question of Partial Removal.—The question not infrequently arises whether an operation should be done, when it is evidently not possible to remove entirely either the original tumour or else the secondary growth in the glands, more especially in those cases where the patient suffers great pain, or where there is a large fungating and foul-smelling tumour. There can be no doubt that, in many such cases, partial operations are both justifiable and advisable. *See* Carcinoma; Sarcoma.

W. Morrant Baker.
Anthony A. Bowlby.

MAMMARY ABSCESS. *See* Breast, Diseases of the.

MARTIN'S BANDAGES are made of pure rubber, and are quite free from sulphur. They are used to exert pressure on tissues which are indurated owing to long-continued chronic inflammation and passive congestion, to compress joints and bursæ which are the seats of chronic effusion, and to support varicose veins; for the latter purpose they are admirable substitutes for elastic stockings.

Rubber bandages are largely employed in the treatment of callous ulcers of the legs, either to support varicose veins, if there be any, or to promote the absorption of the chronic inflammatory products in the edges of the ulcers. The bandages should be worn during the day only, and should be placed in direct contact with the sore; at night, the bandages should be removed and a simple dressing, free from grease, should be applied to the ulcer. The india-rubber bandages are spoiled by grease, so it is most important that ointments should not be used in combination with them. The bandages must be kept very clean; when removed at night, they should be well sponged with tepid water and then hung up to dry. In the morning, before the patient gets out of bed, the leg and ulcer should be washed and dried; the bandage should be applied in a simple spiral from the ankle to the knee, and care must be taken that it is laid on evenly, and only as tightly as can be done without stretching the bandage. When the patient gets up the leg will swell a little, and so stretch the bandage sufficiently to obtain all desirable compression.

The india-rubber bandages retain the perspiration, and the latter is often irritating enough to cause an attack of eczema in a tender skin; should this happen, the bandage must be discontinued and the eczema treated. The bandage may be subsequently tried cautiously, and it may be found that the leg has become tolerant of it.

As a support to varicose veins, the bandage must be applied as above described.

The bandages may be obtained in lengths varying from three to twenty-one feet; in breadths of two and a half or three inches, and in three different gauges of thickness. BILTON POLLARD.

MASON'S SPLINT for excision of the elbow consists of two pieces of perforated metal, moulded to fit the upper arm and forearm respectively, and so jointed as to permit the movements of flexion and extension at the elbow and of pronation and supination of the forearm. The splint should be applied to the inner side of the limb. Within certain limits it is possible to adapt it to the size of the limb for which it is required.

MASSAGE or SHAMPOOING. — *Definition.*—Massage consists of a more or less forcible kneading, pressure, or alternate compression and relaxation by the operator's hands, of the soft tissues of any part of the patient's body. Movement or manipulation of the joints is not included. *See* MEDICAL GYMNASTICS; BONE-SETTING.

Much mystery has generally been associated with the art of rubbing, from the fact that till recently few medical men have practically studied it. Hence, it has been too often left in the hands of so-called 'professional' or 'medical rubbers,' each of whom has been allowed to do as he liked, even when employed by a medical man.

Object.—In most cases, massage is employed to improve local nutrition in a wasted limb, to increase the circulation when languid, and to accelerate the reabsorption of effused products, the result of inflammation or chronic congestion.

Physiology.—Massage induces a more rapid flow of the blood and lymph in any given region of the body; this is chiefly due to contraction from irritation, followed by relaxation of the capillaries and smaller blood-vessels which are controlled by the vaso-motor nervous system, but no doubt the mechanical pressure has a direct influence on the larger veins and lymphatics. By perseverance with friction for a few minutes, the previously cold and clammy limb can be made to glow with natural warmth, an effect which will last for hours in some cases, in others for a few minutes only. If sufficient pressure is exerted in the rubbing, not only the skin and subcutaneous tissues are influenced, but also the deeper lying organs, as the muscles, &c. Rubbing is also employed in chronic constipation due to deficient peristaltic movements of the bowels.

Classification. — Massage has to be modified according to the effect it is desired to obtain, and can be roughly classified as follows:—

(*a*) For deficient or languid circulation, œdema, and chronic congestions of the extremities.

(*b*) For muscular paralysis or paresis.

(*c*) For perverted action or inactivity of the skin.

(*d*) For chronic thickenings around diseased or injured joints.

(*e*) For chronic constipation or obstruction of the bowels.

(*f*) For the relief of pain.

(*a*) *For deficient or languid circulation*, nothing is more efficacious than the manipulation known as '*fulling*;' it is effected by a rapid, transverse, to-and-fro gliding of the two palms alternately on opposite sides of a limb, which is at the same time as firmly compressed as possible. If the leg is to be 'fulled,' the operator begins close to the groin and gradually works his way down to the foot, rapidly moving the hands to and fro. The first time, the hands should be on the outer and inner aspects of the leg; the next, they should be placed higher on one side and lower on the other; the third time, this position is reversed; and finally, the hands are placed anteriorly and posteriorly to the limb. The patient must let the limb remain perfectly passive, so as not to resist the manipulation. 'Fulling' is done either on the bare skin or through some thin underclothing. In chronic congestions and œdema of the extremities, *firm strokings upwards* with the palms, used alternately, are useful; here the skin must be protected from abrasion by olive oil, vaseline, &c.

(*b*) *For muscular paralysis or paresis*, several manipulations are employed. '*Kneading*' is a combination of grasping with large pinching and pressure by the two hands, used alternately, so that whatever is left of the wasted muscles is thoroughly squeezed and moved about. In 'kneading,' the four fingers kept close together should act as one, against the thumb and its thenar mass; care must be taken really to reach the muscles by exerting sufficient pressure, at the same time that the skin is not unduly pinched so as to cause pain. In treating adults, the operator's labour is facilitated if he throws his weight into each grasp of the hand.

'*Circular friction by the thumb*' is most useful when the space occupied by the wasted muscle is small, as in the case of the anterior tibial muscles, or of those on the anterior and posterior aspects of the forearm, &c. It is, however, equally efficacious for large muscles, as the quadriceps extensor of the knee or the glutei. The operator's thumb-end is firmly placed on any given spot, and, while considerable pressure is exerted, small circles, a half to one inch in diameter, are described ten times from right to left and ten times from left to right. A spot an inch higher or lower, or to one side, is then treated in the same way, and so on until every part of the muscle or group of muscles has been thoroughly manipulated. The pressure exerted by the thumb can be increased, if necessary, by placing the other thumb on its nail. The skin must always be protected from abrasion as already described. The muscles of the forearm or the anterior aspect of the tibia require from ten to fifteen minutes to be thoroughly rubbed by this method.

Tapping or *beating* muscles with india-rubber hammers or flat-headed wooden sticks, much employed on the Continent, is less efficacious than the human hand properly instructed.

(*c*) *For perverted action or inactivity of the skin*, simple rapid to-and-fro frictions with the palms, with or without oil, employing but slight pressure, are easily carried out.

(*d*) *For chronic thickenings around diseased or injured joints.* — Upward '*gliding friction*' firmly applied with the palms and fingers around the whole joint, following its contour and the course of the adjacent tendons, is most beneficial; here also the skin must be protected by oil, &c. Fifteen to twenty minutes should be devoted daily to a large joint such as the knee.

(*e*) *For chronic constipation or obstruction of the bowels*, massage is most useful when the large intestine is at fault. The patient should lie on the back with the head and shoulders well raised, and the hips and knees flexed and supported by pillows so as to relax the abdominal walls as far as possible. A thorough kneading of the whole abdomen is then easily done, by the operator's hands alternately grasping and relaxing as large a portion as possible of the abdominal walls and the underlying intestines, one hand following the other as in kneading dough. To act specially on the colon, its course should be followed by the palms, which, while exerting considerable pressure, should glide upwards from the right iliac region to the right ribs, then transversely across the epigastrium to the left flank, and then down to the left iliac region; after a little practice, the left hand ascends, the right hand crosses and the left hand descends with great ease and rapidity, especially if the abdomen is covered by the night-dress. The operator should stand on the right side of the patient.

(*f*) *For the relief of pain*, firm '*stroking*' from above down with the flat palms, used alternately, is always soothing. Nearly all the previously described manipulations

are best ended by a score or two of such firm strokings.

General remarks.—As a rule, the patient should feel more comfortable and rested after being rubbed, and the infliction of pain must be avoided if possible. In fat patients, bruising of the skin frequently occurs, but is of no consequence. In some affections, especially in infantile paralysis, the patient will often for the first week or two, or longer, complain of considerable pain while being rubbed, but afterwards the discomfort gradually ceases, and the rubbing will become, on the contrary, actually comforting and soothing. To effect a good result, massage for a half to one hour, once or twice daily, must be persevered with for at least a month or longer. An intelligent nurse or friend of average strength can be readily taught all the above manipulations in one or two *séances*. BERNARD ROTH.

MASTOID CELLS, Suppuration in the. *See* EAR, MIDDLE, Diseases of the.

MASTURBATION has been defined as 'the production of the sexual orgasm by unnatural means.' Although this vicious habit is one indulged in by both sexes, it is more particularly in males that the surgeon is called upon to interfere. In the case of young children, the irritation of a long prepuce or even the accumulation of discharge beneath it, often leads to manipulation of the parts, and thus lays the foundation of the habit. When it is suspected, the child should be stripped and watched for a few moments, when in all probability the hand will stray to the genitals and unconsciously manipulate them, causing an erection of the penis. But when this is not observed, undue elongation of the prepuce and unnatural development of the parts should lead to the suspicion that, even at a very early period of life, masturbation may have become an unconscious habit. The remedy at this stage is circumcision, and fortunately it is generally a radical cure, for not only is the cause of irritation removed, but the soreness consequent on the operation prevents the child from manipulating the parts, and thus the habit is broken through.

The same treatment applies to much older children. But the cure in their case is not so certain or so immediate, and a recurrence to the practice as soon as the penis is sound should be watched for; on the least suspicion the penis should be freely blistered, and this should be repeated until the practice is entirely discontinued. Excessive masturbation, in children of about nine or ten years of age, sometimes leads to serious consequences, amongst others the occurrence of epileptic convulsions. It is a fact that the convulsions will entirely cease after the operation of circumcision, and recur so soon as the patient has recovered from that operation, indicating no doubt a resumption of bad practices. At a later period of life, amongst lads who are approaching puberty, the surgeon has frequently to deal with cases of self-abuse. Too often the habit has been learned at school, and has been indulged in without knowledge either of its sinfulness or evil effects. It is a serious question how far this acknowledged vice in schools might be prevented by timely warning, given either by the parent or the medical attendant, to the lad before embarking on school life. Be that as it may, it is certain that the surgeon has often to deal with cases in which the habit has become inveterate and most difficult to break through.

In young adult life, sometimes the discovery is made on the confession of the patient, who has been probably alarmed by reading some filthy quack publication on the subject. In such a case it is the surgeon's duty to allay the unreasonable alarm of the patient, holding out to him confident hopes of ultimate cure. It will be found, in very many cases, that the occurrence of nocturnal emissions is the prominent symptom which arouses the patient's fears. In the first place, he should be convinced that within certain bounds these are not harmful. He should then be instructed to avoid, if possible, turning on his back during sleep, and the old-fashioned plan of fixing a cotton reel over the lower part of the spine, thus awakening the sleeper if he should turn over on his back, is not to be despised. If possible, he should get into the habit of voiding his urine in the early morning hours. The application of nitrate of silver to the prostatic urethra is also of service, as also the passage of a full-sized metal bougie. All these plans, combined with careful attention to the general health, cold bathing, good exercise, and the cultivation of pure morals, will help the patient to emerge from the despair in which this unhappy habit has plunged him; and, if an immediate cure be not effected, at any rate his mind will be impressed with the idea that active measures are being taken for his restoration. *See* SPERMATORRHŒA.

In more advanced cases, where the habit has been long confirmed, the constitution thoroughly undermined, and the mental powers impaired, it becomes a question

whether the mental condition is not the incentive rather than the result. Self-abuse amongst the insane is a well-recognised fact, and it is also understood that the period of puberty is fraught with danger to those who have inherited mental infirmity. It can be, therefore, readily believed that, in these extreme and apparently hopeless cases of masturbation, insanity is at the bottom of the disease. From a surgical point of view, little can be done. Constant blistering of the penis is about the only course to be adopted, and that, it is to be feared, affords at best only a temporary alleviation. Vigilant supervision, especially at night, which can hardly be obtained outside the walls of an asylum, and the use of locked gloves are also essential. The administration of bromide of potassium has been much advocated, but in the majority of bad cases it will be found of little use. PAUL SWAIN.

MAXILLA, SUPERIOR, Fracture of the. *See* FACE, Fracture of Bones of the.

McINTYRE'S SPLINT is a double inclined iron trough, adapted to fit the back of the thigh and the upper two-thirds of the leg; below this the splint is continued as two side-pieces, with slots in them along which the foot-piece may be moved. The foot-piece can be firmly fixed at the place desired, and the angle at the knee can be increased or diminished as required.

MEATUS AUDITORIUS. *See* EAR, EXTERNAL, Diseases of the.

MECKEL'S GANGLION, Removal of. *See* NERVE AVULSION; NEUROTOMY.

MEDICAL GYMNASTICS. — Gymnastics were first scientifically applied in the treatment of disease by Peter Henry Ling, a Swedish patriot, who died in 1839. He devised a system of exercises, based on anatomy and physiology, by which every voluntary muscle or group of muscles in the body could be brought into action. Ling classified all exercises into— (1) *Active*, which were motions effected by a voluntary effort of the patient; (2) *Passive*, which were those executed on the patient by the surgeon or trained assistant; and (3) *with assistance*, constituting an intermediate class which were partly active and partly passive; thus, in a partially paralysed limb, there may be still some voluntary contraction left in a given muscle, but not sufficiently strong to flex or extend its joint without the help of a second individual. For further information on *Passive* exercises, *see* MASSAGE.

During the voluntary contraction of a muscle, the patient may overcome a yielding resistance offered by the surgeon's hand, or the patient can resist, gradually but continuously giving way, while the surgeon slowly elongates the previously contracted muscle. Thus, taking the biceps and brachialis anticus muscles of the arm, the surgeon can resist by holding the wrist, while the patient slowly flexes the previously extended elbow, which is described as 'surgeon resisting' (S. R.). The flexed elbow can be slowly extended again by the surgeon, while the patient continuously resists and gradually yields; this is described as 'patient resisting' (P. R.). In some exercises the weight of the limb or part moved is, at first, a sufficient resistance. After the power of the weak muscle has been improved by exercise, greater work is obtained by S. R. or P. R. It has been thought that in some cases S. R. exercises are indicated rather than P. R. ones, but, so far as the writer's experience goes, the difference in efficacy, if any, is slight.

Medical gymnastic exercises should be done slowly, without any sudden jerking, and the patient's respiration should continue regularly the whole time. When P. R. or S. R. exercises are practised, the patient should count slowly aloud one, two, three, &c., which prevents him holding his breath, and obviates all risks of hernia, strains, or other injury from unaccustomed movement.

A brief description of 'medical gymnastic' exercises which are useful to the surgeon will be given, all of which can be carried out without special apparatus by the employment of a little ingenuity. For the medical gymnastics of the spine and thorax, *see* ANTERO-POSTERIOR SPINAL CURVATURE; LATERAL SPINAL CURVATURE; PIGEON-BREAST.

ANKLE-JOINT.—The patient sitting, has the leg supported on a chair with the foot projecting beyond. *Flexion*, *extension*, *adduction*, *abduction*, and *circumduction* are executed either voluntarily by the patient or passively by the surgeon; if the former, when the patient is strong enough, also with S. R.

ELBOW-JOINT.—The upper arm being fixed by the surgeon against the table on which the patient lies, *flexion* or *extension* is easily resisted by the surgeon's other hand, the elbow being either flexed or extended to begin with. *Pronation* and *supination*, also *flexion* and *extension*, of the *Wrist* present no difficulty, if a little time and attention are devoted to carrying out

similar exercises to those already described. The same remarks apply to *flexion*, *extension*, &c., of the individual *Fingers*.

Each movement should be repeated some six to twelve or twenty-four times, according to circumstances, and about three-quarters to one hour daily be devoted to the treatment in order to obtain satisfactory results. Throughout all these exercises, care should be taken that, when the patient is trying to contract (i.e. exercise) a muscle, he is not allowed to involuntarily contract other stronger or normal muscles, which should remain at rest.

Hip-joint.—The *extensors* (glutei) are efficiently brought into action by the patient lying prone and slowly raising the leg, with the knee kept extended, from off the ground or table on which he is lying. In this same position, *circumduction* of the hip, from right to left and *vice versâ*, is easily done. At first, sufficient resistance is offered by the weight of the limb; later, as the patient gains in strength, the severity of the exercise can be increased by the surgeon's hand pressing downwards against the back of the heel (S. R.), or by placing a double bag of shot over the tendo Achillis, a weight of from two to five or ten pounds being generally sufficient. The *abductors* of the hip are obliged to work by the simple expedient of making the patient lie on his side, and do the hip-circumduction with the uppermost leg. The *flexors* are exercised while the patient is lying on his back with the knee extended, either voluntarily or by a lightly applied back-splint. *Inward* and *outward rotation* of the hip are too simple to require description.

Knee-joint.—The *quadriceps extensor* muscle is made to contract while the patient, lying supine, has the knees flexed, and the legs hanging vertically over the end of the padded table on which he lies. One knee is slowly extended; if the weight of the leg is too great, the surgeon assists by partially supporting the foot, while the patient voluntarily performs as much of the movement as he can. The *flexors* are brought into action by the patient lying prone, and trying to raise the foot from off the ground by slowly flexing the knee, with S. R., if necessary, applied to the back of the heel.

Shoulder-joint.—*Circumduction* from before backwards, which brings nearly all the shoulder and scapular muscles into play, is best done while the patient is lying supine on a padded table, the elbow and wrist being kept extended either voluntarily, or, if that is impossible from weakness of their muscles, by means of a light anterior wooden splint.

To bring the *scapular* muscles into action, the patient should lie supine, with the arms carried down by the sides of the trunk, or abducted at right angles to the body, or extended upwards by the sides of the head; he has to resist the arms being brought forwards by the surgeon (P. R.) from one of the above commencing positions, and then slowly to return them to the initial position against the surgeon's gradually yielding resistance (S. R.). The elbows are to be kept well extended the whole time, as described above, and the surgeon should grasp the patient's wrists. The rhomboidei and subscapularis muscles are chiefly brought into action in the second movement, with the arms at right angles to the trunk.

Bernard Roth.

MEDICINAL ERUPTIONS.—Many drugs and chemicals give rise to eruptions, sometimes after being taken in medicinal doses for a considerable period of time, when the system may be supposed to be saturated with them; sometimes they occur after a single dose has been taken, betraying a peculiar susceptibility on the part of the patient (idiosyncrasy).

1. *Iodine, Iodide of Potassium, and other Iodides* may give rise to—(*a*) erythematous patches ('iodic roseola') on various parts; the eruption may pass into a papular form, with large disseminated papules, slightly elevated, seated on a reddened surface, the whole not unlike urticaria; (*b*) purpuric eruptions, often assuming a petechial form, especially affecting the legs; (*c*) vesicular eruptions (rare), said to resemble eczema; (*d*) bullous eruptions on the head, neck, and upper extremities, the bullæ tending to be hæmorrhagic; (*e*) pustular eruptions resembling those produced by bromides.

2. *Bromine, Bromide of Potassium, and other Bromides.*—(*a*) An erythematous eruption; (*b*) a maculo-papular eruption closely resembling a syphilide; (*c*) a bullous hæmorrhagic eruption; (*d*) pustular, acne-like eruptions, usually on the face or chest; also an eruption which has been described as confluent acne. At its height, it is characterised by round flattened elevations covered with moist epidermis, not unlike that in condyloma, or with thick brownish crusts, on removing which the surface is seen to be dotted with minute collections of pus; the lesions are surrounded by a dark-red areola.

8. *Belladonna* may give rise to an eruption partly erythematous, but partly scarlatiniform—i.e. minutely punctate. It occurs in sharply defined palm-sized patches, which usually affect the upper part of the body; there is no burning or itching complained of, and desquamation does not follow.

4. *Chloral.*—An erythematous patchy eruption, with heat and itching, chiefly affecting the neck, front of the chest, the larger articulations, and backs of the hands and feet. Urticarial, papular, vesicular, and purpuric eruptions have also been described.

5. *Copaiba.*—The eruption generally takes the form of a roseola, selecting the hands, arms, feet, knees, and abdomen. The lesions are slightly raised to the touch, and, being in some instances isolated, may resemble urticaria; itching is present, and the skin may smell of copaiba. The eruption is sometimes taken for macular syphilis.

6. *Cubebs* may give rise to a similar eruption, but it is more generalised and does not itch.

7. *Quinine.*—Erythematous, papular, urticarial, and purpuric eruptions have been noted.

8. *Salicylic Acid.*—(*a*) Diffuse erythema, with œdema of the eyelids; (*b*) vesicles and pustules on hands and feet; (*c*) purpuric eruptions.

9. *Tar, Carbolic Acid, Turpentine, Resin.*—A general erythematous urticarial eruption has followed Lister's process. Turpentine produces a similar eruption with great itching, preferring the face and upper portions of trunk. Eruptions have been noticed to be caused by other drugs, as arsenic, cannabis indica, digitalis, mercury, opium, santonin. ALFRED SANGSTER.

MEDULLARY CANCER. *See* CARCINOMA.

MEIBOMIAN GLANDS, Affections of the. *See* EYELIDS, Diseases of the.

MELANOSIS. *See* SARCOMA; MALIGNANT TUMOURS.

MELASMA. *See* CHLOASMA.

MEMBRANA TYMPANI, Puncture of the. *See* EAR, MIDDLE, Diseases of the.

MEMBRANA TYMPANI, Rupture of the. *See* EAR, MIDDLE, Diseases of the.

MENINGITIS. *See* ENCEPHALITIS.

MENINGOCELE.—By this term is meant a hernia of the membranes of the brain through some part of the parietes of the cranial cavity. The sac consists of dura mater and arachnoid, with a covering of skin. Occasionally an interval (subdural), more or less considerable, exists between the two membranes, or, on the other hand, they may be so fused together that it is difficult to differentiate the wall of the sac into two distinct layers, especially at that part most remote from the opening in the skull. Hence, possibly, the presence of arachnoid has been overlooked in those rare instances in which the sac has been described as being formed of dura mater alone. Mr. Bryant mentions such a meningocele as being in Guy's Museum, No. 1563[60]; but on examining this specimen a considerable protrusion of arachnoid is visible, which is disposed in loose folds at some distance from the dura mater. This separation of the two membranes is probably due to the way in which the preparation was mounted when fresh. Mr. Shattock states that after careful inspection of many cases of spina bifida (the analogous condition in the spinal region), he could not say that the arachnoid membrane was ever absent. Although it is conceivable that the wall of a cranial meningocele might be formed of dura mater alone, it does not appear probable that this ever happens.

The hernial sac is distended with cerebro-spinal fluid, and sometimes contains a part of the brain or cerebellum. In the latter case the tumour is known as an *encephalocele*; and if a case of encephalocele be complicated by the co-existence of a hydrocephalic state of the ventricles, then the term *hydrencephalocele* is employed. These tumours are always congenital, are more frequently met with in male than female children, and are due to an arrest of development of the bony wall of the cranial cavity at the point at which they appear. They vary from the size of a marble to two or three times the size of the head of the child; in fact, they may be so small as not to attract attention or so immense as to produce almost complete exencephalia. In the *Pathological Transactions*, vol. xvi., the late Dr. Murchison related a case in which the whole of the cranial portion of the occipital bone was deficient, causing an enormous bag to depend from the back of the head, containing the whole of the brain except a portion of the thinned, expanded, and stretched out anterior lobes, which alone occupied the diminished cranial cavity.

The most usual seat of these tumours is in the median line, especially in the occipital region. They may, however, occur at any other point, as through the frontal suture

or the fronto-nasal suture, in the temporal region, or dipping down into the nasal cavity or pharynx. In the last-named situations they have been mistaken for polypi. Statistics illustrate the frequency with which these malformations occur in the occipital region. The mode of development of the tabular portion of the occipital bone is worthy of note in connection with this point. It is developed from four nuclei, which appear about the eighth week of fœtal life. At birth this tabular portion consists of a flat plate, with fissures running in nearly to the centre from the upper, lateral, and lower angles. It is by the persistence and exaggeration of the two fissures in the median line that these hernial protrusions occur so often in the mesial part of the occipital bone. The upper fissure is the last to close; the lower, or that below the occipital protuberance, is almost obliterated at birth. Hernia does not seem, however, to be more common above than below the occipital eminence. In the museum of St. Thomas's Hospital there are two specimens of meningocele, about the size of a walnut, which each communicate with the cranial cavity by means of an oval foramen nine lines in length, situated below the occipital eminence; and one specimen of encephalocele, about the size of an orange, containing part of the cerebellum, and communicating with the cranial cavity by means of a foramen of similar dimensions and relations. The continuity of the lower fissure with the foramen magnum may explain the frequency of hernia below the occipital protuberance, for in many instances this fissure opens out to form with the foramen a huge opening, bounded behind and laterally by the rudimentary exoccipital and supra-occipital elements of the occipital bone. Through this opening the cerebellum commonly passes out into the cavity of the protrusion.

These tumours when large have the skin tightly stretched over them, are of a pink or bluish colour, and, if fluid, readily transmit light. They may or may not be pedunculated; and the tension of any individual tumour may be so great as to interfere with the discovery of the bony margins of the opening in the skull. The same difficulty will be experienced when much solid matter is present. When the tumour is small, it may be reducible by gentle manipulation; but pressure is very apt to set up signs of cerebral disturbance. This fact is of the greatest importance in the diagnosis between the various forms of congenital tumour occurring in this region—between meningocele and encephalocele on the one hand, and large subcutaneous nævus and dermoid cyst, with or without involvement of the bony vault, on the other, especially when these tumours occur exactly in the median line. It may be noted that nævi and dermoid cysts occasionally make their first appearance a few days after birth. The pulsation of an encephalocele is synchronous with the pulse in the arteries, and clenches the diagnosis of this variety of hernia. Pulsation may, however, also occur in the case of simple meningocele, when there is a large communication between the cavity of the cranium and the cavity of the protrusion. In rare cases, the dura mater is exposed in whole or part without a covering of skin, or there is an ulcerated surface over the centre of the tumour indicating that the dorsal laminæ have not completely closed, so that no epiblast is present from which skin could be produced at the ulcerated spot.

The excess of cerebro-spinal fluid is contained in the expanded subarachnoid space, or in the dilated ventricle, or more commonly occupies both situations. Hydrocephalus externa never exists as an independent affection, but may occur from rupture of hydrocephalic ventricles or as a consequence of large arachnoid hæmorrhage, &c. In ordinary hydrocephalus (hydrocephalus interna) the fluid is limited to the dilated ventricular cavities, and its increase in quantity is intimately dependent upon an inflammatory condition of the lining membrane of the ventricles, which are generally imperfectly developed. Possibly also there is some connection between excess of ventricular fluid and the presence of tubercles or other tumours, which either mechanically interfere with the passage of blood along the veins of Galen, or obstruct the foramina in the pia-matral expansion covering in the lower part of the fourth ventricle, whereby is inaugurated a disturbance of pressure equilibrium within and without the brain. In cases of meningocele and hydrencephalocele, the common association of an excess of fluid in the ventricles with an excess of fluid in the subarachnoid space points to the fact of these conditions originating from one common cause.

When a meningocele is small, the *diagnosis* may generally be cleared up by attention to the following points:—1. The attachment of the tumour to the bone, and its position in the median line. 2. Its congenital nature. 3. Its fluid character—the tension of the cyst increasing during crying, coughing, and other expiratory acts.

4. Cerebral pulsation may or may not be present. 5. The hernia may be partially or wholly reducible, with or without the production of cerebral symptoms. 6. Palpation of the deficiency in the wall of the skull.

Cephalhæmatoma, or a collection of blood between the pericranium and bone, takes place usually over one of the parietal bones. It is limited to one bone by the union of bone and pericranium in the neighbourhood of the sutures, and disappears a short time after birth. A meningocele of the parietal region is rare. Cases have been published of simple fracture of the skull, generally of the parietal bone, in infants, followed by *pulsating tumour*. A cephalhæmatoma forms immediately after the injury, but, the brain membranes being torn as well as the brain-case fractured, cerebrospinal fluid, and sometimes brain-matter, passes through the rent into the cavity of the blood tumour. Any interval from forty-eight hours to many days may elapse between the formation of the typical cephalhæmatoma and its assumption of pulsatile qualities. The wall of the original blood-tumour becomes in fact the sac of a meningocele or encephalocele, which must be treated on the same principles as the congenital variety, but could hardly be mistaken for the latter unless the injury were to happen immediately after birth.

A *dermoid cyst* of the scalp is immovable, tense, non-pulsating, fluctuating, not changing with respiratory movements, and occurs most frequently near the outer angle of the orbit. The diagnosis presents, in rare cases, insuperable difficulties, *see* the interesting case published by Mr. Arnott in the *Pathological Trans.*, vol. xxv.

A *subcutaneous nævus* has no definite margin, increases in size during expiratory efforts, has a doughy, worm-like feel, imparts a bluish tint to the skin over it, is not perfectly fixed, and is not infrequently placed over one or other of the fontanelles.

An *Encephalocele* appears generally as a small lobulated globular or oval tumour, which pulsates synchronously with the arteries. Mr. Gould has narrated a case, in which pulsation was not evident until the tumour had been partially reduced. Pulsation may not be present; therefore, absence of pulsation must not be relied upon as indicative of the absence of brain-matter in the sac of the hernia. The brain-substance in the tumour can be easily palpated through a layer of fluid. If the sac is very large, and has a broad base, the tumour is always a hydrencephalocele, and is associated with great deficiency of the bony boundary of the cranial cavity. In other cases, huge pedunculated sacs may be attached to the occipital or frontal regions, and contain more or less of the proper contents of the cranium. Associated with meningocele and encephalocele may be other malformations, as hare-lip, cleft-palate, talipes calcaneus, spina bifida either affecting a portion or the whole length of the spinal column, a permanent bulbus arteriosus, as in a remarkable case placed on record by Mr. Heath, or indeed any other condition due to an arrest of the developmental processes.

Prognosis.—These malformations when large may seriously impede delivery, may interfere entirely with the life of the child, or make its prolonged existence improbable or impossible.

Treatment.—If the hernia were small, and the opening in the skull of corresponding size, it might be possible to keep it reduced so that, as the bones ossified, a cure would result. Cases have been recorded in which iodine injection, ligature of the pedicle, or even slicing off the tumour, has been more or less successfully practised. The effect likely to ensue from ligature of the pedicle can, of course, be determined by temporary compression of the neck of the sac. None of these methods are warranted by what we know of the pathology of the disease. Non-interference is the golden rule, except when the tumour is rapidly increasing in size and the life of the patient is in great jeopardy. Under these circumstances it is justifiable to resort to the operation of tapping. In a large hydrencephalocele of the vertex, seen by the writer some years ago, Sir W. MacCormac tapped the tumour by means of a capillary trocar connected with a very long and fine tube—gentle pressure and support meanwhile being adjusted to the head. The patient was seven years old, lived for twenty days after the operation, and then died in convulsions. Unfortunately, it is just in those cases in which it is justifiable to interfere that least can be expected from surgical operation. When a peduncle is present, and the tumour is a simple meningocele, the case might terminate happily by the recovery of the child after accidental blocking and sloughing of the peduncle. Operative interference of any sort is out of the question in cases of encephalocele. The cure of certain meningoceles may, however, be attempted by means of the injection of Morton's fluid, which is employed with such success in the treatment of spina bifida; those cases are most likely to be successfully treated in this way which are of medium size and

pedunculated. Lately, a case has been reported as cured by the injection of Morton's fluid into the cyst-wall, or rather externally to the cyst-wall. The mental condition of the child would have an important bearing on the answer to the question whether an operation was advisable. The almost constant co-existence of hydrocephalus or malformation of the brain with hernia of the contents of the skull, renders futile, as a rule, any attempt at treatment. The best and often the only thing the surgeon can do is, by suitable means, to protect the protrusion from pressure or injury. *See* Spina Bifida.

Charles A. Ballance.

MENTAGRA. *See* Sycosis.

METASTASIS. — By metastasis is generally understood the subsidence or disappearance of inflammation in one situation, with its coincident onset at another.

The morbid states in which it is best exemplified are—(1) pyæmia, (2) gonorrhœa, (3) gout, (4) mumps. In pyæmia and gonorrhœa the disease is primarily local; in gout it is at first general, with subsequent local expression; whilst in mumps there is some doubt whether the initial infection consists in a contamination of the blood or of the parotid glands. Many theories have been advanced to account for the phenomena in question — some fanciful, others well-grounded.

With regard to *pyæmia*, it may be stated with confidence that there are several methods by which metastasis is established. (1) A large number of the so-called 'multiple circumscribed abscesses' beyond all doubt owe their origin to embolic infarction. Portions of disintegrated venous thrombi, on being detached, are swept along by the blood current until they arrive in vessels too small to allow of their transit. The septic nature of these thrombi is incompatible with resolution of the inflammation; purulent softening is certain if the patient survives sufficiently long for its development. (2) The decomposed products of the primary local phlegmon are conveyed by the lymph channels, until they meet with some mechanical obstacle to their passage, and thus a concentration of the poison is effected; or, without this hindrance, they light on tissues already diseased or predisposed to inflammation, which then 'become acutely affected as a result of the general febrile disturbance.' In some instances, the lymphatic tracts connecting the primary and secondary foci show no naked-eye signs of reaction to the irritant that has traversed them, but as a rule the reverse obtains, especially when the superficial vessels are involved—e.g. in a poisoned wound of the skin with consequent bubo. (3) Microscopical examination has shown that, in the true infective processes, minute organisms —cocci—multiply with great rapidity in the lymphatics and even in the blood capillaries, which become blocked with the accumulated growth. The vital activity of these bodies varies with the soil in which they vegetate. In some parts it is feeble and transient, in others it is marked and long-abiding. Hence the variation in the result, and the explanation of distant suppurative centres connected by a continuous chain of vegetation. (4) The 'secondary abscesses' may depend upon a general blood-infection, and not stand in *immediate* causal relation to the primary lesion. Of this nature are the diffuse metastases met with in the lungs, joints, and connective tissue in some cases of septicæmia—septic infection. (5) Prior to the enunciation and proof of the foregoing ways and means of metastasis, it was the custom to suppose the incidence of the secondary change to be largely due to the reflex action of the nervous system; an explanation at once imaginary and insufficient, and, as is now known, in most, if not in all, cases demonstrably contrary to fact.

What has been said respecting general pyæmia applies in much the same manner to *gonorrhœa*. At first sight, it seems somewhat curious that inflammation of the epididymis and testicle should follow acute purulent urethritis, after so long an interval has elapsed from the original inoculation; but it must be borne in mind that it takes some time for the inflammatory action to spread along the lymphatics from the urethra to the testicle, and this is one mode in which the metastasis is effected. Gonorrhœal epididymitis or orchitis, pathologically considered, is, in the writer's opinion, primarily and essentially a lymphangitis. On the other hand, the infection may be conveyed by the spermatic tract itself, and this is probably the case when the vas deferens and epididymis are much swollen and indurated, with but little thickening of the cord. *Gonorrhœal rheumatism* is generally taken to be a mild form of pyæmia in subjects predisposed to the action of the poison. The fact that a specific 'coccus' is supposed to be always present in the urethral discharge lends weight to this theory.

The metastases in *gout*—as, e.g., when severe stomachic derangement suddenly supervenes on the equally rapid subsidence of an attack of arthritis—are either merely a

series of phenomena having no causal relation one with another, or, what seems not unlikely, the materies morbi of gout is reabsorbed from the articular structures to act upon the tissue or organ next in order of vulnerability.

Metastatic orchitis as a complication of *mumps* is relatively more common in adults than in children, a fact explained probably by the greater physiological activity of the testicular epithelium in mature life. The specific poison selects first the parotid glands; and secondly, though with much less frequency, and at a later period of the affection, the testicle, for its local development. It is curious that two organs differing so widely in many respects should be attacked by the same agent of disease. It will be remembered that enchondroma has a like proclivity for these glands, and here also there is no obvious explanation of the association.

AUGUSTUS J. PEPPER.

MICROCOCCUS. — A round or oval micro-organism belonging to the class of SCHIZOMYCETES. The term coccus, applied to spherical organisms, has sometimes the prefix mega (*μεγα*, great) to denote a larger variety (Billroth), so that there are two divisions of the round micro-organisms recognised—viz. megacoccus and micrococcus. These round or oval organisms are found in putrid animal liquids, and in some diseases, as below; for their causal relation to which. *See* SEPTIC DISEASES, Classification and Etiology of.

As regards their personal life, they grow by fission, so as often to form chains of from two to several hundred, while in rarer cases they are grouped into fours or more, like sarcinæ, and they multiply by simple fission of their protoplasm. Micrococci cannot resist heat like the spore-forming organisms; consequently it is more than probable that no coccus possesses in any degree the property of spores.

Sapric M.—M. sapricus. — Micrococci of various sizes are found in almost all dead putrefying tissue. Thus they are found in the necrotic foci of pyæmia, and always in the pus of acute abscesses, and in most decomposing albuminoids.

Pathogenic M.—M. erysipelatosus.—A micrococcus is now definitely proved to be intimately connected with the causation of erysipelas. It has been cultivated by Fehleisen, who found the period of incubation in the human being was about twenty-four hours on the average. *See* ERYSIPELAS.

M. septicus, although not so definitely proved (like that of erysipelas) to be an active carrier of infection, has been found so consistently in pyæmic foci as to deserve a prominent place in this list. It is also found in decomposing wounds, growing on the surface of the granulation-tissue.

M. of acute necrosis and osteomyelitis. In acute necrosis and osteomyelitis this micrococcus has often been observed. When cultivated, it forms beautiful orange masses. Inoculated into animals, it produces ordinary septicæmia, unless a bone has been previously injured, when acute osteomyelitis is set up, with abscesses in the lungs, &c., just as in the acute necrosis of man.

M. endocarditicus.—In ulcerative endocarditis, micrococci are always to be seen in the organisms, on the valves, and in the infarcts in the different organs.

M. bombycis, a large coccus organism which causes death by mechanical mycosis, &c.

M. gonorrhœæ. — The micrococcus known for some time to be present in gonorrhœa has been cultivated, and, by inoculation of the growth obtained, been shown to probably produce the disease.

M. variolæ, the organism of small-pox, is, so far as is known, the probable cause of the pustules in their early stages.

M. vacciniæ, a micrococcus found in healthy vaccine lymph, is credited with being the cause of vaccinia.

M. puerperalis.—In puerperal fever a micrococcus has been discovered in the foci of disease, exactly like the organism of pyæmia.

M. nephriticus.—In suppurative interstitial nephritis, secondary to septic disease of the lower urinary tract. Micrococci are found in the tubules of the kidney, and are supposed to have gained access to that organ by growing in the stagnant residual urine and mucus in the bladder and ureter.

VICTOR HORSLEY.

MICTURITION, Disorders of. *See* INCONTINENCE OF URINE; RETENTION OF URINE; PROSTATE, Diseases of the; PROSTATIC HYPERTROPHY; STRICTURE OF THE URETHRA.

MILIUM. — *Definition.* — A collection of sebum distending a sebaceous gland, but without an external opening.

Symptoms.—Milium consists of a small white swelling under the epidermis, occurring in the same parts, and due to the same causes as COMEDONES. There is, however, no external opening, as the matter is retained in the sebaceous gland, and does not pass into the hair-follicle.

Diagnosis.—Milium may be mistaken for xanthoma tuberosum and for molluscum contagiosum. An incision into the little tumour will suffice to distinguish it from the former; as, in milium, the sebaceous matter will be easily forced through the outlet, whereas in xanthoma nothing will escape but a trace of blood, as the tumour is composed of connective tissue, and is therefore solid. Moreover, in xanthoma the appearance is yellower than is the case in milium. It may be diagnosed from molluscum contagiosum by the central depression characteristic of that disease.

Treatment.—Careful incision into the tumour, removal of its contents, and scraping or scarifying its lining membrane. To prevent milium forming, care should be taken to wash the skin frequently with soap and hot water. Constitutional remedies must be resorted to whenever there is any functional derangement or general debility. MALCOLM MORRIS.

MILK-CYST. *See* GALACTOCELE.

MINER'S ELBOW. *See* BURSÆ, Affections of.

MOLE (Nævus pigmentosus).—A circumscribed hypertrophy of the skin, with much small-cell infiltration, in the form usually of a papule or tubercle varying in size from a millet-seed to a hazel-nut, but frequently much larger. In some cases the surface of a mole is smooth; in others it is partially concealed by a growth of hair (nævus pilosus). The larger and coarser varieties of mole are usually congenital; the smaller are not commonly observed until after the age of infancy and early childhood has passed. Congenital moles, as a rule, grow only in proportion to the growth of the body; the non-congenital usually increase in size for a time and then cease growing. In a small minority of cases, and under quite unknown conditions, a mole becomes the starting-point of melanotic sarcoma, or (very rarely) carcinoma.

Treatment.—With the exception of the considerations involved in the last-mentioned circumstance, which render advisable the removal of any mole that attracts attention by its growth or is in a situation where it may be irritated, treatment is necessary only when, from its situation, as on the face, it causes a deformity which a patient is anxious to be rid of. The treatment of quite small moles is very simple. They are best destroyed by the application of strong nitric acid; care being taken not to apply the caustic too freely. For the removal of larger moles, say those from the size of a pea to a horse-bean, a smaller scar will probably be left after removal by the knife or a Volkmann's spoon than by caustic; but great caution should be exercised when the disease encroaches on the thin skin in the neighbourhood of the eyelids, on account of the liability to ectropion from the contraction of scar-tissue in this region. In the case of large moles, say from half an inch to an inch or more in length, the surgeon will do best by removing a portion at a time; the result of the operation being taken as a guide to future proceedings. Either the knife or caustic may be used; the former usually causing less scar than the latter. But it is impossible to lay down a strict rule for all cases.

In the case of very large moles—too large to permit the removal of the whole thickness of the skin at once—a good deal can be done by removing with a sharp scalpel or Volkmann's spoon the *surface* of the skin, only a part of the thickness of the corium or true skin being removed, and no part of the subcutaneous tissue being exposed. The wound should then be covered with a piece of gutta-percha tissue as a first dressing, and after a day or two allowed to scab. By these means, partly by the knife and partly by strong nitric acid, the writer was enabled to remove successfully, and without any subsequent contraction of the scar, a large hairy mole which occupied half the forehead.

W. MORRANT BAKER.

MOLLITIES OSSIUM. *See* OSTEOMALACIA.

MOLLUSCUM CONTAGIOSUM (*Synon.* Epithelioma molluscum–Virchow; Acne varioliformis—French authors).—*Definition.*—A chronic disease of the skin, characterised by the development of small tumours, rarely exceeding the size of a pea.

Cause.—This is not certainly known; lately it has been attributed to the presence of a vegetable parasite. There has been much discussion as to the contagiousness of the disease. In America and on the Continent, where the disease is much rarer, it is scarcely believed in, but in this country its contagious nature is almost universally accepted, this belief being based upon such clinical facts as the following:—

1. The frequent simultaneous appearance of the disease on the face of an infant and the breast of a nursing mother.

2. Its occurrence on contiguous surfaces—e.g. the insides of the thighs.

3. Its liability to affect more than one pupil in a school or one member of a family, at the same time.

It must be confessed, however, that inoculation experiments are rarely successful; probably warmth and moisture, with continued friction, are the conditions most favourable for its inoculation.

Pathology.—If a small molluscum tumour be examined microscopically, it will be found to consist of cells packed together in lobular masses, bounded and separated by fibrous tissue. The cells composing the lobules may be roughly divided into two kinds—(1) those at the periphery, closely packed, having large oval nuclei, and corresponding in appearance to the normal cells of the rete mucosum; (2) those towards the centre of the lobule, which are large, ovoid, vitreous-looking bodies, closely placed or more loosely arranged in a reticulum, often of a granular aspect. These are the molluscum bodies, concerning the composition and nature of which there is still much controversy. In vertical sections of minute commencing lesions it has been shown that the peripheral cells of the new growth are continuous or closely associated with the Malpighian layer of the skin, or with that inversion of it which constitutes the outer root-sheath of the hair-follicle. The molluscum bodies are, probably, the result of retrograde changes in the cells concerned in the formation of the hair-structure.

Symptoms.—The lesions develop slowly, taking weeks or months to attain the size of a pea, which they rarely exceed; they commonly appear as flattened pinkish-white tumours, possessing on the infant's skin a peculiar greasy, semi-translucent appearance. In every lesion there is distinguishable, from its very commencement, a central pit or depression (umbilication), probably the widened mouth of the hair-follicle from which it started. This central depression, together with the early flat sessile appearance of the lesions, has suggested their likeness to pearl shirt-buttons. As the tumours increase in size, they overhang their bases and so become pedunculated, but, unlike the *molluscum fibrosum* tumour, they rarely become pendulous. Two or more tumours are liable to coalesce and merge into one larger tumour, which in this case presents more than one orifice. Large tumours are apt to inflame and suppurate, but this may happen to any tumour that is irritated by friction, &c. On squeezing the tumours, a thick, gruel-like fluid can be made to exude from the orifice; sometimes the fluid is thin and milk-like, and issues in a jet on pressure. If the orifice of a tumour be slightly enlarged with the point of a lancet, and firm pressure be made on either side of its base, there can be forced out or enucleated a pinkish mass, which to the naked eye has a minutely lobular appearance not unlike gland-tissue. The tumours are generally few in number and occur in young subjects, but isolated cases are on record in which hundreds of tumours have been present on adults. No pain or itching is complained of.

Diagnosis.—A well-marked example of the disease is not liable to be mistaken for any other affection. Sometimes difficulty arises when attention is drawn to a single suppurating tumour, the special appearances being masked by the inflammation; the probable existence of other molluscum lesions, perhaps so minute that they have at first escaped notice, will help the diagnosis.

Treatment.—Only local treatment is of use. The tumours may be removed by enlarging their orifices and enucleating their contents. If there is much trouble in completely freeing the capsule, the contents may be removed with a small Volkmann's spoon; the large tumours will probably require such treatment. The base of the capsule may be touched with nitrate of silver, to prevent bleeding. The lesions rarely recur.

ALFRED SANGSTER.

MOLLUSCUM FIBROSUM. — *Definition.*—Soft tumours of the skin, due to hyperplasia of the subcutaneous tissue and deep layer of the corium.

Etiology.—The only known cause is congenital predisposition. The tumours occur in both fair and dark races in both sexes, and are seen at all ages, though they nearly always begin in early childhood, and some in the first few months of life, being probably often congenital, but too small to attract notice. The dermatolytic tumours may, however, be acquired in later life, and there are also tumours, of a very similar character to those of childhood, which develop in elderly people, especially between the shoulders and on the face, but they are never numerous. In a considerable proportion of those in whom the tumours commence in early childhood, it has been noted that they have been stunted in both their mental and physical development.

Pathology.—Nothing is certainly known of the pathology of these tumours, beyond the fact of their being immediately due to a hyperplasia of the connective tissue of

either the deep part of the corium or subcutaneous tissue, or both, while some tumours seem to take their origin from the connective tissue round the hair-follicles. In the diffuse or dermatolytic cases, the presumption is in favour of this hyperplasia being due to an obstruction to the lymph-flow in the superficial lymphatics, but we are entirely ignorant of the way in which it is produced. This theory and many points in its anatomy bring this disease into pathological relationship with elephantiasis Arabum, though the clinical differences are obvious.

Anatomy.—On section of a medium-sized tumour it is found to consist of more or less perfect fibrous tissue, from which a small quantity of clear yellow fluid can be expressed. The fibrous tissue is coarsest and best developed at the base, while in the centre it is loose and gelatinous, and at the periphery fine and delicate. The degree of development of the fibrous tissue is in proportion to the age and size of the tumour; so that in a large tumour there will be very little gelatinous tissue, while a smaller one may consist entirely of it. In all, the papillary layer of the corium and the epidermis are unchanged. Cells with large nuclei are scattered singly, in foci, or in strata between the layers of connective tissue, and are most abundant in the young, and sparse in the old, tumours. The vascular supply is derived from large vessels, which enter at the base and are distributed in fine capillaries at the periphery.

Varieties.—There are the following varieties:—1. Multiple, small, soft tumours, in which the surface of the skin is normal. 2. Dermatolytic tumours, with small tumours like the first variety. 3. Dermatolytic tumours without other tumours.

Variety 1.—The tumours are roundish and soft for the most part, though they may be firm in places, and when pinched up, the contents can be rolled between the fingers. The skin over them is either tense or lax, smooth and of normal colour, except sometimes from vascularity, and it is not uncommon to find the plugged orifice of a sebaceous gland in the centre of a small tumour. The tumours vary in size from a pin's head to a hen's egg, though the majority are not larger than a walnut; some are sessile or even deep in the skin, others pedunculated. They come most frequently and abundantly on the trunk, next on the occiput and the rest of the head, face, and limbs; but they are rare on the palms and soles, where, if present, they get flattened by pressure. Occasionally the mucous membranes become involved, especially the lips, gums, and hard palate. The tumours gradually increase in number and size, but do not tend to shorten life, and are only inconvenient from their size, position, and numbers, and, though sometimes few, are often present in hundreds, and even thousands. Occasionally, when the growth is unusually rapid, they get tense and red, excoriate, or even ulcerate, and slough off from the vessels being stretched and occluded.

Variety 2.—In the dermatolytic cases, besides the tumours already described, there are others much larger, often weighing many pounds; they have a broad attachment, consisting of lax pendulous masses, which may be in folds like a coachman's cape, and feel like masses of skin and fat. These tumours spring most frequently from the occipital region, the side of the neck, flanks, buttocks, thighs, and sometimes from some parts of the face. They may reach to an enormous size, and, when they occur without the small tumours, constitute Variety 3, which is placed separately, because, whilst the other varieties begin in early childhood, these may be acquired. The tumours are often even more diffuse than in the last kind, and, in a case under the care of the writer, the enormous pendulous folds depended like flounces from the buttocks and thighs, in consequence of prolonged suppuration in the buttocks produced by a fall. In a few rare congenital cases, the skin has been very lax when pulled out, but without any hyperplasia, and retracted to the normal degree when the traction ceased; but this is evidently a different condition altogether.

Diagnosis.—When there are multiple soft, sessile, or pedunculated, roundish tumours with the skin over them normal, there can scarcely be any difficulty in the diagnosis. Multiple fatty tumours are most like them, but they are flatter, lobulated, and do not project globosely above the surface, in the way some of the molluscum tumours are sure to do. When the tumours are single or few, the diagnosis from soft moles would be made by the fact of the moles having been congenital, and not having grown materially from birth. They may resemble sebaceous cysts, but though a large comedo is common in the molluscum tumour, on pressure nothing but the comedo can be expressed, while nearly or quite the whole of the contents can be squeezed out from the sebaceous cyst.

Prognosis.—The tumours tend to increase in number and size, and although occasionally the contents of a small one may be absorbed, it makes no practical difference to the disease as a whole. They may be inconvenient, but are never dangerous to life.

Treatment.—Where any one tumour is inconveniently placed, or where there are only a few, if pedunculated they may be removed by ligature, the galvanic cautery or écraseur, and if sessile excised. Large dermatolytic tumours have also been successfully removed in several instances, but the removal must be complete, partial excision having been followed by regrowth. H. Radcliffe Crocker.

MORPHŒA. *See* Scleroderma.

MORTIFICATION. *See* Gangrene.

MOUTH. *See* Palate, Affections of the; Ranula; Stomatitis.

MOVABLE KIDNEY is a condition in which the organ has lost its usual attachments in the perinephral fat, and glides about a varying area attached only by its vessels and ureter. In some cases, it slips about behind the anterior peritoneal covering; in others, it has gradually come forward until it has drawn out for itself a sac of serous membrane, covering both its surfaces, and gathered in round the vessels of the hilus so as to form a mesonephron. For the latter condition, said to be congenital as a rule, the term 'floating kidney' has been suggested, to distinguish it from the commoner 'movable kidney.' Both conditions are not so infrequent as is supposed. Thus, out of 5,500 patients, examined in a German hospital specially on this point, about 1 in 250 had movable kidney. Among women it is found much more frequently than among men, and this fact, perhaps, furnishes us with a clue to its causation; the latter, however, still seems somewhat obscure. But it is significantly frequent between the ages of twenty-five and forty in females, and this being the most active child-bearing period, it seems not improbable that the changes taking place during gestation in the abdomen, and more particularly after parturition, when the parietes and internal organs are relieved from a great strain, may play an important part in the displacement of the organ. Tight-lacing is also supposed to explain its greater frequency among women. This may also be one of the causes why it is more frequent on the right side than on the left, for on the right it is less protected against the constriction of the girdle or stays than on the left, where it is more or less covered by the stomach and spleen. But, in many cases, the occurrence of movable kidney can be traced to some violence, such as a fall or blow upon the side; or to hard riding, which, having once shaken the kidney loose from its attachments, has never permitted it to recover itself again.

The *symptoms* are usually not very marked—indeed, the condition is often discovered accidentally where none have ever been present. But, in some cases, there can be no doubt that very severe suffering is caused by the movements of the organ, and, most probably, by the drag upon the pedicle. Among the symptoms in severe cases may be mentioned dragging, sickening pain in the loins, with nausea and, occasionally, vomiting, diarrhœa or constipation, and frequency of micturition; other less definite sensations are often complained of, such as depression of spirits and general weakness.

The *diagnosis* of the condition is based upon the above symptoms, and on the presence of a movable tumour, of the size of the kidney, somewhere between the normal position of the latter, the umbilicus, and the anterior superior spine of the ilium. This tumour is freely movable in an upward direction or laterally, but not downwards, as the patient stands. It can be easily thrust upwards above the ribs into the normal position of the kidney. If grasped or pressed upon, a dull, sickening pain is complained of.

Treatment is not always called for in these cases. If there be much suffering, however, several means have been found of relieving it. In the first place, rest in the recumbent position is usually temporarily useful, then firm bandaging of the abdomen with a pad placed over the replaced kidney; next, attention to the bowels, and the use of tonics and cold douches, &c.; lastly, stitching the offending organ to the abdominal walls has been tried with benefit. *See* Nephroraphy. Finally, removal of the offending organ has been resorted to in several severe cases, but so far has not been considered a justifiable procedure in this country. In all cases where there is suffering, violent exercise is to be avoided. Occasionally the symptoms are severe and give rise to suspicion of inflammation in the kidney, in which case leeches and hot baths and fomentations should be employed, with the internal use of opium and diaphoretics.

The *prognosis*, in cases where the movements of the organ give decided trouble, is not very favourable as regards the prospect of permanent relief without operation. Once having broken loose from its attachments, the kidney is very unlikely to become fixed again spontaneously. Fortunately, in many cases, the condition causes but little suffering, and is amenable to treatment by rest and palliatives.

A. E. Barker.

MOXA. *See* Issues.

MUCOUS PATCHES.—The mucous patch, known also as mucous tubercle and mucous plaque, is a very frequent lesion of acquired secondary, and of inherited syphilis, and, in an exaggerated form, has been met with occasionally in tertiary syphilis. As a manifestation of secondary syphilis it occurs early, and is associated with the papular eruption. It is met with usually in a multiple form, and is situated either on mucous membrane, or on thin and moist skin subject to friction or the frequent contact of irritating secretions or foreign material. The favourite situations of crops of mucous patches are the vulva in women, the skin about the anus both in men and women, and the scrotum and scroto-crural fold in men; but especially on the tonsils, on the tongue, and at the labial commissures. The lesion, when developed on a cutaneous surface, presents an oval elevation of a whitish-grey or pink colour, dry on the surface, and surrounded by a zone of red and inflamed skin, from which there is a continuous discharge of thin and very fetid serous fluid. When situated on the mucous membrane of the tonsil and tongue the patch has a smoother surface, is more defined at its margin, is less elevated, and causes less local irritation. When mucous patches, on a cutaneous surface in constant contact with another surface, are frequently irritated by the friction of clothes or by discharges, the patient usually suffers much from itching and sometimes smarting pain; but the lesion, when affecting a mucous surface, causes as a rule but little trouble, and is frequently unnoticed. The mucous patch is often associated with some fissuring and ulceration of the adjacent parts, especially when it occurs at the labial commissures, and when met with in congenital syphilis; and also as the manifestation of advanced syphilis described by Fournier as the 'tertiary syphilitic plaque.'

In dealing with cases of mucous patches, particularly when occurring in infants, it is very necessary for the surgeon to bear in mind the well-established fact that the discharge from the surface of this lesion is highly contagious.

The *local treatment* of mucous patches, when situated on a cutaneous surface, should consist in attention to cleanliness of the affected region, in one or two applications of solid nitrate of silver or sulphate of copper, and frequent dusting with calomel powder. When situated on a mucous surface, especially in the mouth, the local application of a ten-grain solution of chromic acid (Butlin) will be almost universally attended with a good result.

W. Johnson Smith.

MUSCÆ VOLITANTES. *See* Vitreous, Diseases of the.

MUSCLES, Affections of.—Contusion. Muscles are liable, like other textures of the body, to suffer from contusions or bruises.

Causes.—The principal are blows and kicks, the impact of spent balls in warfare, and splinters from objects struck or blasted; also falling against a firm obstacle, or the fall of some object on the person.

Pathology.—A bruise implies more or less injury to texture, and may vary from a very slight injury, causing pain and stiffness for a few days, to one which may reduce the muscle to pulp and compromise its vitality. In even the simpler cases, however, there is more or less tearing of the fibres, or of their ensheathing sarcolemma, or of the nerves or blood-vessels. This explains the extravasation of blood, and loss of function in the muscle, which generally follow injury, in varying degree. Bruise of muscle is common, though not so much so as one might suppose from the vast extent of muscular covering with which the body is invested. The muscles more liable to suffer are the deltoid, gluteus maximus, those of the lower limb generally, and of the abdomen.

Symptoms.—Pain is of a dull character. There is inability to use the muscle, with increase of pain when the attempt is made. Swelling is present, due to extravasation of blood and effusion of serum. The swelling is deep-seated; that is to say, under the fascia. Ecchymosis may be evident at once, from injury to the superimposed skin. But discoloration from the bruise of the muscle will not appear for some time (days probably), and will then be at some dependent part, from gravitation of the blood. The symptoms which present themselves later are—atrophy from injury to nervous or vascular supply, or both; loss of power from

injury to the fibres or the motor nerves; contraction from the parts being held in a position of relaxation to relieve pain; lastly, inflammation and even abscess may succeed a bruise of muscle.

Diagnosis.—The only difficulty is in cases where the muscle injured lies over a joint, such as the shoulder. The primary swelling and subsequent (occasional) flattening from atrophy and loss of power in the arm, may be supposed to be due to dislocation. Careful examination should, however, enable the surgeon to make out that there is neither dislocation nor fracture in any given case, and thus certainty is reached by a process of exclusion. *See* Dislocations; Fractures; also Shoulder; Hip, &c.

Treatment.—1. Rest of the muscle and relaxation of it, if possible; 2. Prevention of effusion of blood; 3. Restoration of function to muscle; 4. Prevention of evil results, such as inflammation, contraction, atrophy, &c. The first two indications are best carried out by attention to position and support with a bandage evenly applied over cotton wadding, or by cold, or by anodyne or astringent lotions. Cold may be easily applied by pounded ice in a waterproof bag of any kind, by irrigation, maintained by placing a few threads of worsted hanging from a vessel filled with cold water, or by evaporating lotions. A convenient formula for the latter is ℞. Ammon. hydrochlor. ʒj.; Pot. nitratis ʒj.; Aquæ fʒvj. or viij., to which is sometimes added Sp. vini rect. fʒj. For astringent lotions hazeline, tincture of arnica (1 to 7 of water), or lead and opium (gr. viij. of each to the fʒj.) may be used.

The third and fourth indications should be carried out by early movements, to prevent stiffness and contraction, and the combination of rubbing, kneading, and movement termed 'massage' (*see* Massage). Weakness of the muscle and some pain in using it will continue for a time. Gentle support will often relieve this, along with the douche of hot water at night and cold in the morning. The application of the galvanic current will be necessary should atrophy or paralysis threaten.

In applying electricity to muscle the following rules should be followed:—

If there is simple atrophy without paralysis, this is probably due to want of use, and the Faradic current should be employed to make the muscle contract. If atrophy continue, there may have been some injury to the trophic nerves, in which case the constant current (with massage) may be useful. If the muscle do not answer to the stimulus, then there has been injury to the motor nerve, in which case the constant current should be employed (occasionally reversing and interrupting it) until some reaction is produced, when the Faradic current should be used. In cases of atrophy and of paralysis the maintenance of the temperature of the part is important, and materially assists recovery.

Acupuncture is sometimes of great service in relieving the painful condition of muscles left after an injury, an ordinary darning-needle being plunged a few times into the substance of the affected muscle with immediate benefit.

Strain of a Muscle implies something more than mere stretching—a certain amount of texture gives way. This injury is therefore strictly speaking a minor degree of rupture, and may be considered along with the following affection.

Rupture of Muscle is caused by a pulling strain in the long axis of the muscle, contraction of the muscle itself, or both of these together. Separation of muscular fibres from wound or blow may also occur, but this will be considered under other heads. There are certain causes which predispose to muscular rupture, such as contraction, atrophy, and degeneration. Rupture of muscle may occur in tetanus.

Symptoms and Diagnosis.—The patient feels a sudden pain as if the part had been struck. There is weakness or perhaps inability to use the muscle. These symptoms occur when there has been a sudden or forcible flexion or extension of a joint, powerful muscular resistance to some force, or a sudden effort made, as when a person tries to recover himself after slipping. If the muscle injured be in the lower extremity the patient may fall. On examining the part, if the rupture has been extensive, a gap in the muscle is felt, which is more marked when the muscle is in a state of contraction, in which condition there is added a swelling above (on the proximal side of) the gap or hollow. There is subsequent swelling from effusion of blood and serum, which masks the depression; but the gap in the muscle appears again after absorption of the effusion and disappearance of the swelling. Later on there remain only loss of power and atrophy of the muscle, which are in proportion to the amount of injury. Diagnosis should be easy if the foregoing symptoms are well-marked. When these are slight then the case may be considered one of slight rupture or *strain.*

Treatment.—Rest and relaxation of the muscle, to favour approximation of the torn

fibres. In severe cases, where great weakening or entire loss of power in an important muscle might result, it will be necessary to cut down at the part, and sew together the torn ends with catgut, with strict antiseptic precautions. The resulting uniting medium is connective tissue (at first at any rate); after a time the muscle recovers its power entirely. After the rupture has firmly united, use of the part must be commenced, to prevent contraction, atrophy, &c. If movement is begun or permitted too soon, tearing of the uniting medium may take place, or an abscess may form from the irritation.

Wounds of Muscle.—These may be divided into *subcutaneous* and *open*, and into *transverse* and *longitudinal*. Subcutaneous wounds are generally inflicted by the surgeon for the treatment of some deformity. Open wounds may be treated as ordinary wounds of the soft parts (*see* Wounds). Should the muscle be cut longitudinally, there will be a tendency for the cut edges to close together and so interfere with drainage; should it be severed transversely, there will be a tendency to gape. In the latter instance stitches should be inserted into the muscle itself, and union of the cut surfaces sought for, as already described in the treatment of *rupture* of muscle.

Hernia of Muscle may occur where there is a gap in the investing fascia. The displaced muscle may be replaced and retained in position by pressure, as by a bandage. Should reduction or retention be impossible, the part may be cut down upon, the opening in the fascia enlarged and then stitched up after the muscle is returned. Such an operation should of course be performed only under strict antiseptic precautions.

Contraction of Muscle.—This condition may occur from malposition of parts (as in torticollis), but usually is in connection with disease (as of the joints). It may also occur after an injury, as in contraction of the quadriceps in cases of fracture of the patella. If gradual extension and use of the parts is not sufficient to restore function and symmetry, tenotomy (section of the tendon), or myotomy (section of the muscle), may be necessary. The latter operation only need be referred to here. It should be performed *subcutaneously*, and in one of two ways—either by cutting across the muscle completely, and keeping the parts separate till union has taken place at a sufficient length to atone for the previous contraction, or by making a number of V-shaped incisions in the substance of the muscle, as recommended by Dr. Macewen of Glasgow.

Spasmodic contraction of muscle is due to some nervous affection, and should be treated by tenotomy, myotomy, neurotomy, or nerve-stretching, if internal remedies are not sufficient. *See* Torticollis, &c.

Diseases of Muscle.—*Myalgia*, or pain in muscle, may be due to injury, nerve-pressure, inflammation, rheumatism, certain febrile conditions, certain poisons, or neuralgia. The treatment will be to get rid of the cause, and locally to apply anodynes or counter-irritants.

Inflammation of muscle, or *Myositis*, may result from injuries (as bruise or strain), from hypodermic injections (dirty needles), from rheumatism, or from a poison, such as syphilis or septicæmia.

Symptoms and Diagnosis.—There are the ordinary signs of pain, heat, redness, swelling, and interference with function. It will be possible to locate these in the muscle or muscles affected. Should suppuration occur, there will be throbbing, rigors, &c. Myositis is a very painful affection, and pain is much increased on movement. In the rheumatic variety, pressure and rubbing sometimes relieve pain.

Treatment.—Rest, application of cold in the early and acute stage, hot fomentations or poultices when the symptoms are fairly established, and anodyne lotions, of which belladonna with glycerine is one of the best. An abscess should be opened early and with antiseptic precautions, as otherwise it is apt to burrow. If the abscess is deep-seated, the skin and fasciæ only should be cut with a knife, and then a director be thrust through the muscular substance in the direction of the abscess. In this way, excessive bleeding is avoided. If opening is delayed, sloughing of fascia is apt to follow.

Sequelæ.—Organisation of plastic effusion may give rise to fibrous bands, which necessarily interfere with the function of the muscle. An abscess becoming absorbed may give rise to a caseous concretion. Contraction of a muscle may remain for some time after inflammation, to be treated by extension, friction, and use of the parts.

Muscular Rheumatism.—The commonest examples are lumbago and pleurodynia, the causes being strains, colds, gonorrhœa, syphilis, and rheumatism. It is supposed to be a subacute inflammatory affection, and is very apt to recur. Treatment: counter-irritation and anti-rheumatic remedies. The writer has found in certain

persons, in whom pleurodynia or lumbago are apt to occur from exposure to cold, that tincture of Actea racemosa, in thirty or forty drop doses, repeated every four or six hours, is sometimes beneficial.

Syphilis in Muscles.— Syphilis may give rise to myositis, myalgia, contraction, and gummatous infiltration. *See* Syphilis; Gumma.

When gummata occur in muscle, it is generally in the form of hard masses, which give a beaded appearance to the muscle. They tend to soften and break down. They are not very painful, and do not interfere much with the use of the part. They disappear under treatment with potassium iodide and counter-irritation. If left to themselves they tend to suppurate.

Hypertrophy of Muscle.—This may be true and simple, from use and increase of vascular supply, or false and due to fatty deposit, or to the so-called pseudo-hypertrophic condition. The tongue is prone to suffer from a hypertrophic condition termed macroglossia, caused by attacks of glossitis, due to lymphoid infiltration, and frequently requiring removal of a portion of the organ. *See* Macroglossia.

Atrophy of Muscle.—(1) Simple atrophy may occur from a variety of causes, such as injury, want of use, pressure, injury to a nerve or blood-vessel, ankylosis of a joint, disease of a joint, and lead-poisoning. Treatment must be according to cause, with the use of galvanism, blisters, passive motion, friction, massage, &c.

(2) Atrophy may also occur as a symptom of disease of the nervous system, as in infantile paralysis, progressive muscular atrophy and pseudo-hypertrophic paralysis, which, being medical affections, will not be considered here.

Paralysis in children frequently causes deformities which require, for their treatment, operations. *See* Club-Foot; Lateral Spinal Curvature. The treatment of atrophy after injury is referred to under Bruise of Muscle.

Degenerations of Muscle.—Fatty degeneration may be due to want of use, improper diet, alcoholic indulgence, or disease. Treatment will be exercise, a properly regulated diet, &c.

Waxy degeneration is found in connection with some fevers, granular after myositis or associated with fatty degeneration. Pigmentary degeneration may be associated with atrophy or the wasting of old age. Calcareous degeneration has been observed in connection with a similar condition of other organs.

Ossification of Muscle.—This differs from calcareous degeneration in the fact that there is a formation of true bone. The stony hardness of the deposit, along with the interference with the function of the muscle, should make diagnosis comparatively easy. In regard to treatment there is little to say. Blisters are said to relieve pain and check the morbid process.

Trichinosis, affecting the muscles, occurs not infrequently in this country, but is much more common abroad. The disease is shown by the presence in the muscles of numerous whitish specks, each of which, under the microscope, is seen to contain a small worm coiled up in a spiral form. The ingestion of raw or imperfectly cooked flesh, especially that of the pig, as in hams and sausages, is the only known source by which the trichinæ find access to the body. Within a few days after the worms are swallowed, they produce eggs, and the embryos when hatched speedily find their way to the muscles, either directly or through the vascular system.

Symptoms. — The patient complains, first, of loss of appetite and prostration, the face also swells; the muscles next become painful, swollen, and contracted; œdema then supervenes. This disease has been mistaken for acute rheumatism, but the absence of joint-implication should be a sufficient guide. No treatment is of any avail.

Tumours of Muscle. — These are fibroma, lipoma, enchondroma, osteoma, angeioma, cystoma, myxoma, sarcoma, and carcinoma. A. G. Miller.

MUSCULO-SPIRAL PARALYSIS (Crutch Paralysis, Chair-back Palsy, Drop-wrist).—*Symptoms.*—Loss of power over the supinators of the forearm and extensors of the wrist and hand, in consequence of which the forearm assumes the position of complete pronation; the hand drops loosely forwards on the wrist, the fingers are flexed into the palm and lie over the thumb, which is adducted. Attempts at extension of the hand are followed by some flexion of the first phalanges and extension of the second and third, due to the action of the lumbricales and interossei. A slight amount of supination can be effected with some effort by the biceps, when the forearm is semi-flexed. Extension of the forearm upon the arm will be more or less affected; the higher the nerve-lesion the more complete will the loss of this extension-power be. The onset of the disease may be sudden

or gradual; cases in which it is gradual usually commence with weakness about the hand and wrist, the supinators are then affected, and finally the triceps. There will be loss of sensation over the cutaneous parts supplied by the nerve.

Causes of Sudden Paralysis. — Sharp blows on the musculo-spiral nerve as it winds round the humerus; the palsy from such a cause is usually transient. Division or laceration (1) in direct wounds, (2) by ends of fragments of a fractured humerus, or (3) during removal of sequestra in operations for dead bone; pressure on the nerve by a sharp edge (e.g. back of a chair); laceration of the brachial plexus; cerebral lesion.

Causes of Gradual Paralysis. — Degeneration of nerve after injury; implication of nerve in callus about a fracture of the middle of the humerus; pressure from a crutch; lead-poisoning; syphilis.

Treatment.—In division of the nerve in an open wound, its divided ends should be found and united by suture; the same course should be pursued, if possible, when the nerve is divided in operations for extracting sequestra. In division from simple fracture, the bone may be allowed to unite and then, if the palsy continues, the nerve-ends should be dissected out and brought together with suture. When implicated in callus, the nerve should be cut down upon and freed from the pressure. *See* Nerves, Injuries of.

In crutch and chair-back palsy the recovery is usually spontaneous the cause having been removed, but may be assisted by electricity, 'massage,' and muscle exercise, treatment which may also be useful in the degenerative form. In cases dependent upon lead-poisoning or syphilis, iodide of potassium in 5 to 10 grain doses will usually effect the cure, aided, if necessary, by the mechanical treatment just mentioned.

William H. Bennett.

MYALGIA.—Pain in Muscles.

MYCETOMA.—The Fungous Foot of India. *See* Fungous Disease of India.

MYCOSIS INTESTINALIS. *See* Malignant Pustule.

MYDRIASIS.—Dilatation of the Pupil. *See* Iris, Diseases of the.

MYELOID SARCOMA. *See* Sarcoma.

MYOMA. — Muscular-tissue tumours would be held to be rare, but for the presence of this element in growths whose structure in the main is composed of other tissues, as the myo-fibromata of the uterus and the myo-adenomata of the prostate. With these composite tumours excepted from the list, comparatively few instances of pure myoma have been described, and they, for the most part, have been found either in the immediate area of the kidneys of very young children or in the walls of the alimentary canal, the gullet perhaps most usually. In speaking of myomata, these are regarded as the true type of muscle-tumours, although the term myoma, when introduced, was intended to distinguish tumours, apparently fibrous but in which flat muscular fibres occur abundantly, from the ordinary fibrous tumours formed solely of connective tissue.

Cause.—The myomata which occur in infants are almost certainly congenital; hence their cause is to be found probably in errors of development. For the myo-fibromata of the uterus, which are the commonest form of these growths, it is sufficient to point out that the two elements of muscle and fibrous tissue mainly constitute the organ, and that during the menstrual period of life the uterus is once a month the seat of active hyperæmia. That this periodic turgescence of the organ is the cause of these tumours, seems evident from the shrivelling which often follows, and may be expected to follow upon, the menopause. Lastly, these tumours seem to be hereditary in the female members of some families.

Pathology.—As has been said already, myomata connected with the kidney form some of the best examples of muscular-tissue tumours. They are usually of firm consistency, yellowish-white in colour and irregular outline; on section, bands of interlacing fibres are seen; under the microscope the fasciculi are seen to be composed of muscular fibres, whilst nodules of fibrous tissue are commonly interspersed.

Symptoms and Diagnosis.—As before removal it would be impossible to distinguish these tumours from fibromata, all that can be said is that they are firm and nodulated, sometimes doubtfully fluctuating. Should, however, a suspicion exist of a tumour being a myoma, the fact could of course, as a matter of interest, be ascertained by teasing out a fragment and microscopically examining its structure.

Treatment.—There are no special circumstances attaching to the treatment of myomata. Whether to perform an operation for their removal or to leave them alone has to be determined upon the general principles of dealing with solid tumours.

Alfred Willett.

MYOPIA.—Short-sight. *See* Refraction, Errors of.

MYOSIS.—Contraction of the Pupil. *See* Vision, Disorders of, from injuries of the Head and Spine.

MYOSITIS.—Inflammation of Muscle. *See* Muscles, Affections of.

MYOTOMY. *See* Muscles, Affections of.

MYXŒDEMA. *See* Thyroid Gland, Diseases of the.

MYXOMA.—A new-growth of the connective tissue type, the essential feature of which is a gelatinous material, termed 'mucous tissue.' Tumours of this nature may be quite *simple*, as in nasal mucous polypus; or *complex*, as in myxo-adenoma, myxo-chondroma, or myxo-lipoma. These latter tumours, as a rule, grow either in the salivary and mammary glands or in the areolar subcutaneous tissue; but they are rare, and are of more interest to the pathologist than to the practical surgeon.

Pathology.—Myxoma is usually an affection of the adult period of life. In some complex tumours the myxomatous elements even appear to have been superadded to the original growth, possibly as a degeneration of its tissue. Microscopically, a myxoma resembles embryonic fat. It is composed of scattered cells, usually stellate in shape, with very fine connecting fibres widely separated from each other, whilst in the interspaces a fluid like mucus is contained. This fluid exudes freely from the cut surface, and possesses the specific characters of mucus.

Symptoms and Diagnosis.—Myxomata, other than nasal polypi, can scarcely be said to possess such definite features as to enable one to distinguish them from other tumours, whose consistency seems doubtful and suggestive of partial fluidity of contents. An aspiration and examination of the mucoid fluid extracted might enable a diagnosis to be made before operating. After removal, a myxoma may be diagnosed from a colloid growth, which it most resembles, by the fact that the colloid material is for the most part contained within cysts; but still more by the different microscopic characters of their respective cells and by reactions to chemical tests for mucin.

Treatment.—There is nothing in the nature of a myxoma to contraindicate the removal of any tumour thought to be of this character. Alfred Willett.

N

NÆVUS, literally a spot or mole on the body.—This disease is, according to the classification of tumours at the present day, placed among the angeiomata or vascular tumours. It is popularly known as mother's-mark or strawberry or raspberry tumour, but it has received almost numberless professional synonyms in various countries.

Causes.—Nævus is generally regarded as a congenital affection, and yet it often first shows itself a month or six weeks after birth. It is popularly supposed to be due to some impression made upon the mind of the mother during pregnancy.

Varieties.—It will be most satisfactory to consider nævi from a clinical point of view, and to divide them into three classes—(1) those in which the skin is principally involved—the cutaneous; (2) those in which the subcutaneous tissues are principally implicated—the subcutaneous; and (3) those in which the skin and subcutaneous structures are simultaneously involved.

Situations.—Nævi are generally supposed to be met with most frequently on the head and face, and no doubt these are common situations; but this conclusion may be fallacious, inasmuch as, being more exposed to view, they are apt to attract more than ordinary attention. It is alleged that they are more commonly met with in girls than in boys, and they do not seem to interfere with the general health. Nævi occur in all parts of the body, not only on the skin, but also on mucous surfaces, as the conjunctiva, extending even to the retina. They are found in the mouth, inside the cheek, on the hard palate and gums, on the tongue, fauces, and pharynx, and in the cavities of the nose and ear; and, further, the vascular structure has been noticed within as well as without the skull, the capillaries of the dura mater and scalp being simultaneously involved.

These vascular growths are also not uncommonly met with on the pudenda, and one case is recorded of nævus of the scrotum.

Symptoms and Diagnosis.—With regard to the *cutaneous* variety, there is usually no difficulty in arriving at a correct diagnosis. The nævus presents itself as a crimson spot of variable shape and size. It is generally circular, not uncommonly having an irregular, leaf-like edge. In some cases it is smooth on the surface; in others it has a granular appearance not unlike the surface of a raspberry, hence its popular title, raspberry-mark. Its progress is comparatively slow, owing to the resisting nature of the skin. It may or may not be raised above the level of the skin, and it often has at its circumference a scarlet appearance whilst the centre presents a cicatricial aspect, having a white glistening surface with small vessels meandering in all directions. Pressure with the finger causes the colour to fade or almost disappear, but the instant the pressure is relaxed the growth reassumes its vivid hue. There is, as a rule, no marked pulsation in this variety, but the tumour may become excessively turgid when the child cries. There is a great disposition in this variety for the nævus to remain stationary, and ultimately to disappear altogether without operative interference.

The diagnosis of the *subcutaneous* variety is not always so easy, and the difficulty depends to some extent upon its depth from the cutaneous surface, as well as upon the thickness of the integument covering it. Surgeons of repute have committed and acknowledged errors in diagnosing these cases: thus an instance is recorded in which a child had a small tumour situated at the inner angle of the right orbit, presenting apparently all the characters of a subcutaneous nævus. Threads were passed through the tumour with the view of effecting a cure. Cerebral symptoms came on soon after the operation, and the child died. At the post-mortem, an encephalocele was found passing through the suture between the ethmoid and frontal bones. Again, an operation was undertaken with the view of removing a supposed atheromatous tumour of the cheek. The growth turned out to be a vascular tumour, and as the hæmorrhage was smart it was removed by ligature. Erectile tumours have also been mistaken for enlarged glands, and a meningocele at the anterior fontanelle for nævus.

The subcutaneous nævus has generally the following characters:—The skin is thinned and transparent, and through it may be discerned a bluish patch of variable hue, having an oval or globular outline with or without definite limits. Sometimes, probably arising from position or from extreme thickness of the skin, no change of colour is noticeable, and the patient is brought to the surgeon because there is a slight fulness or swelling of the part, which, if it be on the face, occasions a slight or well-marked deformity. The size of course varies, but on manipulation the growth has a doughy, soft, boggy feel, not unlike a bag of earthworms or even a piece of fat. Sometimes it has a granular or shotlike feel to the touch. Slight pressure diminishes the size of the tumour, but the growth refills steadily and surely as the pressure is withdrawn. There is little, if any, decided pulsation, and if present it is of a slow, indolent character.

The *mixed* form of nævus partakes, as may be supposed, of the characters of the two varieties just described. The skin itself is often disproportionately affected; there is frequently only a small crimson patch involving the skin, whilst the subcutaneous structures are implicated to a far greater extent than might at first sight be supposed; thus, in one instance the superficial redness was scarcely the size of a threepenny-piece, whereas the deep swelling was fully four inches in diameter.

Pathology and Progress. — Pathologically, a nævus may be described as a tumour consisting of blood-vessels communicating in various degrees, and united more or less by connective tissue, and matted together in a mass in the subcutaneous or some other tissue. Two classes of nævi are described. 1. The simple angeiomata, in which the new vessels are exactly like the normal capillaries or arteries and veins. These vessels may be newly formed, but, in many instances, they appear to be the original vessels enlarged to a considerable extent. 2. The cavernous angeiomata, in which there is a structure closely resembling the corpus cavernosum of the penis. Here there are a number of alveolar spaces, sometimes much larger than those in true erectile tissue, which are distended with blood supplied by numerous arteries, the fluid circulating feebly through them. Other observers believe that nævi commence in the capillary network of vessels which normally surround the hair-follicles.

Nævi make variable progress: the strictly cutaneous form either remain stationary, or disappear spontaneously without any interference on the part of the surgeon; in the subcutaneous and mixed forms an operation of some kind is generally called for. But these, again, may remain stationary, or they may suppurate and thus get disintegrated; or they may undergo fatty degeneration, when they are known as nævoid lipomata; or they may undergo cystic degeneration, the cysts being filled with a clear, sanguinolent fluid.

Treatment.—There is scarcely any limit to the number of methods that have been devised for the cure of nævus, and perhaps it is well that the surgeon should have a choice, because each case must be judged on its own merits; and the treatment will necessarily vary with the nature of the case, depending upon the situation and character of the morbid growth. The main object is to arrest the growth, so as to leave a non-vascular cicatrix in place of the nævoid tissue. As already stated, surgical interference is not always required; without any assignable reason the vascular spot sometimes disappears spontaneously, or its disappearance seems to be induced by some trifling cause. Such cases are, however, rare, and more frequently the surgeon is compelled to have recourse to operative measures of some kind.

1. *Compression.*—This plan of treatment at first sight seems inviting, but it is obvious that the morbid growth must be so placed as to ensure a firm *point d'appui*. Abernethy treated a severe case of nævus of the arm by applying a many-tailed bandage of sticking-plaster to the part. A roller was applied over the plaster and kept wet, so that (1) equable pressure was obtained, and (2) reduction of temperature effected. The cure, which was, however, only partial, took six months.

It has been alleged that even the pressure of the child's clothes has arrested the growth. Collodion and styptic colloid applied thickly have certainly a marked effect in reducing the size of nævi. An astringent effect may also be produced by a saturated solution of alum, either in rose-water or glycerine. The ether spray has been employed, and also a method of subcutaneous rupture, in which the nævi is rapidly squeezed so as to break up the vessels when full.

2. *External applications* may be used to excite either adhesive or superficial suppurative inflammation. Dieffenbach recommended that pure liquor plumbi should be applied on lint. After a few days the swelling becomes whiter, flatter, and firmer. A mixture of 1 part of tartarised antimony to 2 parts of emplastrum resinæ has been used, and must be continued until pustulation takes place. Again, corrosive sublimate, 4 parts to 30 parts of collodion, causes rapid desiccation, and the application of liq. arsenicalis, or the tincture of iodine, or the compound iodine ointment, has been followed by good results.

Blisters and croton-oil are occasionally used. The application of nitrate of potash causes a vesicle; the moistened finger is dipped in the powder, and the nævus gently rubbed with it.

Vaccination was at one time a favourite remedy; but even if the nævus be cured, it is uncertain whether the patient is protected against an attack of small-pox. If employed it should be done efficiently. Nélaton's plan was to take the finest insect needles, and charge the points with virus direct from the child's arm. Having passed a needle in, it was left *in situ* for a few instants until the tissues had time to become impregnated with the virus. Some surgeons make a point of applying the vaccine lymph at the circumference of the growth. It has been further suggested to inoculate the nævus with pus. The process of tattooing has been employed, using white lead or oxide of zinc, or calcined magnesia, with a sufficient quantity of vermilion or other colouring substance.

The potassa caustica also has its advocates; or the potassa cum calce (Vienna paste) may be used. The paste is spread on the part, and is allowed to remain for ten or fifteen minutes, whilst the skin around is protected by adhesive plaster. Strong nitric acid is a very efficacious remedy, and answers exceedingly well if carefully applied to the strictly superficial variety of nævi; but it often fails in the mixed variety, because the supply of blood, coming as it does from below, is not arrested, and hence the vascular mark may shortly reappear. Again, the actual cautery is very serviceable, and it is recommended by some surgeons to thrust the heated metal in all regions of the vascular mass, central, deep, and superficial. A less heroic form of applying heat is found in placing sufficiently long needles under the growth, and heating the proximal ends with a spirit lamp. Free incisions have also been made in the tumour, and lint or sponge firmly inserted.

The treatment of nævi by the application of ethylate of sodium, introduced by B. W. Richardson, is one that deserves

consideration on the part of the surgeon, its great advantage being that it leaves very little scar, the skin becoming slightly wrinkled, and having the appearance of tissue-paper. The ethylate should be applied, not with a glass rod, but with a brush; the only trifling objection to the latter is that with one use it is destroyed. A quill pen may be advantageously employed.

3. *Injections.* — The next method of treatment is that of injecting some material, of a more or less stimulating character, into the substance of the growth. Numberless chemical agents have been employed with variable success; thus, tannic acid, a saturated solution of alum, carbolic acid and olive oil, dilute nitric acid, pure alcohol, or a strong solution of nitrate of silver are used. The injection of the tincture of the perchloride of iron has been extensively tried with varying results, but all observers now agree that there is some risk in its use, because of the intimate communication that exists between the reticular structure of the nævus and the veins, which are often large; and it is scarcely possible to be quite sure that the fluid is not injected straight into a large vessel. The risk may be reduced to a minimum by adopting the suggestion of first breaking up the tumour, either by vigorous compression with the finger and thumb, or with a couching needle, which is introduced and worked in a radiating or fanlike manner from a single orifice in the skin. The liq. ferri persulphatis has also been used as a good styptic injection. The tincture of iodine is also serviceable, inasmuch as it is not so active an agent as the preparation of iron, for it does not produce coagulation. The injection of liquor ammoniæ appears to be on the same dangerous footing as that of the liq. ferri perchloridi.

4. *Electrolysis.*—Another method which has of recent years attracted well-deserved attention is electrolysis. This method is most simple and efficacious, and while it may be employed with advantage in the superficial or cutaneous nævi, it holds the first place and is *par excellence* the best mode of dealing with the subcutaneous or mixed varieties. Its principle is to coagulate the blood. A Stöhrer's continuous battery may be employed, and about six or eight cells used if the battery is in good working order. One or two needles, which ought to be protected with some non-conducting material so as to preserve the skin, are attached to the negative pole, which is best made of steel; and one to the positive, which is said to be better if made of gold or platinum, although a charcoal point is preferred by some. These are passed into the tumour. After the needles have been in for three or four minutes decomposition takes place—this is shown by bubbles of gas passing by the sides of the needles. The needles may be withdrawn and re-introduced, and if this process be carefully performed little or no blood exudes. The object of the operation is to produce a clot. It is well not to exceed six or eight cells at first, inasmuch as some children seem to suffer from shock during the operation. Further, if too many cells, say eighteen or twenty, are used, there is a prospect of suppuration. Between six and twelve cells, the writer believes, are the limits; but, as already observed, much depends on the quality and efficiency of the battery. *See* Electrolysis.

5. *Setons.* — Setons may be used advantageously in superficial or slightly mixed nævi, but it is important that the threads should be passed well below, and not through, the nævoid structure, their object being to obliterate the vessels passing to the skin-surface.

6. *Ligature.*—The elastic ligature is a favourite method with some surgeons, and is certainly suitable in many cases, but it is uncertain in its action. In treating cases with the ordinary ligature of hemp or silk, it is important to leave as little scar as possible; hence, if the ligature can be applied subcutaneously all the better, and it is worth a primary trial, even if there be a red superficial patch on the skin—i.e. a mixed nævus—because, as the blood-supply comes chiefly from below, there is a great probability that the ligature will not only destroy the subcutaneous growth, but will also eradicate the superficial red spot. Yet it cannot but be admitted that the subcutaneous ligature is often followed by failure, for it is by no means easy to comprise within its grasp one or more important vessels that principally feed the tumour; hence a second or even a third operation may become necessary. Nevertheless, if the operation be successful, the scar left after it is trivial, compared with the results that follow those operations in which the skin itself is included.

Subcutaneous Methods.—A needle in a handle is armed with a long piece of strong hempen thread, and is made to puncture the skin about a quarter of an inch from the circumference of the

nævus. It is then made to pass straight across under the tumour, and to emerge at a corresponding spot on the opposite side. The loop is now held in the left hand, and the needle is withdrawn, still armed with one thread. The needle is re-introduced at the first point of puncture, and is made to go (of course subcutaneously) round the circumference at the right side of the tumour, and to emerge at the same hole on the opposite side. The needle is then unthreaded and withdrawn. Thus there are a loop and one end emerging at one point, and a single thread emerging at the other. This single thread is now placed in the needle, which is again introduced at the first point of puncture, and carried round the circumference on the left side, being made to emerge as before at the opposite puncture. The thread is now removed and the needle withdrawn unarmed. There are now, of course, two apertures—one of entrance, which remains as a pinhole, and one of exit, at which are found the loop and two ends of the continuous thread. The operation is completed by passing the two free ends through the loop, drawing them tightly and tying them, not in a knot, but in a bow, so as to allow of them being tightened, if necessary, from day to day. By this ligature the tumour is cut into halves, and disappears by adhesive or suppurative inflammation.

Ligature involving Skin.—The well-known knot devised by Fergusson is one by which a radical cure may be readily effected. The only drawback to it is that by its use the skin is destroyed; but it is especially applicable to nævi situated on the trunk or other parts not usually exposed to view. Fergusson originally used a needle in a handle, but of late years preferred an ordinary surgical needle. Supposing the latter to be employed, the operation is thus performed:—The needle, having an eye of sufficient size to carry two thicknesses of thread easily, and threaded with a long and strong hempen ligature, is made to enter the skin about a quarter of an inch beyond the circumference of the nævus, under which it is passed. One thread of the loop, it matters not which, is now divided, and its opposite end threaded in the eye still armed. The needle, having now two threads, is made to pass at right angles under the tumour, and on emerging the threads are released. The corresponding ends having been selected, a groove is made with scissors at the circumference so as to receive the threads, and they are tied in a reef-knot as tightly as possible. This method encircles the tumour and cuts it into four portions. It is important to tie the knots as tightly as possible, so as to ensure the rapid and complete destruction of the disease, and to give the patient as little pain as possible in the separation of the slough.

A modification of the above operation may be advantageously employed. It consists in passing two hare-lip pins under the nævus at right angles to one another, and encircling them with a ligature tied tightly in a bow; the needles are removed immediately after the application of the ligature, and the ligature taken away in twenty-four hours.

7. *Enuclcation.*—This is a very old method of dealing with subcutaneous nævi, but John Bell's dictum of 'cutting out' the tumour and not cutting 'into it' has led surgeons to be over-apprehensive as to hæmorrhage. The idea of alarming hæmorrhage is greatly exaggerated. Some surgeons cut right through the diseased structure and take away each half piecemeal with curved scissors, removing no skin; or turn back rectangular flaps of skin, which should be retained even when involved in the nævoid growth.

8. *Écraseur.*—This instrument has been used, but can only be recommended in the case of very delicate children.

9. *Ligature of Vessels.*—1. The principal vessels supplying the nævus have been tied; thus in a case of nævus of the cheek, three needles were placed under the facial, left coronary, and angular vessels respectively, and a twisted suture employed. 2. The ligature of the main vessels has been attended with very negative results. Thus, the common carotid has been ligatured for tumours of the orbit and other tumours of the scalp; but, if this plan of treatment be adopted, it is obvious that the vessel selected should be one that directly supplies the growth, as, for example, the external carotid when any of its branches are involved.

10. *Amputation.*—This extreme measure can only be necessary in most exceptional cases, and should only be undertaken as a *dernier ressort.*

Summary of Treatment.—As the result of experience, it may be stated generally that for the superficial nævi, either strong nitric acid, the actual cautery, or the ethylate of sodium may be employed; and for the subcutaneous and mixed varieties, electrolysis, the ligature in some form, or enucleation may be practised.

FRANCIS MASON.

NAILS, Diseases of the.—The surgical affections of the nails will be described in the following order:—(1) Hypertrophy and deformity; (2) Onychia; (3) Ingrowing nail; (4) Eczema and Psoriasis; (5) Parasitic disease.

HYPERTROPHY.—Hypertrophy of the nail is not uncommon, and may depend on various causes which induce long-standing congestion of the matrix, or may be merely an accompaniment of old age. Very commonly the hypertrophy is attended by a deformed condition, the nail being irregularly developed and misshapen, becoming extremely thick, and assuming the character of a horn, variously twisted in different cases. Such nails, except from their size, may give no trouble; but, on the other hand, the edge may be directed against the skin, and then the pressure of the boot will cause a sore.

Treatment.—The projecting part of the nail may be removed by means of strong scissors—a groove having been first made with a sharp-edged file; or the nail may be completely removed. In some cases, after the last-named treatment, the nail may be reproduced in a normal fashion; but frequently it is impossible to cure the tendency to reproduction of the deformity, except by paring away the matrix or destroying it, as by strong nitric acid.

The nails sometimes become hypertrophied and misshapen as a result of local nerve-lesions, being remarkably curved and thickened, and in some instances ridged like an oyster-shell; this diseased condition being accompanied by withered and glossy skin and other results of injury to the nerves. The *treatment* is of course that of the nerve-lesion on which the deformity depends. *See* NERVES, Injuries of.

ONYCHIA.—This term is commonly applied to any long-continued inflammation of the matrix of the nail, which is accompanied by ulceration and its necessary results—purulent and more or less fetid discharge, with loosening and discoloration of the nail. As in many other affections of the nails, the appearances presented by the disease may be alike, although the causes are different. Thus simple, syphilitic, and strumous onychia have been all described.

In a typical and severe case (*onychia maligna*), the extremity of the affected finger is inflamed and bulbous, dark red or livid; foul sanious matter escapes from beneath the nail, which is partly raised from its bed by granulations springing from the ulcerated matrix. All the parts are acutely tender, the patient shrinking from the slightest touch. Cases such as this are seen most frequently in children, and more often in the fingers than the toes. The disease will be found usually to have begun as a consequence of some injury, as from a squeeze of the finger in a door or from its being trodden upon. In rare cases, the disease may advance until necrosis of the last phalanx occurs.

It is not necessary to assume the presence of a constitutional defect in all cases of onychia; but the possibility of a predisposing cause in the form of struma or syphilis should be borne in mind, and especially when more than one digit is affected. In a case of syphilitic onychia, the symptoms are generally far less acute than when the disease has been caused by injury; and the diagnosis is made sufficiently easy by the presence of other signs of syphilis in the neighbourhood or elsewhere.

Treatment.—The finger should be well fomented with a weak lotion of permanganate of potash or carbolic acid, and a piece of lint dipped in an arsenical lotion (liq. arsenicalis f℥j., aq. ad f℥j.) should then be applied, the process being repeated twice or three times daily; or, instead of the arsenical lotion, powdered nitrate of lead or iodoform may be dusted over the part. If the disease does not yield to this treatment, the nail should be removed, and the same treatment continued. In syphilitic onychia, black wash or calomel is the best local application; and a course of mercury or iodide of potassium should be given internally. In strumous or cachectic subjects, good food, cod-liver oil, steel, and arsenic are indicated; the local treatment resembling that proper for the simple form of the disease.

In the majority of cases, onychia can be cured by the above-mentioned treatment without much difficulty. In a small number of cases, however, there is some inherent vice in the matrix which leads to a redevelopment of the disease, notwithstanding all treatment; and the only effectual method of cure consists in removal of the matrix, by shaving it off with the knife or destroying it by caustics, of which nitric acid is the best.

INGROWING NAIL.—This term is applied to a very painful affection, in which the irritation caused by the edge of the nail pressing against the soft tissues ends in ulceration with exuberant granulations. The sharp edge of the nail impinges against the ulcerated surface of the skin which overhangs it, not by growing into it, but by the granulations growing out against the edge of the nail. The disease is practically con-

fined to the great toe, and almost invariably to its outer side. When the disease exists elsewhere, it is complicated by some diseased condition of the matrix. Predisposed to by an unusual development of the skin which naturally overhangs the nail, the trouble begins as a consequence of some slight injury, as from the pressure of tight boots or the like.

Treatment.—In a simple case, the edge of the nail should be cut away when any soreness is felt; but when the disease is fully established, and the edge of the nail overlapped by granulations, a more formal operation must be undertaken. Nitrous-oxide gas having been given, or the toe frozen, a slip of the entire length of the nail must be removed by pushing one blade of a pair of scissors beneath it, and twisting off this portion from the matrix with a pair of torsion-forceps. The slip removed should not be more than a fourth, or at most a third, of the nail; and, even if both sides are operated on, a useful central portion will be left. A radical cure can be produced by carrying the scissors well into the matrix of the nail and removing the lateral portion. When there is much overlapping of the skin, a small flap may be sliced off with a scalpel. *See* Ingrowing Toenail.

Eczema and Psoriasis of Nails.—Any long-continued, however slight, disease of the matrix will produce alteration in the texture and appearance of the nail; and as the altered nail is but a deformity resulting from a disease not primarily in itself, but in the underlying parts, it is only possible to get an accurate idea of the primary disease by studying the condition of the surrounding integuments. Thus, a rugged, furrowed, and brittle condition may be due in one case to eczema, in another to psoriasis, and in another to favus or ringworm, the appearances in all being not very different. Hence the impossibility of describing, in any useful way, the appearances of so-called eczema or psoriasis of the nails. They must be diagnosed in connection with the disease of the vascular tissues in their neighbourhood.

Similar appearances of the nails are sometimes present (and often called eczema or psoriasis) when there is no obvious eczema or psoriasis elsewhere. In such cases, most careful examination should be made with reference to the possibility of local irritation by extraneous matters accidentally applied, the nature of the patient's employment sometimes giving a clue to the source of the disease; or the disease may be parasitic.

Treatment.—When eczema or psoriasis of the nail is accompanied by a like disease elsewhere, the general treatment is obvious. The nails should be kept short, and occasionally softened by applying lint soaked in some alkaline wash, as of bicarbonate of soda (ʒss. to fʒj. of water). Accumulations of scales, &c., should be removed carefully by a nail-cleaner (made of bone or ivory, not steel). Lotions such as the following should then be tried:—Liq. carbonis deterg. fʒss.-fʒj., glycerini fʒj., aquam ad fʒiv.

The disease is generally obstinate.

Parasitic Disease.—The appearance of a nail affected by parasitic disease is sufficiently like that produced by long-standing irritation from other causes (eczema, psoriasis, &c.) to lead easily to an error in diagnosis. The possibility of the presence of a parasite should, therefore, be always borne in mind. A clue will usually be obtained from the presence of the disease (favus or ringworm) elsewhere: tinea of the nails, for example, in a child being accompanied usually by ringworm of the scalp. But in all doubtful cases a careful microscopic examination should be made of scrapings from the diseased nail; after softening and getting rid of extraneous fatty matters, by the application to the specimen first of ether for a few minutes, and subsequently, for some hours, of liquor potassæ.

Treatment.—The treatment of parasitic disease of the nails resembles that of the same disease when in the scalp or elsewhere. But the uncertainty is greater on account of the difficulty in thoroughly applying anti-parasitic remedies to the diseased surface. Great care should therefore be taken in scraping away the diseased portion of the nail, after softening by means of warm water and alkaline lotions, and in applying the remedies as thoroughly as possible. *See* Tinea Tonsurans; Favus.

W. Morrant Baker.

NASAL BONES, Fractures of the. *See* Face, Fractures of Bones of the.

NASAL DOUCHE.—To wash out the nose effectually and comfortably, certain simple precautions are to be observed. This process may be required for hæmorrhage, whether accidental, operative, or spontaneous, and is of important use in catarrhal and ulcerative inflammation, especially in the chronic fetid form known as ozæna.

A stream of water or lotion may be passed in at one nostril and out at the other, without impeding the respiration of

the patient if the latter assume the proper attitude, sitting or standing with the chin over the edge of a basin, bucket, or sink, the neck flexed, and the mouth open for breathing purposes. Another vessel contains the water or lotion, which should be an antiseptic liquid, not strong enough to cause pain, but strong enough to disinfect. Nothing is better than a solution of chloride of zinc, averaging an eighth of a grain to the ounce in strength. For hæmorrhage the hottest water that can be borne is far better than cold or iced. In any case plain water does very well to begin with, especially if there be pus, mucus, and scabs to be cleared away. The feeling of the patient may be consulted as to the temperature of the liquid, when used for allaying decomposition and inflammation. Hot or warm liquids, when not demanded for hæmostatic purposes, are better avoided when disliked; for some persons thus experience pain, who can bear and even enjoy cold or iced liquid in a state of nasal catarrh.

The liquid may be washed through the nostrils, in the attitude of the patient as above described, by means of a Higginson's syringe, a convenient method for the surgeon. But when undertaken by the patient, the syphon-tube is invaluable and may be required several times daily. A yard or a yard and a half of india-rubber tubing, transmitting a stream an eighth to a quarter of an inch wide, is slung over the edge of a jug containing the liquid, placed on a shelf or hung against the wall above the patient's head. One end of the tube is weighted, and reaches from the bottom of the liquid to the edge of the vessel, round which it may be curved by inserting six or eight inches of wire to prevent acute flexion and obstruction. The other end reaches from the edge of the vessel to the nose of the patient, and should be considerably longer than the immersed end, to permit syphon-flow when once the tube is filled throughout, and this is readily effected by the patient closing the mouth and opposite nostril temporarily, and taking a deep inspiration through the tube. The tip of the longer end should have a suitable nozzle, ending in an india-rubber 'teat' with a large central hole of a size suited to the nostril.

Nasal douche tubes are specially constructed with neat vulcanite or metal fittings. These consist of a piece of bent stiff tube to hang over the edge of the vessel, or, in the case of a mere stiffening of wire inside the tube at the flexure, a weighted inverted funnel to ensure deep immersion of the short end of the tube. In either case a nozzle is fitted to the long end. The force of the continuous stream thus produced can be modified by varying the height of the vessel. RUSHTON PARKER.

NASAL POLYPUS is a growth from the lining of the cavity, more or less pendulous, encroaching upon the breathing space, and on that account accompanied by arrest or modification of nasal respiration. The vast majority are gelatinous-looking objects which can be seen on inspection through the nostril, their presence being first indicated by their obstructive effect. Their point of attachment can never be seen when they are inspected *in situ*, but it is found to be usually on the upper and middle turbinate bones, and, less frequently, the inferior turbinate. Their surface is the mucous membrane of the nose, of which the ciliated epithelium shows abundant vibratile motion when examined microscopically, in a liquid, shortly after removal. Their gelatinous-looking substance is the loosest form of connective tissue, holding mucus in its meshes, and often resembling that class of tumours known as myxoma. They are, probably, mere hypertrophic excrescences of the submucous connective tissue, growing under the stimulus of some constant irritation, and owing their pendulous character to their composition and attachment.

Polypi are common at most periods of life, except in childhood and old age, and may exist in one or both nostrils, singly or in a group. Their lower extremity occasionally becomes excoriated, inflamed, and indurated or distended with blood, presenting, on inspection, under these circumstances, a momentary resemblance to some malignant growths. By pressure upon adjacent parts of the nose they may be attended by a mucous or purulent catarrh, with, in rare instances, ulceration, and even perforation, of the septum.

The *treatment* of polypus is removal, effected by constriction with a wire-loop snare, or by the use of suitable forceps. Satisfactory removal can be practised by either method, and, in some cases, with very little pain or inconvenience to the patient, followed by great subsequent comfort, which is now and then permanent after a single operation.

In using the snare, the wire is passed into the nostril along the floor of the nose, the loop being adjusted as long and as wide as the parts will allow, and then is passed upwards so as to surround the pedicle. This is divided, on constricting the loop, by

means of the écraseur, of which it is commonly a part, or, in default of this, by means of a simple piece of metal tubing, such as a piece of broken catheter, which can be slid along for the purpose.

In removing polypi otherwise, a pair of dressing-forceps is more frequently employed than anything else. Such an instrument, finely shaped and fairly long in the jaws, which should be serrated in their whole length, is more convenient than the short, thick sizes. It is not, however, sufficient to deal with polypi from the front, but the left forefinger should be passed behind the soft palate and made to meet the forceps, so as to insure clearing the posterior nares and pharynx, into which large pendulous nasal polypi often hang.

However removed, these 'gelatinous' or 'mucous' polypi, as they are called, have a tendency to be reproduced, at longer or shorter intervals, and accordingly various substances are applied with the view of preventing their re-formation. Tannic acid and sulphate of zinc have been recommended as snuffs. Salicylic acid, also as a snuff, has been used with advantage by the writer; and lotions of perchloride of iron, boracic acid and alcohol, carbolic acid and glycerine, have been known to act satisfactorily in arresting the growth of polypi. The same methods of local medication have been employed in the first instance, the persistent use of tannin snuff having been followed by sloughing and separation of the polypi; and injection of the above lotions into the substance of the growths, by means of a subcutaneous syringe, has resulted in their shrinkage and disappearance.

Other *non-malignant growths* of firmer consistence, and commonly called 'fibrous' polypi, are sometimes met with. They do not arise from the turbinate bones or outer wall, but from some part of the roof, from the margin of the posterior nares, or adjacent pharynx, in which case they are 'naso-pharyngeal' polypi. They are much less frequent than the mucous, much less easy to remove, but still capable of effectual extirpation, although they are commonly attached to the bone beneath them.

Treatment.—Extirpation alone is here practicable. If the growth be pendulous, or have a narrow attachment, the wire snare, plain or galvano-caustic, may be satisfactorily used for the purpose. Certain examples may be removed easily with ordinary dressing-forceps, or the special form alluded to. But, in the event of inaccessibility by what may be called the blind method of removal, inspection and direct excision should be practised. Some have slit the nostril up towards the eye, others have excised the upper jaw, or temporarily turned aside that bone, subsequently replacing it with its attached soft parts. By all these methods the nasal cavity can be exposed and explored.

But a far better method of entrance into, and inspection of, the nose for foreign bodies as well as tumours within it, is through the mouth under the upper lip, the fold of which is divided along with the nasal cartilages at their attachment to the bone. The nose is raised up with the lip, and a good view can be obtained throughout the nasal cavity, from which the tumour can be removed to its finest detail, without external mutilation of any kind. The writer's personal experience of this method has convinced him of its excellence.

Malignant tumours of the nose, whether polypoid or not in form, are of much less interest than others, being, fortunately, much less frequent, though hardly amenable to treatment at all, and being generally liable to rapid recurrence and eventual fatality. They can be recognised pretty easily by their rapidity of growth, by their tendency to bleed, and sometimes to infect the lymph-glands of the neck behind the angle of the jaw. When purely nasal, their removal may be practicable, and sometimes advisable, by the method beneath the upper lip, as above described, especially if situated far back. If situated in the upper and anterior parts of the nose, it may be easier to operate by direct entrance from the face. *See* Rouge's Operation.

Such tumours, though arising in the nose, are not infrequently attached to the superior maxillary bone, invading the antrum, or other parts beyond the nasal cavity. In that event, excision of the upper jaw is required, by the methods detailed in the article on the subject (*see* Jaws, Operations on the).

The obviously malignant growths are generally carcinomata, arising from the nasal mucous membrane, exhibiting in their minute anatomy the general characters variously found in carcinomata, with the special features derived from the surface from which they grow. Others have an adenomatous structure and a doubtful malignancy, neither of which can be decided until after operation, the former by microscopical examination, the latter by clinical observation, and waiting for recurrence or its fortunate absence.

Rushton Parker.

NASO-PHARYNGEAL CATARRH.

See RETRONASAL CATARRH.

NASO-PHARYNGEAL GROWTHS.

1. NASO-PHARYNGEAL VEGETATIONS are small pendulous or sessile growths, produced by hypertrophy of the adenoid tissue so abundant in the vault and sides of the naso-pharynx.

Cause.—Hardly known. They are most frequently met with in cold and damp climates, and then generally in delicate children. Colds, the acute exanthemata, and local irritation from food and cold air in cases of cleft palate, have been ascribed as causes. Some regard them as congenital, some as hereditary, and some, but apparently without sufficient evidence, as of strumous or syphilitic origin.

Pathology.—The vegetations occur in greatest abundance in the region of the pharyngeal tonsil, but may also be found on the lateral walls of the pharynx and about the orifice of the Eustachian tubes. They may be soft and friable, or hard and tough, and are generally very vascular. Microscopically, they consist principally of retiform adenoid tissue containing large numbers of lymph corpuscles, with here and there closed follicles similar to those of the tonsil.

Symptoms.—These vary according to the age of the patient, the amount of obstruction to nasal respiration, the vascularity of the vegetations, the copiousness of the secretion, and the condition of the mucous membrane lining the Eustachian tube, middle ear, lower pharynx, and nasal cavities. In a well-marked case, the voice has what Meyer calls a 'dead' character. It is muffled, the nasal resonance is lost, and the *m* and *n* sounds are pronounced as *b* and *d*. The face, from the patient breathing with the mouth constantly half-open, assumes a characteristic vacant expression, similar to that familiar to all in the case of enlarged tonsils; pellets of mucus, often tinged with blood, are constantly hawked up; and blood is occasionally found in the mouth or on the pillow in the morning. More or less deafness is frequently present, and it is often for this that medical advice is first sought. In infants, obstructed and noisy respiration and snoring during sleep should call attention to the affection. Granular pharyngitis, enlargement of the tonsils, and hypertrophic nasal catarrh are not uncommon concomitants; and purulent otitis with permanent impairment of hearing may result if the affection is neglected. A peculiar malformation of the chest, similar to that which may be met with as a consequence of enlarged tonsils, has not infrequently been observed.

Diagnosis.—The growths can be readily detected by the finger passed behind the palate, and when abundant do not feel unlike, as Meyer expresses it, a bunch of earthworms. The examination is generally attended with bleeding. In the rhinoscopic mirror they appear as fimbriated fringes, or flattened elevations of a pale, pink, or dark red colour, often encroaching more or less over the posterior nares and orifices of the Eustachian tubes.

Treatment. — The vegetations may undergo atrophy as the patient gets older, or cease to cause obstruction as the naso-pharynx increases in size. But, as the deafness and other symptoms to which they give rise may in the meantime become permanent, they had better be removed as soon as detected. When soft and small, and not very numerous, they may sometimes be got rid of by means of astringent injections or by the application of solid nitrate of silver. The former may be applied by Meyer's tube, which is passed through the nose, or by a post-nasal syringe. But injections, to be of any service, must be persevered in for long periods. If nitrate of silver is used it should be applied fused on the end of a long and suitably bent probe, as the use of all caustic-holders is attended with danger. It should be continued as long as bleeding follows its use. Usually more active treatment is called for. Thus, the softer growths may be scraped off by the finger-nail, a method especially useful in the case of very young children, where the parts are small and rhinoscopy difficult. For tougher and firmer growths, some cutting instrument or the galvano-cautery is necessary. Those situated on the vault may safely be removed by most of the methods that have been recommended; but extirpation by Löwenberg's or Woake's forceps, especially when the growths are of any size, is perhaps the best. When the patient is tractable, and a rhinoscopic examination can be obtained, the forceps may be directed by the mirror. Otherwise chloroform had better be given, and the forceps can then be guided either by the mirror, or by the finger passed behind the palate. Growths on the lateral walls and about the Eustachian tubes must be dealt with more carefully, as here there are important structures in relation with the pharyngeal walls, and an injury of the Eustachian tube may lead to inflammation and even suppuration in the middle ear. In such cases, the patient should

always be placed under chloroform, and the growths destroyed either by a small galvano-cautery, accurately directed by the rhinoscopic mirror, or by Zaufal's nasal speculum, or, as some prefer, by Meyer's ring-knife, which is passed through the nose. To obtain space for the mirror, the palate may be drawn forward by the palate-hook, or better, by fine india-rubber tubing passed through the nostrils out at the mouth and fastened across the lip, the latter method allowing the surgeon the use of both hands. Should any unusual hæmorrhage follow the removal of the growths, it may be arrested by astringent injections, tannic acid insufflations, &c. The patient should be instructed to breathe through his nose; and it may be useful to keep the mouth closed during sleep, either by securing the jaw by a four-tailed bandage, or by the use of the 'contra-respirator' advised by Guye.

2. Naso-pharyngeal Tumours or Polypi. The term naso-pharyngeal polypus is commonly applied to any tumour growing in the upper part of the pharynx. Such tumours have generally a fibrous or a fibro-mucous structure; but sarcomatous, carcinomatous, and still more rarely enchondromatous growths may occur. The naso-pharynx may, moreover, be invaded through the posterior nares by mucous polypi, or by malignant or other growths originating in the nasal cavities or antrum.

(*a*) *Fibro-mucous Polypi.*—These consist of a mixture of fibrous and myxomatous tissue, and commonly spring from the mucous membrane about the posterior nares, which has a structure intermediate to the soft pituitary membrane of the nose and the more fibrous covering of the vault of the pharynx. They are usually smooth, of a soft fleshy consistence, reddish in colour, and ovoid in shape; they are generally pedunculated and hang loosely in the pharynx, sometimes projecting below the soft palate, but more rarely they have a broad base, and send processes into the nasal cavities.

Symptoms and Diagnosis.—Fibro-mucous polypi may give rise to symptoms similar to those of the fibrous variety to be next described. Unlike the latter, however, they are not attended with hæmorrhage, and have no tendency to displace and destroy surrounding parts. They feel, moreover, less firm and resisting to the finger introduced behind the palate.

Treatment.—They may generally be twisted off by the finger or forceps passed behind the palate. If their base is too broad to admit of this, it may be severed by the galvanic écraseur, in the way described in the next section.

(*b*) *Fibrous Polypi.*—These generally spring from the periosteum covering the basilar process of the occipital or body of the sphenoid bone, and consist of tough fibrous tissue without elastic fibres, and often intermixed with sarcomatous elements. Their vessels have usually very thin walls, and in some instances are so numerous in parts of the growth as to give it a cavernous structure. They are smooth and firm, and covered with a very vascular mucous membrane, which gives them a dark red colour, while their surface is sometimes eroded by ulceration. They may be either pedunculated or sessile, and at first are usually confined to one side of the pharynx; but as they increase in size they form secondary attachments, displacing and destroying the surrounding bones, encroaching upon the nose, mouth, orbit, or spheno-maxillary fossa, and sometimes protruding externally through the nostrils or cheek, or upwards into the cranium. They generally occur in young adult life, grow slowly, are very liable to return after removal, but show a tendency to atrophy after the age of twenty-five. They have occasionally sloughed away spontaneously, and have then shown no signs of return, even after many years.

Symptoms and Diagnosis.—At first there may be no symptoms, but later headaches, drowsiness, and obstruction of one or both nostrils supervene, accompanied by a mucous and often fetid discharge, and frequent attacks of epistaxis. Occasionally, the polypus may be seen through the nose or projecting below the palate; otherwise it may be detected by the rhinoscope, or by the finger introduced behind the velum. As it encroaches upon surrounding parts it may give rise to deafness, difficulty in deglutition, and dyspnœa; whilst the eyeballs may be protruded, the facial bones widened out, and the nose flattened, causing the characteristic deformity known as 'frog-face.' The determination of its attachments now becomes very difficult, but may be facilitated by manipulation with a suitably curved probe. The repeated hæmorrhages produce severe anæmia, and the patient, if not relieved, may die of exhaustion.

Treatment.—When small and pedunculated, a fibrous polypus may sometimes be torn off by the forceps introduced behind the palate. When, however, the attachments are at all extensive, this method should not be attempted, as it may be attended with

profuse hæmorrhage, and, when the bones of the cranium have been invaded by the growth, by fatal inflammation of the brain. For these the galvanic écraseur should be employed, the wire loop being passed through the nose, and directed round the base of the polypus by the finger in the pharynx. The stump left after the severance of the growth should then be completely destroyed by the post-nasal galvano-cautery, passed behind the palate. The patient should be subsequently carefully watched, and the cauterisation repeated should there be any sign of a return of the growth. When the polypus is too large for removal by the natural passages, the soft palate may be split and, if necessary, part of the hard palate cut away, and the growth then removed by the ordinary or by the galvanic écraseur, and the base scraped away from the bone or destroyed by the actual or galvanic cautery. When the growth has taken a forward direction, invading the nose, it may be exposed by turning up the ala of the nose, or by Rouge's method; or, if sufficient room cannot be thus gained, by the removal or resection of the superior maxillary bone after the method of Langenbeck. If the patient is weakened by repeated hæmorrhages so as to be unable to bear a serious operation, electrolysis may be tried —a procedure which, though not invariably successful, has been attended with some brilliant results. Under its use the hæmorrhages have been arrested, and the polypus sufficiently reduced in size to allow it to be removed through the natural passages.

(*c*) *Malignant Polypi.* — These have generally a sarcomatous or, more rarely, a carcinomatous structure. It is not always possible to diagnose them from fibrous polypi before removal. They grow more rapidly, however, and there is often glandular enlargement and severe pain. Where a small piece of the growth can be removed, a microscopical examination will generally clear up any doubt. When seen early, they should be widely extirpated by one of the methods above described. If they have attained any size, they are beyond the aid of surgery. W. J. Walsham.

NAVEL. *See* Umbilicus.

NECK, Diagnosis of Swellings and Tumours of the.—The character of many of the enlargements met with in the neck is in some measure indicated by their position. Thus, bronchocele will be found in the situation of the thyroid gland, while aneurisms are more frequent at the root of the neck. The colour and appearance of the skin will show the approach of inflammatory swellings to the surface, and in some cases the infiltration of cancer will be recognised in the same way. Upon palpation it will be readily ascertained whether the tumour is fluctuating or solid, or whether it presents a combination of these two conditions. In rare instances, the presence of air in the tissues may be detected by the peculiar crackling sensation communicated to the fingers. This may be due to emphysema from rupture of some part of the air-passages. Hernia of the mucous membrane of the trachea has also been recorded, and occasionally the apices of the lungs can be felt above the clavicles, especially when they have become emphysematous from some intra-thoracic disease. The most important fluid swellings are as follows:—

1. *Abscesses*, which are usually known by their painfulness and rapid growth, together with the signs of inflammation which accompany them. As they generally begin in lymphatic glands, their recognition will be assisted by the detection of any local lesions which may have set up lymphatic irritation.

2. *Cysts.*—Cutaneous sebaceous cysts present no difficulty. Hydrocele of the neck, which is a large collection of serous fluid contained in a single or multilocular sac in the anterior or posterior triangle, is known by its slow and painless growth and by the clear straw-coloured fluid which escapes from the canula when it is punctured. Many are congenital, and they may be associated with solid growth of a sarcomatous type. In the submaxillary triangle ranulæ may protrude as well as in the floor of the mouth, and occasionally deep-seated sebaceous cysts are also found in this region. Bursal tumours may form between the hyoid bone and the thyroid cartilage, and upon the ala of the thyroid cartilage. These, as well as the more common cysts of the isthmus and lobes of the thyroid gland, may be known by their moving with the larynx in swallowing. In hydrocele of the neck and thyroid cysts the contents may be of a bloody character, and blood-cysts are sometimes found, which have resulted from the degeneration of nævi. Hydatid cysts and cysts of the cysticercus cellulosæ may occur in the neck. They are very rare, and will probably not be recognised until a puncture has given exit to clear watery fluid, containing hooklets or pieces of cell-wall.

3. *Aneurisms* are known by their expansile pulsation, and by their position upon the course of great arteries. At the

root of the neck they may be in connection with the arch of the aorta, the innominate, the subclavian, or carotid arteries. Bruits heard upon auscultation, and differences in the character of the radial pulse of the two sides, will assist the diagnosis. There may also be evidence of pressure upon the recurrent laryngeal nerve. There will be less difficulty in recognising the position and character of the disease when the distal portions of the carotid or subclavian arteries are affected.

The *solid* swellings may be classified as follows:—

1. *Glandular.*—These are usually the result of chronic inflammation, and they are frequently associated with scrofula or syphilis. Some are secondary to malignant affections in their vicinity. Cancer of the lip or tongue is the most frequent cause of these enlargements in the upper part of the neck, while the supra-clavicular glands may be implicated in scirrhus of the breast. Enormous growths of a primary character are found in the various forms of lymph-adenoma. Some of these are very malignant, infiltrating the deeper structures as well as the integuments.

2. *Nævi* and other tumours of the skin and subcutaneous tissue are frequent. Papillomata are sometimes observed, which appear to have some connection with the branchial clefts of the developing fœtus.

3. *Lipomata*, which may be of the common lobulated and encapsuled form. It is in this region, however, that we generally find the rarer diffused fatty tumour. This may either invade the front of the neck, where it looks like an enormous double chin, or it may form an unsightly prominence covering the nape of the neck. Small masses of fat have been observed in the supra-clavicular regions associated with absence of the thyroid body, in sporadic cretinism.

4. *Bronchoceles*, which will be recognised by their position and by their movement during swallowing.

5. *Growths in Muscles.*—Gummatous swellings due to tertiary or hereditary syphilis may attack any of the muscles, and in infants the sterno-mastoid is especially liable to localised induration, which may sometimes arise from congenital syphilis; but far more often it is produced by severe strain during the process of parturition, such as the traction upon the muscles while the head is being delivered in a footling presentation.

6. *Malignant and semi-malignant tumours*, of which the sarcomatous affection of the lymphatic glands already mentioned is the most common form. Epithelial cancer sometimes occurs primarily in the skin, or it may spread from some deeper seat in the air and food passages. The implication of adjacent tissue and glands, the age of the patient, and in many cases the rapid growth, will assist the diagnosis of these tumours. N. Davies-Colley.

NECK, Inflammatory Affections of the.—Cutaneous erysipelas rarely attacks this region except when it spreads from the face. Erysipelatous and phlegmonous inflammations of the fauces are apt to invade the larynx, where they give rise to grave symptoms, from œdema glottidis.

Stiff-neck is a congestive inflammation of the fascial or muscular structures, due to cold draughts, chills after exertion, or strains, especially of the sterno-mastoid muscle. It comes on suddenly, with a good deal of pain, which is aggravated whenever the patient attempts to move his head from the constrained position in which it is held by the spasmodic contraction of the muscles. Usually it disappears spontaneously in a day or two, but more rapid relief can generally be procured by warm applications, or, still better, by the domestic remedy of covering the part with flannel, and then ironing it over with an ordinary flat-iron as hot as can be borne. A gentle aperient, followed by half-drachm doses of citrate of potash, will also be beneficial.

Abscesses of the neck may be diffused or circumscribed. The latter are usually set up by inflammation of the lymphatic glands, which are very abundant in the deep as well as the superficial strata. In the upper part of the neck, abscesses are frequently secondary to ulceration of the mouth, fauces, and pharynx. If farther back, they are often caused by eruptions of the scalp. Alveolar inflammation and necrosis of the lower jaw occasionally give rise to abscesses in the submaxillary region. At the root of the neck, abscesses may receive an impulse from the subjacent arteries, and there may be considerable difficulty in distinguishing these from aneurisms. Diffuse suppuration may originate in the glands, but it is more often the result of a contusion or exposure to draughts. It is usually met with in adults of a somewhat enfeebled constitution. There is rapid swelling, with redness of the skin and brawny hardness, which is soon followed by softening and fluctuation. The tissues involved are generally beneath the deep fascia, and they may be either in the space which intervenes

between this and the fascia investing the depressors of the hyoid bone, or still deeper, beneath both the fasciæ. In the latter case, there is great danger of the inflammation spreading down into the mediastinum and lighting up pleurisy or pneumonia. Sometimes also death has occurred from the perforation of one of the large vessels of the neck.

Abscesses should be opened early, to prevent their spreading beneath the fascia, and also on account of the unsightly scars which they leave behind when allowed to make their way to the surface. It is still more important to give exit to the matter by early incision when the suppuration is diffuse. In many cases this treatment should be adopted even before the brawny swelling has begun to fluctuate, and, after the incision, careful provision should be made for the free discharge of the matter through drainage-tubes.

Occasionally abscesses develop at a still greater depth, beneath the prevertebral fascia. They are usually the result of disease of the bodies of the cervical vertebræ. By bulging forwards they obstruct the pharynx and œsophagus, and thus hinder the passage of food. They also tend to spread sideways and reach the surface in the posterior triangle of the neck; or they may run downwards into the posterior mediastinum, and burst into the pleura or pericardium. As soon as a fluctuating tumour is detected at the back of the pharynx, it should be opened in the middle line by a knife introduced through the isthmus of the fauces; or an attempt may be made to open it aseptically by dissecting down upon it from the posterior triangle of the neck, and introducing a drainage-tube. N. Davies-Colley.

NECROSIS.—Necrosis is the term used to denote, in bone, what is expressed by the word sloughing when speaking of the soft tissues. It implies that a portion of bone has died *en masse*, whereas caries signifies molecular death or ulceration. Thus necrosis and caries of a bone have their counterparts in sloughing and ulceration of the soft tissues.

Necrosis may affect only the cortical part of bone, and is then called peripheral. This is probably the most common form. The cancellous tissue alone is rarely involved, except in a localised osteomyelitis, in which case it might be called 'central necrosis,' but the symptoms, pathology, and treatment are the same as in chronic abscess. When the whole thickness of a bone is necrosed, as sometimes occurs in acute diffuse periostitis, it is called 'total necrosis.'

Causes.—Necrosis is much more common in some bones than others, the long bones being by far the most frequently affected, whilst the short and flat bones are, comparatively speaking, but rarely so diseased. No age appears to be really exempt, but the young undoubtedly suffer most. Between the ages of twelve and eighteen it is most common, attacking the poor and ill-nourished with far greater frequency than the healthy and well-to-do.

Everything which tends to interrupt or impede the circulation and nutrition of a bone, whether it be in the periosteum, medulla, or in the bone itself, may give rise to necrosis. Thus it is a common sequel to the various inflammatory diseases of bone, but it may also occur by extension of inflammation from the surrounding parts, as in whitlow. Of external causes, injuries such as wounds, bruises, compound fractures, amputation, and gunshot injuries, are the most frequent. Extreme degrees of heat and cold, such as frost-bite and burns, may also give rise to necrosis. Of internal causes, the specific fevers are the most definite. During convalescence from scarlet fever, measles, smallpox, typhoid, typhus, and rheumatic fevers, some inflammation in one of the long bones or its periosteum is not infrequently observed. This may end in the death of a small portion of bone.

Syphilis also gives rise to necrosis by ulceration and destruction of the soft parts over a bone, or by inflammation of the periosteum, as is described under chronic Periostitis, or by condensing Ostitis, a disease in which the Haversian canals may become so nearly obliterated as to lead to obstruction of the circulation in a portion of the shaft. Mercury and phosphorus have also been known to cause necrosis, but are now more rarely the direct exciting causes than they were in former times. Other constitutional states there may be, which predispose to inflammation of bone and its consequent death; but little more can be said, except that feeble, ill-nourished children of the strumous type are more prone to it than the healthy and robust.

Pathology. — The inflammatory conditions of bone, which may arise from any of the above causes and produce necrosis, have been described under Ostitis, Periostitis, and Osteomyelitis, and need not be repeated here. A portion of bone being dead, either as a direct consequence of inflammation, or, as in a compound fracture,

from its exposure and separation from the periosteum and surrounding parts, we have now to consider how the dead is separated from the living bone and removed from the body. The process is accomplished by inflammation and suppuration, if this condition be not already present as the exciting cause of the necrosis. The living bone and periosteum surrounding the dead become inflamed. That part of the inflamed area which is in immediate contact with the dead breaks down into pus, whilst the peripheral or outlying part is forming new bone. The various stages of the process will be found described under rarefying Ostitis.

As the Haversian canals dilate and inflammatory exudation is poured out into the tissue surrounding the vessels, new capillary loops are formed and become covered with leucocytes. This inflammatory new-formation is converted into granulation-tissue, which, eventually producing fluid pus, forms a line of ulceration separating the dead from the living bone. In the peripheral parts, especially in the periosteum covering the dead bone, the inflammatory new-formation, instead of becoming granulation-tissue, develops into new bone invaginating the old. This new bone forms a more or less complete casing, leaving an aperture here and there for the escape of pus. These openings are called 'cloacæ,' and the dead bone locked up within the new ensheathing bone, when loosened from its surrounding parts, is called a 'sequestrum.'

On the superficial aspect of the tibia, if the periosteum has been destroyed, this invaginating sheath may be absent, and the dead bone is not encased as above described. Exfoliation, which is the term used to express this process of removal without invagination, occurs also not infrequently in the skull. It is, however, only in the superficial or peripheral necroses that such exfoliation can occur. Reproduction of bone after the removal of the sequestrum is generally fairly perfect. The periosteum being the principal agent in the formation of this new bone, we find that in the cases of exfoliation, especially of the tibia and skull in which the periosteum has been completely destroyed, the gap is generally filled up by granulations which organize into a firm fibroid tissue. In the deeper parts of this new cicatricial tissue some bone is reformed, but to a great extent a groove in the bone remains, which is filled as above described. This is especially so in the case of the skull. In cases of total necrosis, where there is a perfect invaginating sheath, the reproduction of bone is almost perfect, even when the necrosis has involved the whole shaft from epiphysis to epiphysis, provided the epiphysis itself and its cartilage are intact. In cases where the epiphysis is involved and partially or completely destroyed, the reproduction is more or less imperfect.

The *symptoms*, at first, are generally those of one of the antecedent inflammations of bone, and presumably the abscess that has formed has been opened, or has been discharged without the surgeon's assistance, before coming under observation. He has now to consider the best means for detecting the presence of dead bone beneath, its probable size and character, and the possibility of its being loose and fit for removal.

Firstly, with regard to the actual presence of dead bone; the history of an attack having the characters of one of the inflammations of bone would point in this direction. One or more sinuses having button-like, pouting granulations, with considerable enlargement of the bone beneath, would increase the probability; and the introduction of a probe, which strikes with a clear ringing sound upon the hard non-vascular sequestrum, will confirm the opinion already formed.

Secondly, as to its size and character; a small and superficial necrosis will be attended with a small amount of discharge, and very little enlargement of the bone affected; there may be few openings close together, or possibly only one sinus may be present. Moreover, it can be seen and felt quite close to the surface. In the case of a large extent of both surface and thickness, as in total necrosis, there will be a very copious discharge, a large development of new bone, and several sinuses at considerable intervals from one another; and, on examination, the probe will pass through new bone for some distance before it strikes upon the sequestrum.

Lastly, its fitness for removal will depend on whether it has become loose. The length of time that has elapsed, since suppuration was first fully established, will be the first point for consideration. In the very young, necrosed bone is much more quickly separated from the living than in the young adult. The rapidity diminishes with age till the full adult period is reached. In the old, the process of separation is oftentimes very slow, on account probably of the feeble circulation. The superficial necroses are more quickly separated than the central and total necroses. The total

necrosis of acute diffuse periostitis is an exception to this rule; if the whole shaft up to the epiphysial line has died, it will be very quickly loosened from its connections. The periosteum has already been stripped from the bone, and the cartilaginous epiphysial line is easily disconnected from the shaft. The rapidity with which a necrosed portion of bone will separate, depends also on the particular bone affected. Those of the upper extremity are more rapidly loosened than those of the lower, probably on account of their greater vascularity. In the young adult, two to three months will probably be about the average length of time for the bone to become loose in the lower extremities, whilst in the upper, the average would be about six weeks to two months. When thoroughly loose, the probe on striking the dead bone often produces a hollow note. Two probes may also be introduced into two different sinuses, and by alternate pressure a movement of the sequestrum may be effected; or, in case of exfoliation, a director may often be introduced beneath the edge of the sequestrum, which is then tilted up and felt or seen to move.

The *prognosis* must necessarily vary very greatly according to the extent of the necrosis, the bone that is affected, the proximity of the disease to a joint, and the constitution of the patient. We have also to bear in mind that, in old and long standing cases, amyloid disease of the viscera is liable to ensue, as it does in caries.

Treatment. — Free incision for the evacuation of pus is the first and most important consideration. Dependent openings should be made wherever it seems likely that pus would have a tendency to gravitate. Absolute rest should be obtained either by a splint or pillow. Antiseptics should be so far carried out as to prevent decomposition and putrefaction of the discharge, but, in the writer's opinion, it is not necessary to employ the rigid Listerian method throughout the prolonged treatment of such cases as these. When the abscess is first opened, especially in chronic cases (e.g. syphilitic), it may be wise to do so in the hope that necrosis may not ensue. In acute diffuse periostitis it will be found, however, a vain hope. Putrefactive bacteria are already present in the pus before it is evacuated, and necrosis to a greater or lesser extent invariably ensues. The exceptions to this rule are so rare as to be beyond the scope of this article. Such material as the salicylic. iodoform, or wood wool, firmly applied with a bandage and changed once a day, is generally sufficient. It absorbs the discharge and prevents it from decomposing. This also enables the surgeon to see, at the earliest possible moment, when a still more effective opening may be made for the evacuation of pus.

When the time comes for the removal of sequestra, to which allusion has already been made, ether will have to be administered and possibly a tedious operation undertaken. In most cases Esmarch's bandage will be found of great assistance, enabling the operator to see clearly when he has removed all the dead bone. The cloacæ being enlarged or thrown into one another by the chisel, gouge, or one of the various forms of cutting bone-forceps, the sequestrum is seized by a pair of large necrosis-forceps and extracted. If there is any difficulty, such as may arise from both ends of the sequestrum being still under cover of its ensheathing bone, it may be divided into two parts and then easily removed. Of course, a small sequestrum can often be removed with only a slight enlargement of the sinus, and the application of a small pair of dressing-forceps or a director. In the case of an exfoliation there is still less trouble, as it only requires lifting from its bed.

As regards general treatment, the patient may require considerable care and attention, especially in the case of acute diffuse periostitis, to keep his powers in a fit condition to cope with a prolonged and exhausting disease. Good, wholesome nourishment should be frequently given, wine or brandy being added according to the particular case in hand. The more a patient can take and assimilate, the better chance he seems to have of living through such an illness as that produced by a severe necrosis.

H. H. Clutton.

NEEDLES. — The suture-needles in common use are either straight, 'semi-curved'—i.e. curved towards the point—or full-curved, i.e. curved along their entire length. The straight needles are the easiest to introduce, and are the best for stitching together large surfaces, such as amputation-flaps; the curved needles are not so easy to use, but are very serviceable in regions which are depressed below the surrounding parts, such as the angles of the eye, or in cavities, such as the vagina. The 'full-curved' needles should be held between the forefinger and thumb, and introduced by a movement of supination; a needle-holder is a great assistance when very small curved needles are employed. For carrying

silk, catgut, or horsehair, an eye like that of an ordinary sewing-needle answers very well; but it does not do for wire, as the loop of the latter is too bulky, and is liable to slip from its place and check the passage of the needle. To meet this difficulty several special needles have been invented. In one the wire is screwed into a female screw at the end of the needle; in Lister's needle the eye is placed laterally, and is deeply grooved so as to carry the wire. Price's needle has two eyes, placed one in front of the other, and is deeply grooved: to thread it, pass the wire from before backwards through the posterior eye, next in the opposite direction through the anterior one, and, finally, turn the end of it sharply backwards into the groove on the anterior surface of the needle. Murray's needle contains in the blunt end a conical canal, the larger end of which opens in a groove on the side, and the smaller at the heel of the needle; the wire is passed in at the heel of the needle, and projected at the side of it; the tip of the wire is then turned down and pulled back till it is jammed in the conical canal. Ward-Cousins has introduced, or re-introduced, a needle and wire all in one piece.

Tubular needles are also used for passing wire sutures, and Startin had them so made that, whilst capable of being used separately, the two together form part of an ellipse, and when passed from opposite sides of the wound one fits into the other; a complete tube is thus formed, through which the wire may be passed, so that, on removal of the needles, the wire will remain *in situ*. The tubular needle is very useful for passing wire sutures in the operations for cleft-palate and vesico-vaginal fistula. For the former operation T. Smith has invented an instrument, which consists of a tubular needle at the extremity of a long handle, to which a reel is attached to hold the wire, and a wheel to project it through the tubular needle. A very similar instrument was described by P. C. Price in 1860. Spencer Wells has devised a needle with an 'opening eye,' so that a loop of thread may be removed from it without being cut; it is of special value where the quilled suture is used. Spencer Wells has also devised a needle with a notch near the point, for use in operating for vesico-vaginal fistula; the suture is passed through one side of the fistula with a nævus-needle, and the notched needle passed through the other side; the loop of the suture is then caught by the notch, and, as the needles are withdrawn, the suture is left in position.

The name, 'nævus needle,' is applied to a sharp-pointed needle on a handle, which has the eye near the point; and 'aneurism needle' to one which differs from the last-named in being more curved and blunt-pointed.

Hagedorn's Needles are flattened laterally, and are of equal width and thickness from the eye to the point. They have a cutting edge, which resembles a Beer's cataract-knife, on the convex border of the needle near the point. The eye is placed laterally, as in Lister's needle for wire sutures, but it is not grooved. The advantages of these needles will be evident, if the wounds they make be compared with those made by the curved needles in common use. The latter, being flattened transversely to the curve, make an incision parallel with the direction of the wound, so that when the suture is tied the incision made by the needle is pulled into a triangular wound, which does not always heal by first intention. Hagedorn's needle makes an incision at right angles to the direction of the wound, and consequently in the line of traction of the suture, so that the latter will rather tend to approximate its edges, and so interfere as little as possible with primary union of the needle-puncture. The greater strength of the needle which results from its being curved on the edge instead of on the flat, prevents its being bent out of the desired course when it penetrates indurated tissues, and the direction of the wound which it makes involves less damage to nerves and tendons in suturing operations.

Hagedorn's needle for suturing intestines has a rounded point instead of the cutting edge described above.

Bilton Pollard.

NEPHRALGIA, or pain in the kidney, may be produced by a variety of causes, and it appears likely that the list of these will, as the result of further study, be extended far beyond its present limits.

The most common cause of nephralgia is the presence of calculus in some part of the kidney. We are not yet in possession of sufficient facts to enable us to indicate exactly the situation of the stone, nor are we able from the character of the pain alone to estimate its size. It may be said generally, however, that where the nephralgia is paroxysmal, the stone is more likely to be in the pelvis of the organ and more or less movable, and *vice versâ*. The pain is usually dull and aching, and referred to the situation of the kidney; but it may be

sharp and spasmodic, and radiate down the side into the testicles, or to the tip of the penis. It is increased as a rule by pressure over the kidney, and usually also on movement of the body, and is sometimes severe enough to produce nausea, or even vomiting. This is especially likely to take place where a stone is lodged in the commencement of the ureter, and is being forced into the latter, giving rise to bleeding and, probably, plugging by clot. The whole assemblage of symptoms associated with the passage of a stone or clot into the ureter is known as Renal Colic.

Nephralgia is also produced by new growths in the kidney, but, probably, not usually until they have either commenced to cause distension of the pelvis, blocking of the ureter by growth or blood-clot, or change of place of the kidney itself with more or less drag on the pedicle. This change of place must always occur where the organ is much enlarged from any cause; the increase of size finds no room above on account of the diaphragm, and can only take place downwards and inwards. Gravity also plays a part here, and it also appears not improbable that the muscular action of the ureter, under irritation, may actually drag somewhat upon the mass. Nephralgia is also produced by tubercular disease of the kidney, and in at least three ways—(*a*) by ulceration, (*b*) by the production of blood-clots and consequent block of the ureter, and (*c*) by impaction of tubercular shreds in the latter. Of course, blood-clot due to injury of the kidney from any cause will also produce renal pain, either continuous or paroxysmal. Again, shrinking of the whole organ after interstitial nephritis may produce a neuralgic condition, and cystic dilatation has been known to produce the same thing. Cases are on record where, on exposure and removal of a kidney on account of severe pain and the suspicion of stone, nothing has been found but a small shrunken organ. Slight pyelitis, too, may cause pain, either as the result of the inflammation alone, or by producing more or less blocking of the ureter by a swollen mucous membrane. Then again, nephralgia often accompanies a movable kidney, and probably is due here to the dragging on the nerves of the pedicle, produced by the change of position of the organ. Finally, there are cases in which patients have suffered severe pain for years in the kidney and yet, after death, nothing has been found in the organ to account for it, the cause remaining as obscure as in the case of many other neuralgias.

The *treatment* of nephralgia will, of course, vary very much in different cases, since it is but a symptom of a variety of different conditions. Where, for reasons given in discussing the various objectively morbid conditions of the kidney, no local treatment of the organ is possible, we shall best deal with the nephralgia by enjoining perfect rest in the recumbent position. Next to this, warm applications to the flank will be most suitable. After these measures have failed, we have little left but the usual anodynes. A. E. Barker.

NEPHRECTOMY, or the removal of the whole kidney, is a measure unknown as a formal operation until the last few years. Any detailed history of the operation would be out of place here, and it need only be said that it was first performed on the human subject, as a definitely planned procedure, by G. Simon of Heidelberg on August 2, 1869, he having previously shown by experiments on dogs that it was feasible and physiologically safe. Before Simon's case the kidney had been removed, on a mistaken diagnosis, twice completely in America, and once incompletely in Germany; but the first impetus to the study of the whole question of nephrectomy, as a definite surgical procedure, dates from the publication of Simon's successful case and of his numerous experiments, in 1871. In this country the operation was first done by Dr. Meadows in 1871, under the impression that the tumour dealt with was an ovarian cyst; then by Mr. Durham, rather as an exploratory measure for a painful tumour of the flank. The first British surgeon to perform nephrectomy designedly appears to have been Mr. Jessop of Leeds, whose patient, a child of two and a half years of age, from whom he removed the kidney for encephaloid disease in January, 1877, recovered and lived several months afterwards. Within the last few years, the kidney has been frequently excised for various morbid conditions, in England and elsewhere, and the knowledge of the condition requiring this treatment, and of the details of the operation, has increased rapidly with the publication of every case, unsuccessful as well as successful. But in spite of the long array of nephrectomies now before us, much difficulty remains in deciding as to the choice of cases in which this procedure should be adopted, and the exact method to be followed. Nephrectomy has been performed now for renal neoplasms, for calculus, for pyo- and hydronephrosis, tubercular kidney, injury to

and rupture of the organ, and for floating and painful kidney, and the reader is referred, for the consideration of these conditions, to the special heading of each. The question remaining for us now is the method of procedure, and here there is still much difference of opinion, which must last for a considerable time to come. There are, however, some general conclusions which may be considered as fairly established, and these will be alluded to when the various methods have been described.

There are three points in the abdominal walls at which the kidney may be removed —(1) in the loin, at the outer border of the erector spinæ muscle; (2) at the outer border of the rectus abdominis muscle; (3) in the linea alba. The chief advantages of the first of these methods are that the peritoneal cavity is not opened, that no important structure is wounded in reaching the kidney, and that the wound can be freely drained, from behind, without much risk of infecting the peritoneum. The main advantages in opening the abdomen at the outer border of the rectus (Langenbuch's incision) are, first, that the kidney and its pedicle are here most easily reached, and this not through the anterior layer of the meso-colon, which contains large veins, but through the posterior or external layer, which has very few vessels; secondly, the operation wound in the perinephral tissues can be made practically extra-peritoneal, by stitching the outer layer of the meso-colon to the anterior lip of the incision in the abdominal wall early in the operation, and so shutting off the general cavity of the abdomen from that left behind by the removal of kidney, which can now be freely drained. The strongest reasons for choosing the third method of removal—i.e. by median abdominal section—are found in the fact that freer access is thus gained, not only for the removal of larger renal tumours and ligature of their pedicles, but also that the state of the opposite kidney can by this means be ascertained, by passing the hand across the abdomen, and actually feeling the organ with the fingers. It is necessary, however, to mention that though the hand may reach the kidney opposite to the one it is proposed to excise, its soundness or the reverse cannot be ascertained by mere palpation. Great enlargement, or, on the other hand, great reduction, in size or complete absence might be detected; but the organ might be tubercular, or fibroid, or contain a moderate-sized calculus, and yet the hand be unable to detect the condition. This plea for the median incision cannot, therefore, be allowed to have much weight.

The chief objections raised to the first or lumbar method are, that the organ is more difficult to reach from behind, especially its pedicle; also, that the space between the last rib and the iliac crest is too limited for the removal of large tumours; finally, that the condition of the opposite kidney cannot be ascertained by direct examination. The drawbacks to the second or lateral incision are that the peritoneal cavity is opened, and also that if the tumour cannot be removed without the escape of some of its contents, it is not so easy to drain, without contamination of the peritoneum, as in the first method. Also, that if there be any oozing of blood, it is likely to find its way into the cavity of the abdomen, both during and after the operation. The liability to hernia at the seat of incision appears to be greater here than at the more posterior wound. The same reason may be urged more strongly against the median method, where the difficulty of keeping the peritoneal cavity clean is still greater under all conditions. Besides this the intestines may be much in the way, and give rise to great trouble by protruding from the wound. Further, the anterior layer of the meso-colon must be divided to reach the kidney, and here there is much risk of bleeding, from the large size of the veins running through it.

A careful review of all the arguments, for and against these several procedures, and their results, justifies the conclusion that each has its proper place in surgery, and that it remains for future experience to determine the exact conditions under which each should be adopted. For the present, it may be said generally that, for the larger solid and non-inflammatory tumours (if these are to be operated on at all), abdominal section is to be preferred; while, for the fluid tumours of the kidney and inflammatory conditions, one of the lumbar incisions is best suited.

Something remains now to be said as to the details of each method of performing nephrectomy. First of all, in every case the strictest antiseptic precautions should be observed from beginning to end. The lumbar incision is the same as that in Nephrotomy, until the surface of the kidney is reached. The subsequent steps of the operation are determined by the condition of the organ. If its surface be quite unaffected by present or bygone inflammation, it is easily and rapidly separated by the finger from the surrounding

fat until the pedicle is reached. This is true, whether we are dealing with a healthy kidney, or one in which there is a stone, or a new growth, or a collection of cysts the result of obstruction. But, if the organ have become adherent by inflammation to the perinephral fat, itself condensed and shrunken so that it forms one firm tough investment intimately united with the capsule, it is best to enucleate the kidney out of the latter, leaving it behind with the condensed fat. Indeed, it is not possible to do otherwise in many cases, for the material surrounding the kidney is so tough that it can hardly be torn with the finger, and so vascular that, if at all roughly dealt with, it bleeds so freely as seriously to endanger the patient's life. This process of enucleation is rarely a difficult one, if the surface of the kidney is closely followed, no matter what the amount of condensation of the tissues around may be; but if this guide is lost, and the finger is carried into the surrounding tissues, the difficulties are enormously enhanced. These general rules will be found serviceable for this part of the operation, but beyond them each case must be treated on its own merits.

Having reached the pedicle, the vessels are ligatured in two bundles with stout carbolised silk, passed through the middle of the mass and tied over each half in succession, and then round both together. The ureter may be either simply divided or tied with the vessels, or by itself later, and may either be left in the wound or, perhaps better, be drawn to the surface and secured there in the angle of the skin incision, so that no regurgitation may take place into the wound. This might be a serious matter if the ureter were dilated and full of foul urine or pus, which, escaping into the wound, would render it septic.

After this, the organ may be removed by a few snips of a scissors as near the kidney as possible, or even leaving a little of its tissue if sound. This tissue will soon cease to secrete and become fibrous, when the renal vessels are once tied. The ligatures, in some cases, have to be applied while the kidney is *in situ*; in others, the organ can be lifted out of the wound beforehand. But, in whatever way the act is performed, every care should be taken to avoid dragging upon the pedicle, whether in passing the aneurism needle through it, or later in manipulating the organ, every such strain adding materially to the shock of the operation. The writer has endeavoured to ascertain the effect upon the circulation of ligature of the pedicle in several cases in which he has performed nephrectomy, by having the pulse carefully watched throughout, and in the last case by having a sphygmographic tracing of the pulse made while the operation was proceeding. He has found that the pulse is not very much affected to the touch, but the tracing showed some irregularity during the process of manipulation of the organ, followed by increased arterial tension when the pedicle was ligatured. These observations, however, will require to be repeated frequently before we shall be able to pronounce positively upon this point. The ligatures should be cut short in aseptic cases, but, where there is suppuration, it is better to leave them long and carry them out of the parietal incision, and wait for their coming away in the usual manner. This they will not do in a perfectly aseptic wound, but become encapsuled, giving no further trouble. As to the relative merits of catgut and silk, this is not the place to discuss them. It may be remarked, however, that most surgeons prefer silk for this part of the operation.

After division of the pedicle, it only remains to insert a drainage-tube (which should be large and long), and to close the external wound with a few wire or silk sutures, all blood-clots having first been removed from the perinephral space. An antiseptic dressing is then applied over all. It is well in these operations to remember the occasional presence of aberrant renal arteries, entering as they may any point of the concave surface of the kidney. They may be met with at any stage of the operation, and, if great care is not observed, may be torn across, and should always be looked for and secured as early as possible.

Nephrectomy by lateral abdominal section (Langenbuch's) is thus performed:—The patient lying upon the back, an incision about four inches long is made at the outer border of the rectus muscle through the tendinous tissue of the linea semilunaris. Any slight bleeding having been stopped, the peritoneum is opened, some part of the colon presenting most probably in the wound. This is gently pushed inwards, on which the external or posterior layer of the meso-colon is exposed. In this there are no vessels of importance, and the incision through the peritoneal layer may be made in almost any direction suitable for the removal of the kidney, but a vertical line is to be preferred. If the tumour to be removed contain fluid, whether urine, pus, or blood, it may now be wise to unite the anterior lips of both peritoneal wounds—that of the abdominal wall and that of the meso-colon

—closely together by catgut sutures, so as to shut off the general cavity of the abdomen from the perinephral space about to be freely intruded upon. By this measure, if the fluid in the tumour should burst its covering, it is prevented from contaminating the whole abdomen, and can flow freely out of the parietal wound. If this is done, moreover, a drainage-tube may be inserted through the front abdominal wound into the post-peritoneal space, after removal of the kidney. In other respects the rest of the operation is performed exactly as that in the median line described below. Access to the kidney and pedicle is much easier in this lateral operation than in either of the others; but an examination of the opposite kidney is not so easy as with a median incision.

In nephrectomy by median abdominal section, the steps of the operation up to the actual enucleation of the organ are almost the same, generally, as in Ovariotomy. The division of the abdominal muscles and peritoneum, and the precautions to be observed throughout as to bleeding, treatment of the intestines, &c., are alike in both procedures. But when the bowels have been drawn aside and the anterior layer of the meso-colon has been reached, the special difficulties of the nephrectomy commence. First of all, a transverse incision is made in the anterior layer of the meso-colon, great care being taken to avoid wounding the large veins, which run usually transversely across the diseased organ. If necessary, these should be secured by double ligatures and divided, which is better than running any risk of their being torn in enlarging the opening or getting out the kidney. Then, the organ is separated from its surroundings by the finger swept either outside or inside the capsule, according to the amount of destruction of fat by inflammatory sclerosis, or the absence of this process (*see* above). Sometimes this process of enucleation is very easy, and accompanied by but little bleeding, as in the case of renal new-growths of moderate size; sometimes it is extremely difficult, especially where inflammation has existed for a long time in the kidney. When the pedicle has been reached, the organ can be lifted out of the abdominal wound and the vessels and ureter secured, as in the lumbar operation (*see* above). Then the organ is removed with the scissors, and the pedicle is allowed to slip back into the post-peritoneal space left by the enucleation. Nothing now remains to be done but to clean out all blood-clots from this space, close the peritoneal wound over it with catgut stitches, carefully cleanse the peritoneal cavity, and unite the edges of the abdominal wound with silk, as in ovariotomy, a gauze or salicylic-wool dressing completing the operation. If there be any indication of likelihood of effusion of blood or serum into the post-peritoneal space, a knife-blade may be thrust through the lumbar abdominal wall, from within, at the point of election (*see* Nephrotomy), and a drainage-tube inserted to drain this space, which is then shut off from the general cavity of the abdomen by suture of the edges of the peritoneal wound with catgut.

Any comparison of the results of these three methods of performing nephrectomy, and their relative mortality, has at present but little value as a guide in the choice of an operation. The diseases for which they have been employed are so various, and the stages of these affections at which nephrectomy has been performed so very different, that no reliable conclusions can be drawn from mere statistics. The author's attention to the whole subject has been very close for several years, and his personal experience of the operations considerable, yet, at the present moment he is unable to profess any decided leaning to one method more than another, speaking of the removal of the kidney generally. Perhaps there is a slight tendency amongst surgeons to prefer lumbar nephrectomy for the common affections. But the whole question can only be decided when we are able to group our cases more accurately, and have a far larger amount of material to judge from than at present.

Arthur E. Barker.

NEPHRITIC COLIC. *See* Nephrolithiasis.

NEPHRITIS, or inflammation of the kidney, is met with in a great variety of forms, from the mildest catarrh to the most destructive suppuration. In surgery we are not often concerned with it as a primary affection, but usually as secondary to some general or local condition. It is not proposed to do more here than give an outline sketch of the simpler forms, as they come under the notice of the surgeon.

Simple nephritis, as distinguished from pyelonephritis and pyelitis, may be either *acute*, *subacute*, or *chronic*. The *acute* form is met with after injuries to the kidney, exposure to cold, the use of over-stimulating diuretics, such as cantharides and turpentine, or too large doses of other irritants, such as the mineral acids, nitrate

of potash, and carbolic acid; it is also met with in various acute febrile states. Besides these exciting causes, may be mentioned one to which considerable attention has of late been directed. This is the reflex irritation of the kidney produced by operations on, or acute inflammations or injuries of, the lower urinary organs. The manner in which this irritation operates, in producing renal hyperæmia, is best explained by the theory of reflex vaso-motor disturbance. The violent stimulus to the nerves of the urethra, penis, or bladder, produces first a contraction of the renal capillaries, followed by great dilatation. The congestion thus arising may be, on the one hand, so slight as hardly to deserve the name of an inflammation, or, on the other, may be deep and persistent. In the first case we have a transient catarrh, in the latter a definite interstitial nephritis. The kidney in the last condition will be found more or less enlarged, darker than usual in colour, and on section engorged with arterial blood, and possibly dotted with small ecchymoses.

The *symptoms* here, whatever the nature of the exciting cause, will usually be the same. In the first place there will be dull aching pain in the affected kidney or kidneys, aggravated by either movement or pressure over the flank. There will also be fever, with malaise, headache, anorexia, and insomnia, sometimes nausea or even vomiting. The attack may have been ushered in by a rigor; the skin will probably be hot, flushed, and dry; the mind is not usually affected. The objective symptoms are found in the state of the urine. This is usually very scanty, or, if both kidneys are affected, there may even be temporary anuria; it is highly coloured or 'smoky,' acid, and loaded with lithates, and deposits a brownish sediment. This, under the microscope, will be found to consist of blood-corpuscles and blood-casts, of urates and renal epithelium. The fluid will probably be of low specific gravity and highly albuminous.

In the *subacute* form, there is only a difference of degree in all these phenomena.

The *treatment* of simple acute nephritis, apart from that of any condition which may have played a part in the production of the disease, is aimed at reducing the work thrown upon the kidneys, and diminishing their acute congestion. The first of these requirements is met by encouraging the skin to act by hot vapour or water baths, with the cautious administration of diaphoretics and smart purgatives, and by the regulation of the diet, which should be very light, consisting chiefly of milk. The second is fulfilled by local blood-letting over the kidney in sthenic cases, or dry cupping in asthenic cases, followed by hot poultices, and by complete rest in bed and avoidance of exposure. Diuretics are to be avoided, and alcoholic stimulants used sparingly.

The *chronic* form of this disease has a special interest for us here, inasmuch as it is met with in many surgical affections to which it is secondary. Chronic interstitial nephritis may be produced, simply by the continued operation of many of the causes spoken of above, as agents in the acute disease. The most interesting of these, however, for the surgeon is prolonged irritation, either in the bladder or urethra. This irritation may be due to stone or stricture, to villous growth or chronic cystitis, and is capable of producing very profound changes in one or both kidneys. Taking a well-marked case of chronic interstitial nephritis as an example, we may expect to find the affected organ smaller than usual; its capsule does not peel off easily, or may actually adhere closely to the cortex, and leave a granular or broken surface on being separated forcibly. The cortex is more or less reduced in depth, and is granular, toughened, or even almost fibrous on section. The same may be said of the pyramidal portion; the calyces are pale. Under the microscope we see all the evidence of interstitial hyperplasia, with more or less atrophy of the secreting substance.

The *symptoms* of chronic interstitial nephritis are not very distinctive in all cases; still there are some which assist us much if taken with other evidence, and especially the past history of the case. First, the character of the pulse aids us. It is hard and incompressible, and gives the tracing of high arterial tension with the sphygmograph. The muscular vigour and general strength of the patient will be probably much lowered. The urine is usually pale and of lower specific gravity than normal; it is deficient in urea, and often contains albumen and a few casts. In amount it may be normal, but it will probably be somewhat below the average standard.

The *treatment* of chronic interstitial nephritis is general rather than local. The avoidance of rapid alternations of temperature stands first; then, the maintenance of an equable action of the skin by warm clothing, baths, and frictions, and the regu-

lation of the bowels by purgatives. The diet should also be carefully attended to, and all articles tending to over-stimulate or throw much strain on the eliminatory functions of the kidney must be avoided. Every source of irritation in the urinary tract should be removed if possible, but it must be remembered that the use of instruments to this end should be as far as practicable avoided; the passage of catheters, for instance, or operations on the urethra or bladder, being very badly borne in many cases where this condition is present. Indeed, chronic interstitial nephritis is chiefly interesting to the surgeon as one of the barriers to operation on the lower urinary organs. Where any source of chronic irritation has been long present in the urinary tract, it should always be looked for; and any evidence of its presence should be carefully sifted before such an operation is decided on. ARTHUR E. BARKER.

NEPHROLITHIASIS, or the presence of calculous matter within the kidney, is a very common condition. Owing to some fault in digestion (using the term in its widest sense), or, on the other hand, to some deficiency of energy in the kidney, the amount of organic matter, thrown upon the latter for elimination, exceeds its powers of excretion in solution at some particular time, and a certain quantity is deposited in a crystalline or sub-crystalline form in the organ. It appears probable, however, that without some local morbid condition—e.g. a catarrhal state of the lining of the tubules, pelvis, or calyces—such a deposit will not take place, no matter how concentrated the urine, and many arguments are adduced in support of this view.

The exact point of origin of the earliest traces of renal calculi it is not easy to determine; but it appears probable, from the most recent observations, that they begin to be formed in the renal epithelium. Impaired energy in the cells of the latter, whether it be due to over-exertion and consequent exhaustion, or decay from age, may lead to the accumulation in them of one or other of the crystalline matters met with in calculi. Be this as it may, small concretions are frequently found in the straight tubules, and projecting from the pyramids. These, which are formed of crystals, altered by their suspension in an albuminous medium, are the centres around which the larger stones are formed. According to the condition of the urine in which they eventually sojourn, they will receive laminated deposits of one or other of the calculous materials. Those most frequently met with in the kidney are—uric acid, oxalate of lime, and phosphate of lime. In the majority of cases, the small concretions pass rapidly into the ureter and bladder, giving rise to no further renal derangement; but, in other cases, the crystals are retained in the tubes or calyces, attached to some roughened spot, and there become aggregated, so forming by gradual accretion the smaller or larger stones with which we are familiar. These are met with at all ages, and in both sexes with about equal frequency. Carbonate of lime calculi have also been found in the kidney, but are very rare. All parts of the organ may be the seat of these concretions, but the urate and oxalate calculi are more likely to be found in its substance than the phosphate and carbonate of lime, which are met with in the pelvis. Calculi of the kidney are mostly irregular in shape, but the greatest irregularity is seen in those lying in the pelvis, where they often form large, branching, tree-like accretions. Where phosphate of lime is deposited, it sometimes forms simply a thin coating over the pelvis of the kidney, without any actual definite calculus. Such a deposit clings closely to the mucous membrane on which it lies, and may be very extensive, or only cover one or more small patches. All renal concretions may be single or multiple, but are more commonly single.

Calculi in the kidney may give rise, on the one hand, to little or no trouble throughout a long lifetime, or to the most intolerable suffering or even rapidly fatal disease. They claim our attention on account of—(1) pain; (2) HÆMATURIA; (3) obstruction of the ureter and HYDRONEPHROSIS; (4) suppuration due to their presence, with or without PYONEPHROSIS.

The evidence of the presence of calculi in the kidney is based, in the first place, upon the family and personal history of the patient, and then upon certain subjective and objective symptoms. In many cases, there is a history of the uric acid diathesis in the patient's family for one or two generations, and in his own case, perhaps, for a long time anterior to the date of his present ailment. He may have lived, too, for a longer or shorter time in a 'stone country' himself. He will often give the history of having habitually passed highly acid urine, depositing lateritious sediment on cooling, or may even have voided small calculi from time to time, with or without what is known as RENAL COLIC. The symptoms will de-

pend, not so much upon the size and shape of the stone, as upon its situation and the condition of the kidney in which it lies. For it is well known that a large and irregular mass may lie for years within the kidney without giving rise to much trouble, while a small, comparatively smooth, calculus may be a most troublesome inmate of the organ.

Taking the simple cases of nephrolithiasis first, in which there is little or no structural alteration in the kidney, we have to consider certain symptoms, *subjective* and *objective*. Among the former pain stands foremost. This is either local or radiated, or both. When local, it is usually described as constant, dull, aching, or gnawing, but it may be pricking or lancinating. It is subject to exacerbations, often without any assignable cause, but is generally much aggravated by movement, and sometimes to such an extent as to render the patient bedridden. In such cases, the pain can often be traced to the blocking of the ureter by a blood-clot, produced by the movements of the calculus in the pelvis of the kidney. The radiated pain is usually described as localised about the neck of the bladder, or running down towards the groin in front of the thigh, and into the testicle or penis; it has even been observed as low as the foot. Tenderness on palpation over the kidney is another symptom often prominent, but it may be conspicuously absent. Nausea is also occasionally noticed, and that not only on the passage of a stone down the ureter, but also from its presence in the pelvis of the organ. It is also often felt as the result of a blood-clot, from irritation of the stone, stopping up the ureter and causing distension of the pelvis of the organ, or, again, where a clot passes down the ureter slowly.

The *objective symptoms* in *simple* non-suppurating cases are not many. Among the first comes hæmaturia, which may be very abundant, giving rise to bright red urine, or only cause a 'smokiness' of the secretion. In all cases, however, the blood is thoroughly mixed with the water. Next to this symptom comes frequency of micturition, which is often marked. Then, retraction of the testicle is noticed in a small proportion of cases. Finally, there may be a trace of catarrhal products in the urine, the latter remaining acid. This is a valuable symptom if disease of other parts of the urinary tract can be excluded, and when taken with other evidence.

In *suppurative* cases, or, where there is impaction of a calculus in the ureter, we find, of course, several additional objective symptoms and a few subjective. Among the latter are rise of temperature, thirst, headache, and anorexia. The rise of temperature is often very regular at night, and may equal two or three degrees. The objective symptoms will be those of pyonephrosis or hydronephrosis, with more or less pus in the urine in the former case. But without either pyo- or hydronephrosis, the kidney may be enlarged by chronic inflammation so as to be felt easily by the hand; or, what is more common, the perinephral fat may be condensed or destroyed by inflammatory irritation due to the stone, and its place may be taken by a thick layer of fibrous tissue, which gives the impression, on handling, that the organ itself is enlarged. In such a case, the position of the organ will probably be somewhat altered, and we shall find it lower and more internal than usual. This is probably due in part to its increased weight, and possibly also to increased muscular contraction of the ureter under the stimulus of inflammation.

Treatment.—During the last few years the treatment of nephrolithiasis has undergone much change. The preventive treatment, in the first place, has improved with the increasing knowledge of the laws which govern digestion and excretion. But where a calculus has actually formed in the kidney, we are no longer satisfied with simply dealing with each symptom as it arises, be it pain, suppuration, or bleeding; but we aim, in suitable cases, at the removal of the directly offending cause—viz. the stone. It is necessary, however, to insist on the exclusion of cases unsuitable for operation. On the one hand, many individuals spend a long life almost or altogether free from pain, in whose kidneys considerable stones are found after death, and, on the other, we often find very small calculi giving rise to the most acute suffering and even danger. Again, facts are accumulating which show that most of the symptoms, ordinarily attributed to the presence of a stone in the kidney, may be present to a perfectly deceptive degree for years, and yet on operation, or after death, no trace of a foreign body be found in the organ or in the bladder. Three chief conditions, then, should be clearly present before the question of operation is entertained, even for a moment:—(1) That the symptoms should be as clear as possible; (2) that the patient's sufferings should be intolerable in spite of all treatment, or that there should appear to be danger from prolonged bleeding or suppuration; (3) that the disease should not have lasted so long as to have damaged the patient's general

health so far as to render the operation a desperate one, and, above all, so long as to risk the functions of the opposite kidney.

If these conditions be fulfilled, we have a choice of three operations—of NEPHRO-LITHOTOMY, NEPHROTOMY, and NEPHRECTOMY. But in simple cases of nephrolithiasis, in which there is clear evidence of the presence of a calculus and little or none of further morbid conditions about the organ, but where the sufferings are severe, we now almost entirely limit ourselves to the first of these procedures. For it has been abundantly shown, already, that it is quite possible to excise a calculus from an otherwise healthy kidney, with little or no risk to the patient, and with no special damage to the organ. If this be so, nephrolithotomy, and it alone, is the proper operation wherever possible. There are, however, as already stated, cases where all the subjective and objective symptoms point to the presence of a calculus, and yet where none can be found on reaching, handling, and puncturing the organ. Here it is in some cases right to incise the kidney at once, and search the pelvis and calyces for a foreign body, and, if the symptoms have been very severe, to proceed to nephrectomy, even though none be found. The latter operation, however, will doubtless become much rarer as our powers of examination and diagnosis become more developed.

The general treatment of nephrolithiasis, short of operation, will embrace careful attention to diet, the use of baths, and friction of the skin in order to promote its healthy action, and the regulation of the bowels. The liver should be particularly attended to, the mineral waters of Friedrichshall and Rubinat being used with much benefit. Warm clothing and regular exercise should also be enjoined.

Prognosis.—Lithiasis of one kidney does not appear to shorten life. A patient may develop small calculi in the kidney, and continue to pass them by the ureter for years, without any decided impairment of health. It is only when the foreign matter is retained in the organ from any cause, and begins to produce secondary changes there, or the retention of secretion or of pus, that it becomes really dangerous. And even when both kidneys produce calculi which do not lodge in them, they may for a long time, if not indefinitely, remain adequate for all the wants of the system. But when calculi commence to be retained on both sides, they indicate a vice which will probably lead to grave complications before long. There appears, however, to be no very decided tendency for calculi to appear on both sides at the same time; they are frequently unilateral. ARTHUR E. BARKER.

NEPHRO-LITHOTOMY, or the removal of a stone from a kidney not sensibly enlarged and with no evidence of accumulation of pus, is one of the most recent achievements of modern surgery. With the improvements in diagnosis of renal disease, we have learned to recognise, in many cases, the presence of a calculus, either in the pelvis or substance of the organ, *before this has been followed by suppurative irritation.* If, under these circumstances, the foreign body be removed, there is an immense gain to the patient. The dangers of suppurative pyelitis are prevented, suffering is relieved, and the organ, often comparatively healthy, is preserved to the economy. This operation was first performed on definite principles by Mr. Morris in February, 1880, and since then has often been repeated, with equal success, by other surgeons.

It is necessary to insist on the difference between this procedure and that of ordinary nephrotomy or incision into a suppurating kidney. This is quite distinct as to principle, aim, and prognosis. To incise the loin, and subsequently a sound organ, in order to remove a foreign body whose presence is causing certain subjective symptoms only, is totally different from cutting into the perinephral tissues in a state of inflammation, and opening up the kidney itself in order to give exit, not only to the calculus, but also to the products of inflammation, the result of its prolonged sojourn in the organ. And the prognosis of the two operations is quite different. In the first instance, though it may be more difficult to find the stone, the incision, being made in comparatively healthy tissue, heals readily in many cases; in the second, a freely suppurating cavity having been opened through more or less diseased tissues, many risks are run connected with septic infection, and a fistula in the loin is almost invariably left, a condition by no means devoid of danger, and giving rise, in all cases, to much discomfort. Both operations have their place, and their own special advantages; but they must always be kept apart, as essentially different.

The procedure itself is not difficult, but there are still great obstacles to its general employment. On the one hand, all the symptoms of stone in the kidney may be present, and yet, on reaching the organ by incision through the soft parts, no evidence of its presence may be detected, either by

the most careful palpation on all its aspects, or by acupuncture to the fullest extent, although the stone is actually in the organ. On the other hand, there are conditions beside renal calculus, producing symptoms which, for the present at all events, we are unable to distinguish from those of undoubted nephrolithiasis. *See* NEPHRALGIA. Both these facts have been established by operations on the living, and by observation, during life, of cases which have afterwards become the subjects of post-mortem examination. It is fortunate, however, that the same experience has also established the fact that exploration of the kidney by direct palpation, acupuncture, and even incision into its substance, is a procedure attended with very little risk if every precaution against septic infection be observed.

The operation itself is essentially the same as that of NEPHROTOMY, except that the point of incision into the kidney is determined by the situation and size of the stone; also, perhaps, there may be more difficulty in reaching the unenlarged organ behind the ribs, than in those cases for which nephrotomy is usually performed, where the kidney is mostly increased in size and has descended somewhat in the abdomen. But, on the other hand, there may here be less difficulty in examining the surface of the organ, on account of the absence of perinephral irritation, with consequent destruction or induration of the fatty and areolar tissue surrounding its capsule. In some cases in which nephro-lithotomy is performed, the wound in the kidney remains open for a long time, giving rise to urinary fistula in the loin; in other cases it heals up rapidly and finally, any discharge from the interior of the organ finding its way down the ureter, and this often for a long time after the lumbar wound has quite closed.

The *prognosis* after this operation is very favourable. Up to the present all the cases of true nephro-lithotomy recorded have proved successful. It is important, as already stated, to remember this, and to distinguish between these results and those of nephrotomy and nephrectomy for more advanced disease. Many lives will be saved and much suffering averted by recognising this immunity from risk of nephro-lithotomy; and the necessity for early diagnosis of renal calculus and treatment by this operation, before such structural changes have taken place in the kidney as to render one or other of the more severe measures necessary.

ARTHUR E. BARKER.

NEPHRORAPHY, or the stitching of the kidney to the posterior abdominal wall, in cases of mobility of the organ, accompanied by severe symptoms, is an operation performed many times of late years with considerable benefit, but not often enough as yet to enable us to form a definite judgment upon its proper position as a surgical procedure. Up to the present time, however, it has been shown to be without risk, and the only point which can be urged against its performance is, that it is not always followed by permanent fixation of the organ and complete relief of suffering. The operation is only suited to those cases of movable kidney in which there is no mesonephron. *See* MOVABLE KIDNEY. Should the latter be present, it would be impossible to perform nephroraphy without injuring the peritoneum; but where the kidney simply slips about in the loose perinephral fat there is little danger of this, and the organ can be reached easily.

The operation consists in cutting down upon the kidney by one of the usual incisions for reaching the organ in the loin (*see* NEPHROTOMY); then the fatty capsule is drawn into the wound and stitched with eight or ten catgut sutures to its deeper edges. Besides these stitches, one or two are passed through the abdominal wall in front of the incision, and then through the cortex and proper fibrous capsule of the organ, which is pushed backwards by an assistant, to return through the abdominal wall behind the incision. These last sutures are fastened with buttons, and draw the kidney itself backwards towards the wound. A large drainage-tube having been inserted, the wound is closed with a few silk or catgut sutures. Very little bleeding ought to take place at any part of the operation, but some is seen on piercing the cortex of the kidney. This soon ceases, and if the wound be treated, as it should of course be, on the strictest antiseptic principles, the blood will have no ill-effect on the wound.

The drainage-tube may be left for a week or ten days, and the small amount of irritation necessarily produced will probably increase the firmness of the adhesions between the kidney and abdominal wall behind. The after-treatment consists in keeping the patient in the recumbent position for a considerable time after the operation, in order that the weight of the kidney may not stretch the new adhesions. The bowels should also be regulated. Subsequently, when the patient gets up, an abdominal belt should be worn, furnished with a pad, pressing gently, but firmly, over the renal

region in front. But, even with this, the patient should avoid all but the gentlest exercise for a long time after the operation.

It appears probable that we shall hear more of this procedure in the future, as it seems to offer many advantages over other modes of treatment in suitable cases, and to involve little risk. Writing in June, 1883, Dr. Newman says he had collected eight cases in which this operation was performed, and among these there were no deaths: at least five were cured of their troubles, the other three were too short a time under observation to judge of its effects. ARTHUR E. BARKER.

NEPHROTOMY, or simple incision into some part of the kidney, is performed for a variety of conditions, chief among which are calculous or tuberculous pyelitis, pyo- and hydronephrosis. It is an operation of some antiquity, but, amongst the older surgeons, was performed only when the collections in the kidney or its pelvis had made their way very close to the surface, and were about to burst externally. Recently, the operation has been revived and developed, and is now performed at a much earlier stage of disease than formerly. Thus done, and with all the improvements of antiseptic surgery, nephrotomy is a measure attended with but little risk. It is now almost always performed at the same spot—viz. midway between the last rib and the crest of the ilium, and at the outer edge of the erector spinæ muscle. The incision through the skin and soft parts varies with the views of different operators. Sometimes it is vertical, along the outer border of the erector spinæ, for two or three inches; sometimes it is transverse, or obliquely downwards and forwards for the same length, or a combination of the vertical and oblique incision is adopted. But whatever line is chosen, the central point of each is practically the same for all ordinary conditions. Supposing the operation to be for calculus in the kidney, without much or any enlargement of the organ—a condition in which greater difficulties are met with than in others—the steps of the procedure are as follows.

The colon is carefully unloaded by enemata. The patient is then placed on the opposite side, with a thick sand-bag under the flank, so as to make the side operated on as prominent as possible. The incision preferred by the writer is oblique, parallel to and a little below the last rib; it should sever the skin and superficial fat at once. The muscular layers are then divided, on a director, until the posterior tendon of the transversalis muscle or fascia lumborum is reached. When this white structure is divided sufficiently, all the soft parts are held asunder with broad spatulæ, and then, the surrounding fat being carefully torn through with the finger or probe, the kidney is found embedded in it. In this dissection one or two arterial twigs may be cut, but are easily secured in the clip-forceps. The kidney may now be opened up in various ways, but is best incised longitudinally with a narrow-bladed scalpel, the organ being pushed toward the lumbar wound by the hand of an assistant pressed against the abdominal wall. When an opening has been made with the knife large enough to admit the finger, the wound may be enlarged by simple dilatation with the latter, or by the blades of a forceps thrust into it and expanded. This opening up of the organ will of course in many, if not all, cases be preceded by the other means of ascertaining its state, such as palpation, with the finger on both front and back aspects, and by acupuncture, and may be done boldly when we have by these means satisfied ourselves of the presence of a stone. But, even in those cases where the latter is not detected by these means, but there is still strong evidence of its presence from the subjective symptoms, &c., it will be proper to incise the pelvis from within outwards, and explore it well with the sound or finger. In such cases, too, the substance of the organ may be incised without much risk, if the cut be made steadily in either of the planes of the uriniferous tubules; but for calculus of the pelvis incision of the parenchyma is unnecessary.

There is, usually, smart bleeding when the cortex is cut into, but this will soon cease, as a rule, under pressure, either directly applied, as with a sponge, or indirectly, through the abdominal wall. If it prove too troublesome, the wound should be packed with antiseptic wool or a sponge wrung out of a strong antiseptic solution, the abdomen being firmly compressed with a bandage. In all cases, the incision in the abdominal wall should be carefully drained by a tube reaching quite down to the kidney, in some cases passing well into the organ. This tube will have to be kept in for a longer or shorter time, varying with the needs of the case. If it is one of hydro- or pyonephrosis the tube should be long, and provided with a rubber shield to prevent its slipping into the sac. The whole operation and the after-treatment of the case, whatever its nature, should of course be con-

ducted on strict antiseptic principles. Either silver or silk stitches may be used for the lumbar wound; the writer inclines to the use of the latter.

Prognosis.— It is impossible to give any reliable statistics showing the relative dangers of nephrotomy, the operation having been done for so many different conditions. But it may be fairly said that *per se* the procedure is not attended with any special dangers in most cases. Unfortunately the diseases for which it is performed are usually very advanced, and the operation is too often undertaken merely as a palliative, and if the patients succumb, the result is recorded against nephrotomy. Increased knowledge of the possibilities of renal surgery, and improved power of diagnosis will no doubt effect a reform here. Renal disease will be recognised much earlier than hitherto, and will be submitted to the surgeon, with confidence, at a stage in which the risks of operation are immeasurably less and the prospect of permanent benefit far greater. Eventually nephrotomy will probably become a rare operation, while nephro-lithotomy for disease at its earliest stage will proportionately increase in frequency.

ARTHUR E. BARKER.

NERVE-AVULSION. — Nerve-avulsion denotes the tearing out of the trunk of a nerve, as far as possible, from the bony foramen it passes through. This operation is resorted to as a last resource where previous NEUROTOMY or NERVE-STRETCHING has failed to give more than temporary relief in cases of severe neuralgia. The operation has almost invariably been performed on one or other of the branches of the trigeminal nerve, in the following way.

Operation.—The patient having been deeply anæsthetised, a vertical incision is made in the course of the nerve, and just over the bony foramen through which the trunk leaves the skull. The nerve is then freed from its peripheral attachments, is grasped in strong forceps—e.g. torsion-forceps, &c.—and wrenched out as far as possible. When the bone is left untouched, it will be found that the nerve almost invariably breaks off at the external orifice of the canal, the reason being that it is tightly fixed to the margin of the hole by very tough fibrous bands, which pass from the epineurium to the periosteum.

When the necessities of the case (e.g. return of the pain, &c.) demand that the rest of the nerve should be excised, the bony canal has to be opened up. In the case of the infra-orbital nerve this may be done in two ways:—(1) The soft tissues filling the orbit may be detached along the lower border of the same and held up by Wagner's retractor, which is spoon-shaped; the nerve will then be seen running along the floor of the orbit, covered by a thin plate of bone and periosteum. The advantage of exposing it in this situation lies in the fact that the anterior dental branches are given off from the nerve while it remains in the canal; so that if the neuralgic pain is referred to the alveolar border of the jaw, it is obviously necessary to remove the whole nerve. (2) In very obstinate cases, it is advisable to remove not only the infra-orbital nerve but Meckel's ganglion also, as far as possible. This has been done by trephining the wall of the antrum and following the nerve back to the ganglion, which is then torn out. In this way the posterior dental branches are removed and, when thoroughly performed, anæsthesia of the palate obtained—a very important result, as the palate is frequently the starting point of the pain.

The inferior dental nerve is best reached at its peripheral extremity by depressing forcibly the angle of the mouth, while an incision is made parallel to the gum and just opposite the canine tooth, at the line of reflection of the mucous membrane from the jaw. The soft parts are then separated from the periosteum until the mental foramen is reached, and the fibres of the nerve felt issuing from it The nerve-trunk should be exposed, and a loop of silk knotted on it. The outer margin of the foramen is next broken open with a sharp chisel and small bone-forceps, each blade of which is pyramidal in shape, so as to allow of either being inserted into the canal for the desired distance (usually an inch to an inch and a half), and the nerve is then lifted up by the ligature from its bed and removed as far as possible.

The nerve can be reached from inside the mouth also, where it enters the upper extremity of the dental foramen, the guide being the small bony spine on the lower margin of the same. The internal pterygoid is held aside with a retractor, while the nerve is freed for some little distance with a blunt instrument. It can also be reached, at the same point, by trephining through the ramus of the jaw and laying the nerve bare *in situ*.

The wound in all cases should be mopped out with strong carbolic acid solution (1–20), or chloride of zinc 40 gr. to f℥j., then dusted with iodoform, and plugged with iodoform wool until granulations spring up from the

bottom, when it is to be frequently irrigated with weak Condy's fluid or sanitas.

The anæsthesia produced will gradually diminish to a very considerable extent, but the relief is always permanent where the cause is clearly shown to be neuritis. In all cases, deep HYPODERMIC INJECTIONS of ether, &c., should be attempted before operating. *See* NEUROTOMY and NEURECTOMY.

VICTOR HORSLEY.

NERVE-SECTION. *See* NEUROTOMY.

NERVE-STRETCHING.—By *nerve-stretching* is understood, either the bloodless operation of stretching the nerve-trunks in a limb by forcible extension of the distal joints, or the operation of laying bare a nerve, lifting it from its bed, and pulling it either in the direction of its course or at right angles to the same. Under the term nerve-stretching is also often included NERVE-AVULSION, an operation in which a nerve-trunk is completely torn out of its bed, as far as possible.

The following paragraphs relate only to nerve-stretching as defined above. The method of operation will be discussed first, next the anatomical changes and physiological effects it produces, while its value as a therapeutical agent will be given in conclusion.

1. The *bloodless operation* is performed thus: The patient being anæsthetised, the limb is first fully flexed at the proximal joint (e.g. the hip), the middle joint (e.g. the knee) is then slowly but firmly extended, and, when at the point of extreme extension, the distal joints are also extended. (Of course in this case the ankle will be forcibly 'flexed.') This state of tension is to be kept up for not less than from ten to fifteen minutes, and then the limb should be thoroughly shampooed, firm pressure being directed centrally, for another period of ten or fifteen minutes. The only point of risk to be mentioned is, obviously, the possibility of the vessels being diseased; and it is to be noted that the tension on a diseased popliteal artery is not much lessened by previously flexing the hip-joint.

2. The *cutting operation* is performed in the following way:—The patient being anæsthetised, a free incision is made in the direction of the nerve, and vertically over it. The superficial structures are divided to the same extent as the skin, and the muscles separated and held aside with retractors; the nerve will then be found lying beneath a layer of fat, and surrounded by a quantity of loose connective tissue, which forms a 'false' sheath. This fatty tissue is now to be freely incised, until the epineurium or proper sheath of the whole nerve-trunk is exposed, contrasting by its shining white appearance with the surrounding yellow fatty tissue. The nerve should be freely isolated by knife and forceps, so as to admit of the forefinger being passed beneath it; if it is lying at the bottom of a deep wound, or if it is a small nerve, it should be gently lifted by a blunt hook until it can be grasped between the finger and thumb; care is to be taken that the hook is not used with force, otherwise many nerve-fibres will be damaged by the pressure of the instrument. *See* NEUROTOMY.

The nerve being firmly held between the finger and thumb, is then to be steadily pulled for about five minutes, first centrifugally, and then centripetally for a like period of time. The tension must be gradually applied and kept constant the whole time, while all jerks (the force of which is unknown) are to be avoided. The actual amount of force, with which it is advisable to pull, varies from a maximum of thirty pounds for the sciatic nerve to half a pound for the supra-trochlear. The amount of force must necessarily vary with individual development and the state of the nerve (Marshall). It will now be found that the nerve is loose and elongated, owing to its elasticity being relatively very imperfect.

The extension of the nerve is mainly produced by the nerve being drawn tightly along the length of the segment of the limb in which it lies, since in the ordinary position of a limb at rest, and even in the position of extension of one joint, the nerve-trunks are never taut, and when the limb is flexed they exhibit a wavy border, showing their complete relaxation.

The nerve is now replaced in the bottom of the wound; any bleeding vessel is to be ligatured, the wound perfectly dried, and the sides then brought together by a supporting silver suture or two, passed deeply through skin, fascia, and muscle, and crossing about half an inch in front of the relaxed nerve. The cut edges are then to be united with numerous catgut or horsehair sutures, and a small drainage-tube inserted at the dependent end of the wound. The whole operation should be performed with strict antiseptic precautions, and healing obtained by the first intention; with this view, the drainage-tube in the largest wound (if perfectly aseptic) may be left out on the third day, and a large dry dressing with proper pads, &c. applied, and left on

for a week or ten days. Restriction of movement in the limb by a splint will be found practically very useful in ensuring rapid union of the wound; indeed, in cases of locomotor ataxy and other instances where the parts are deprived of the normal trophic influence of the central nervous system, this precaution must never be omitted.

3. *After-treatment.*—After the bloodless operation, the patient should be kept quiet in bed for a day or two, and then allowed to exercise the limb gradually, shampooing being performed daily. After the cutting operation, the same treatment should be adopted as soon as the wound is absolutely healed. This obviates the possibility of cicatricial bands fastening the cicatrix to the sheath of the nerve, a condition of things which is productive of considerable discomfort to the patient, by causing twinges of pain when the hip is flexed or firm pressure made in the neighbourhood of the scar.

4. *Effects of Nerve-stretching.*—(*a*) *Anatomical Changes, Macroscopic.*—It has been shown that when a nerve (e.g. the internal popliteal) is stretched by a weight below 10 lbs., the tension is thrown almost entirely on the fibrous sheaths of the nerve, viz., the loose epineurium binding the primitive bundles together, and the denser perineurium which ensheaths each primitive bundle. Also, all the nerve-fibres are straightened, and only altered, as described below, when the pressure reaches to more than two-thirds of the breaking strain. As a natural consequence of the tension the blood-vessels are compressed and emptied, while the lymph-spaces are absolutely obliterated and their contents driven out into the efferent trunks. It is very clear then, that if there is any inflammatory tension in the nerve, this must be got rid of by such a thorough compression of the vessels and connective tissues. (The 'bone-setters' in Turkey cure neuralgia of nerve-trunks by exerting very powerful and hard pressure along the course of the nerve, from the periphery towards the central end.)

Microscopic.—Harless and others have shown that the myelin sheath of the nerve-fibres exhibits transverse ruptures of every degree; while in cases where very severe tension has been employed, or at the point where a hook has been applied for the purpose of forcibly lifting a nerve from its bed, the myelin has been found to be broken up and aggregated in small droplets within the neurilemma. The axis-cylinder in some specimens appears attenuated and nodose, but is very rarely injured. Provided the nerve is not torn across, regeneration always takes place.

(*b*) *Physiological Effects.*—These may be considered under two headings—(*a*) Effects on the conducting power of the nerve-fibres; (*β*) effects on the nerve itself, including the explanation of the beneficial effects of nerve-stretching in neuralgia, sciatica, &c.; (*γ*) effects on the central nervous system.

(*a*) *Effects on Conduction.*—A mixed nerve contains: (1) motor fibres; (2) sensory fibres; (3) vaso-dilator fibres; (4) fibres (possibly identical with 1) conveying trophic influences; (5) secretory fibres.

The effect of stretching a nerve gently is to heighten the conducting power of all these fibres, so that a limb, the main nerves of which are moderately stretched, exhibits slightly increased mobility, slight hyperæsthesia and marked increase of reflex excitability, increase in blood-supply and increase in nutrition, coupled with rise of temperature.

A stronger pull on the nerve will change this hypertonic into a hypotonic state, for then every function of the fibres, except that of movement, will be obviously diminished, and the first group of fibres to show this change is the sensory set, the result being diminution of reflex excitability, hyperæsthesia, and ultimately anæsthesia. A still more severe pull will affect the efferent conducting paths in the same way; thus, slight paresis up to paralysis may be produced, and at the same time trophic ulceration with loss of digits, and œdema of cellular tissues (most probably from vaso-motor paralysis) may be seen. These profound trophic changes are not seen in man, owing to the fact that the amount of force required to produce them would be obviously unjustifiable. In fact, if the operation is performed for the relief of pain (e.g. in sciatica, tabes dorsalis, &c.), although half-measures are much worse than useless, still no paralysis beyond that of sensation, and that slight, should be produced in the part supplied by the nerve. The amount of force necessary to produce this may be put down as one-third of the breaking strain, as a rule. In every case, recovery of power of sensation, &c., will be obtained if the nerve is not divided, and if proper after-treatment is adopted.

(*β*) *Effects on the Nerve itself as an Organ.*—These are rather questions of anatomy, and have been discussed above, but one point of pathological interest has not been referred to, and may be mentioned here. It had been known for some time that

a person could accurately localise touch and pain in a nerve-trunk, and that the pain in neuralgia, sciatica, &c., was referred, as a rule, to the trunk of the nerve, which was found to be tender on physical examination, &c. Mr. Marshall assumed the existence of *nervi nervorum*, pressure on which from inflammatory exudation, &c., would explain the localised symptoms just described; and at the same time he showed that nerve-stretching would so damage these nervi nervorum as to diminish their conducting power. The writer has found that nerve-fibres and sensory nerve-endings are present in the sheaths of nerves, so that the anatomical basis of the above theory is supplied. It will be obvious that a very slight increase of vascularity, and consequent œdema, will cause very urgent symptoms by pressing on such nerve-endings enclosed within a firm sheath like the epineurium, and more especially in nerves (like the inferior dental, &c.) which lie in hard inextensible bony canals.

(γ) *Effects on the Central Nervous System.*—It still remains a question whether the extreme stretching of a nerve does produce any real effect on the spinal cord or base of the brain. It can very easily be shown, by exposing the spinal cord within a very short time of death, long before rigor mortis has set in, that, contrary to what has been frequently stated, there is no mechanical effect whatever produced on the nerve-centres by stretching peripheral nerves; the simple fact being that nerves are so fixed by fibrous bands in the bony foramina of the spine and skull, as to preclude the possibility of the least movement being transmitted. There then remains the possibility of the mechanical irritation of the nerve-fibres causing changes (functional) in the nerve-centres. Brown-Séquard and Quinquaud have asserted that, given anæsthesia by hemisection of the cord, this can be removed by nerve-stretching. This requires confirmation, as Prevost has obtained simply negative results in repeating the experiments. There certainly appears to have been produced, in guinea-pigs, a condition of greatly exaggerated irritability of the motor centres, leading to convulsions, &c., but very little can be argued from guinea-pigs direct to man, especially on this matter.

5. *Nerve-stretching as a Therapeutical Agent.*—It will be best, perhaps, to enumerate the different diseases in which nerves have been stretched with distinct advantage, and under each heading to mention the principal points which require special attention. It must be remembered that the estimates given, of the percentage of cases in which relief was afforded, are necessarily rough and inaccurate, owing to (1) cases being published too early, and (2) cases of non-success being omitted from public records.

A. *For Abnormalities of Movement.*—(α) *Spasms.* — Motor nerves have been stretched for spasmodic contractions of voluntary muscles with variable success, probably in about 50 per cent. of all cases. The cases should, however, be arranged in at least two groups—viz. spasms caused by old injury to nerve-trunks (Nussbaum's classical case is a good example), and spasms in which it is at present doubtful whether the irritative lesion is in the nerve-trunk or nerve-centres. As might be expected, the percentage of cures is very high in the first class and very low in the second. A common example of the second class is facial tic or *tic convulsif*, in which case the facial muscles are affected with twitchings commencing insidiously. In these cases, the facial nerve has been exposed by an incision opposite the lower end of the parotid gland, and the nerve stretched on a small blunt hook. As a necessary result facial paralysis ensues, but as this clears up, the spasms tend to return, from which it would appear that the disease is usually of central origin. Putnam found that in a healthy dog eight pounds' pull was sufficient to paralyse; it is very probable that five pounds is adequate for the human being. He also makes the valuable and practical suggestion that, when nerve-stretching is undertaken for the relief of spasm, the patient should be preferably anæsthetised with ether, so that, if necessary, the effects of the anæsthetic may be got rid of during the operation, in order to see the effect of the latter on the affection. Reflex spasm, such as blepharospasm accompanying attacks of neuralgia, must of course be treated by stretching the afferent sensory nerve. *See* Facial Spasm.

(β) *Contracture.* — Wryneck (Billroth) and other instances of contracture in cases of peripheral lesion have yielded to nerve-stretching, but many cases have failed as soon as the conducting power of the nerve has been restored. In cases where the seat of the lesion is doubtful, nerve-stretching should be tried, as possibly productive of good.

(γ) *Tetanus.*—This condition has frequently been treated with nerve-stretching (45 times, Marshall, 1883), but with so small a proportion of successes (14), as to leave it perfectly open whether the good results were not simply cases of ordinary recovery by other means which were em-

ployed at the same time (e.g. Calabar bean, chloroform, &c.). Since we thus get information of very doubtful value from the records of empirical treatment, and since the pathology of tetanus is so obscure, nerve-stretching in this affection cannot be detailed at greater length here, but it may be worth while to mention that the successful cases appear to have been those in which the worst symptom was trismus and not opisthotonos.

(δ) *Reflex Epilepsy.*—In some cases of epilepsy (Nussbaum, &c.) the attack is preceded by violent pains, localised distinctly in different nerves, and, in these cases, very marked relief (amounting to cure in several instances) has been obtained by stretching the nerve-trunks thus indicated. Possibly, those cases in which an attack can be warded off by tightly ligaturing the limb in which the prefatory symptoms appear, could be similarly benefited.

(ε) *Paralysis.*—Paralysis of movement, in cases where a nerve-trunk has been damaged but not divided, have been relieved by lifting the nerve from its bed, freeing it from its attachments, and gently stretching it. The operation has been performed in cases of paralysis from central lesions, with the obvious result of discredit to the operation and operator. Motor inco-ordination in cases of locomotor ataxy is said to have been improved by nerve-stretching; but this requires confirmation, especially as several cases of motor inco-ordination thus relieved do not appear, from the clinical records, to have been genuine cases of ataxy.

B. *For Abnormalities of Sensation.*—(α) *Hyperæsthesia.*—Just as in the case of disturbances of movement, those cases of aberrant sensation which are due to direct injury, &c., of the nerve-trunk are those which are most relieved by nerve-stretching. Hyperæsthesia, however, may be due to central causes, capable of relief by operation where diagnosis is possible. In stretching nerves for the relief of pain, it is to be remembered that although it must be thoroughly done, still less force is required than when disturbances of movement (e.g. spasms) have to be treated. A second point of considerable practical importance is the possibility of the pain disappearing *gradually* after the operation, in consequence, no doubt, of the gradual absorption of fluid, &c. It frequently happens that the patient experiences some pain (almost always much mitigated) for several days, but cure is ultimately certain if the operation is thoroughly carried out.

(β) *Neuralgia, Sciatica, &c.*—The causation of the pain in these cases has already been discussed, and after ordinary means have been exhausted (e.g. counter-irritants, anodyne applications, deep injections, &c.), nerve-stretching, or, in the case of a purely sensory nerve, nerve-avulsion, will almost certainly result in cure, since the percentage of successes appears, at the lowest estimate, to be 74 per cent. (Marshall). The special points in connection with nerve-stretching for neuralgia and the pathology of the affection have already been discussed, so that no more need be said here on the subject, save that occasionally a tumour (psammoma) may grow in the membranes covering the long roots of the nerves in the spinal canal (Marshall).

(γ) *Lightning Pains* (*Tabes*).—As locomotor ataxy often exhibits peripheral lesions and symptoms, it is not surprising that the lightning pains in that affection have been considerably relieved by nerve-stretching. Owing to the low trophic level of tabetic tissues, special attention must be paid to the wound in these cases, and the condition of the nerve noted before it is pulled. The relief from the pains varies in duration considerably in different cases, but always appears to have been gratefully appreciated by the patient.

(δ) *Anæsthesia.*—The relief of anæsthesia by nerve-stretching has been employed, with especial success in cases of anæsthetic leprosy, by the British surgeons in India. Lawrie published 30 cases, all successful; in fact every case appears to have been so. *Nerve-splitting* has also been found of service, especially where the nerve has become nodose and thickened.

C. *For Abnormalities of Nutrition.*—In 1881, Dr. Bastian caused the sciatic nerve to be stretched to improve the state of nutrition, in a limb the seat of infantile paralysis. The effect was to markedly increase the temperature and colour of the part, and apparently improve the state of the tissues.

VICTOR HORSLEY.

NERVES, Injuries of. — SECTION.—Like all other parts of the body, nerves may be injured in various ways; of these, section by a sharp cutting instrument, such as a knife, is at once the most common and simple. The changes that occur in the nerve-ends after division may be shortly described as follows. The whole of the peripheral portion undergoes degenerative changes in its entire length and distribution. The white substance of Schwann becomes segmented and collects in globules of

varying size within the sheath; finally, the whole of the myelin is destroyed. The axis cylinder splits into numerous longitudinal fibrils, and is gradually completely disintegrated. The nerve, as such, is entirely destroyed within four or five weeks.

After this complete degeneration, regenerative changes occur in the peripheral extremity, independently of its reunion with the proximal end. The nuclei of the sheath of Schwann multiply, and, after a time, unite to one another so as to form new axis-cylinders. Around these the myelin sheath is subsequently formed, but seldom attains the natural dimensions. The length of time required for regeneration of the peripheral end is not certainly known, but the writer has seen new nerve-bundles in the peripheral end six months after section, and is inclined to think that a further period of a year or more frequently elapses before regeneration is nearly complete. It is probable that regeneration is more rapid in young subjects than in old; and it is certain that union with the proximal end materially hastens regeneration.

The changes occurring in the proximal end are, unlike those of the peripheral, strictly limited in their extent, being confined to that portion of the nerve immediately above the point of section; according to some authors, to the next node of Ranvier. In this limited portion of nerve the same degenerative changes occur that have been described as affecting the whole peripheral end, but regeneration is much more rapid. The most noticeable condition of the upper end is the bulbous enlargement, which developes immediately above the point of section within a few weeks of the injury, and which is never met with in the nerve below the point of section. This bulb, which is, roughly speaking, about twice the diameter of the normal nerve-trunk on which it is situated, and oval in shape, is generally matted to the surrounding tissues, and feels very tough and resistant to the fingers. On section, numerous nerve-bundles may be seen, and a microscopic examination will show that the bulb in question is made, not only of fibrous tissue, but also of nerve-tubules, smaller in size than is natural, with a proportionately small myelin sheath, and collected into smaller bundles than are those of nerves in a normal condition. These tubules are either persisting ones, which have altered in size on account of the pressure to which they have been subjected by the dense fibrous tissue, or else new tubes in process of development.

The Union of the Divided Nerve is brought about by a gradual development of new axis-cylinders from the nuclei of the sheath of Schwann, in both the proximal and peripheral ends, forming a uniting medium through which, when perfected, nerve-currents may be transmitted. Whether union will occur in any individual case or not, depends much upon the amount of separation of the divided ends. When these are maintained in close contact and in good apposition, union is both more rapid and more perfect than in the absence of such conditions; yet, even when closely apposed union may fail. If, on the other hand, there is wide separation of the divided ends, and especially if muscle or scar-tissue intervene, union will most likely not occur at all, and in any case will be long delayed. But, though delayed, union may occur even after excision of as much as two to three inches of a nerve-trunk.

The changes that occur in the parts supplied by the divided nerve are many and various. They affect mobility, sensitiveness, and nutrition.

The *muscles* supplied by the divided nerve are at once paralysed, and remain in this condition so long as reunion is delayed. Not only are they paralysed, however; they also rapidly waste and degenerate. The atrophy of the muscle is much more than can be accounted for by simple want of use, and is infinitely more rapid and complete. It is accompanied by degenerative changes in the intimate structure of the muscular substance, which becomes the seat of fatty change. Within three or four months the muscles have practically disappeared; and not only does the affected muscle diminish in bulk, it also becomes actually shorter, and may thus cause considerable interference with the freedom of action of other muscles. Notwithstanding their complete atrophy, the muscles become entirely regenerated if union of the divided nerve ensues.

The electrical reaction of the muscles, after section of their motor nerve, is a point of some interest and importance. Within twenty-four hours of the nerve-section, their faradic irritability begins to diminish, and within four or five days is completely lost. In the first day or two after the nerve-injury the galvanic irritability may be increased, but is more frequently not appreciably altered. After this time it gradually diminishes, and in the course of three or four weeks the strongest current fails to produce any contraction. It is during and before this period of diminishing galvanic irritability

that the 'reaction of degeneration' becomes marked. Normally, the kathodic closure contraction of a healthy muscle is greater than the anodic closure contraction. After nerve-section, when degeneration sets in, the anodic closure contraction first becomes equal to, and then greater than, the kathodic, a reaction which indicates degeneration of muscle and nerve, and is therefore a valuable diagnostic sign. After union of the divided nerve has taken place, voluntary power in the previously paralysed muscles returns before faradic or galvanic irritability. The patient may be able to use the muscle for many months before it will contract on application of the electric current.

Loss of Sensation.—Supposing the divided nerve to contain sensory fibres, sensation will be more or less impaired after injury. In most cases complete anæsthesia results, the patient losing all sense of touch and pain, of heat and cold. In other cases, and especially where the part is supplied by nerve-filaments derived from more than one trunk—e.g. the ring finger, which is supplied by both the median and the ulnar nerves—more or less sensibility may persist.

In testing the amount and extent of impaired sensibility, it is necessary to be very careful. Examination of a supposed anæsthetic area should always be made in such a manner as to exclude the possibility of exciting sensory impressions through the medium of neighbouring nerves. Thus, if a finger be pressed or pushed, the patient may perceive through his 'muscular sense' that it is being touched. Or, if the supposed anæsthetic area be tested by the surgeon gently rubbing it with his finger, the vibrations conveyed to the neighbouring healthy nerves will correctly convey tactile sensations. In order, therefore, to avoid being misled, all examinations should be conducted with as little interference as possible with neighbouring parts. The point of a pencil is as good as anything for testing the sense of touch; and the surgeon should notice not only whether the patient can *feel*, but whether he can also correctly *localise* his sensations.

Trophic Changes.—The alterations in the nutrition of the paralysed parts is of much importance. It has already been mentioned that the muscles not only atrophy, but also degenerate. The skin is liable to be attacked in various ways. In some cases there is not much alteration, but in most the surface becomes smoother than is natural, and occasionally, in addition, shiny and glistening, the papillæ appearing to be obliterated. Eruptions of eczema, herpes, or acne may result. In many cases ulcers appear in the anæsthetic area, and are frequently due to injury of some kind or another which, on account of its painlessness, has passed unnoticed by the patient. Sometimes, however, these ulcers occur while the part is completely protected, and must then be attributed to interference with the trophic nerves. When protected, these ulcers will generally heal, though they may be slow to do so.

In addition to ulcerations, local gangrene may result from nerve-injury — e.g. the finger-tips may be destroyed; the gangrene is of the dry variety. Painless whitlows, with loss of the nails, are also not uncommon. The hair of the affected area frequently falls off, and in other cases becomes brittle and stumpy. The nails may be cast off entire, or may become fibrous and brittle, very curved, ridged, and furrowed. Their appearance is often very characteristic.

Disease of the Articulations.—The joints supplied by a divided nerve generally suffer in proportion to the affection of the soft tissues. An interval of considerable length may intervene between the nerve injury and the joint-disease, but, in some cases, the latter commences within a few days of the former. The pathological processes that occur are not, as a rule, in any way different from those met with in acute rheumatism. There is the same synovitis with exudation of plastic lymph, the same tendency to affection of the fibrous tissues of the articulation, and, as in acute rheumatism, the inflammation may entirely resolve. Fibrous ankylosis, is, however, much more common after nerve-injuries than in simple rheumatism, and, indeed, may almost be said to be the rule rather than the exception. The writer has seen one case, at least, of true bony ankylosis.

Many or few joints may become inflamed, but when one of the nerves of the upper extremity, which supply the hand, is the seat of the injury, many of the finger-joints are commonly affected.

Clinically, as well as pathologically, these cases resemble closely acute or subacute rheumatism on a limited scale. The diseased joints become slightly swollen, extremely tender to the touch, and painful on movement. Gradually, the more acute symptoms pass off, and, in the larger number of cases, a more or less complete ankylosis remains. This ankylosis is, as a rule, incomplete, and over a limited area movement is fairly free. The extent to which a limb may be crippled by this form of arthritis can scarcely be exaggerated, and, occurring as it does in combination with

other trophic lesions, it is liable to be accompanied by an amount of deformity and suffering not easily exceeded.

Alteration in Temperature.—The immediate result of division of any of the main nerve-trunks of the extremities is vaso-motor paralysis, and consequent hyperæmia of the paralysed area. As a result of this increased blood-supply, the temperature is raised above that of the corresponding part on the opposite side. The increase in temperature varies in different cases, but is usually about two or three degrees. After a few days, the alteration in temperature is less marked, and in the course of a few weeks the temperature not only sinks to the former level, but the paralysed area becomes several degrees colder than is normal. The fall may amount to eight or ten degrees.

The changes that have just been described as following on nerve-section, may also be met with as the result of any other injury to a nerve. It is quite a mistake to suppose that the various trophic changes are dependent upon some irritated or inflamed state of the nerve-trunk, for they are met with after simple section in cases where the nerve is completely divided, and in no way implicated in scar-tissue. In addition, it must be remembered that, within a few days of section, the degenerate nerve-tubes are quite incapable of conveying any nervous currents, and cannot therefore be the means through which the nutrition of the tissues may be actively influenced.

Diagnosis of Nerve-section.—The diagnosis of division of a peripheral nerve is usually an easy matter. In recent wounds, however, unless the surgeon bears in mind the possibility of such an injury, he is not at all unlikely to overlook it, the paralysis and loss of sensation being frequently unnoticed or uncomplained of by the patient. Later on, the muscular wasting and shortening, the 'reaction of degeneration,' evidenced by the use of the galvanic current, the paralysis, trophic changes, and loss of sensation make the diagnosis sufficiently clear. It must be borne in mind that, from a diagnostic point of view, the evidence adduced from an examination of the muscles is of much greater weight than that derived from an examination of the sense of touch, which, as has already been mentioned, may be to a great extent preserved.

Treatment of Divided Nerves.—In all recent cases of division of nerve-trunks, primary suture of the divided ends should be performed. The nerves are very elastic, and on section retract to considerable distances, frequently necessitating an enlargement of the wound. If the cut ends are at all jagged or torn, fresh sections should be made, and contact ensured by thorough stretching. From three to six sutures are generally requisite, and are best passed by means of a small curved needle carried in the long axis of the nerve-fibres. It is quite immaterial whether the needle be passed through the whole thickness of the nerve-trunk or only through the sheath, so long as thorough apposition is obtained. There is no reason for believing that passage of a needle through the nerve inflicts any serious harm.

The best material for sutures is fine kangaroo-tendon. The writer's preference for this material is based upon the fact that he has seen cases in which suture with carbolised catgut failed, apparently because the sutures did not last a sufficient length of time. It must be remembered that nerves do not unite rapidly; if, therefore, there be any tension on the part, it is certainly advisable to use some material which will maintain the divided ends in apposition for a longer time than does catgut. Every endeavour should be made to obtain primary union of the wound, for, if much suppuration occur, separation of the recently united nerve by inflammatory products, or matting in fibrous tissue, is likely to ensue.

Supposing the divided nerve to have escaped primary suture, and the patient is not seen for some months later, an operation for resection of the separated extremities and secondary suture should be undertaken. There are not at present a sufficient number of recorded cases to allow of any opinion being offered, as to the amount of time that may elapse after which suture can be successfully performed. The operation should, therefore, not be withheld, in any case, simply on account of the length of time that has elapsed since the original injury. The application of an Esmarch's bandage materially facilitates the search for the nerve, but, at the best, the operation is liable to be prolonged. The incision should be made in the long axis of the nerve at the seat of injury.

It is often advisable to expose the nerve-trunk above or below, and then to trace it down until the cut end is reached. The divided ends are always adherent to the surrounding tissues, the upper being bulbous, the lower often atrophied. They should be freely separated and fresh sec-

tions cut as cleanly as possible. There is no object in cutting away much of the lower end, for it is all equally atrophied. Neither need the entire bulb be removed —though the greater part of it should be— for it offers a better hold for the sutures than does the nerve-trunk itself. If the nerve seems much shortened, the ends should be thoroughly stretched before being sutured, and the limb should be put up in such a position as to ensure as little longitudinal tension as possible. The sutures should be of the same material and may be passed in the same way, as has been described in the account of primary suture.

The *prognosis* of cases in which nerve-suture has been performed must be somewhat uncertain. When the patient is young, when good apposition has been obtained, and when the wound has healed by first intention, it is most probable that the functions of the nerve will be restored, either completely or else in part. In some cases sensation may return and motion may never be regained; in other cases the reverse holds good.

The *length of time* required for this restoration is most various. In recent cases primary union of the divided ends is but rarely attained, and the process of degeneration and subsequent regeneration is necessarily a lengthened one. In cases of secondary suture, sensation sometimes commences to return within twenty-four hours, but a much longer time is requisite for the restoration of the atrophied muscles. In any case, the surgeon must not be disappointed if no improvement makes itself apparent for weeks or months. The writer has seen patients, in whom restoration of function did not commence until nearly two years after suture. But, whilst waiting for repair, other treatment should by no means be neglected; it is most important to prevent, as much as possible, the deformities and trophic lesions which are almost certain to ensue. Perhaps the most important rule to observe is that the whole extremity which is the seat of injury, and especially the paralysed part, should be kept warm; cold is certainly prejudicial, and repair in many cases is apparently more rapid during the summer than the winter months. Galvanism is often useful, even in cases where muscular irritability is absent, and appears to have some influence in maintaining the nutrition of the part. It should be persevered with so long as any hope of union remains. Daily friction and shampooing of the limb should be practised, and any tendency to fixation of joints and muscular contraction should at once be combated. The treatment of cases of arthritis is most unsatisfactory at best. In the early stages, blisters are sometimes useful, and, as early as the inflammation allows, the patient should be anæsthetised and all recent adhesions be broken down.

Partial Section.—Contrary to the opinions of some authors, the writer is quite convinced that partial section of a nerve-trunk is by no means so severe a lesion as complete division. It has been stated that trophic lesions of various kinds are more frequent after partial than after complete division. The writer has observed several such cases during considerable periods of time, and feels certain that the amount of paralysis, of anæsthesia, and of trophic lesions is in direct proportion to the amount of nerve-fibres divided. The prognosis of union in such cases is also better than in those of complete division, for the divided tubules are but little separated, and so can more readily rejoin.

In recent cases of partial division it is as well to suture the divided strands, more especially in cases where almost the whole trunk has been severed. If, however, the patient is not seen until the wound is healed, the treatment to be adopted will depend on the amount of function that is lost. Supposing this to be very considerable, it is advisable to cut down on the nerve at the seat of injury, then to resect the ends and perform secondary suture, if division be found to be practically complete. It is always best to do this if the functions of the injured nerve are almost lost, for it must be remembered that those which remain may be really dependent upon some abnormal distribution of another nerve-trunk, complete division of the damaged nerve having really occurred. Where an examination tends to show that but few nerve-fibres have been divided, the case may fairly be left alone so far as operation is concerned.

Injuries to Peripheral Nerves.—Considering the almost innumerable injuries of peripheral nerves, it must be allowed that severe symptoms resulting from such an accident are relatively uncommon. It is probable that when symptoms do arise, they are due to implication of the nerve in the scar-tissue and to secondary neuritis, and not directly to the nerve-wound; and it is because a partially divided nerve can less readily contract, and so escape inclusion in the scar, that partial division of a filament is more likely to be followed by troublesome symptoms than if the division has been complete. The symptoms of injury to or irrita-

tion of a peripheral filament are—reflex contraction of neighbouring muscles, producing painful spasm, rigidity, and uselessness of the injured extremity; pain of a neuralgic nature radiating over an area of varying dimensions; occasionally, paralysis of neighbouring muscles. In hysterical patients the health may be seriously affected.

The *treatment* of such cases consists in removing the cause. If the wound has cicatrised, it will frequently be found that at one spot the cicatrix is extremely sensitive, and that any pressure exercised in this situation at once causes radiating neuralgic pains, and perhaps muscular spasm. If this be the case, the cicatrix should be completely excised. If any suspicion exist that the pressure of some foreign body, such as a shot, is the exciting cause of the symptoms, a careful examination of the supposed seat of irritation should be made, and any foreign body should be removed.

Pressure on Nerves.—Pressure may be applied by external objects, or may be due to the growth of tumours, displaced bones in cases of dislocation, the callus thrown out in repair of fractures, implication in cicatrices, &c. The effects of pressure on a mixed nerve are most apparent in respect to its motor function; paralysis of muscle may be present, while sensation is retained; the reverse is rare. Cases of crutch palsy afford good examples of the effects of extraneous pressure, whilst paralysis from pressure on the nerves of the arm during sleep—especially drunken sleep—is also of common occurrence.

The *diagnosis* of such cases is usually easy, and the *prognosis* is good. *Treatment* by galvanism and friction, with abstinence from the use of the crutches, if these are the cause, usually results in a cure within a few days or weeks. Pressure on nerve-trunks by cicatrices is generally characterised by the gradual onset of the symptoms which are common to all cases of nerve-injury. Thus, the anæsthesia is preceded by numbing and tingling pains, and by parasthesiæ of various kinds. Paralysis and wasting of muscle are also gradual. Trophic lesions are slowly established. Such symptoms as those accompanying the gradual contraction of a cicatrix are a sufficiently clear evidence of pressure on a nerve. Supposing the anæsthesia and paralysis to continue, after a sufficient length of time has elapsed to allow of the cicatrix becoming more supple and less adherent, an operation should be undertaken in order to free the compressed nerve from the fibrous mass in which it is embedded.

Injuries of Nerves in Fractures.—Lacerations of Nerves.—Were it not for the extreme elasticity and toughness of the nerve-trunks, there is no doubt they would suffer in cases of fracture much more frequently than is actually the case. They do not, however, always escape. There are two ways in which nerves may be damaged in cases of fracture. They may either be torn at the time of the accident, or they may be compressed by callus. If torn at the time of the accident, the symptoms will, of course, supervene immediately, whereas, if gradually implicated in callus, the onset will be gradual, in the manner already described as occurring in cases of pressure on nerves by cicatrices.

Where a definite history of sudden, or else of gradual loss of function can be obtained, the diagnosis is rendered comparatively easy. This, however, is by no means always the case. The pain of the injury, the subsequent bandaging and splinting of the damaged limb, frequently prevent the patient having any very clear idea of the condition of his sense of touch and of his muscular power. It is often not until the splints are removed that paralysis or numbness is noticed. But even when the surgeon feels satisfied that a nerve is torn at the time of fracture, it is in all cases advisable to wait until union of the broken bone has occurred. Secondary suture of the lacerated trunk offers prospects of union which are practically as good as those of primary suture; and it is not worth while to make a simple fracture into a compound one, in order to unite a torn nerve.

The *treatment* of the injured nerve after union of the fracture has occurred is, however, clear. If there be any doubt as to whether it is a case of nerve-laceration, or one of callus-implication, it is as well to wait and see if improvement results as the callus is absorbed. If no such improvement occurs, an exploratory operation should be undertaken, the nerve should be exposed, and, if torn, should be sutured. If, however, there is no laceration of the nerve, but it is implicated in callus, the bone which surrounds it should be chiselled away. In some instances true pressure may be exercised, not by callus, but by fragments of comminuted bone. The writer has seen one such case, in which removal of an outlying portion of bone which compressed the median nerve and caused paralysis, was followed by rapid disappearance of all symptoms.

Nerve-injuries in Dislocations.—As in fractures, so in dislocations, nerves

may be torn at the time of accident, or else simply compressed by the displaced bone. They may also be torn in attempts at reduction. It is in connection with dislocations of the shoulder-joint that such troubles are most likely to occur, and not only may the nerves forming the brachial plexus be torn in the axilla, but the whole of the cords of the plexus may be torn out from their attachments to the spinal cord.

The *treatment* of such cases is often most unsatisfactory. Where the dislocation is unreduced, and the symptoms are due to the pressure of the displaced bone, much improvement generally follows on reduction; but where the nerve-trunks have been torn, the case is little likely to improve, and though an operation for suture may be undertaken, the difficulties attending it are generally very great.

Contusions of Nerves.—A severe blow on a nerve-trunk may be followed by all the symptoms which ensue on complete section; in other cases sensation may be lost while motion is retained; or the reverse may occur. The nerve itself may be either simply contused, and to the naked eye may present no abnormal appearance, or else it may be entirely crushed. The *prognosis* in these cases is necessarily most uncertain. It is not possible to ascertain accurately the condition of the nerve. In many instances rapid restoration of function ensues. In others, improvement is so slow that two or three years may elapse before the functions are entirely restored; and, in yet others, no repair ensues. The *treatment* is practically the same as that already recommended in cases of nerve-section.

Punctured Wounds of Nerves.—Punctured wounds of nerves are sometimes followed by symptoms indicating division of some fibres and irritation of others. Thus, partial anæsthesia and paralysis, with muscular wasting, may be combined with hyperæsthesia, and neuralgic pains with muscular spasm. In the early stage, the treatment consists of rest in order to allay the irritability of the damaged fibres, which are only in part divided, and are liable to be implicated in any inflammation that results from the injury. In the later stages, when the irritability has passed off, the treatment already recommended in cases of nerve-section should be adopted.

Neuritis.— Neuritis may supervene upon any injury to a nerve, but it is fortunately of rare occurrence. There is no doubt that the cut ends of all divided nerves are most usually implicated in the inflammatory process by which the wound is healed; but such inflammation is strictly limited to the injured portions, and causes no definite symptoms. The form of neuritis which is here alluded to tends to spread along the whole length of the nerve. It may be either acute or chronic. The changes common to all inflammatory processes are combined with gradual destruction of the nerve-fibres and swelling of the whole trunk.

The *symptoms* are intense pain both in the course of the inflamed nerve and also in its peripheral distribution, combined with muscular spasm, atrophy and trophic lesions. *Treatment* consists in rest, cooling applications, and leeching. In chronic neuritis, counter-irritation is most efficacious, and in obstinate cases nerve-stretching should be resorted to.

Anthony A. Bowlby.

NETTLE-RASH. *See* Urticaria.

NEURALGIA. — Neuralgia may be shortly defined as local pain without local signs of inflammation or disease.

Causes.—The causes are predisposing and exciting, but in very many cases of neuralgia no definite cause can be assigned. With regard to the first, an hereditary tendency to nervous affections—e.g. epilepsy or lunacy—is the most important. Any debilitating influences, whether mental or physical, predispose to neuralgia. The chief exciting causes are: 1. Exposure to cold. 2. Pressure or irritation of nerve-trunks. 3. Peripheral irritation. 4. Irritation or disease of the central nervous system.

1. Exposure to cold appears to act by setting up inflammatory changes around the nerve, but the exact manner in which the nerve is affected is not certainly understood.

2. Nerve-trunks may be compressed or irritated either by pressure on them, or implication of their substance by a tumour, or else by surrounding inflammation—e.g. the neuralgic pains caused by pressure of a thoracic aneurism upon the intercostal nerves is sometimes very severe. The pain is referred to the periphery of the affected nerve. The implication of nerves in the scars of cicatrising wounds affords an excellent example of pressure by inflammatory exudation. In stumps, neuromata are commonly found (*see* Neuroma), and are the source of very severe neuralgic pains. Sometimes, slight wounds of the digits or other parts are followed by extremely tender cicatrices, pressure on which at one particular spot causes intense shooting pain, due to inclusion of a small nerve-filament at this point.

3. Peripheral irritation may reflexly cause neuralgic pains in very distant parts; surgically speaking, this is one of the most important causes of neuralgia. The following may be adduced as instances of this reflex neuralgia. A stone in the kidney may cause severe neuralgia of the testis; a carious tooth may cause facial neuralgia in any of the branches of the fifth nerve; a wound in the hand may cause pain in the arm or neck; a foreign body, such as a shot, pressing on a peripheral nerve may cause neuralgic pains, which are referred to all parts of the affected limb.

4. The irritation of a tumour pressing on the brain or spinal cord may cause neuralgic pains in distant parts. Pressure on the cord or nerve-roots, in spinal caries, often results in severe pains in the chest and abdomen. Structural disease of either the brain or cord may produce similar symptoms.

Symptoms.—The one essential symptom is pain. This pain is localised more or less accurately to the area supplied by a certain nerve or nerves. It is usually described as of a darting, shooting, or plunging character, and radiates from a central point. Pressure, upon the spot where the affected nerve emerges from beneath the deep fascia or from a bony canal, intensifies the pain.

Epileptiform neuralgia is the name given to a very severe and fortunately rare form of this disease, which from its obstinacy is very liable to come under the notice of the surgeon. This most painful affection (which is well described by Trousseau in his *Clinical Medicine*) almost invariably attacks the face, and may follow the course of any one or of all of the branches of the fifth pair of nerves. There are two varieties. In the one the pain is accompanied by spasm and twitching of the facial muscles; in the other there is no such spasm. The pain is not constant but paroxysmal, and is liable to much variation. As in other forms of neuralgia, many weeks or months may elapse between the attacks, which, when they supervene, are liable to be repeated day after day for a considerable time. The patients vary in age, sex, and constitution. They may be old or young, men or women, robust or weakly.

The paroxysms of pain are usually of a most startling character, and their onset is very sudden. Their duration varies from four or five seconds to half a minute, seldom exceeding the latter limit. They may be repeated so rapidly that the intervals are scarcely appreciable, or a considerable time may elapse between the paroxysms. The paroxysm may be started by various causes, most of which act on the peripheral distribution of the fifth nerve. Quite suddenly, without a moment's warning, a draught of cold air, an attempt to swallow liquid or to masticate food, the slightest touch of the hair of the face or of the skin, an attempt at speaking, or a sudden noise may be followed by a severe pain. This, commencing at a single spot, rapidly radiates over the whole of the branch of the nerve which supplies the surrounding area, and spreads in many cases to the remainder of the face. At the onset of the paroxysm the patient frequently appears to lose all self-control. He grasps his head with both hands as though he would crush it, he clenches his teeth, clutches violently at surrounding objects, or writhes in agony on the floor. It is impossible to exaggerate the sufferings of these patients.

The precise character of the pain varies at different times and in different patients. To some it is 'like a bundle of red-hot wires being driven into the face and then twisted in all directions' (Walsham), to others of a stabbing and cutting character. Some patients describe the pain as similar to that experienced by severe crushing of a part, others say it is 'as if the flesh was being torn away.' The mucous membrane of the lips, gums, and nasal cavities is just as much the seat of pain as is the skin, and in some instances the secretions are variously altered, the nostril becoming hot and dry, or the eye becoming full of tears.

On account of the frequency with which movements of the mouth cause an attack, the patient often presents an appearance of extreme caution in his actions. When speaking, he does so with clenched teeth, and with lips scarcely parted. In eating and drinking his movements are very slow. His face is kept wrapped up to prevent the contact of any foreign body or of a sudden blast of cold air. Sometimes, under the perpetual mental strain, the patient's health gives way, for he is often almost incapacitated for sleeping or eating and drinking, and his whole thoughts are concentrated on himself. In other instances the health is maintained in a manner which is very surprising, and the general appearance of the patient, when free from pain, is often most deceptive. Occasionally, the subjects of epileptiform neuralgia seek relief from their sufferings in suicide, a termination which sufficiently emphasises the severity of the complaint.

Diagnosis.—The diagnosis of neuralgia is not difficult, but care is necessary not to

confound the pain caused by real and serious disease with a pain that is purely functional.

Treatment. — Apart from medicinal treatment, which will not be considered in the present article, the first essential is to discover and remove the cause. Thus, search should be made for any tumour or inflammatory growth forming on a nerve-trunk, for any source of peripheral irritation, and for disease of the central nervous system. Neuralgia of the fifth nerve has been completely cured by removing small fibrous growths on the gums, and by gouging away the alveolar borders of the jaw-bones, where these have been found to be unduly sensitive to pressure. In many cases, counter-irritation by means of blistering fluids, iodine, &c., produces excellent results; and in cases of neuralgia of the extremities a thorough course of 'massage' and shampooing is often most beneficial. In cases of sciatica and other neuralgic pains of the limbs, galvanism sometimes gives great relief. It should be applied for a space of ten or fifteen minutes daily, and must be persevered in for several weeks before a cure can be expected. The current need not be a very powerful one.

In addition to the removal, if possible, of the exciting cause, the operations of NEUROTOMY, NEURECTOMY, and NERVE-STRETCHING may be advantageously employed. The chief objection to the two former is that, except in the case of purely sensory nerves, the resulting paralysis from division of motor as well as sensory branches is a most serious evil, and every other method should be thoroughly tried before such an operation is undertaken on one of the nerve-trunks of the extremities. In cases of neuralgia in any part of the body, but especially in the case of such a disease affecting the branches of the fifth nerve, neurotomy almost always gives temporary relief. In some cases the relief is permanent, but in many more it is only temporary. The return of pain in any given area must not be interpreted as implying a reunion of the divided nerve, for this comparatively rarely occurs. Neuralgia is often reflex, being excited by any peripheral irritation; and where the original source of irritation has been removed, the nerve-centres may yet remain in a state of undue irritability, and may be excited by irritation of any other centripetal branch. In spite of such obstacles, the operation of neurotomy is fully justifiable in cases of obstinate neuralgia.

If neurotomy fails, the operation of neurectomy may be undertaken. The *rationale* of such a proceeding is that after excision of a portion of the nerve-trunk reunion is less likely to occur. This is certainly true, but in most cases the return of pain is not due to such repair. It is the opinion of the writer that such an operation excels neurotomy only in those cases in which the excision of a portion of the nerve involves the division of other sensory branches—e.g. in excision of the infra-orbital the branches to the teeth and palate are also cut away. In all cases of neuralgia severe and obstinate enough to call for operative interference, nerve-stretching should always be practised before either neurotomy or neurectomy, for it is often equally or even more efficacious, and in the case of the motor nerves the damage done to peripheral parts is infinitely less. Further, in those cases in which neurotomy or neurectomy are performed, it is certainly advisable to combine nerve-stretching with such a procedure, the nerve being stretched before it is cut. The operation is one of universal application in all cases of neuralgia.

The treatment of epileptiform neuralgia is most unsatisfactory and uncertain, yet good and permanent results do follow surgical interference in a certain number of cases. As in other forms of neuralgia, nerve-stretching of either the inferior dental, the supra- or infra-orbital should be tried before division of these trunks, but either neurotomy or neurectomy, or excision of Meckel's ganglion, may be practised. Each operation is generally followed by some period of relief; the pain may not return for months, and it must be borne in mind that many patients are quite willing to purchase temporary immunity at almost any cost. They will submit to operation after operation, so long as the faintest hope of benefit remains. ANTHONY A. BOWLBY.

NEUROMA.—A neuroma is a tumour of a nerve, but the structure of neuromas varies. They may be divided into (*a*) true, (*β*) false. (*a*) A true neuroma is one which is composed of nervous tissue. This tissue may either consist of nerve-fibres, medullated or non-medullated, or else of true ganglionic cells with a surrounding network of fibres. In almost all true neuromas the nerve-tubules are not continuous with those of the nerve-trunk to which they are attached, and, as a rule, are not arranged in any definite order, but form an irregular network mixed with a varying amount of loose connective tissue. The majority of the fibres are smaller than those composing

a normal nerve, and often some of them have scarcely any medullary sheath. Although the matrix in which these fibres lie is generally composed of connective tissue, it may consist of myxomatous or sarcomatous elements. Neuromas composed of nerve-fibres or of ganglionic elements are very rare; the writer has not seen such a case.

(β) A false neuroma is a tumour situated on a nerve, and not itself containing any nerve-elements. There are several varieties of false neuromas, but the most common of such tumours are fibromas. These consist almost entirely of white fibrous tissue with but few connective tissue cells. Myxomas, gliomas, and sarcomas are also met with in nerves, the latter more commonly than the former. They differ from the fibromas in the greater rapidity of their growth, in their tendency to infiltrate rather than simply to push aside the nerve-tubules among which they grow, in their greater softness and succulence, and in their cut section being pink, homogeneous, and gelatinous, instead of white, shining, and fibrous.

Neuromas, either true or false, are most common on the nerve-trunks of the extremities; they vary in size from a pin's head to an egg, but are most commonly about as big as a nut. In shape they are usually rounded or oval, smooth on the surface and firm to the touch. Neuromas, especially those composed of fibrous tissue, frequently lie between the nerve-bundles, pressing them aside and not actually involving them in their growth. But, in other cases, one or more of the nerve-bundles may pass completely through the tumours.

Another variety of neuroma is the traumatic neuroma, which is met with in stumps after amputation, or in any nerve that has been completely or partially divided. Such tumours vary in size according to that of the nerve on which they are situated; they are, roughly speaking, about twice the diameter of their nerve-trunk, and their length is about double their width. They are smooth and oval, tapering at their extremities, and directly continuous with their nerve-trunk. They are generally adherent to the surrounding tissues, and, on section, may be seen, with the naked eye, to be composed of longitudinal bundles lying in a fibrous matrix. Under the microscope, they are found to consist of a mixture of fibrous tissue and nerve-tubules. The latter are smaller in diameter than normal nerve-fibres, and appear to be either old fibres which have atrophied from pressure, or else young tubules which are not fully developed. In some cases the nerve-trunk above the neuroma is thickened and indurated to a variable length.

The 'painful subcutaneous tubercles' which are met with in the subcutaneous tissues—chiefly of the extremities—are included by some authors amongst the neuromata. The writer has examined many such tumours, but has never been able to demonstrate any connection with a nerve-filament. They are composed of fibrous tissue, and are most commonly found in women.

The *diagnosis* of neuroma depends partly on the symptoms induced by their presence, and partly on the physical characters they present when examined. The attention of the patient is first called to the tumour by pain, which varies in its character. It is felt both at the seat of growth and in the parts to which the affected nerve is distributed. It is often continuous, but is liable to sudden exacerbations. It is sometimes of a dull, aching, numbing character, but more often sharp, shooting, and of a neuralgic nature. As in true neuralgia, so in neuroma, the pain often radiates beyond the affected trunk, so that other neuromas may be suspected where none are really present. In addition to pain, the pressure on the nerve-trunk gives rise to various paræsthesiæ, and the patient complains of numbness, 'pins and needles,' tingling, and formication in the parts to which the nerve is distributed. Where the sensory nerve-fibres are completely compressed or crushed by the growth, absolute anæsthesia will ensue. This is rare. Muscular movements of a twitching character, and, occasionally, choreic or epileptiform convulsions result from irritation of motor fibres, whilst the complete compression of the same is indicated by paralysis of the muscles supplied by them.

The interference with the trophic nerve-fibres by the growth in rare instances results in the production of various so-called trophic changes. The chief of these are a smooth, glossy appearance of the skin, striation and brittleness of the nails, ulceration of peripheral parts, painless whitlows, loss of hair, increase or diminution of sweat, and wasting and loss of faradic contractility of the muscles.

On clinical examination by the surgeon, a neuroma will be found as a smooth, oval or rounded swelling, varying in size as before mentioned, and situated in the course of a nerve-trunk. It can readily be moved in a lateral direction, but is found to be scarcely, if at all, movable in the long axis

of the nerve on which it is placed. Pressure upon the tumour causes pain, both at the seat of the swelling and also in the parts supplied by the diseased nerve; the latter point is important. The pain caused by the presence of the neuroma may be allayed by pressure exercised upon the nerve-trunk, between it and the spinal cord. The diagnosis of neuroma having been made, an opinion as to its intimate structure must depend chiefly upon the rapidity of its growth; in proportion as this is rapid, the probability of the sarcomatous nature of the tumour is increased.

Finally, it may be mentioned that neuromas, both innocent and malignant, may be multiple, being found in some instances on almost all the nerve-trunks of the extremities.

Treatment.—There is but one effectual treatment for neuromas, and that is removal by the knife. The incision should be made in the long axis of the affected nerve, and the tumour carefully enucleated with as little injury to the adjacent nerve-bundle as possible, for it should be remembered that, in many cases, the neuroma may be removed without dividing the nerve-trunk. In all cases in which excision of a portion of the diseased nerve becomes necessary, this should first be forcibly stretched to a sufficient extent to allow of immediate suture of the cut ends. For, if the nerve has been resected without this precaution being taken, it may be difficult or impossible to bring the cut surfaces into apposition. In cases where so large a portion of nerve has been excised as to render suture impossible, the chances of union are rendered much more uncertain, though no case must be regarded as hopeless in this respect.

ANTHONY A. BOWLBY.

NEUROTIC FEVER. — This term, which can only be considered as quite provisional, is here employed to denote that kind of pyrexia which is sometimes seen in patients the subject of severe traumatic lesions of the central nervous system.

Etiology.—Pyrexia has been clinically observed to occur in a number of different injuries and diseases of the central nervous system; and, so varied is the list, that the nature of the lesion can have very little influence of itself, excepting by some peculiarity of the way in which it injures the brain or spinal cord, and, above all, in the frequency with which it attacks certain portions of the central nervous system. The etiology of neurotic pyrexia will therefore be the etiology of a number of affections grafted on to certain predisposing conditions, which may now be very briefly alluded to.

Such predisposing conditions are race, age, and constitutional disposition. Race has been alluded to elsewhere (*see* SURGICAL FEVER), and the influence of age is very well known, the tendency of young children to exhibit the symptoms of fever, on comparatively slight provocation, being an every-day clinical observation. No apology is here made for using the expression 'disposition,' for, none other being to hand, that will serve as well as any to indicate that in some persons the heat-producing metabolic processes are much less under control than in others, and that consequently, such individuals are, like children, subject to easily produced changes of body temperature. This same condition may be artificially brought about, in otherwise normal individuals, by the prolonged action of severe illness and physical exhaustion.

Pathology.—Although of later years considerable attention has been drawn to this subject, the experimental evidence upon it is extremely incomplete. It will make the situation clearer, perhaps, if we state at once the theory which at present obtains acceptance, and which is based on the work done up to the present time. It being well established that the heat-production of the body is brought about by the metabolic activity of the parenchymatous tissues (especially the muscles, &c.), it follows as a necessary corollary that the rise of temperature will vary in amount—(1) according to the activity of the tissue-metabolism, and (2) according to the state of the vessels on the cooling surfaces of the body. The complication introduced into the question of pyrexia, by necessary consideration of the influence of the vaso-motor system in causing loss of heat, may here be passed by, for, as a practical fact, its immediate action is only to diminish the general effect, since the heat-production is much greater than the loss by cooling. We are, therefore, brought to consider the circumstances which influence the activity of tissue-changes, or, in other words, regulate the amount of heat produced. The only one recognised until lately as being possible was movement—i.e. contraction of muscles, produced, of course, by changes induced in the contractile tissues by the action of the central nervous system. But in the large majority of cases of neurotic pyrexia there is no such active movement at all; in fact, there is usually profound and extensive paralysis. We are thus led

to believe that, in these cases, the tissues produce a relatively enormous amount of heat, because their metabolic processes are no longer controlled by the damaged nervous system. General and experimental considerations have further extended this idea, until it is now believed, by some, that there are supreme heat-controlling centres in the cortex of the mid-parietal region of the brain, from which impulses pass down to an important subordinate centre in the medulla oblongata, and thence to smaller centres in the spinal cord. Each of these is supposed to inhibit with greater or lesser effect the peripheral tissue-changes, which consequently become greatly exaggerated when the controlling or inhibitory influence is withdrawn by disease or injury.

Symptomatology.—It will be sufficient if the above pathological theory is illustrated by the commonest clinical conditions, under which neurotic fever is met with in practical surgery. The part played by the central nervous system in the instances of traumatic fever, urethral fever, &c., is alluded to under those headings, and under that of surgical fever. In all these instances the pyrexia has been found to run a fairly definite course. We are now, however, introduced to a series of cases which present no such constancy of temperature curve except at the end—namely, just before death, when the case terminates fatally, as will be subsequently explained. Such cases are concussion of the brain, compression and laceration of the brain, hæmorrhage into the brain, especially into the ventricles and into the pons, laceration of the spinal cord and, occasionally, compression of the same; injury of the cord usually producing pyrexia when the lesion is in the cervical enlargement. Other rarer conditions are—tumours of the central nervous system and so-called hysterical cases. It is obvious, at once, that the weak point in the pathological theory above referred to, and which seeks to explain those cases, is that it is put forward in the absence of knowledge concerning the pyrogenous influence of foreign substances, such as extravasated blood, &c., on the brain or on the dura mater, the sensitiveness of the latter to mechanical stimulation being excessive. We can only repeat that, when the injury occurs in the neighbourhood mentioned above as the theoretical seat of the heat-centres and their connecting fibres, pyrexia is more likely to be produced.

Course of the Pyrexia.—In a large number of cases, the first effect of the injury is to produce a subnormal depression of temperature from Shock. This is quickly followed by reaction, which is accompanied by pyrexia, termed the 'fever of reaction.' If the case terminates fatally in a few hours, the temperature commonly rises steadily but rapidly to 107°–109° F., or even higher (111°, Brodie), and often continues to rise for an hour or two after death. If, on the contrary, the case recovers without another bad symptom, the temperature simply rises to 101° to 102° F., or even less, and falls gradually to normal within twenty-four hours of its commencing to rise. Not infrequently the case, though ultimately proving fatal, lasts for several days. Under these circumstances the temperature usually rises to a comparatively low degree—viz. to 100° to 102° F.—and remains at about that point until a few hours before death, when it rapidly shoots up to 107° to 109° F., &c., which hyperpyrexia is occasionally continued after death. As hinted above, the hyperpyrexia at the end of these cases is the most striking feature of the temperature curve, and is possibly connected with the customary failure of the central nervous centres before the general systemic processes. In cases of hysterical hyperpyrexia it seems likely that we have to do with functional derangement of the calorific centres, especially such as exist in the cerebral hemispheres.

Prognosis.—Always of the worst, if the temperature rapidly rises towards hyperpyrexia. Bad, if there is profound and prolonged preliminary shock. Good, if with moderate shock the temperature soon reaches a moderate height and as soon returns to normal.

Treatment.—Hopeless, if hyperpyrexia has set in, and the cause is not removed. The ice-pack will be found to reduce the temperature one or two degrees, but it only delays the end a very little time, and the rebound after its use is greater. In cases of simple and moderate 'fever of reaction,' the ice-cap to the head, or, if necessary, iced towels on the trunk, should be applied. The obvious line of treatment, where feasible, is to attempt the removal of the cause of the pyrexia. Victor Horsley.

NEUROTOMY and NEURECTOMY.

By the term 'neurotomy' is implied division of a nerve, by 'neurectomy' excision of a portion of its length. In either case, the nerve is exposed by an incision in a line parallel to its course, dividing the various structures that lie between the nerve-trunk and the surface. As in the case of ligature of vessels, there are certain

'seats of election' for the exposure of the chief nerves, and it is at such places that the nerve-trunks can be exposed with the least amount of damage to the surrounding parts. These operations are much facilitated, in the case of the extremities, by a previous exsanguination of the limb by the use of an Esmarch's bandage; the operation being rendered bloodless, the nerve is more easily exposed and its condition more readily ascertained. After the nerve has been found, it will generally be advisable to remove the bandage before stretching (if this is necessary), for, if left on, it constricts all the tissues to such an extent, that no impression will be made by the operation upon that portion of the trunk which lies above the bandage.

The Supra-orbital Nerve.—The supra-orbital notch can always be readily felt. The nerve, after emerging from the orbit, passes directly upwards towards the scalp. It may be exposed by an incision carried through the skin, fascia, and occipito-frontalis muscle. In this case, as in that of the supra-trochlear, the usual rule of making the incision parallel to the course of the nerve may be departed from, and the skin may be incised in a line parallel with the eyebrow, the reason being that transverse scars on the forehead are less perceptible than are longitudinal ones.

The Supra-trochlear Nerve. — The pulley for the superior oblique muscle may usually be readily felt at the inner angle of the orbit; the supra-trochlear nerve emerges immediately above it, and may be reached by an incision similar to that required for exposure of the supra-orbital nerve.

The Infra-orbital Nerve. — The infra-orbital canal, from which the nerve emerges, is in a line drawn from the supra-orbital notch to the canine tooth of the same side. The nerve may be exposed by an incision in this direction; it will be found at a considerable depth from the surface. In exposing any of the above nerves there is often troublesome bleeding from their accompanying vessels, and the operation generally takes a longer time than might be anticipated.

Meckel's Ganglion.—This ganglion has been excised for the cure of epileptiform neuralgia. It is reached as follows:—A crucial incision is made in the cheek, with its centre opposite to the infra-orbital canal; bleeding having been checked, a portion of the anterior wall of the antrum is removed with a half-inch trephine. A stout bristle, a piece of quill, or a slender probe, is then passed as a guide along the infra-orbital canal, and the floor of the latter is carefully cut away from below with bone-scissors, until the posterior wall of the autrum is reached. During this part of the operation, great care must be exercised in order to avoid injury to the infra-orbital nerve. The trephine is now applied to the posterior wall of the antrum, and the bone having been removed, the ganglion will be most easily found by carefully tracing the nerve until its connection with the ganglion is reached. The latter may then be cut away with a pair of curved blunt-pointed scissors. Should there be troublesome hæmorrhage after the posterior wall of the antrum has been removed, pressure with the finger or with a pad of lint should be applied; the hæmorrhage is best avoided by taking great care not to lacerate with the trephine the soft structures posterior to the antrum.

The Inferior Dental Nerve.—Numerous operations have been practised for the exposure of this nerve. The following is the best:—The mouth being opened as widely as possible with a gag, an incision is carried along the anterior border of the ramus of the lower jaw, extending from the last upper molar to the corresponding tooth in the inferior maxilla. The mucous membrane being divided, the finger can be inserted between the internal pterygoid muscle and the ramus of the jaw. The muscle being pushed aside, the sharp spike of bone at the orifice of the inferior dental canal will then be the best guide to the nerve, which may be caught up as it enters the foramen by the backward sweep of a sharply curved aneurism-needle. Care is requisite to avoid mistaking the internal lateral ligament of the jaw for the nerve.

The Facial Nerve will be best reached by an incision extending from the lower part of the lobule of the ear forwards on to the ramus of the jaw. It quickly breaks up into its constituent branches.

The Spinal-accessory Nerve emerges from the posterior border of the sterno-mastoid, at a point a little above the middle of a line drawn from the clavicle to the mastoid process. It may be readily exposed at this point by an incision dividing the skin, platysma, and the deep fascia. Care must be taken not to mistake the superficial cervical nerve for the spinal accessory—the former curves forward round the sterno-mastoid, the latter runs in an oblique direction towards the back of the neck.

The Brachial Plexus is most easily exposed by an incision similar to that em-

ployed for the ligature of the subclavian artery—i.e. along the outer half of the clavicle. Lower down, the same nerve-trunks may be exposed by an incision carried down the middle of the axilla. Here also the *circumflex nerve* is most readily reached.

The Median Nerve may be exposed in the arm by an incision on the inner side of the biceps muscle; the nerve crosses the brachial artery in an oblique direction from without inwards. In the upper and middle part of the forearm this nerve is deeply situated, but at the wrist may readily be laid bare by an incision on the inner side of the palmaris longus tendon.

The Ulnar Nerve may easily be felt behind the internal condyle of the humerus. It may be reached in this situation by a longitudinal incision dividing the skin and fascia. In the forearm the nerve is deeply placed, but at the wrist may be reached by an incision on the outer side of the tendon of the flexor carpi ulnaris.

The Musculo-spiral Nerve is readily exposed by a longitudinal incision on the outer side of the limb, at a point midway between the external condyle of the humerus and the insertion of the deltoid. After the skin has been divided, the nerve may be easily felt to roll under the finger on the outer surface of the humerus; it should be cleared by separating the triceps from the biceps and brachialis anticus.

The Radial Nerve is easily accessible at the place where it passes from under the tendon of the supinator radii longus to the back of the wrist; here, by an incision on the posterior border of this tendon three inches above the wrist-joint, the nerve may be found, after dividing the skin and fascia covering it.

The Great Sciatic Nerve.—To define the course of the great sciatic nerve, draw a line from a point between the great trochanter and the tuberosity of the ischium, and half an inch nearer the latter than the former, to the middle of the popliteal space. The nerve may be exposed in the upper part of its course by an incision immediately below the gluteal fold, the biceps muscle being drawn inwards. If the incision be made below the middle of the thigh, the nerve will be found on the inner side of the same muscle.

The Internal Popliteal Nerve will be found, immediately beneath the deep fascia, in the middle line of the popliteal space.

The External Popliteal Nerve may be readily felt close to the inner side of the biceps tendon, covered by the skin and fascia.

The Posterior Tibial Nerve accompanies the artery of the same name down the back of the leg, its course being marked by a line drawn from the middle of the popliteal space to the hollow behind the inner ankle. In the upper part of the leg it is best exposed by an incision similar to that usually employed for ligature of its accompanying artery. At the inner ankle it will be found about a quarter of an inch behind this vessel.

The Anterior Tibial Nerve lies behind a line drawn from the front of the head of the fibula to a point midway between the two malleoli. The operation for its exposure does not differ from that for ligature of the anterior tibial artery.

The Musculo-cutaneous Nerve is easily reached by an incision just below the middle of the leg, in a line drawn from the front of the head of the fibula to the posterior border of the external malleolus. It will here be found emerging from the muscles on the outer side of the leg.

ANTHONY A. BOWLBY.

NEVILLE'S SPLINT. — Another name for ARNOLD'S SPLINT.

NIGHT-BLINDNESS. *See* NYCTALOPIA; AMBLYOPIA.

NIGRITIES. *See* CHLOASMA.

NIPPLE and AREOLA, Diseases of the.—MALFORMATIONS.—These may be congenital or acquired.—*Congenital Absence of the Nipple* (*Athelia*) is only met with in absence of the mamma. *Multiple Nipples* (*Polythelia*) are very rare, except in conjunction with multiple breasts. *Acquired Malformations.*—Complete destruction of the nipple has been met with as the result of burn. *Flattened Nipples* are not uncommon either from an error in development or from the pressure of the dress. This condition is of no importance unless the patient becomes pregnant. It may then be necessary, shortly before labour is expected, to raise the nipple by the occasional application of a small cupping-glass or a breast-pump, or by the suction of a strong infant or an adult. The parts must be bathed with warm water and gently manipulated. Violent dragging on the nipple, to 'draw the nipple-strings,' must of course be forbidden.

Fissures of the Nipple. Sore, Cracked, or Excoriated Nipple.—These occur during lactation. The *causes* are the constant moisture of the part, want of cleanliness, or the biting of the child. Thrush or

aphthæ in the child's mouth are variously asserted to be the cause and the effect of the sore nipple.

Symptoms.—The nipple swells and often assumes the form of a mushroom. It is at first red and excoriated, but not actually ulcerated. There is a slight serous or semi-purulent discharge. In the more advanced stages fissures form, radiating from the nipple into the areola. Their edges are raised and indurated, the floor is dark red and bleeds readily. Prominent granulations may project above the edges. The ulceration may extend, and even cause destruction of the nipple. The pain is excessive, the act of suckling becoming almost unbearable.

Treatment.—Sore nipples may be prevented by scrupulous cleanliness. The nipple should be frequently sponged with a concentrated solution of boracic acid, which, being tasteless, will not cause the child to refuse the breast. Brandy and water is often used for the same purpose. If a sore nipple threatens, an india-rubber shield should be used when the child is sucking. If a fissure forms the child must not be applied to the breast, but the milk must be drawn with a breast-pump. The following applications will be found useful. In the early stages, oxide of zinc and starch-powder; in the later, carbolic acid lotion (1 in 20), painted on twice a day; solid nitrate of silver occasionally to the fissure; Liq. plumbi ʒss., Sp. rect. fʒj., Aq. ad Oj., applied on lint; boracic acid ointment. In some cases painting with flexile collodion gives relief. If the condition be neglected, abscess in the areola or mammary abscess may follow.

Eczema of the Nipple.—The nipple and areola are occasionally the seat of true eczema. The parts become red and tender, small vesicles form and burst, leaving a raw surface, from which an abundant serous discharge flows, often drying into crusts. There is much itching and uneasiness. Both nipples may be affected. It is most common during suckling, but is also met with as a part of general eczema, and more rarely as a consequence of scabies. It is very difficult to cure. The following are amongst the most useful applications:—Nitrate of silver lotion (gr. ij. to fʒj.), with the occasional use of a stronger solution (gr. xx. to fʒj.); lead lotion; calamine lotion; glycerine of borax; carbonate of lead ointment; zinc ointment. The extra-pharmacopœial remedies of most service are boracic acid lotion (concentrated solution), boracic acid ointment, boro-glyceride, glycerole of the sub-acetate of lead, and glycerole of lead and vaseline ointment. Extract of belladonna, in the proportion of ʒj. to ʒj., may be added to these ointments.

So-called 'Eczema of the Nipple' as a precursor of Cancer.—Sir James Paget has called attention to a condition of the nipple closely resembling eczema, which he has observed to be followed by cancer in the gland after lasting from one to three years. The areola is in some cases intensely red, raw, and finely granular, 'like the surface in very acute diffuse eczema'; there is a copious yellowish discharge, which dries into scabs. It is accompanied by itching and burning sensations. In other cases the disease is more like psoriasis, the surface being covered with dry scales. As a rule, the morbid condition does not extend beyond the limits of the areola; occasionally, superficial ulceration takes place, ending in complete destruction of the nipple. The base of the ulcer is indurated. When cancer follows it is usually directly under the nipple, but there may be an interval of apparently healthy tissue between. The pathology of the disease has been accurately investigated by Mr. H. T. Butlin. He finds the following conditions:– Proliferation of the mucous layer of the epithelium and small-cell infiltration of the corium of the areola; dilatation of the galactopherous ducts, with proliferation of the epithelium, sometimes choking the lumen; small-cell infiltration around the diseased ducts; proliferation of the epithelium in the acini, and finally the extension of the epithelium into the surrounding structures. No treatment is of any use. Sir J. Paget considers it advisable to anticipate the development of cancer by removal of the breast, when this so-called eczema is met with in women about the age at which cancer is likely to develop, and more especially if there is a strong hereditary tendency to the disease.

Chancre of the Nipple.—Primary sores are occasionally met with in wet-nurses from the infection of syphilitic children. The mother is never affected in this way. *Mucous Tubercles* are sometimes seen on the nipple in secondary syphilis.

Abscess of the Areola is not uncommon in nursing women, especially in cases of sore or fissured nipple. There are the usual symptoms of redness, swelling, heat, and pain, followed by the formation of a small fluctuating swelling. The pus may burrow subcutaneously, but shows no tendency to extend deeply into the mamma.

Treatment.—As soon as the redness and swelling appear, the child must be removed from the breast and the milk drawn

with a breast-pump. Extract of belladonna and glycerine (equal parts) may then be painted on and hot fomentations applied. If this fails to arrest the formation of pus, the abscess must be opened, as soon as fluctuation is recognised, by a small incision radiating from the nipple.

MARCUS BECK.

NITROUS OXIDE GAS. *See* ANÆSTHETICS.

NOCTURNAL INCONTINENCE. *See* INCONTINENCE OF URINE.

NODES. *See* PERIOSTITIS; SYPHILIS.

NOMA.—A term applied by old writers to Phagedæna of the Female Genital Organs, and also to Cancrum Oris. *See* CANCRUM ORIS.

NOSE, Diseases of the.—CONGENITAL DEFORMITIES.—The external parts of the nose may be entirely absent, an aperture alone being left, owing to suppression of the nasal process of the embryonic face, together with fusion of the eyes into one in Cyclopean fœtuses. Or the nostrils may exist as a couple of cartilaginous snouts without the support of nasal bones, orbital cleft and some defect of the eye usually coexisting.

The nose may be perfect on one side and malformed on the other, of which the writer has seen an instance. In a case seen by the writer, under the care of Mr. Chauncy Puzey, a male infant had a peculiarly broad, flattened, and grooved nose, owing to imperfect apposition of the nasal bones and septum, the effect of which was a deep median furrow, on the sides and floor of which the skin was stretched continuously, making manifest the character of the defect. Operative treatment has very much reduced the deformity.

OCCLUSION of one or both nostrils may exist in front, while bony closure of the posterior nares may be found behind. As further instances of congenital deformity, a minor degree of one of the above deformities has been seen in the form of a fissure of the nostril and a narrowed fissure of the eyelids. The malformation in hare-lip, also, so far affects the nostril as to be worthy of incidental mention.

Treatment.—These defects are rare curiosities, but are sometimes susceptible of improvement by plastic operation, the plan of which in each instance will be devised by the ingenuity and common sense of the surgeon consulted.

ACQUIRED DEFORMITY.—Deformity of the nose may occur in after-life in consequence of injury or disease.

Total loss.—The nose may be cut off at a single blow, or may disappear, bones and soft parts, as the result of syphilitic necrosis and erosion. *Partial loss* may result from a less severe process of necrosis and ulceration in syphilis, or from the erosion of lupus.

Flattening of the nose may likewise result from the loss of the nasal bones by syphilitic necrosis, without affection of the external soft parts. A similar depression and flattening may follow bad fracture, without loss of the bony framework of the nose, which is here simply displaced.

Considerable lateral inclination of the nose, to even a grotesque extent, may result from fracture, or may exist without previous injury. A slight degree of deviation from the middle line is present in most people, and this is sometimes exaggerated in the case of long noses to the degree of caricature.

Treatment.—For total loss of the nose a reconstructive plastic operation may be undertaken, by dissecting an integumentary flap of suitable shape from the forehead (the Indian method) or from the upper limb of the patient. In the latter, the method of Tagliacotius, the arm is immovably attached to the head, where it has to be maintained during union of the flap. For partial reconstruction of an ala or other portion of the nose, a plastic operation on a smaller scale is effected by taking a flap from the cheek. Such procedures are only admissible after entire soundness of the tissues has followed the disappearance of all trace of ulceration and inflammation, and their results are not satisfactory. For their detailed execution, see the article on RHINOPLASTY. An artificial nose of enamelled silver, supported by a spectacle-frame, is probably more successful in restoring the natural appearance of the face. To prevent or correct the deformity that may result from fracture, see the next paragraph.

INJURIES OF THE NOSE.—*Fracture of the nose*, the result of blows or violent falls, is sometimes attended with much disfigurement, owing to ecchymosis and swelling of the integuments. Through this, however, the fracture of the nasal bones or septum may be recognised by mobility, crepitus, or alteration of shape.

The depressed or displaced state of the fractured bones is apt to be perpetuated as a deformity, owing to the rapidity with which union takes place. Depressed nasal bones should, therefore, be at once elevated under chloroform by strong forceps covered

with wash-leather, by means of which also the septum can be straightened. A splint of collodion and lint may be made to support the bridge of the nose, and it may sometimes be necessary to plug one of the nostrils.

A plan of treatment, recommended by the writer, consists in waiting a day or two until the chief tenderness has gone, fomentations or cold applications being employed in the meanwhile if apparently required, after which the systematic manipulation of the nose is frequently practised every day, beginning before the end of the first week. It does not matter how great the immediate deformity at the time of injury, so that the nose be not permitted eventually to acquire a bad shape. This daily manipulation will effect the ultimate acquisition of any shape that may be desired, even to the improvement of a nose which, before the injury, may have been ill-shaped. The greater part of this daily fingering can be done by the patient under the superintendence of the surgeon, who inspects from time to time, and makes suggestions as required.

Wounds of the nose, operative or accidental, should be closed by the neat application of sutures, when not attended by great loss of skin or excessive bruising of the cut edges. In the latter event the injury should be left to granulate, and be suitably dressed with an antiseptic ointment, supplemented by washing with warm antiseptic lotions.

Foreign bodies are introduced by children through the nostril for the amusement of passing them back and ejecting them by the mouth. Such objects as peas, beans, buttons, pencils, bits of rolled paper, cabbage-leaf, &c., serve for the experiment, which, whether self-inflicted or vicariously performed, now and then fails, and the object sticks.

The removal may be easy or difficult according to circumstances. In the event of much pain and tenderness, and restiveness on the part of the child, the difficulties may be great without an anæsthetic. For extraction forwards by the nostril, a pair of slender-beaked forceps, toothed at the end, will answer the purpose. In easy cases, ordinary dissecting-forceps may answer. Or the object may be pushed back and ejected by the mouth, care being, if possible, taken that it be not swallowed, or, what is worse, admitted into the glottis or trachea.

Blood-tumour of the septum may occur in association with fracture, and its spontaneous disappearance may usually be looked for. *Acute abscess* of the septum may follow fracture or blood-tumour. The treatment is incision in one nostril, with excision of a fragment of cartilage, at the margin of the opening thus made, to further drainage. *See* Septum Narium, Affections of the.

Diseases of the Skin of the Nose.—Persons of bibulous habits, more especially men, sometimes become the subjects of what is called 'bottle nose,' in which the nose, with or without the adjacent portions of the face, is reddened, congested, and irregularly swollen. This appearance and convivial habits are often combined; but the same appearance may now and then be found in abstemious persons (*see* Acne Rosacea).

Lipoma nasi is a peculiar enlargement of the nose, greatly resembling in shape that of some true 'bottle noses.' This affection is nothing more than a chronic inflammatory hypertrophy of the nasal integument, and is remediable by operation. The thickened masses of skin are carefully dissected off the nasal cartilage, the latter being protected by a finger kept within the nose. The greater part of the excrescence should be removed, but it is not necessary to excise every fragment of thickened skin. The resulting sore granulates up under appropriate dressing, and the thickened fragments atrophy in the process of healing. No 'cosmetic' operation is better worth the undertaking.

Little warts, pimples, or congenital dermoid tumours (moles) may be situated on the nose, but are commonly not interfered with, though their removal would often improve the appearance of their possessor. The skin of the nose may also be the seat of adenoma—a rare affection, however, in this situation.

Epithelioma may occur at the tip and orifice of the nose in old persons. The writer has seen two cases, of which one was excised successfully with the cartilage of the organ. A deformity was left, but in some cases plastic reconstruction might be done. In the other case the feeble health of the patient did not permit operation, and the disease ran its course.

Rodent ulcer is more common than epithelioma, and although usually met with in old age and middle life, it sometimes occurs at an earlier period. It usually attacks the ala at first, when, from being a scabby excoriation, it becomes a small chronic ulcer, having a circular or irregular shape, with a slight induration round the margin. Excision well beyond the margin

and floor of the ulcer should be practised. *See* CARCINOMA; ULCERS.

Lupus is a chronic inflammatory affection of the skin, occurring, as far as the nose is concerned, in youth and early adult life, mostly in the female sex. The disease presents various distinctive appearances and effects.

The nasal integument covering the cartilage, chiefly at one of the alæ, becomes scabby superficially, and covered with granulations beneath. This may exist without loss of shape, the organ simply presenting the condition of a chronic sore. A severer degree consists in a gradual erosion of the tissues, including the cartilage, beneath the superficial coating of granulations, from which serum and pus exude, drying into scabs. The term 'lupus exedens' is applied to the severest cases of deforming lupus.

The *diagnosis* is chiefly a question of age. All flabby ulcerations of the nasal skin, which do not heal spontaneously or speedily in young persons, are varieties of lupus, the recognition of which is rendered more certain if occurring in persons of an obviously strumous habit, though it often occurs without assignable cause or constitutional taint. Chronic ulcerations of inveterate character in the same situation in middle life, and not amenable to anti-syphilitic treatment, are almost sure to be rodent ulcer.

Treatment.—The early appearances of lupus, before erosion has become apparent, may be so mild and restricted as to mislead the observer into a reliance upon weak lotions and ointments, under the impression that healing is likely to be promoted. Even an occasional application of caustic substances, with temporary improvement, is apt, without perseverance, to dishearten or disgust both the patient and the practitioner. The tissues which are morbidly affected require to be removed, and this is best effected by scraping them away. A blunt knife, or a Volkmann's sharp spoon, will do this best. The same effect may be produced by rubbing the granulations into a pulp with chloride of zinc, or nitrate of silver, sulphate of copper, potassa fusa, &c.; by freely treating them with nitric acid, acid nitrate of mercury, and other strong liquids; or by burning them with the red-hot iron, Paquelin's thermo-cautery, and the like. All these methods, if thoroughly and repeatedly used, accomplish the same object, that of removing from the surface of tissues still healthy, the baneful influence of tissues hopelessly diseased and exerting a chronic contagious effect if left behind. Any general constitutional management, such as the selection of a diet suited to the existing strength and digestion of the patient, and attention to essential comfort, may be required in lupus, as an incidental part of the treatment. *See* LUPUS.

DISCHARGES FROM THE NOSE.—Nothing is more common, at all ages, than the occurrence of a watery discharge on exposure to wet or dry cold. The effect may be quite transitory if the cause be not much prolonged. Some persons are extremely sensitive, and are affected with running at the nose on slight provocation of the above nature, and liable to severe and protracted catarrh if the cause of the preliminary running be maintained. The discharge then becomes thicker from secretion of mucus, which eventually may become purulent. Much inconvenience, a certain degree of illness, and generally frontal headache, attend severe nasal catarrh, which invades the frontal sinuses as well as other extensions of the nasal mucous membrane. The disease is believed to be frequently a constitutional infection as well as a local catarrh, and its simultaneous or consecutive appearance in persons living or associating together leads to severe 'coryza' and 'influenza' being regarded as somewhat 'infectious.' Warmth and nursing are the utmost required for treatment, which is more generally omitted altogether, as most people in this climate are accustomed to perform their duties whether thus affected or not. Some believe they can cut short a cold at the very commencement by the prompt and frequent use of a snuff containing nitrate of bismuth and morphia in powder. In severe chronic catarrh, the use of the NASAL DOUCHE is most agreeable and also useful. It is preferable in the form of cold water, to which may be added a trace of common salt, chloride of zinc, borax, boracic acid, or chlorate of potash.

Chronic Coryza is a common symptom of inherited syphilis in childhood and infancy. An acrid sero-purulent discharge fills the nostrils and reddens the skin at the orifice by irritative contact. The nasal douche is here invaluable. If this local washing be not speedily effectual, the internal administration of mercury (if it has not previously been otherwise necessary) must be resorted to. The most convenient mode is in the form of grey powder, one-third or half a grain at a time, once, twice, or thrice a day. *See* RETRO-NASAL CATARRH.

OZÆNA is the name given to a more intractable nasal discharge, muco-purulent

in character, attended with much fetor, associated with syphilis, especially the inherited form, and almost always a sign of ulceration of mucous membrane and necrosis of bone in the nasal cavity. Depression of the nose and notched edges to the upper incisor teeth, when present, reveal at a glance the constitutional features of the local malady.

The nasal douche, with solution of chloride of zinc, one-eighth of a grain to the ounce, frequently and persistently used, is all-essential for treatment, and may be necessary, in the first instance, to remove the abominable smell, and otherwise facilitate the examination of the patient.

In adults suffering from tertiary syphilis, a similar condition will be found attending necrosis of the bones inside the nose, and multiple ulceration of that cavity and of the palate and mouth. Here also the nasal douche, medicated as above, is a source of daily comfort and satisfaction to the patient. But the internal administration of mercury, as grey powder, one grain at a time, given thrice, twice, or once a day, will suffice to promote sound healing, when supplemented by removal of loose pieces of necrosed bone.

Necrosis of the Bones lining the nose most commonly occurs in syphilitic persons. In adult life it is usually the tertiary degree of acquired syphilis, while in children or adolescents it is the inherited form of the disease. At first, gummatous tumours form in the submucous tissue and periosteum, chiefly of the palate, and if the disease continue untreated, the gummy tumour or tumours burst, decomposition ensues, and progressive ulceration of the soft parts, with baring of the bone and its necrosis takes place. The disease is seldom confined to the nose or mouth, but is commonly shared by both cavities.

Fetor, purulent discharge, with a sense of exposed bone on using a probe or director passed into any aperture in the mucous membrane of the palate or nostrils, will reveal the condition of things, and enable the surgeon to feel whether the bone be loose enough for detachment.

Treatment.—Introduce a pair of dressing- or sequestrum-forceps and extract any pieces of loose bone that readily move, if the mucous apertures be wide enough for the purpose. This may frequently be done simply, speedily, and with no more pain than many patients are willing to bear. In the event of great tenderness, or any difficulty in at once extracting the bone, place the patient under an anæsthetic, and enlarge such apertures as require it and seem most convenient for extraction. Be prepared, in the event of much bleeding (for it is sometimes very profuse), to employ vigorously the hot douche with a Higginson's syringe, by which means it can be quickly applied and the bleeding speedily staunched. *See* Rouge's Operation.

For after-washing, chloride of zinc in tepid water, an eighth of a grain to the ounce, or a grain to the pint, may be used. If there be other gummata arising, or persistent ulceration of the soft parts, the use of washes and lotions will not be sufficient, however assiduously employed. But a grain of grey powder in the adult, and a third or half a grain in the young, given thrice, twice, or once a day, will procure eventual healing.

Rushton Parker.

NURSING. *See* Sick-room, Management of the.

NYCTALOPIA. — Night-blindness. Often, but incorrectly, used to denote *day*-blindness (Hemeralopia). *See* Amblyopia.

NYSTAGMUS.—This name signifies an involuntary and more or less constant oscillation of the eyes. The movements are, in nearly all cases, bilateral, similar, and synchronous in the two eyes. They accompany, and do not impede or otherwise affect the normal voluntary movements. In different cases they vary much in direction, velocity, and amount, and, in the same case, they usually vary to some extent with the position of the eyes and head, and with the patient's state of mind, being increased by nervousness or excitement.

Causes and Pathology.—The oscillations of the eyes are, probably, the expression of abnormal action in the centres which preside over the ocular movements. In a large majority of cases, the affection occurs in association with some imperfection of vision dating either from birth or from very early infancy, such as congenital amblyopia without ophthalmoscopic changes, congenital defects in the discs, microphthalmos, high degrees of refractive error, albinism, congenital cataract, corneal opacities left by purulent ophthalmia in the first weeks of life, and so forth. In these cases, the disordered movements may reasonably be attributed to the absence of normal visual impressions, and the consequent want of stimulus to fixation, at the time of life when the centres for ocular movements are normally developed and trained. In the uncommon cases in which a congenital nystagmus goes with

normal or nearly normal vision, an independent defect in the development of these centres must be assumed. The affection sometimes shows a remarkable tendency to hereditary transmission; thus it was ascertained in one instance (Lloyd Owen, *Ophthalmic Review*, vol. i. p. 239) to have been present in nine individuals belonging to four generations, and to have been transmitted in such a manner that the male children of the female members of the family were the only ones affected, the females themselves being entirely exempt. Beyond a general prevalence of hypermetropia, no family ailment, nervous or otherwise, was discoverable; the nystagmus was present from birth, and persisted unaltered throughout life.

Nystagmus is met with as an acquired disease amongst *coal miners*, especially affecting those who have to work in a stooping, cramped position, or lying on the side. The cause of the affection, in these cases, is no doubt, to some extent, analogous to that already indicated. The miner works between black walls with a very feeble light; the stimulus to fixation is reduced to a minimum, while at the same time the necessity for constantly turning the eyes strongly upwards or to one side, in consequence of the position above referred to, makes an excessive demand upon the energy of the nerve-centres. Perverted action is the consequence. The effect of a stooping position, in increasing or inducing the oscillations of the eyes, is sometimes very evident on clinical examination in cases of miners' nystagmus. Lastly, nystagmus occurs, occasionally, as the result of injury to the head and in cases of disseminated sclerosis, in which conditions the disturbance in the brain-centres must be assumed to be altogether independent of ocular conditions. The commonest form of nystagmus is that in which the excursions of the eyes are horizontal, the least common that in which they are purely vertical. Oblique movements and rotatory movements around the antero-posterior axis are not uncommon. In the congenital variety, the patient is not, as a rule, troubled by any appearance of oscillation in the objects at which he looks, while in the acquired forms it is often otherwise, and the dancing of objects before the eyes may render work impossible. Although the will has usually no direct influence in causing or arresting the movements, the patient often acquires the habit of keeping his head and eyes in the particular position in which the movements are smallest; in some cases they cease entirely during strong convergence. In a few cases the head also makes continuous oscillatory movements; whether these latter are ever of a compensatory nature is doubtful.

Treatment.—In all cases of congenital nystagmus, an examination should be made as to the cause of the amblyopia which underlies it. In some, an operation for cataract will be indicated; in others, the correction of high refractive errors; while, in the absence of both these faults, blue glasses will sometimes be found to increase the acuity of vision and lessen the nystagmus. In miners' nystagmus, a total discontinuance of underground work, together with iron and strychnia, has in many cases effected a cure, partial or complete; the removal from the mine is the essential step, and a return to it, at any future time, is likely to bring about a return of the nystagmus. PRIESTLEY SMITH.

O

OBTURATOR ARTERY.—This vessel normally arises from the anterior division of the internal iliac artery, runs along the side of the pelvis, passes through the groove at the upper part of the obturator foramen, and dividing into two, embraces the fleshy origin of the obturator externus muscle. In the proportion of 1 in 5 cases, however, the vessel arises from the deep epigastric, and drops down into the pelvis to reach the obturator foramen; in this course it is in relation with the upper end of the crural canal—the crural ring. In about one-third of the number of cases met with, the artery passes in contact with the femoral vein, and hence to the outer side of the ring; in the remaining instances the artery encircles the ring. It is this latter position which renders the artery surgically important, as in it the vessel may be cut when an incision is made to relieve the constriction in femoral hernia. The former variety is called the safe, the latter the unsafe, abnormality of the vessel.

To prevent wounding the vessel, a blunt-pointed knife should be used to incise the constriction. If it should happen that the artery is wounded, one or other of the following methods may be adopted to stop the hæmorrhage:—

(1) Compress the bleeding point for five minutes between the finger and thumb.

(2) If this is insufficient, enlarge the wound slightly and tie or twist the bleeding point or points.

(3) If neither avail, pass a threaded needle around the bleeding point and tie it.

(4) If no other means avail, make an incision as for ligature of the external iliac, and reach the bleeding point by pushing aside the peritoneum. James Cantlie.

OBTURATOR HERNIA.—The rupture escapes through the obturator canal. This canal is placed at the upper and outer part of the thyroid foramen, and is directed from behind forwards and inwards. The hernia pushes in front of it the fascia covering the obturator externus muscle, and perhaps, also, a few fibres of that muscle. It appears on the surface beneath the pectineus, with which muscle its fundus is covered. The tumour is above the adductor brevis, is behind and to the inner side of the femoral vessels, is to the outer side of the tendon of the adductor longus, and to the inner side of the capsule of the hip. The neck of the sac is in the obturator canal. It would appear that the obturator artery is found with equal frequency to the inner and to the outer side of the neck of the sac. In about one-fifth of the reported cases it has been found behind it. The contents are usually small intestine, with or without some omentum. In one recorded instance a part of the bladder occupied the rupture. This form of hernia is, as a rule, met with in females of from forty to fifty years of age.

It is doubtful if the rupture, when of its ordinary size, can be diagnosed unless it be the seat of some acute change. The tumour is nearly always very small—so small that it causes but a very indistinct swelling beneath the pectineus muscle. Strangulation has frequently occurred in this hernia, and the rupture, when so circumstanced, has been reduced both by taxis and by herniotomy.

When the rupture is strangulated, there will be the usual symptoms of that condition, together with an absence of signs of strangulated hernia in any of the usual positions. Beneath the pectineus muscle there is a small, hard, tense tumour, which is the seat of some pain, is tender and dull on percussion. There is pain on moving the hip, especially when it is moved actively. Pain may be complained of along the course of the obturator nerve. It is said that the neck of the sac has been felt and recognised through the vagina.

In applying the taxis, the thigh should be flexed, adducted, and rotated a little outwards. The pressure should be applied in a direction from before backwards, with a slight inclination outwards, so as to correspond with the line of the obturator canal.

In performing herniotomy, an incision from two to three inches in length is made over the tumour, parallel to the femoral vessels, and about one inch to their inner side. The fascia lata is exposed and divided, and the pectineus muscle is laid bare in the incision. The muscle is incised vertically in the line of the original incision, and the fundus of the sac will be exposed.

The stricture will be found at the neck of the sac in the obturator canal. The director must be introduced on the inferior aspect of the neck, and the stricture divided by cutting, either directly downwards, or downwards and a little outwards.

Frederick Treves.

OBTURATORS. *See* Cleft Palate, The Mechanical Treatment of.

OCULAR MUSCLES, Affections of the.—The mechanism presiding over the movements of the eyes consists of three distinct parts: the muscles attached to the outer surface of the globe; the nerves, which convey impulses to the muscles; the brain-centres, in which the impulses originate. A clear conception of the way in which this complex mechanism acts must be gained, before the various symptoms which indicate disturbance of it can be understood. Within certain limits imposed by its attachments, each eye can be moved in all directions around an imaginary point situated about 2 mm. behind the centre of the globe. When the head is upright, and the eyes look straight forward at a distant object—i.e. when the visual axes are perpendicular to the plane of the face—the eyes are said to be in their primary position.

Muscles.—Reckoning from the primary position, the action of the individual muscles is as follows:—The internal rectus turns the eye directly inwards. The external rectus directly outwards. The superior rectus chiefly upwards, but at the same time a little inwards, causing a slight inclination of the vertical meridian of the cornea inwards

(towards the median line above). This twisting action depends on the fact that the optic foramen, from the margin of which the muscle takes origin, lies not directly behind the eyeball but a little nearer to the median line of the skull. The inferior rectus chiefly downwards, but also slightly inwards, with an inclination of the corneal meridian outwards, for the same reason as in the foregoing case. The two oblique muscles send their tendons, not from behind forwards like the recti, but rather from side to side; their chief action, therefore, is to twist the globe upon its antero-posterior axis; but as they do not lie parallel with the equator, but pass to their insertions somewhat from before backwards, they also move the eye in oblique directions intermediate between the horizontal and the vertical. Thus, the superior oblique turns the eye downwards and outwards, and inclines the vertical meridian of the cornea inwards; it acts together with the inferior rectus, and counteracts the twisting action of the latter. The inferior oblique turns the eye upwards and outwards, and inclines the vertical meridian of the cornea outwards; it acts together with the superior rectus, and counteracts the twisting action of the latter. When the eye stands in any position other than the primary, the actions of the individual muscles are somewhat modified, for the directions in which they pull are altered in relation to the chief axes of the eye. In simple upward, downward, and horizontal movements from the primary position, the vertical meridian of the cornea remains vertical, but in oblique movements it becomes slightly inclined in the direction of the movement; thus, when the eye is turned upwards and to the right, the meridian of the cornea is inclined slightly, its upper end being towards the right, and so on for other movements of like kind.

Nerves.—The ocular muscles are actuated by three pairs of nerves. The third nerve (motor oculi) supplies all except the external rectus and the superior oblique; it also supplies the levator of the lid, the sphincter of the iris, and the ciliary muscle. The sixth nerve (abducens) supplies the external rectus. The fourth nerve (trochlear) supplies the superior oblique.

Brain-centres.—In the substance of the brain, the fibres which are contained in the nerves above named undergo rearrangement and partial decussation. They are connected largely with the grey matter of the corpora quadrigemina and its vicinity, and with higher volitional centres in the cortex; the co-ordination in these centres appears to be such that all impulses issued to the ocular muscles take effect bilaterally, producing harmonious movements of the two eyes together. The necessity for such co-ordination lies in the fact that, in every normal act of vision, the object looked at is pictured on corresponding points of the two retinæ. The centres are complex as regards their anatomical relations and functions, and are not yet completely made out. The following are those of which we have the most definite physiological evidence: — (*a*) A centre in the right side of the brain, which combines fibres from the internal rectus of its own side with fibres from the external rectus of the opposite side, and thus produces movement of both eyes to the left. (*b*) A centre on the left side, which in like manner turns both eyes to the right. (*c*) A centre which actuates both internal recti, producing movements of convergence; it is closely associated with another centre, which actuates the two lower recti and turns both eyes downwards, and also with others which govern the sphincters of the iris and the ciliary muscles in both eyes, producing contraction of the pupils and accommodation. (*d*) A centre which receives fibres from the two external recti and produces movements of divergence, or rather of diminished convergence. As will be seen later, there are many forms of disturbance of ocular movements which can only be explained by reference to these compound or associated centres.

The conditions which disturb the movements of the eyes are numerous, and of very different kinds, namely:—(1) Adhesions between the globe and the eyelids, effusions and new formations in the orbit, and even faults in the shape of the eyeball itself, which in a mechanical manner oppose or limit the excursions of the eye in certain directions; (2) faults in the muscles, due to malformation, injury, or to the tissue-changes which occur as the result of excessive or deficient nerve-stimulus; (3) lesions of the nerves at various points between their origin in the brain and their distribution in the muscles; and (4) conditions which disturb the action of the brain-centres. It is evident that any single lesion or fault belonging to either of the first three classes will affect the movement of one eye only, and will throw it out of harmony with its fellow whenever the impaired movement is attempted; the commonest affections of this kind are the paralyses of the ocular nerve-trunks. On the other hand, any condition belonging to the fourth class, whether it be merely a functional overaction, as in

the squint of the hypermetrope, or a suspension of action through a paralysing lesion, as in the conjugate deviation of hemiplegia, will produce ocular symptoms which are essentially bilateral. So far as they move at all, the two eyes still move in company with each other; to all affections of this class, therefore, the term *concomitant* may be applied. Before discussing these different affections in detail, it will be convenient to speak of certain phenomena which are common to several of them.

Deviation of the Eye.—In health, the eyes are invariably so directed that the object looked at is pictured on the yellow spot in each retina. If either eye is directed otherwise, it is said to deviate or squint; it has a strabismus. The commonest forms of strabismus are those in which the optic axes converge too much, or diverge, and the name is applied especially to the concomitant varieties—to those, namely, which are produced by excessive or defective action of the centres for convergence and divergence, rather than to deviations due to paralysing lesions of nerve-trunks; but it applies strictly to the latter also. A less common form of deviation is that in which both eyes are turned involuntarily towards one or other side, in consequence of a loss of equilibrium in the centres which preside over conjugate movements. *See* Strabismus.

Diplopia or Double Vision.—Under certain exceptional conditions, objects are seen double by one eye used alone (monocular diplopia, polyopia); here the fault lies in the refraction of the eye, not in its position. Such cases have no connection with our present subject. In binocular diplopia the two images belong to the two eyes respectively, and when one eye is covered one image disappears.

Double vision indicates a deviation of one or other eye. The image seen in the wrong position belongs to the deviating eye, and is termed the false image; it is usually fainter than the true image because it is formed, not at the yellow spot, but at a less sensitive part of the retina; hence, also, the greater the deviation of the eye, and the greater the consequent displacement of the false image, the fainter does this image become. On this account, the confusion and giddiness produced by double vision are usually greater when the deviation of the eye is slight and the images near together, than when they are widely separated; in the latter case, and, indeed, in most cases of long-standing deviation, the false image is suppressed, the mind taking no cognisance of the second and erroneous impression. The relative positions of the two images give valuable and very precise indications as to which is the deviating eye, and as to the direction and amount of the deviation. The following rule holds good in all cases:—*The false image and the cornea are displaced in opposite directions.* The reason of this will appear from the following considerations.

We judge of the position of objects from the position of their pictures in our eyes; but, in order that the judgment shall be true, we require to know the position of our eyes. Of this latter we are informed by the muscular sense—in other words, by the amount of the impulse issued by the brain-centres to the muscles. Now if, from any cause whatever, either eye fail to respond correctly to the impulse issued by the brain, we misjudge its position, and, as a consequence, we misjudge the positions of objects pictured on its retina; we project the retinal images as though the eye stood in its right position. For example, supposing the right eye to deviate to the right, while the left eye, obeying the impulse of the will, looks straight forwards at an object directly in front of it. As the cornea of the deviating eye moves outwards, the retina of course moves inwards, so that in this eye the object is pictured on the outer half of the retina instead of at the yellow spot. But if the eye were in its right position, this part of the retina would correspond in direction with objects lying to the patient's left, hence, with this eye, which deviates to the right, he sees things displaced to the left. If, therefore, in any case of doubtful nature, we can ascertain what is the position of the false image in relation to the true image, we shall know what is the direction of the deviation of the corresponding eye. Thus, if the images are crossed in regard to their respective eyes, we know that the deviation is of the opposite kind—namely, one of divergence; if the images are homonymous (each standing to the side corresponding to its own eye), we know that the axes of the eyes are crossed; if the image, instead of standing vertical, appears inclined to either side, we know that the vertical meridian of the corresponding eye is inclined in precisely the opposite direction.

In studying the positions of the double images, we cause the patient to look steadfastly at an object, such as a slip of white paper or a lighted candle, with both eyes open; then, covering each eye alternately,

and telling him to keep looking at the object with the other, we ascertain which eye was properly directed and which was deviating. By causing him to follow the object with his eyes in different directions, we learn in which direction the images separate most widely, and in which they come nearest together; and thereby ascertain in which particular movement the error is greatest, and which muscle is at fault. If the distance between the two images is constant in all positions of the eyes, we know that the affection is of the concomitant form and is not due to a fault in any individual muscle or nerve. A coloured glass placed in the trial spectacle frame before one or other eye, so as to colour the corresponding image, makes the examination easier; it should be placed by preference before the eye which looks straight at the object, for the image seen by the deviating eye is already somewhat the fainter of the two, and, if its intensity be still further lowered by the interposition of the coloured glass, it may probably be altogether overlooked.

Diplopia may be produced in a person with healthy eyes by means of a prism. Rays of light passing through a prism are deflected from their course; hence a prism held before the eye displaces the image of the object looked at on to a part of the retina other than that on which it would naturally fall, and hence double vision. Conversely, diplopia may be corrected by a prism so placed as to counteract the displacement of the image due to the deviation of the eye. A prism deflects rays towards the side corresponding with its own base, and since the actual displacement of the retinal picture in a deviating eye is the opposite of the apparent displacement of the false image in space, the correcting prism must be placed with its base towards the same side as the false image; or, to put the matter simply, let the thick edge of the prism be over the weak muscle. The strength of the prism which corrects the diplopia serves as a measure of the deviation of the eye.

Diseases and Injuries of the Ocular Muscles.— These, as distinguished from paralyses due to nerve-lesions, are not common. In rare instances, one or more of the muscles may be congenitally wanting; in others, abnormal adhesions of the muscle among themselves have been noted; clinically, an accurate diagnosis of such conditions is not possible. Perforating wounds, near to the eyeball, may damage one or other of the muscles so as to permanently impair or annihilate its action; an improperly performed operation of tenotomy for squint may do the same. The deviations thus produced may frequently be remedied by surgical readjustment of the damaged tendon. *See* Strabismus. Occasionally, by violent injury with a hook or similar object, a muscle is torn away from its posterior attachment, as in a case, seen by the writer, in which a young man jumping over a table came in collision with a gas-burner, which tore the upper eyelid and the ocular conjunctiva, and dragged out the greater part of the internal rectus. Morbid contracture of a muscle occurs as a result of prolonged excessive effort, as in the strabismus of hypermetropia, and loss of tone in the antagonistic muscle, as in paralytic strabismus.

Paralysis of the Ocular Muscles.— *Causes and Pathology.*—In a large majority of cases, these paralyses correspond with the distributions of the third, fourth, and sixth nerves. In order of frequency, paralysis of the group of muscles supplied by the third nerve probably stands first; next, and nearly as frequent, paralysis of the external rectus (sixth nerve); lastly, and considerably less frequent, paralysis of the superior oblique (fourth nerve). Isolated paralysis of one of the muscles supplied by the third nerve is comparatively rare; it indicates lesion in a separate branch of the nerve, or in the muscle itself. Syphilis, rheumatism or chill, and injury are the commonest causes of these paralyses. It is chiefly in the later stages of acquired *syphilis*, much less commonly in the hereditary disease, that they, and especially the third-nerve paralysis, are met with. The lesion may be within the skull, in the sphenoidal fissure, or in the orbital portion of the nerve. Whether it is most commonly of the nature of a gumma, a meningitis, a periostitis, or an inflammation of the connective tissue of the nerve itself, is uncertain. As in the following form, chill to the surface is not infrequently concerned in lighting up the mischief. *Rheumatism* in its acute febrile form is rarely associated with ocular paralysis, but the rheumatism, so-called, which occurs locally, as the result of cold or damp to the surface, is very frequently so. *Gout* must certainly be included as a predisposing cause, for it is especially in those who are immoderate eaters and drinkers, and who show signs of lithiasis, that exposure to cold acts in this way. *Diphtheria* is frequently followed by paralysis of the ciliary muscles (loss of accommodation), less often by paralysis of the external muscles of the eye. *Injuries*

of the skull, especially such as involve fracture of the base, extravasation of blood, meningitis, tumour, abscess, aneurism of the basilar arteries—in short, all changes within the skull which, by pressure or otherwise, can interfere with the nerves at the base of the brain, may paralyse the ocular muscles. Lesions of the nerve-fibres in the substance of the brain are likely to cause paralysis of bilateral form, rather than such as can be referred to one or other of the nerve-trunks. Transient paralyses of the ocular muscles are frequent during the earlier stages of *locomotor ataxy*; the nature of the lesion is uncertain; it is not in direct connection with the changes in the spinal cord.

Symptoms and Diagnosis.—Paralysis of an ocular muscle reveals itself by symptoms which are definite, and can be studied with precision. Movements requiring the action of the paralysed muscle are impaired or lost. We tell the patient to follow the movement of a finger passed in different directions before him, his head being kept in a fixed position, and we notice that while one eye moves to the usual extent upwards, downwards, and to each side, the other is unable to accompany it in a certain direction. Covering the unaffected eye, we then bid the patient do his utmost to follow the finger in this direction, and we find that there is a point beyond which his strongest effort fails to move the eye. The precise position of this point depends upon the completeness or incompleteness of the paralysis, and upon whether movement in the said direction depends solely upon the muscle which is paralysed, or is aided by others.

The eye deviates away from the paralysed muscle. The unaffected eye being in the primary position—that is, looking straight forward at a distant object—the affected eye, although no special effort is demanded of the paralysed muscle, deviates somewhat in the direction of the opponent muscle, the tonic contraction of the latter overbalancing the weakened tonicity of its antagonist. The deviation of the affected eye is called the 'primary deviation.' It increases when the patient looks in the direction which demands the action of the paralysed muscle, and decreases when he looks in the opposite direction. It is increased, in cases of long duration, by an actual shortening of the opponent muscle. Again, telling the patient to look at the distant object as before, we bring a hand or a piece of paper in front of the sound eye. By a strong effort, the patient then brings the affected eye to bear upon the object, and at the same moment the sound eye, moving in the same direction behind the paper, takes up the deviation. This deviation of the sound eye, when the affected eye fixes, is called the 'secondary deviation;' it is greater than the primary deviation, for the brain-centre takes no cognisance of the nerve-lesion, and issues an equal impulse to the two sides as in health. Under this impulse the normally innervated muscle acts vigorously, while the paralysed muscle acts feebly.

With both eyes open the patient sees double. This is true, of course, only when the patient actually sees with both eyes; any defect in the visual power of the deviating eye promotes the suppression of the false image. If it should happen that the deviating eye has decidedly the better vision of the two, the patient will contrive by a compensatory position of the head to bring this eye to bear upon the object at which he desires to look; and if the affected muscle be only partly paralysed, a strong impulse will be issued to this muscle, and consequently a secondary magnified deviation of the fellow-eye will be induced, and we shall have the phenomenon of a patient looking straight with a paralysed eye and squinting with a non-paralysed eye. As a diagnostic symptom, *double vision* is of value only when the nature, or the existence, of a deviation would otherwise be uncertain. In paralysis of the fourth nerve, for example, it enables us at once to make a diagnosis, which would otherwise be hardly possible. It also enables us to measure the amount of a deviation, and to accurately judge of its progress towards recovery. The laws which it follows have already been explained. See *Diplopia.* In cases of very slight deviation of the eye, there may be only a confusion or unsteadiness of sight due to an overlapping of the two images, rather than a true diplopia; or diplopia may be elicited only by causing the patient to turn his eyes strongly in the particular direction in which the weakened muscle acts. In many cases the complaint made is rather of giddiness than of double vision, and this is attributable to the patient's inability to estimate, with certainty, his position in relation to surrounding objects, and especially in relation to the plane of the ground on which he walks.

To avoid the double vision and the giddiness which goes with it, the patient frequently keeps his head turned in a direction which neutralises the deviation of the eye. Thus, if the right eye deviate towards

the right, he will turn his face round towards the left, so that, in looking before him, he may turn the left eye also towards the right, and thus restore parallelism between the two. Or he will adopt the simple expedient of keeping one eye closed; the closed eye will, in most cases, prove to be the paralysed eye, but should this latter have the better vision of the two, its services may be retained, while the other is excluded for the sake of avoiding double vision. Ocular paralyses often declare themselves to the observer, at first glance, by these peculiar positions of the head. The distinctive symptoms of the several varieties of paralysis of the ocular muscles may now be stated briefly; they will be understood by reference to the distribution of the nerves and the general symptomatology already given.

Third-nerve Paralysis. — Ptosis, drooping, or complete falling of the upper eyelid; loss of the inward, upward, and downward movements of the eyeball, discoverable on raising the lid and bidding the patient to follow the movements of a finger in various directions. Deviation of the eye outwards, through unopposed action of the external rectus, the deviation being neutralised when the sound eye looks towards the paralysed eye, increased when it looks away from it; also a slight deviation downwards, through unopposed action of the superior oblique. Double vision, when the lid is raised, the images being crossed—i.e. the image belonging to the right eye standing to the left, and *vice versâ*; dilatation of the pupil; loss of accommodation. When downward movement is attempted, a slight twisting on the antero-posterior axis, with some movement downwards and outwards, may be observed, from the action of the superior oblique. The false image stands higher or lower than the true image, according as the sound eye is directed upwards or downwards respectively. Its upper end is inclined somewhat away from the sound eye, through the superior oblique having lost its antagonist. Incomplete forms of third-nerve paralysis are frequently met with. Occasionally, one or other of the muscles is affected alone. Isolated paralysis of the inferior oblique is very rare, but well-marked cases have been observed; the symptoms are the counterpart of those of paralysis of the superior oblique.

Sixth-nerve Paralysis.—Loss of movement outwards beyond the middle line; deviation of the eye inwards, through unopposed action of the internal rectus—i.e. convergent strabismus, increased by efforts to look towards the paralysed side, decreased by looking in the opposite direction. Homonymous diplopia—i.e. image of right eye standing to the right, image of left eye to the left, or the diplopia is avoided by a compensatory turning of the head towards the paralysed side, or by keeping one eye closed or covered. When the eyes are directed horizontally, the false image is erect, and on the same level as the true image; but, in looking upwards, it stands a little lower than the true image, and in looking downwards it stands higher. These changes are probably due to the actions of the oblique muscles being somewhat modified, as compared with those of the fellow eye, by the deviation inwards.

Fourth-nerve Paralysis.— Defect of mobility hardly to be discovered, even on close inspection; but the diagnosis made easily from the diplopia. Double vision occurs only on looking below the horizontal line, for only in this direction does the muscle normally come into action. The false image is lower than the true, and inclined towards it; the images are homonymous, each opposite to its own eye. The displacement of the false image increases as the eyes are directed more downwards and towards the affected side. Near to the horizontal line the false image overlaps the true; above the horizontal line vision is undisturbed.

Two or more of the foregoing forms of paralysis may occur together, from lesions involving several nerve-trunks, and they may occur bilaterally from lesions which damage the nerve-trunks of both sides. Bilateral affections, however, are in many cases due to disturbance in a centre common to fibres passing to both sides. The latter diagnosis is indicated when the movements of the eyes are found to be concomitant—i.e. when the two eyes move with equal excursions. An exception to this rule presents itself sometimes in the late stage of a peripheral paralysis, when, though the actual paralysis has entirely disappeared, the eye still deviates through shortening of the antagonist muscle; under these circumstances, since the conductivity of the nerves is equal on the two sides, the movements are strictly concomitant.

Treatment.—In presence of certain of the causes enumerated above, treatment directed especially to the ocular paralysis would obviously be out of place. Uncomplicated paralyses of single nerve-trunks, such as occur from chill, usually tend to spontaneous recovery. Iodide of potassium in moderate doses should, however, be given

in all such cases, whether syphilis be definitely concerned in them or not. Mercury may sometimes be desirable as well. With a view to preventing recurrence, the habits of life and constitutional state, especially with regard to lithiasis, should be attended to. The temple of the affected side should be protected from cold by a silk handkerchief tied round the head. In the early stages, a shade should be placed over the affected eye to remove the diplopia; later, when movement is returning, the weak muscle should be exercised each day by attempts at the movement in question, while the good eye is covered. The recovery of single vision may sometimes be promoted by the use of a prism, which partly corrects the deviation. Electricity effects an immediate and marked improvement in some cases, and, though the immediate result is usually transient, a systematic repetition of the remedy may aid recovery. Galvanism (primary continuous current) is probably more useful than faradism (induced current), because its action is more penetrating, but the latter also gives positive results. Armed with moist sponges, the anode is applied to the neck in the neighbourhood of the mastoid process, the cathode over the closed eyelids. The sitting should not last more than two or three minutes, and should be repeated daily or on alternate days. The strength of the current must be such as not to cause pain, care being especially necessary in the case of the continuous current. Operative treatment is only justifiable when all improvement has been at a standstill for some months; then, if the paralysed muscle have recovered some power, but deviation persists in consequence of shortening of the antagonist, tenotomy of the latter, and sometimes advancement of the former, may be performed with advantage. These operations are described in connection with Strabismus.

Concomitant Affections.—This group includes the common convergent strabismus of hypermetropia, the divergent strabismus of myopia, conjugate deviations, ophthalmoplegia externa, nystagmus, and some other varieties of motor disturbance depending on excessive or defective action of the brain-centres. The common characteristic is that there is a similar fault of movement in both eyes, the disturbing cause taking effect either in the centres which govern bilateral movements, or at any rate so high up in the nerve-mechanism as to involve fibres belonging to both sides. It will be convenient to speak here of the paralytic conditions, as they are allied with the diseases described in the foregoing paragraph. *See* Strabismus.

Conjugate Paralysis.—Both eyes deviate to one side and cannot be turned towards the opposite side. The causes of this affection are the same as those of other central paralyses. It is generally but not always associated with hemiplegia. If the eyes are turned to the right, the lesion is situated in the right side of the brain and involves the centre which normally turns both eyes towards the left. The deviation is due to the unopposed tonic contraction of the corresponding centre in the left side. Conjugate deviation to the right, therefore, goes with left hemiplegia; the patient cannot look to his paralysed side. It is the motor analogue of the sensory symptom, hemiopia, in which a lesion of the right side of the brain blinds the right half of each retina, and the patient cannot see to his paralysed side (Hughlings Jackson). The right halves of the two retinæ in conjunction constitute the visual organ for the left side; hence a lesion on the right side of the brain, whether it cause hemiplegia, conjugate deviation of the eyes, or hemiopia, tells in its results always in the same direction. Although the two recti which are concerned in this paralysis are totally inactive for conjugate movements, they may remain active for convergent and divergent movements; thus, in a case observed by the writer (*R. L. Ophth. Hosp. Reports*, vol. viii. p. 185), neither eye could to the smallest extent follow the movement of an object moved laterally before the patient's face, but both eyes performed movements of convergence when the object was moved from a farther to a nearer point, in line with the oblique direction of the eyes. Conjugate paralysis may rapidly disappear, or it may be of long duration. In several cases observed by the writer, the recovery of movement has been unsymmetrical on the two sides, the eye turned outwards returning to its normal position sooner than the eye turned inwards, so that a convergent squint resulted.

Paralysis of Convergence.—The power of converging the eyes is lost, and there is a fixed divergence, which the strongest effort on the part of the patient is unable to diminish. The fixity of the divergence distinguishes the disorder from ordinary divergent strabismus, such as occurs in myopia and after an excessive tenotomy, for, in the latter, the divergence diminishes during efforts of accommodation for a near object. Yet there is no true paralysis of the internal

recti, for conjugate movements to either side are performed with ease. This eliminates the possibility of lesion of nerve-trunks, and indicates a lesion in the centre for convergence or of strands connected therewith.

Paralysis of Divergence.—This is a counterpart of the foregoing. The eyes maintain a fixed convergence, which does not diminish on looking at a distant object, and which is thereby distinguished from the ordinary convergent strabismus of hypermetropia; yet the external recti are not paralysed, for conjugate movements to either side are performed freely. These conditions are rare. In a case of each form observed by the writer (*op. cit.* vol. ix. pp. 22, 428), the paralysis involved not only the movements of convergence and divergence respectively, but also those movements which, as before stated, appear to be anatomically associated with these. In the one case, there was total loss of convergence, downward movement, accommodation, and contraction of the pupils in both eyes; in the other, there was total loss of divergence and upward movement in both.

Ophthalmoplegia externa is a term used to indicate loss, partial or complete, of all movements in both eyes. It implies a central lesion of a more extensive kind than those which cause the paralyses of particular movements above described. It represents the simultaneous occurrence of all these forms. Accommodation and contractility of the pupils may, however, remain intact.

Nystagmus. *See* NYSTAGMUS.

Spasm.—It is probable that each form of bilateral deviation, described above, may occur from spasmodic action as well as from paralysing lesion. Over-action of the convergent centre, associated with accommodative spasm, occurs in some cases of hysterical paroxysm. It is the cause also of some cases of concomitant strabismus, in young children who are not hypermetropic. The commonest form of deviation from over-action of this centre is that which results from hypermetropia. *See* STRABISMUS.

PRIESTLEY SMITH.

ODONTOMA, or TOOTH TUMOUR, is the name originally given by Broca to the group of cases in which the tumour consists of tooth-elements more or less hypertrophied. The majority of these are outgrowths from the pulp of well-formed teeth, or at least have their connection with the teeth well marked, and are, therefore, of interest, principally, to those engaged in dental surgery.

There is one form of odontoma, however, which is strictly surgical, since it is apt to give rise to serious mistakes in the diagnosis and treatment of one form of tumour of the jaw. This depends upon some modification of the germs of one or more of the molar teeth of the lower jaw, before the development of the cap of dentine, which leads to the formation of an irregular mass of dental tissues, in no way resembling a tooth in shape. These cases are very rare, and occur only in the lower jaw. The symptoms are those of a dense tumour expanding the bone, in which there is no pain, unless the mass should interfere with the development of the wisdom-tooth, or be mistaken for a misplaced tooth or a sequestrum, when acute inflammation may be excited in the jaw itself by ineffectual attempts at removal. Very eminent surgeons have been misled by these cases, and have unnecessarily sacrificed portions of the lower jaw, when, as experience has shown, enucleation of the growth could invariably have been undertaken with success. The writer recently had a case of the kind under his care, in which persistent efforts to remove what was supposed to be an impacted tooth had given rise to so much inflammation about the jaw and gums that, when the writer was first consulted, he believed the patient to be suffering from a rapidly growing tumour of the interior of the jaw, and recommended removal of a portion of the bone. Fortunately, on the subsidence of the inflammation, the case more resembled one of necrosis, and on attempting to search for and remove a sequestrum, an odontoma measuring 1¼ by 1½ inch, and weighing 315 grains, was readily enucleated. This consisted of dental tissues irregularly arranged, and represented one or two molar teeth.

Displacement of otherwise healthy and well-formed teeth may give rise to enlargement of either jaw, and even supernumerary teeth have been known to form distinct tumours connected with the maxillary bones. Such cases must necessarily be very difficult of diagnosis, and are best treated by exploration before any serious mutilation is undertaken.

CHRISTOPHER HEATH.

ŒDEMA is the result of undue exudation of *serum* or *liquor sanguinis* into the interstices of connective-tissue and lymphatic vessels. There are several possible factors, one or more of which may be involved in a given case. Foremost, on account of its frequency and extent, is

increased pressure in the capillaries. This, in turn, may be the consequence simply of venous obstruction, as when a vein is ligatured, varicosed, occluded by a clot, or pressed upon by a tumour or aneurism. Or, the feeding arteries may be flooded from paralysis of the vaso-motor nerves, a condition occasionally seen when the lower extremities are œdematous in fracture of the spine, even in the absence of renal or heart disease, or any extrinsic cause of obstruction to the flow of blood. Another illustration of this variety of œdema is afforded by the rapid but transient swelling which follows sharp irritation of the skin. Cardiac feebleness, again, may be so marked that the inertia of the column of blood in the veins is with difficulty overcome. The back-pressure on the capillaries, even if it does not lead to stagnation therein, is sufficient to account for very considerable exudation of serum. Familiar examples of this are afforded by the œdema of the legs in persons convalescent from the acute fevers, or weakened by some constitutional malady like cancer, or reduced by protracted pyrexia, as in phthisis. 'Œdematous erysipelas' of old people, the subjects of feeble circulation, is another instance in point, and, inasmuch as one cause of the œdema is abiding, there is permanent enlargement of the part, which becomes more solid with the lapse of time.

Now, since the pressure in the *lymphatics* reciprocates that in the blood-vascular capillaries, it will easily be seen that blocking of the former may, of itself, entail obvious transudation of fluid into the areolar spaces. *Elephantiasis*, as met with in Orientals, is largely due to distension of the lymphatics, which are infested with the parasite *filaria sanguinis hominis*. Again, there are grounds for the belief that coagulation of lymph in its accustomed channels forms part of the pathology of *phlegmasia alba dolens*. On the other hand, when the hindrance to the venous circulation is great, the surrounding lymphatics are dilated. Amussat found this a frequent occurrence in varices.

Nor must the state of nutrition of the blood-vessels be ignored. The capillaries are subject, with the other tissues, to fatty atrophy from disease, whether it be from palsy of the limbs or from forced rest, as in fractures. Sustained high temperature causes a similar change, and this is another explanation of the œdema met with after the specific fevers and other acute febrile disorders. In albuminoid disease, the alteration in structure of the coats of the small arteries facilitates the transudation of serum.

The composition of the blood must have some influence on the exosmosis, for it is well known that the rate of dialysis varies directly with the amount of crystalloid ele ments contained in a given fluid.

In certain cases, œdema appears to be to some extent compensatory to the removal of the normal constituents of the tissues; thus, it is not rare to find adipose tissue infiltrated with serum coincidentally with the absorption of fat from the cells, in wasting diseases like phthisis.

It should be borne in mind that a general tendency to dropsy causes the swelling associated with a local inflammation to appear out of all proportion to the intensity of the irritation—e.g. extensive œdema at the site of an eczematous patch at once raises the presumption of albuminuria, which may not have been previously suspected either by the surgeon or patient.

Varieties of Œdema.—It is customary to divide ordinary cases of œdema into two groups—(1) *simple or serous*, and (2) *inflammatory or plastic*. The former occurs in renal and cardiac disease, and in many forms of local obstruction to the circulation. Simple serum differs from inflammatory fluids in that it contains no fibrinogen, for it does not coagulate spontaneously on exposure, nor on the addition of red blood-corpuscles. It is highly albuminous. Tissues infiltrated with serum pit deeply on pressure. They are paler than natural, and look glistening and jelly-like. On section or puncture the fluid rapidly escapes, being expressed by the elasticity of the connective-tissue fibres between which it is contained.

Inflammatory œdema, or the 'hydrops fibrinosus' of Vogel, varies within very wide limits both as to its extent and solidity. The looser the texture of the tissue infiltrated the more marked is the swelling. It is quite phenomenal in the scrotum, where it occurs from local causes—wounds, extravasation of urine, &c.—and as a sequel of scarlet fever and smallpox (Erichsen).

Acute œdematous laryngitis, especially when it follows perichondritis, is of grave clinical significance, owing to the rapidity of the exudation and the encroachment of the swelling on a vital part of the economy. Chemosis of the conjunctiva is another example of sudden development of œdema.

The fluid may be so highly fibrinous as to coagulate quickly and firmly. This is one form of 'solid œdema.' On the contrary, it may remain in the liquid state two

or three days in a limb that has been amputated for cellulitis.

Renal and cardiac disease diminish the tendency to coagulation by lessening the amount of fibrinogenetic substances in the fluid, which is then in fact a mixture of serous and plastic effusion. This combination is not uncommonly met with in the lungs of patients who have succumbed to renal disease. The lung-texture is lacerable from the pneumonic change, and loaded with serosity from the 'serous apoplexy.' It may here be noted that simple serous effusion, within the ventricles of the brain and beneath the arachnoid membrane, presents a somewhat cloudy appearance, which is commonly mistaken for evidence of meningitis. On dissection, however, it is found that the pia mater can be readily stripped from the cerebral substance, and the convolutions separated without tearing.

Œdema, both simple and inflammatory, is seen in connection with fractures of the bones, where it is due partly to the rupture of vessels and the pressure of blood-clot, and partly to exudation the result of injury to the tissues. It may be considerably increased by the injudicious application of bandages and splints, when the tension on the capillaries may become so great as to lead to sloughing of the soft tissues.

Malignant anthrax œdema.—In some cases of anthrax or charbon, where the typical 'pustule' is absent, there is firm gelatinous œdema, especially about the eyelids; and in another manifestation of the disease, called *internal anthrax*, there is commonly brawny œdema of the cellular tissue of the neck.

Myxœdema. — The chief anatomical change in this affection is a conversion of the gelatin and chondrin of the connective-tissue—particularly of the hands, feet, and face—into mucin, a reversion as it were to the embryonic condition. The skin looks swollen and has a waxen appearance. There is little or no pitting on pressure unless the kidneys are diseased, when ordinary serous œdema may be added to the more special features of the case.

Duration of Œdema.—Œdema may be so transient as to last only a few minutes, as when a wheal is produced by flagellation. Or it may be long abiding from (*a*) continuation of the cause—e.g. varicosity of the veins of the leg and cachectic states of the body; (*b*) permanent occlusion of blood-vessels and lymphatics—this is sometimes seen in 'white leg'; (*c*) coagulation and subsequent organisation of the inflammatory effusion.

The *density* of the swelling varies as the amount and coagulability of the fluid effused and the time it remains unabsorbed. The higher grades are designated '*solid œdema*,' for there is little pitting on pressure, and change of position has very slight effect upon it.

Treatment.—The chief indication is to remove all causes that impede the circulation. In the varicose œdema of the legs, pressure by means of an elastic bandage evenly and continuously applied is the method to be adopted.

In most cases, considerable aid may be obtained by elevating the limb sufficiently to allow of the ready return of blood from the veins, without materially increasing the resistance in the arteries. This plan is especially applicable to fractures of the leg, where pressure cannot be safely employed.

In long-standing cases—e.g. those due to wide-spread thrombosis of the veins—massage, with after-pressure, will help in the absorption of the exudation. This plan is excellent if systematically carried out.

In acute inflammatory œdema, where there is danger of sloughing, free incisions should be made; and where this is not practicable, as in the throat, the part should be scarified.

Serous œdema from renal or cardiac disease, which cannot be overcome by posture and the administration of drugs, may be relieved by a number of fine punctures made in the skin with a darning-needle, or Southey's tubes may be inserted.

AUGUSTUS J. PEPPER.

ŒSOPHAGOTOMY is required for the removal of foreign bodies impacted in the upper part of the œsophagus, when all other methods of extraction have failed. It has been also performed to facilitate internal division of a stricture of the œsophagus.

The patient should be placed upon his back with the head and shoulders slightly raised, and an anæsthetic should be given. The face should be turned to the side opposite to that on which the incision is made. This should be the left side, unless there is a decided projection, caused by the foreign body, to be felt upon the right side.

An incision, three to four inches long, should now be made through the integuments along the anterior border of the left sterno-mastoid, with its centre corresponding to the position of the foreign body. The skin, superficial fascia, platysma myoides, and deep fascia will be thus divided; the sterno-mastoid will be exposed, and it should be drawn outwards by a retractor.

The carotid sheath now comes into view, with the descendens noni nerve lying upon it, and the omo-hyoid muscle crossing it. The sheath should be carefully separated by a blunt director or the finger from the trachea, the thyroid body, and the larynx, with the depressors of the hyoid bone which cover them. The omo-hyoid muscle should be drawn outwards, or, if it is found to be in the way, it may be divided. Care should be taken to avoid wounding the superior and inferior thyroid arteries, and the recurrent laryngeal nerve, which lies in the groove between the trachea and the œsophagus. The superior and middle thyroid veins may have to be ligatured and divided.

When the carotid sheath and its contents, together with the sterno-mastoid and the omo-hyoid, have been drawn outwards by a large blunt retractor, and the trachea with the overlying structures has been drawn to the opposite side in a similar manner, the œsophagus and lower part of the pharynx will come into view. If the impaction be low down, it may be also necessary to divide a few of the outer fibres of the sterno-hyoid and sterno-thyroid muscles. A long-handled curved forceps should now be introduced through the mouth, and when it has reached the foreign body the blades should be expanded, so as to indicate clearly the part of the œsophagus which has to be incised. A longitudinal incision should now be made in the œsophageal walls, of a size determined by that of the foreign body. If it should be found to be too small, it may afterwards be enlarged upwards or downwards, as may be most convenient. All vessels that bleed should at once be tied, firstly, in order that the parts may not be obscured by blood, and secondly, to prevent the cellulitis which might follow the decomposition of blood extravasated through the tissues. As soon as the opening has been made, the finger should be introduced and the exact position of the foreign body ascertained. It may then be laid hold of by appropriate forceps and cautiously removed.

If the impaction is quite recent, and the œsophagus free from inflammation or laceration, it may be safe to carefully bring together the edges of the œsophageal wound with chromicised catgut sutures, while the edges of the external wound are left open for the discharge of blood and serum, and of any foreign material which may escape through the walls of the œsophagus. In many cases, however, it is advisable to leave the wound of the walls of the canal open, as well as that of the superficial structures. For a week or more after the operation the patient must be fed with a small œsophagus tube, which may be left in, or if the patient cannot bear this, it may be passed for every meal. Nutrient enemata may also be necessary for a few days. Later on, the patient should be allowed to begin cautiously the swallowing of liquid food. There will often be a small fistulous opening for a few weeks, but this usually closes without any trouble.

Œsophagostomy is performed in the same manner as the operation just described, except that the incision should be as low on the left side of the neck as practicable. The œsophagus will have to be found without the guidance of the forceps or sound introduced by the mouth, and after it has been found and opened, the edges of the incision, and especially the margins of the mucous membrane, should be carefully stitched to the skin at the lower extremity of the external wound. In the after-treatment, great caution must be exercised in introducing the feeding tube, to avoid laceration of the wall of the œsophagus, or the passage of the instrument by its side into the adjacent tissues.

N. Davies-Colley.

Œsophagus, Injuries and Diseases of the.—Foreign Bodies of various descriptions are apt to become impacted in the œsophagus, such as masses of imperfectly chewed food, bones, and especially fish-bones; pins, coins, and other metallic substances; and lastly, artificial teeth, which, with the plates to which they are attached, have, of late years, frequently been swallowed, and after lodging in some part of the canal, have become firmly fixed by the hooked projections or 'bands' with which they are provided. The point of impaction is usually one of the three natural constrictions of the œsophagus, and especially the highest, which is at the upper extremity, just below the level of the cricoid cartilage; the second constriction is three inches lower, where the œsophagus deviates slightly to the right, to pass under the arch of the aorta; and the third is where its lower extremity traverses the diaphragm.

The *symptoms* will vary in some degree with the position of impaction. If this is high up, there may be considerable dyspnœa and coughing from laryngeal irritation. Pain may be complained of at the spot where the body is fixed, or it may be referred to some other region, such as the notch of the sternum. If the body is in the cervical portion of the canal, there will

probably be some tenderness upon external pressure. Swallowing is usually difficult and painful, and it may be impossible; or, after the food has been swallowed, it may be retched up again. When the obstruction is complete, there will be a constant expectoration of saliva and mucus. In some instances, foreign bodies have remained for a long time without giving rise to any serious symptom. Usually, however, ulceration supervenes, and its presence will be indicated by the blood and pus retched up by the patient. Abscesses may follow in the adjacent tissues, the air-passages may be opened, and inflammation set up in the lungs; or some great vessel, such as the aorta, may be perforated, and give rise to sudden and fatal hæmorrhage. In rare instances, it has happened that the ulceration has loosened the impaction, and permitted the foreign body to be ejected through the fauces, or to pass onwards into the stomach.

The *diagnosis* is sometimes rendered difficult by the fact that, after a foreign body has been dislodged, some abrasions may have been left, and the uneasy sensation still remaining may convey the impression that no change has taken place in its position. If the body is large, and not entirely in the œsophagus, it may be possible to reach its upper extremity by means of a finger inserted through the fauces, or its exact situation may be detected by some projection to be felt externally. When it is high up in the gullet the laryngoscope will also be of service, but in many cases it will be necessary to rely upon the passage of a probang furnished with a smooth metallic or ivory bulb, by which contact with any hard substance will be communicated to the fingers. If there is any suspicion that a previously impacted body has been dislodged, a careful examination should be made of all vomited and fæcal matters.

Treatment.—Foreign bodies in the œsophagus must be removed by the mouth, or pushed onwards into the stomach, or in rare cases it may be necessary to cut down upon them in the cervical portion of the canal. If the body be high up, a sudden jar, such as a slap on the back, may dislodge it into the pharynx, whence it will probably be ejected by the spontaneous efforts of the patient. The vomiting which occurs during the examination of the parts is also sometimes effectual in displacing the foreign body, and emetics have been given by the mouth, or where this was impossible, by the rectum or subcutaneously, with the same object. Such an expedient, however, would only be justifiable if the body were small and recently impacted, for there is some danger of rupture of the œsophagus during the efforts of vomiting. If the body is a mass of solid food, or if, though hard, it is smooth and not very large, it may be gently pushed on by means of a sponge probang into the stomach. The same plan may also be resorted to when a sharp or angular body has become impacted low down, and has resisted repeated efforts to extract it. Should such a body have entered the stomach, it will be necessary to keep the patient quiet, and to give him plenty of solid bulky food with but little fluid, so as to secure the safe transit of the foreign body through the intestines.

When, however, the impacted foreign body is hard, angular, and of considerable size, and especially when it is fixed high up, we should endeavour to remove it with the long-handled curved forceps. Coins may be extracted by means of a special apparatus, consisting of a blunt flat hook attached by a thin slip of steel to the probang. They are usually impacted high up, with their flat surfaces directed forwards and backwards. For pins, fish-bones, and similar substances, the dilating horsehair-probang is of great value. This should be introduced into the gullet for a short distance beyond the obstruction, and then, after expansion, be gently withdrawn. If this instrument be not at hand, a good substitute may be made by attaching a skein of thread to the end of a flexible bougie, so as to entangle the body in the numerous loops which are thus formed. Fish-hooks have been removed by means of a perforated bullet or ivory ball threaded on the gut, and then pushed down so as to fill the concavity between the barbed point and the shank.

If, however, all these methods have failed, and if the foreign body remains in or near the cervical portion of the œsophagus, operative interference should at once be resorted to, without waiting for the complications which the ulceration of the walls of the canal will soon produce. *See* Œsophagotomy. In some cases, in which dyspnœa is an urgent symptom, it may be necessary to perform laryngotomy before attempting to extract the foreign body. After it has been removed, the patient should be kept quiet, and fed with milk and other unirritating liquids.

Injuries of the œsophagus most frequently occur from the accidental or suicidal swallowing of strong acids or caustic alkalies. The patient is usually much col-

lapsed, and there may be lividity and severe dyspnœa from laryngeal spasm. The tongue, fauces, and pharynx are white and wrinkled, or red and swollen, according to the nature of the material swallowed. There is intense burning pain in the throat and along the gullet. Vomiting may occur, and the ejected matter will consist of altered blood and shreds of mucous membrane, mingled with the contents of the stomach. At a later period there will be frequent retching up of thin, watery, blood-stained mucus. If the stomach was empty when the material was swallowed, the inflammation and perforation of its walls will usually prove speedily fatal. If, however, the œsophagus has received the chief injury, sloughs will come away and a stricture will gradually form, which may lead to the slow starvation of the patient.

Treatment.—When the patient is able to swallow, the appropriate antidotes should be at once administered to neutralise the action of the poison. *See* Acids, Alkalies, Swallowing of. The patient must be kept quiet, and fed with nutrient enemata, to which small quantities of tincture of opium may be added. When the acute inflammatory symptoms have begun to subside, liquid nourishment may be given by the mouth, and bougies should be passed to prevent contraction, or in some cases a soft tube may be retained in the canal, and the patient fed through it. The surgeon should also be prepared to perform laryngotomy, if the dyspnœa from œdema glottidis or spasm should threaten suffocation.

Serious and even fatal results have occasionally followed other forms of injury. The performers of so-called sword-swallowing have sometimes died suddenly from the perforation of a great blood-vessel or of one of the serous cavities of the thorax; or acute and sometimes fatal inflammation of the coats of the œsophagus has resulted from its repeated irritation. In violent efforts of vomiting, the gullet has been lacerated or completely torn through. It has also been wounded from without by stabs or incised wounds of the neck (*see* Throat, Injuries of the), and more rarely in those of the thorax. In all these cases, rest with a milk diet will be necessary, and in the more severe cases, especially when there is perforation of the coats, the patient must be restricted to nutrient enemata.

Diseases.—With the exception of stricture, the diseases to which the œsophagus is liable are rare and comparatively trivial. It is sometimes the seat of a transient catarrhal inflammation, of which the chief symptoms are pain and difficulty in swallowing. Diphtheritic exudation, aphthous ulceration, and submucous abscesses are occasionally observed. In tertiary syphilis we may get gummatous deposits and ulceration, which are very likely to lead to a subsequent stricture. After death, not infrequently warty growths are found in the mucous membrane, or cysts in the submucous tissue, or myomata in the muscular coats; but these very rarely cause any serious inconvenience during life. In rare instances, congenital malformations have been recorded, such as an imperforate condition, which is of course rapidly fatal; or a diverticulum, forming a pouch in which food may collect. This has usually been in the cervical region, and it has sometimes been indicated during life by the formation of a visible swelling after a meal, which could be emptied by external pressure. Similar pouches are also said to occur lower down, as the result of the perforation of the tube from abscess of a bronchial gland.

Strictures of the œsophagus may be classed under three heads—(1) Spasmodic, (2) simple, and (3) malignant. Dysphagia may also be occasionally due to causes external to the gullet. An enlarged gland or tumour, or an aneurism, may sometimes compress the canal, and so produce the symptoms of stricture. As a rule, however, a bougie can be passed into the stomach in these cases, and if the obstruction be situated in the neck, its character can be ascertained by external examination; if in the thorax, an exact diagnosis will be difficult, except sometimes in the case of aneurism, which may be recognised by auscultation or a comparison of the radial pulses. *See* Dysphagia.

1. *Spasmodic stricture* is usually, but not invariably, met with in hysterical women, and it may be associated with a slight amount of genuine contraction.

2. *Simple stricture* is, almost always, the result of cicatrisation after the destruction of the coats of the œsophagus by some escharotic agent. Occasionally, however, it is set up by some other form of ulceration, such as that which follows syphilitic deposit or the temporary impaction of a foreign body. In a few instances, a contraction of some part of the œsophagus, and especially of its cardiac end, appears to have been congenital, or to have occurred, without any obvious cause, in very early life. This may consist of a mere fold of the mucous membrane, or it may affect all the structures of its walls.

3. *Malignant stricture* is by far the most common form, and it is nearly always epitheliomatous. Beginning in the mucous membrane, the disease spreads to the subjacent coats and sometimes to the neighbouring glands. Colloid, scirrhous, and other forms of tumour have been recorded. The disease may be annular, or it may be confined to one side of the tube.

The chief *symptom* of stricture will be dysphagia. This is at first slight, the patient having to cut up or bite his food smaller, and being a little slow in swallowing it down. Soon there is complete inability to eat solid food, which is either ejected by retching, or else a piece becomes fixed in the tube for some time, and prevents the passage even of liquids, until it is dislodged from its position. In some instances, such a stoppage comes on suddenly and is the first indication of the disease. The patient has now to subsist entirely on fluids, and he gradually emaciates. There is frequent vomiting or retching of frothy mucous fluid, in great measure derived from the unswallowed saliva, and if there is ulceration, this will be accompanied by small quantities of stinking pus and blood. There may be pain in the gullet, or it may be referred to some other part, such as the notch of the sternum. At first the sense of hunger is great, but often, in the later stages, the patient becomes apathetic and loses this craving. Finally, the disease is usually fatal by starvation; but, in the malignant form especially, death often occurs from some perforation of the air passages, which allows food to pass into the lungs and set up pneumonia, or some great vessel may be opened by ulceration, and prove fatal by profuse hæmorrhage.

The *spasmodic* form may be suspected in neurotic patients, where there is but little emaciation or loss of strength. The inability to swallow is apt to be inconstant, and there is not the intense craving for food which is characteristic of genuine stricture. Usually, a full-sized bougie can be passed with or without the aid of an anæsthetic.

When, however, there is a distinct history of continuous dysphagia, accompanied by progressive emaciation and a constant desire for food, the diagnosis will lie between *simple* and *malignant* stricture, and will depend chiefly upon the history of the case, the age and sex, and to some extent also upon the general appearance of the patient. If the obstruction is high up, an external examination may reveal some swelling or induration of the neck, from cancer of the œsophagus or its lymphatic glands. In most cases of malignant stricture the disease begins without any assignable cause. The patient is generally of the male sex, and over forty years of age. There may be some appearance indicating a special cachexia, but this will be difficult to distinguish from the emaciated condition dependent upon the privation of food. In the simple form there will be the history of some cause, such as the swallowing of a corrosive substance, or the impaction of a foreign body; or the patient may have been the subject of syphilis, of which traces may be looked for upon the skin, the tongue, and the fauces. In the rare cases in which the contraction has existed from birth or early childhood, there will probably be a history of slowness in swallowing, and of regurgitation, or, so to speak, rumination of the material swallowed.

In all cases of stricture, the diagnosis is much helped by the use of a flexible bougie about three-eighths of an inch in diameter. The mouth of the patient should be widely opened, and the head thrown back. The instrument, after being well softened in warm water and oiled, should be passed with the operator's right hand, his left index finger guiding it into the pharynx and past the orifice of the glottis. Frequently, a slight hitch is felt when the bougie has reached the notch of the sternum or a little lower. This may be due to the change of direction of the œsophagus at this point, corresponding to the change from the anterior convexity of the cervical spine to the concavity of the dorsal region. If the œsophagus be healthy it is only necessary to make the patient bend the head forwards, and the instrument will slip on till it reaches the stomach, and is stopped by coming into contact with the greater curvature of that organ. If more than sixteen inches of the bougie are found to have passed the front teeth, we may be certain that the whole of the gullet has been traversed. If, on the other hand, the instrument be stopped before this length has passed, and if after slight withdrawal or rotation, or after flexion of the neck as above described, the instrument fails to penetrate further, there is probably a stricture at the point reached, and the position of the stricture is indicated by the length of the bougie which has been inserted. The exact point in the œsophagus is easily ascertained by subtracting six inches from the amount, that being the average distance of the upper

end of the canal from the front teeth of the adult.

On withdrawing the instrument, it should be carefully examined for indications of ulceration, which it may afford by a smear of blood or pus upon its surface. In many cases it will be necessary to use bougies of other sizes and shapes, and in some it may be desirable to have the assistance of an anæsthetic, to overcome the spasm which resists the introduction of the instrument. Some information as to the position and narrowness of the stricture may be also obtained by auscultation with a stethoscope placed on the left side of the trachea in the neck, or to the left side of the spines of the vertebræ in the back.

Treatment.—In the *spasmodic* form, nervine tonics and sedatives should be given, and a bougie should be passed from time to time; the local application of galvanism is also beneficial.

In the *simple* form, early recourse should be had to dilatation by bougies, even before the granulating sores which precede the contraction have completely healed. The instrument, when passed, should be left in for a few minutes daily, and cautious attempts should be made to introduce larger sizes, until the full calibre of the canal has been restored. In some cases it is possible to introduce only a fine catgut bougie. If so, this may be used as the guide for passing gum elastic tubes of various sizes, which may be left for several days in the œsophagus, the patient meanwhile being fed through the tube. Great care is necessary in the introduction of bougies, for there is often a pouched condition of the gullet above the contraction, which renders the upper orifice of the stricture difficult to find. At the same time the walls of the pouch are thin and soft, and they have sometimes been perforated with fatal results. Until the œsophagus has been dilated, the patient should be fed with fluid diet, for otherwise great distress may be produced by temporary closure of the stricture with a morsel of solid food.

Internal Œsophagotomy has been occasionally performed as a help to dilatation, but there is danger of cutting beyond the walls of the canal, and opening some large vessel or one of the adjacent serous cavities; while the cases, in which alone it can be practised, are of permeable strictures, and may be more safely treated by bougies.

If, after repeated efforts, it is found impossible to pass a bougie, even with the help of an anæsthetic, and if the ability to swallow even liquids is gradually diminishing, while the patient steadily loses weight and strength, it will be necessary to resort to Gastrostomy, which has, as might be expected, yielded much better results in this than in the malignant form of stricture. It is important to perform this operation while the patient has still strength enough to bear the diminution of food necessitated during the establishment of the artificial opening, as well as to permit of the formation of firm adhesions between the stomach and the parietes. When formed, the gastric opening will usually require to be permanent, but, in some instances, the rest thus given to the stricture has led to its amelioration; the power of swallowing has returned, and it has been found possible to close the opening.

Œsophagostomy has also been practised in a few cases. It is, however, only applicable where the stricture is limited to the upper part of the canal, and, even then, the dangers which attend it make the operation decidedly inferior to gastrostomy.

When the stricture is near the cardiac orifice, Signor Loreta has recently suggested and successfully carried out another operation. Having opened the abdomen and drawn a part of the stomach out of the wound, he makes an incision into it, and through the opening introduces a dilator into the lower part of the œsophagus, and, after forcibly dilating it, withdraws the instrument, sewing up the wound of the stomach wall, and returning the stomach to the abdominal cavity.

In *malignant* stricture, the treatment can only be palliative, except in the rare instances in which the disease is confined to the upper part of the canal; in which case it may be possible to remove the growth, and attach the upper end of the canal to the edges of the lower part of the wound, so as to provide an opening for the reception of food. See *Œsophagostomy*, under Œsophagotomy.

After the diagnosis has been made, so long as the patient is able to take plenty of liquid nourishment, it is unwise to use instruments, for fear of perforation. As soon, however, as the passage of liquid food becomes difficult, and the patient begins to waste, a flexible tube should be passed by the mouth or nose through the œsophagus into the stomach, and there retained, so as to allow of the regular feeding of the patient. As a rule, the stomach tolerates the presence of the tube, but if any symptoms of gastric disturbance arise, the tube may be withdrawn a short distance, so as

to place its lower end in some part of the œsophagus below the stricture, but out of the cavity of the stomach. Mr. Charters Symonds has recently suggested an improvement upon this plan. A gum elastic tube, furnished with a funnel-shaped upper expansion, is passed through the stricture until its dilated extremity rests upon the top of the stricture. It is inserted on the end of a conical bougie, or by a special introducer. The tube keeps the stricture from closing, and its calibre is sufficient to allow a free passage to properly prepared food, which can now be swallowed by the patient in the ordinary way. The saliva also and mucus, which, when the longer tube is kept in, well up into the mouth and have to be expectorated, are enabled by this method to pass onwards through the tube into the stomach. A piece of silk thread is attached to the upper rim of the tube, and brought out at the corner of the mouth, to be fixed by a loop round the ear. When it is desired to examine or change the tube, it is drawn up by means of the silk thread. After inspection it can readily be returned to its old position, or a larger one may be introduced in its place, as considerable dilatation results from the continuous pressure of the tube.

When, however, bougies cannot be passed, or if passed, cannot be retained, increasing weakness and wasting may render operative interference necessary. The most generally applicable is gastrostomy. In some cases in which the disease is situated high up, it has been proposed to establish an artificial opening in the lower part of the neck (see *Œsophagostomy*, under Œsophagotomy), but even in these cases the operation of gastrostomy is preferable.

N. Davies-Colley.

OLD AGE.—It would be useless to attempt to define in years the period of life which, in the study or the practice of surgery, shall be called old age. Its essential characteristics are the degenerations prevalent in all the structures and increasing in them. But these do not begin at nearly the same age in all persons or in all parts of the same person; and their advent and progress are so dependent on inheritance, previous health, occupation, and the other external conditions of life that, in practice, it is often better to estimate a patient's age by his appearance and physical capacity than by the years since his birth. It will be in this view that old age will now be spoken of in its relation to each of the chief subjects of general surgical pathology, and first in its relation to injuries, including surgical operations.

The risks of shock, especially if it be prolonged and attended with enduring pain, increase with advancing age in the same measure as the accumulations of degenerative changes and the effects of previous diseases. The recovery from shock is often slow and interrupted by relapses, and sometimes old people who, in a calm life, have been deemed healthy, die very soon after the shock of injuries which to the younger might have been trivial.

Hæmorrhage is not especially dangerous to the aged, unless they be very infirm or unsound. This used to be often proved when free venesection was customary, and is shown in the facility of recovery from occasional large bleedings from the prostate, and from the epistaxis to which some gouty old persons are subject. Anæsthetics are generally well borne: but it is a good rule to use chloroform rather than ether, because of its lesser tendency to excite bronchial irritation or pulmonary congestion.

The repair of injuries, although with increasing age it becomes generally less ready and complete, is often very remarkable in even the oldest persons. This is especially true after injuries of the face and the upper half of the body; but in all parts and at any age healing may be expected unless hindered by local conditions, such as the impossibility of keeping parts in contact, as in fractures of the neck of the femur, or by conditions of general disease, such as would hinder healing at any age. Old persons appear, indeed, in less risk of the failure of local repair than of that general repair which should be achieved in convalescence. Some may have escaped all the immediate dangers of a severe injury or operation and all those of its earlier consequences, and the local injury may be nearly healed, but in what should be convalescence they waste, decay, and slowly die. This is especially likely to happen to those who are unable to take their usual food; and to those whose organs are not only degenerate through old age, but damaged by the effects of former diseases. Indeed, however striking may be the marked instances of repair of injuries in the aged, their risks from degenerate blood-vessels, weak hearts, habitual bronchitis, and other like defects, can never be deemed slight.

Among the sequences of injury, old persons are much less liable than the young to the infection of prevalent con-

tagions, such as scarlet fever and small-pox; less liable, also, to septic poisoning and pyæmia; rather more to erysipelas and to a more dangerous form of it with frequent relapses. Injuries, also, are very likely to bring out and localise the diseases to which old persons are liable; such as gout and osteo-arthritis, or the gangrene to which the diabetic are prone.

Inflammation in old age is usually less active than in earlier life; that is, under similar conditions and in the same parts, it is slower both in progress and in recovery; more likely to be or to become chronic; and, in cases which may be deemed of equal intensity, it is less productive of new organisable material, more prone to œdema, to mere congestion and gravitation of the blood, to more decay and sloughing of the softer tissues, or else to thickening and contraction which time does not repair. Commonly, too, inflammation in old persons shows less influence on adjacent lymph-glands than in the younger; they seldom become quickly or much swollen, still more seldom suppurate in a secondary inflammation. But the greater contrasts are due to the constitutional conditions which prevail in the different periods of life. Scrofula, which commonly gives its characters to the inflammatory process in early life, is in old age rare. Any scrofulous disease may, indeed, be found in even far advanced age, and all the characters of the scrofulous inflammation may be well marked in old persons who have never before shown signs of it; but this is as rare near the end of life as it is common near the beginning. The constitutions which more often put their mark on the inflammations in old age are the gouty and the so-called rheumatic gouty, such as appears in the changes of osteo-arthritis. These may be seen, indeed, in any period of life; but, even when they appear early or in middle age, they accumulate with advancing years, and are the cause of some of the most characteristic disabilities and infirmities of old age—the stiff curved spines, nodular and stiffened joints, contracted hands, deformed feet, and others. In all of these are evidences of thickened and contracted fibrous tissues, wasted articular cartilages, and nodular enlargements of the articular ends of bones, of which the type is seen in the justly named *malum coxæ senile*. And the effects of all these changes are the greater, because they coincide with the wasting and diminishing elasticity and pliancy of tissues due to the natural senile degeneracies.

The progress of inflammation in old age is often affected by the accumulated changes of structure due to previous diseases in internal organs, especially those which hinder or weaken the movement of the blood, or materially alter its constitution. The persistency of eczema, and its tendency to ulceration in the lower limbs when the veins are varicose, is an example of the first, and the frequency of gangrene in senile diabetes is one of the second. There are also instances of peculiar nervous conditions in inflammation in old persons, such as the intense neuralgic pains which not only precede but often remain long after, the eruption in herpes zona, and in the pain of carbuncle and of senile gangrene, especially that which is associated with arterial degeneration.

In correspondence with the inactive and degenerative tendencies of inflammations in the old, they do not need, and often do not bear, active treatment. As a general rule, old people require more than ordinary care in securing rest and a good position for the inflamed part, warmth, sleep, a scarcely if at all diminished diet, comprising both vegetable and animal food, and, with moderation, any habitual quantity of stimulants. They commonly bear opiates well, especially when the inflammation tends to produce gangrene; but of other medicines it is generally true that, as age advances, so the utility of most things regarded as remedies in earlier life diminishes.

In comparing the pathology of Morbid Growths in old age and in earlier periods of life, it may be noticed that, although there may be no form of which the growth may not commence at any age, yet a very large majority of those commencing before the middle period of life are innocent tumours, and a very large majority after that time are malignant. In other words, the tumours which begin to grow in the earlier period are generally composed of structures like the fully organised and vascular tissues of the body; and those of the later period are generally composed of structures like the embryonic or the epithelial tissues. The contrast is marked enough to help in the diagnosis of tumours beginning in old age.

Among cysts, very few begin to form in old age. Sebaceous cysts sometimes do so on the scalp and on the trunk, but the more common event is, that they which have long existed, increase and ulcerate

through the thinned and feebly sustained skin. Seminal cysts, also, may first appear at an advanced age, and, even in the oldest men, they may be repeatedly filled with the characteristic fluid containing spermatozoa.

Fatty tumours, though rarely beginning, commonly continue to grow, in old age; and very often, with the progress of senile decay, the integument covering the most prominent or most dependent part of a fatty tumour sloughs or ulcerates, and may thus become dangerous to life. The chance of such an event may be counted among the reasons for removing such tumours in due time; for this chance is at least as great as that of the calcification of the tumour, in which its increase might be stayed. Many an old age is rendered unhappy by the weight and other troubles of a fatty tumour, which might have been removed safely many years before.

Among fibrous and myomatous tumours, those that are common in the prostate gland probably begin not rarely in old age, and those that have begun earlier may constantly increase. They are commonly a cause of the bossed and unsymmetrical shapes of enlarged prostate glands, and they are very rarely calcified. In this respect the uterine fibroid tumours differ from them; these not seldom in old age cease to grow, and become more dense and in parts calcareous. Of other fibrous tumours the growth may continue to the very end of life.

In cartilaginous tumours the decay of age is like to bring ossification; in osseous tumours increase. It is very rare to find instances of either kind beginning in old age, and in this there may seem strange contrast between the tumours and the very frequent and abundant osteophytes, which form, late in life, at the articular borders and other parts of bones.

Papillary tumours or overgrowths are commonly first formed in old age. They are exemplified in the warts on the scalps, and more rarely on the hands and feet of old people; in those of the tongue; and in the pigmental papillary growths on the back and other parts of the trunk; and in some of the 'bark-warts' on the face. Not a few of such papillary growths in the softer parts become in old age cancerous.

Nævi or erectile tumours, such as commonly begin in fœtal life or earliest childhood, are in some degree imitated in old age, and in any time during or after middle life, by the little bright vascular spots which are commonly formed in the skin of the trunk, especially in that of the front of the chest. But these never materially increase in size, or lead to grave disturbance, or need treatment.

The contrast between the whole group of the innocent and the malignant tumours, in respect to their first occurrence in the earlier or the later periods of life, has been already mentioned. A similar but not equal contrast may be observed between the two chief groups of the malignant, which are structurally distinguished as sarcomata and carcinomata, or as embryo tissue and epithelial tissue tumours. The former may first appear at any time of life, and are more common in children and young persons than are many of the innocent tumours, such as the fatty and the fibrous. The latter are rare before middle age, but, after that time, their frequency in proportion to the number of persons surviving increases with advancing years.

Among the sarcomata, the myeloid, which, though structurally connected with the rest of the group, are clinically not malignant, are very rare in later life. So are the spindle-celled in an unmixed form; and these, also, are of the least malignant in that they very seldom recur at a distance from their primary seat, and very seldom infect the lymph-glands. Thus the less embryonic structures correspond with the less malignity.

The increasing frequency of cancer in advancing years is important in diagnosis. The older the patient the greater is the probability that a recently developed morbid growth is cancerous, or, at least, malignant. And it is true, not only of such as are produced in parts which previously appeared healthy, but of those which form in parts which were before harmlessly diseased. Thus, in advancing age, the crusted thickenings of skin called 'bark-warts' are apt to become seats of epithelial cancer; pigmental moles become malignantly melanotic. Similar changes not rarely occur in middle age; in the cancerous ulcerations of old scars, especially those of burns, and of the epithelial and papillary diseases of tongues; but, on the whole, the general rule seems true that the liability of many long-diseased parts to become cancerous increases with the increase of age. And another general rule, but subject to many exceptions, in the old is that the progress of cancers, both local and in their extension to lymphatics and distant parts, is slower than in the earlier times of life.

When cancer is transmitted by inheritance, it commonly appears earlier in those

to whom than in those by whom it is transmitted. The cancerous child may die before the cancerous parent; or a parent, who may have transmitted a tendency to cancer, may die before manifesting the disease in him- or herself.

The general characteristics of disease in old age are so especially illustrated in the diseases of some parts, that it is customary to class examples of them as distinct varieties. Thus, senile prurigo, senile purpura, and senile gangrene are often separately described, and may be studied as the best examples of disease modified by senile degeneration. They are treated of in their appropriate articles; and in several instances it is worth observing that the greatest frequencies of certain diseases are in old age and in early childhood. Thus it is with cataract, hydrocele, inguinal hernia, urinary calculus (at least among the children of the poor), phimosis, prolapse of the rectum, cutaneous warts, eczema, excess of uric acid, and some others. The causes of the similarly named disease at the two extremes of life may be in many respects widely different; the apparently similar result may be attained in dissimilar ways; but the fact may, nevertheless, deserve careful study. JAMES PAGET.

OLECRANON, Fracture of the. *See* ULNA, Fracture of the.

OMENTAL HERNIA. *See* HERNIA, Reducible.

ONYCHAUXIS—Hypertrophy of Nail. *See* NAILS, Diseases of the.

ONYCHIA. *See* NAILS, Diseases of the.

ONYCHO-GRYPHOSIS — Horn, or Claw-like Nail. *See* NAILS, Diseases of the.

ONYCHO-MYCOSIS—Parasitic Disease of Nail. *See* NAILS, Diseases of the.

ONYX.—A crescent-shaped, purulent infiltration at the lower part of the cornea, resembling the *lunula* of a finger-nail. It may be mistaken for hypopyon, and is indeed often associated with it. Unlike the latter, it does not change position with movements of the head. *See* HYPOPYON.

OÖPHORECTOMY.—This term is generally applied to the operation for the removal of an ovary or ovaries which, though diseased, are not so diseased as to form tumours of any size. It is also applied to the operation for the removal of healthy ovaries, the object being in this case to bring on the menopause prematurely, and thus, by arresting the monthly nervous and vascular excitement in the uterine organs, to cure other diseases which are thought to be dependent upon these periodic disturbances, or are exacerbated by them. Its most successful and important application is in the removal of the ovaries and Fallopian tubes for the cure of fibromyoma of the uterus, and its indications and method of performance for this purpose will be found in the article on UTERINE TUMOURS.

It has also been advocated and practised for the cure of hystero-epilepsy and insanity, when these conditions appear to be associated with the catamenia. It is, however, very doubtful whether this is a legitimate field; the results at present obtained certainly do not encourage its frequent use in these cases.

There are two well-marked conditions of the ovaries, the result of blood-changes and inflammation, which may occasionally, if they can be correctly diagnosed, not only justify, but demand oöphorectomy. Their causes and pathology have been but little studied at present.

In the one case the ovaries are found enlarged, distended with unruptured follicles or small cysts, and with the outer coat much thickened. This condition is probably the result of chronic ovaritis, the thickening of the external layer of fibrous tissue preventing the rupture of the follicles. The affected ovary will usually prolapse from its weight, the prolapse still further interferes with its circulation, it is constantly congested, and is liable to injury during defæcation, sexual intercourse, or from the treatment of inexperienced gynæcologists. So long as it does not become adherent a cure is possible. The treatment should consist in a careful regulation of the bowels, avoidance or sparing use of sexual intercourse, rest in the recumbent position during menstruation, the thorough application of the continuous hot douche night and morning, and counter-irritants applied externally to the skin of the abdomen on the affected side. Sometimes a watch-spring ring pessary, if it can be worn, will aid the cure by supporting the ovary. Small and continuous doses of perchloride of mercury are also useful.

If one or both ovaries, thus diseased, become fixed by adhesions to the bottom of the pouch of Douglas, and especially if the uterus retrovert and press upon them, nothing but oöphorectomy will give relief,

and some of the most satisfactory results of this operation will be met with in this class of cases. It is, however, only justifiable when every other method of treatment has failed, and the patient has become a complete invalid.

In the other condition, referred to above, the ovaries on removal are found to be small, hard, and shrivelled—in fact, cirrhosed—the follicles having entirely disappeared. This may be in some cases merely a further stage of the condition we have been considering, but there is good reason to suppose that it may result without such intermediate state, from the blood-changes in some of the specific fevers, notably scarlet fever and measles, especially when these diseases attack the patient severely about puberty.

With the large chronically inflamed ovary menstruation is generally irregular, but is more often too frequent and too free, while with the cirrhosed ovaries it is painful, scanty, and with long intervals, or it may be altogether absent.

The cirrhosed ovaries are rarely displaced, and can often not be defined by the most careful bi-manual examination. They are often bedded in adhesions to the Fallopian tubes, to the side of the broad ligament, or to neighbouring structures.

Nothing in the way of medicine or treatment seems to relieve the dysmenorrhœa or amenorrhœa in these cases, and though oöphorectomy may be occasionally successful, it does not seem to yield such good results as in the previous class. This is not to be wondered at, because the large ovary is, from its size and surroundings, and from the constant enlargement without rupture of the follicles, a source of constant pain, whereas the cirrhosed ovaries are not so often painful in themselves, but are a cause of indirect suffering from the imperfect performance of their functions.

It will be found a good rule, and one that should rarely if ever be broken, to refuse to perform oöphorectomy unless an ovary can be distinctly made out, by physical examination, to be in a diseased condition. Even then the operation should never be performed, unless the surgeon is convinced that all other possible means of cure have had a fair and sufficiently prolonged trial. The only points in the method of performing the operation which need be alluded to, as Ovariotomy is given in full detail, are—

1. Greater care in opening the peritoneum.

2. Special care in sewing up the wound, as, the parietes not having been stretched, a weak cicatrix, and the chance of ventral hernia, are more likely than after ovariotomy, unless all the layers of the abdominal wall are accurately united.

3. The greatest care should be taken to remove all the ovarian tissue and the tubes close up to the uterus; it is therefore necessary to leave a short stump, and the ligatures must be tied tightly. If both ovaries are removed, both pedicles should be transfixed and tied, and the sponging completed, before the organs are cut away.

The after-treatment is exactly the same as in ovariotomy. When both ovaries and tubes have been closely and cleanly removed, the patient usually has a short metrostaxis within a day or two after the operation, and then entirely ceases to menstruate, and loses her sexual feeling. The rare cases in which a third ovary is present, and escapes detection and removal, may account for some apparent exceptions to this rule. Other exceptions are due to imperfect removal of ovarian tissue: a very small portion left behind, even on the distal side of the ligatures, will not only keep up menstruation, but will leave the sexual appetite; indeed, in some cases, a small remnant of ovarian tissue thus left, and probably irritated by the neighbourhood of the ligatures, seems to increase the sexual feeling.

A very occasional metrostaxis will occur in young women after the most complete oöphorectomy, but there is always the chance of a third ovary in these cases. When the ovaries have been very adherent, so that they have to be literally scraped out, menstruation may continue for a time unaffected, and the same phenomenon is observed in some cases in which papillomatous ovarian growths have to be enucleated; evidently very small portions of ovarian tissue are sufficient to stimulate the uterus. In married women, the probable loss of sexual feeling should be clearly put before both husband and wife before the operation is performed.

Most patients suffer, for a longer or shorter period, after the operation from the usual troubles of change of life, such as chills, perspirations, flushings, headache, and pains in the joints.

J. Knowsley Thornton.

OPHTHALMIA. *See* Conjunctiva, Diseases of the.

OPHTHALMOSCOPY — the art of examining the interior of the eye with the ophthalmoscope. The optical conditions necessary for distinct vision are (1) transparency of the dioptric media of the eye

(cornea, aqueous humour, lens, vitreous humour); (2) accurate focussing, on the percipient elements of the retina, of all rays passing through the pupil from the objects on which the attention is fixed. If the pupil remain widely dilated when a considerable amount of light is passing through it, we frequently see, and more especially when the eye is at the same time ametropic, or out of focus, that, instead of appearing black as usual, it is bright, and, as it were, shining with a yellow or yellowish-red light. When this is the case, we may observe that we are nearly in the line joining the source of light and the pupil. In other positions we see the pupil dark or black as usual. The ordinary black appearance is due to the fact that the head of the observer intercepts the rays, which would be reflected in the direction of his own eye.

The principle of the ophthalmoscope consists in bringing the eye of the observer in the axis of the cone of light which passes through the pupil of the eye examined; when this can be done, it is evident that the conditions requisite for seeing the rays reflected from the interior of that eye are complied with. This was first done by Helmholtz, by reflecting light into the eye from the surface of a piece of glass, which being at the same time transparent, allowed some of the rays again reflected from the interior of the eye to pass into the observer's eye placed behind the glass, and by means of these transmitted rays the fundus became visible. A modification was soon introduced, by which the image obtained became more luminous and distinct. This consisted in making use of a metallic or silvered glass mirror, with a hole in the centre. The eye of the observer, placed at the back of the mirror close up to the hole, enables him to catch some of the rays reflected from the fundus of the eye into which the light has been thrown by the mirror, and in this way to obtain the desired image. This arrangement is that of the *ophthalmoscope mirror* as it is now used. Various forms are given to the mirror; thus it may be plain, concave, or convex, or the two surfaces of the silvered glass may have different curvatures, and these be again either homocentric or heterocentric; but the main points, so far as the mirror is concerned, are that there shall not be disturbing reflections from the two surfaces or from the sides of the aperture, both of which conditions are complied with by making the glass thin or by using polished metal.

Two methods of ophthalmoscopic examination are in use—the *indirect* and the *direct*, both of which have their advantages. (1) In the indirect examination, the ophthalmoscope, placed close to the observer's eye, is held at from 12 to 20 or more inches from the eye to be examined, at a few inches from which and in the line of the rays reflected from the eye, the observer holds a convex lens of 2½- to 3-inch focus. When the mirror is so placed as to cast the light into the eye an inverted aërial image of a portion of the fundus oculi is found between it and the convex lens, and situated at or near the focus of the latter (according to the state of refraction of the eye). It is this image which forms the actual object of examination. In order that this aërial image may be seen distinctly, it is evident that the observer's eye, and with it of course the ophthalmoscope mirror, must at least be as far from it as the distance of the observer's near point.

(2) By the direct method a much greater magnifying power is obtained, but a smaller portion of the fundus is seen at one time, so that, for a topographical examination and for making a quick survey of the back of the eye, the indirect is more satisfactory; indeed, it is but seldom that the use of the direct examination affords information of diagnostic importance which would escape detection by the more rapid indirect method. In examining by the direct method, the observer brings his own eye and mirror close up to the eye to be examined, in which case, if his own refraction be normal (emmetropic), he will receive on his retina an image of the fundus from all eyes the rays from any point of the back of which are parallel, or moderately divergent, on emergence—that is to say, from emmetropic, or not too highly hypermetropic, eyes. To see the fundus distinctly in cases of myopia, it will be necessary for him to place in front of the eye he is examining—or, more conveniently, immediately behind the aperture in the mirror of the ophthalmoscope, a concave lens sufficiently strong to convert the rays, which from points in the myopic fundus are convergent on emergence, into parallel or moderately divergent bundles. It is evident, then, that an ophthalmoscope to be used for direct examination is necessarily a little more complicated than that which will suffice for indirect examination, inasmuch as it requires the addition of lenses behind, or at any rate some arrangement by which lenses can be placed behind the aperture in the centre of the mirror. As ordinarily manufactured, it is fitted with a number of lenses, which can be brought

into position by some simple mechanical arrangement, and which enables the observer, on the assumption that both he and his patient are fully relaxing their accommodation, to ascertain the state of refraction of the eye he is examining.

A number of different forms of ophthalmoscope, with lenses capable of being moved into position behind the centre of the mirror —so-called 'refraction ophthalmoscopes'— are in use. Some of these are more fanciful and of less practical value than their inventors believe. The chief points to which attention should be given in selecting such ophthalmoscopes, besides those already mentioned, are that the mirror should be capable of being inclined to 30°, or thereabouts, to either side; that the aperture should not be very small, and should be placed as near as possible to the lens behind it; and that there should be a sufficient number of lenses of not greater than 1 D interval between each. With a properly constructed ophthalmoscope and considerable practice, a fair degree of approximation can be made to the degree of ametropia by the direct examination, provided always that the ametropia is not excessive.

The points to which special attention should be given in making an ophthalmoscopic examination are the following:—1. The degree of transparency of the dioptric media; 2. the condition of the optic nerve and vessels; 3. the condition of the fundus at and around the macula lutea and, 4. at the periphery.

The degree of transparency of the media is made out mostly by means of the mirror alone. The reddish reflex from the back of the eye obtained by throwing light into it, reveals, by its greater or less uniformity and clearness, whether or not any obscurity exists in any of the dioptric media. Sometimes, when slight and diffuse, an opacity may only first be recognised when an attempt is made by either method of examination to obtain an image of the fundus. Under such circumstances, the details of the structures otherwise visible at the back of the eye appear veiled, so that they are more or less indistinctly recognisable. Opacities, made out by using the mirror alone, may completely interrupt the reflex from the fundus, or do so only partially, here and there, and may be stationary, altering their position only with the eye, or movable ('floating opacities'). The *complete* opacities are mostly due to dense exudations in the vitreous, either inflammatory or hæmorrhagic, inflammatory exudations occluding the pupil, and advanced cataract. Extensive exudations or effusions of blood into the anterior chamber are readily diagnosed by other means than ophthalmoscopic examination. *Partial* opacities, again, when not in the cornea or aqueous chamber, are to be found in the lens and vitreous. In the lens they are, practically, invariably stationary, and can be localised from the direction in which they alter their position with movements of the eyeball. As the lens lies anterior to the point of rotation of the eyeball, the change in position coincides in direction with that of the eye, and is more extensive the more anteriorly the opacity is situated. Opacities of the lens appear with the ophthalmoscope in various shapes as dark striæ, dots, or diffuse patches, according to the nature of the lenticular change. So, also, the track of a foreign body which has passed into the eye through the lens is easily detected, by the more or less dark area of interruption in the reflex.

Opacities of the vitreous are either stationary or floating, and assume many varieties of shape, density, and colouring, according to their origin and nature. If stationary, they alter their position in a direction opposite to that of the eye, unless when far forward, as in the case of the plastic exudations immediately behind the lens in some cases of inflammation of the ciliary body (cyclitis). Vitreous opacities appear punctiform, filiform, membranous, or in large irregular dark patches, which latter are often blood-clots, and not infrequently give a dark reddish reflexion. The colour of a large mass of blood, as well as of a growth in the vitreous chamber, is often more distinctly seen by placing the ophthalmoscope mirror at the side of the eye, instead of straight in front of it. Occasionally, in old-standing disease of the eye, the opacities in the vitreous are seen to sparkle with a metallic lustre, owing to the development of cholesterine in the particles of exudation (*synchysis scintillans.*)

In examining the optic nerve, attention must be paid to the following points:—(1) Its colour, transparency, contour, and surface. (2) The size and condition of the arteries and veins. (3) The appearance of the structures immediately surrounding it.

1. The intraocular end of the optic nerve, the *papilla optica* or *optic disc*, is normally transparent, its fibres being divested of their opaque myeline sheaths in passing through the sclerotic coat, altered in this position to a fine close network of connective tissue —the *lamina cribrosa.* As the depth of the transparent portion of the papilla is greatest in the nasal half, that portion is

more highly coloured and less different from the adjacent retina than the other parts, especially the outer portion of the temporal half, all of which is paler than the nasal half. The colour of the nerve as a whole, as well as of its different portions, is subject to very considerable physiological variation. Mistakes are frequently made by not keeping this in mind. Pathologically, the colouring of that portion of the optic nerve which can be seen with the ophthalmoscope may be increased or diminished. It is increased owing either to increased vascularity or swelling, as in hyperæmia and optic neuritis. It is diminished owing either to diminished vascularity or to shrinking, displacement, or loss of substance, as in anæmia, optic atrophy, and glaucoma. The excessive pallor which it assumes in cases of atrophy is greatly owing to the strong white of the lamina cribrosa shining through. It must be remembered that, owing to the great amount of white light reflected from the lamina cribrosa, the colour of the nerve, as seen with the ophthalmoscope, depends a good deal upon the amount of light thrown into the eye; the stronger the light the paler does the nerve appear. Occasionally, masses of pigment, seldom extensive, are to be seen in the papilla as a physiological variety; they lie in the deeper layers of the nerve on a level with the choroid, so that the retinal vessels may be seen to pass over them from the nerve. In health, the margins of the nerve are sharply distinguishable from the surrounding tissues. This distinct outline is lost more or less completely in cases of neuritis, owing to the swelling and hyperæmia of the nerve, sometimes, indeed, so entirely that the actual position of the nerve itself is mainly recognisable from the position of emergence of the great vessels, or, when that point is obscured by the swelling, by the situation from which they appear to diverge. In rare cases, some of the optic nerve-fibres retain their myeline sheath for some distance into the nerve-layer of the retina. This condition also gives rise to the ophthalmoscopic appearance of an obliteration of the sharp margins of the papilla, but is easily recognisable from that caused by neuritis.

The surface of the nerve again is subject to varieties both in health and disease. As already mentioned, the outer portion is not so deep as the nasal, and it not infrequently happens that there is a funnel-shaped depression in the centre, or slightly to the temporal side of the centre, of the nerve. The extent of this depression, both in depth and superficies, is very variable. It has received the name of 'physiological excavation of the papilla.' The ophthalmoscopic appearance of such a physiological excavation is that of a white disc, the absence of colour in which contrasts strongly with the other parts of the nerve, especially the portion lying to the inner or nasal side of the depression. Within this disc the vessels appear out of focus, but by selecting the proper lenses to place behind the ophthalmoscope mirror in the direct examination, they may be traced down to the bottom of the depression, converging to the point from which they bifurcate, and following exactly the walls of the funnel-shaped depression. On focussing accurately the bottom of the depression, the meshes of the lamina cribrosa are often distinctly visible. If the examination be made by the indirect method, and the convex lens be moved from side to side, the peripheral ring-shaped portion of the nerve appears to glide more or less distinctly backwards and forwards over the indistinctly visible vessels of the central disc, a parallactic movement which shows that the latter are out of focus, owing to their lying at a deeper level than the rest of the surface of the nerve. Excavation of the optic nerve occurs also pathologically in glaucoma and optic atrophy. When it occurs in glaucoma, the whole cross section of the nerve gradually recedes, owing to the increased intraocular tension; the vessels are observed to bend sharply round the edge of the nerve, and to be pushed towards the inner side, the surface of the nerve appearing at the same time of a bluish-white colour, and giving the characteristic parallax, on indirect ophthalmoscopic examination, indicative of a depression. The vessels can not generally be traced down the side of the depression, but appear discontinuous from the edge to the bottom of the excavation, where, as the atrophy of the fibres caused by the pressure increases, the retiform structure of the lamina cribrosa becomes more and more distinctly visible. Excavations, in cases of optic atrophy, are less characteristic, though seldom likely to be confounded with true glaucomatous changes.

2. The central artery and vein branch, at various depths in the nerve, into two main trunks, which pass upwards and downwards, afterwards subdividing somewhat, and curving outwards round the region of the macula. The arteries are somewhat narrower and for the most part straighter than the veins, and appear with the ophthalmoscope lighter in colour, owing to the

difference in the colour of the blood and greater thickness of their walls. This latter circumstance gives rise also to a reflection seen as a white stripe along the arteries, and only very indistinctly marked in the case of the veins. The arrangement of the vessels is subject to physiological variation, and not infrequently there is to be seen a more or less distinct pulsation in one or more of the venous trunks lying in the papilla. Pathological changes are met with in the vessels, with respect to their position, size, configuration, and blood-current. As already stated, the pressure which leads to pathological excavation of the papilla, often causes a displacement of the vessels, pushing them more or less completely to the inner side. Both arteries and veins, or more frequently the arteries alone, may be much diminished in size in various atrophic processes, as in retinitis pigmentosa or other secondary and primary optic atrophies, sometimes so completely as to give rise to the appearance of mere threads. In neuritis optica the vessels, more especially the veins, are greatly swollen and tortuous, their perivascular spaces sometimes being loaded, and appearing as parallel whitish lines on either side. Aneurismal dilatation, as well as hæmorrhage around the vessels, is also met with as the result of pathological processes. A not very uncommon occurrence is a rhythmic pulsation in either the venous or arterial trunks. Venous pulsation is not generally pathological; but, when occurring over a large extent of the vessels, is due, most frequently, probably, to Graves's disease, or insufficiency of the tricuspid valve. Arterial pulsation is usually due to increased intraocular tension, and is therefore a frequent symptom in glaucoma, where it it almost invariably confined to the trunks or the papilla; a more extensive arterial pulsation is sometimes seen in Graves's disease, and along with aortic regurgitation. Three conditions—embolism of the central artery, thrombosis of the central vein, and hæmorrhage into the sheath of the optic nerve, produced by fracture through the foramen, cause a varying degree of interruption in the current through the retinal arteries and veins, which may often be distinctly recognised with the ophthalmoscope.

3. Immediately surrounding the disc there is usually seen a narrow white zone, the so-called scleral ring, the portion of the sclerotic immediately surrounding the nerve being seen, owing to the aperture in the choroid being larger than that in the sclerotic. Immediately surrounding the scleral ring, again, may be seen a ring of choroidal pigment, or, much more commonly, only a crescentic, or it may be one or more crescentic portions of such a ring, more often on the temporal side, where the choroid seldom lies so close up to the nerve as elsewhere. It frequently happens that the breadth of the scleral ring in this position is pretty considerable, owing to the same cause, and this occurs as a physiological variation independent of the state of refraction; but, when more than about one-third of the papilla in breadth, it is usually associated with some change or atrophy of the corresponding part of the choroid, and is most generally found in myopia, constituting the change which has received the name of *staphyloma posticum*, the importance of which has been greatly exaggerated. In high degrees of myopia the staphyloma posticum is seen to extend right round the nerve, though almost always most extensive at the temporal side. In glaucomatous excavation of the papilla the scleral ring disappears, the excavated nerve being surrounded by a more or less broad yellow ring, due to some degenerative change in the choroid.

In health the retina is transparent, so that the only structures which are visible in it are the vessels, which are to be seen dividing dichotomously all over except at the centre or region of the macula lutea, where there is a conspicuous absence of large vessels, the region being mainly supplied by fine twigs curving outwards from the papilla above and below it. These all converge towards the macula, without, however, being traceable right up to it. The distinctness with which the deeper structures of the choroid is to be made out depends upon the density of the pigment in the hexagonal cells, histogenetically belonging to the retina, but more strongly adherent to the choroid. When this pigment is very dense, it completely excludes any view of the choroid; otherwise a more or less distinct picture is obtained of the vascular system of that membrane, according as its own cells are more or less filled with pigment. With little pigment in the hexagonal cells and much in the choroid, only the larger choroidal vessels are visible, the variously shaped interspaces between which are darkly pigmented. With little pigment in both retina and choroid, the whole capillary system of the latter (choriocapillaris) is also recognisable. There is, therefore, a great difference possible in this respect in the ophthalmoscopic appear-

ance of the fundus in different individuals, the two extremes being met with in the negro and albino.

The retina is subject to various pathological changes, either as a whole or in its vessels and pigment-cells, the alterations being for the most part accompanied by changes in the choroid and nerve. A loss of transparency occurs whenever there has been a sudden disturbance in the retinal circulation, brought about by one of the causes already mentioned, the retina assuming an opaque, whitish appearance, due to œdema. This change takes place over a greater or less extent of the membrane, but is absent in the macula, owing to the retina in that situation being thinner, so that the normal red reflection is preserved there, giving the appearance, on ophthalmoscopic examination, of a bright red spot. The transparency of the retina is also more or less altered by inflammation (retinitis), when it at the same time becomes hyperæmic, and in some situations distinctly striated, owing to swelling of the layer of nerve-fibres. Detachment of the retina, if it has existed for some time, causes it to lose its transparency and to assume a greenish or bluish-white aspect. When recent, detachment of the retina is not always very easy to diagnose, owing to œdema of the undetached portion, the frequent cloudiness of the vitreous, and the retention of its transparency by the portion detached. When the pushing forward of a detached portion is at all considerable, it can generally be seen to lie out of focus, requiring a different glass behind the ophthalmoscope from that with which other parts are seen distinctly, to bring it prominently into view; thus the vessel becomes indistinct at the edge of the detached membrane, and can again be seen distinctly only by accurate focussing; in this way it is possible to diagnose the abnormal position. *See* Vitreous, Diseases of the; Retina, Affections of the. Different sized hæmorrhages of various shapes are to be seen in the retina in certain affections of the blood, as in leucocythæmia and pernicious anæmia, or owing to inflammatory and degenerative changes in the vessels. The small extravasations are mostly flammiform, but larger ones assume all sorts of irregular shapes.

From what has already been said, it will be readily understood that choroidal affections often do not produce changes recognisable with the ophthalmoscope, unless they have, either from the first or subsequently, been of such a nature as to involve the retinal pigment; thus, we may have an acute choroiditis existing, with little other ophthalmoscopic change than the opacity of the vitreous caused by part of the exudation having found its way into the vitreous chamber. As soon, however, as the hexagonal cells are invaded, the masses of exudation and degenerative changes which exist at the sites of inflammation come into view, giving rise to very different appearances. The exudations into the choroid may take place in large diffuse patches, producing the appearance of yellowish or white plâques, bordered in places, and here and there covered by masses of displaced and proliferated pigment, or they may occur in disseminated small patches of various shapes, and at different parts of the fundus. Often such changes first make their appearance at the equator, for which reason, as already observed, it is important to make careful examination of the peripheral portions of the fundus. Cases in which the retinal pigment is scarce, whilst the cells in the choroid are densely pigmented, give rise to such a curious mottled appearance that one is apt to consider the condition pathological. This is, however, only justifiable when different portions of the fundus present widely different appearances in this respect, or when, though little or no view of the choroid is obtained in some situations, it is distinctly visible in one or more localities; we may then assume that there has been some process leading to change or atrophy in the hexagonal cells, an assumption which can often be verified by proper subjective tests.

Choroidal changes are often limited to the region of the macula, especially in old people, so that an examination of that region should always be made when an amblyopic defect is unaccounted for by appearances elsewhere. It is often very difficult to get a distinct view of the centre of the retina, owing to the fact that the concentration of light on the macula causes great contraction of the pupil, besides which, the reflection from the cornea frequently adds to the difficulty. It is, therefore, necessary to use some mydriatic, the most convenient for such purposes being homatropine. In the form of retinal sclerosis or inflammation which has received the name of retinitis pigmentosa, there are generally to be seen, besides atrophic changes in the nerve and vessels, a number of bone-corpuscle-shaped pigmentary spots, which may easily be made out to lie well into the retina. Their appearance is very characteristic, and is most frequently met with

in a ring-shaped distribution between the centre and equator.

With the exception of the scleral ring, to which reference has been made above, no portion of the sclerotic is visible with the ophthalmoscope in a healthy eye. A beautiful ophthalmoscopic appearance is given by a somewhat rare congenital defect, which consists in the partial absence of the choroid. In this condition of coloboma of the choroid the sclerotic is brought into view lying as a bright white membrane below the transparent retina, the vessels of which may be seen crossing it at various places. A defect of the choroid allowing the sclerotic to come into view is also met with as the result of accident—rupture of the choroid. The ophthalmoscopic appearances of this accident are at first frequently so veiled by the hæmorrhage accompanying it, and which destroys for the time being the transparency of the vitreous humour, that it is generally not until some time that a distinct view is obtained. The rupture generally takes place at the back of the choroid, in the vicinity of the nerve and macula. G. A. Berry.

OPISTHOTONOS. *See* Tetanus.

OPTIC NERVE, Diseases and Injuries of the.—Congenital Abnormalities.—A. Not infrequently there is a very delicate veil of connective tissue over the central blood-vessels at their exit, and for a short distance beyond. Sometimes this condition is much exaggerated, rendering the disc decidedly pale, and obscuring the vessels.

B. Imperfect closure of the embryonic fissure in the optic cup and adjacent part of the pedicle leads to coloboma of the iris, choroid, or optic nerve-sheath, according to the part involved. The latter—coloboma of the sheath of the optic nerve—is comparatively rare. The main branches of the central vessels are seen to emerge near the upper edge of the disc-area, while the lower part, corresponding to the cleft in the sheath, is very pale and deeply excavated, with fine vessels curving round its margins. The appearances vary considerably in different cases, and the condition is frequently accompanied by coloboma of the neighbouring part of the choroid below.

Diseases.—The optic nerve, with its retinal expansion, is a direct prolongation of the brain, and it will be well to bear in mind this relationship as serving, in some measure, to explain their peculiar liability to suffer in intracranial disorders. For the ophthalmoscopic appearances of the normal optic disc and its variations, *see* Ophthalmoscopy.

Pathology.—This nerve is peculiarly prone to suffer in affections of the central nervous system, in some forms of chronic poisoning, and in certain general disorders. Inflammation of an acute or chronic character may attack it at any point in its course, may affect its whole thickness or only a part of it, and may or may not lead to permanent atrophy, total or partial. Again, without recognised inflammation, the nerve may undergo degenerative changes resulting in a simple atrophy. Occasionally, the occurrence of an inflammation or simple atrophy of the nerve is intelligible enough, as, e.g., an optic neuritis in association with orbital cellulitis, or a simple atrophy subsequent to rupture of the nerve-trunk. Generally, however, the pathological process is most difficult to trace, and our knowledge must still rest largely on hypothesis. It is impossible, in the space at our disposal, to enter into discussions as to the relation between optic neuritis and intracranial disease, &c.; but the following facts should be remembered in connection with the exceptional vulnerability of this nerve.

1. From its development and structure the optic nerve is to be regarded as a direct prolongation of the central nervous system, and is therefore to be distinguished from ordinary cerebro-spinal nerves.

2. Their position and long course along the base of the brain render the nerves, commissure, and tracts liable to be affected in inflammation of the membranes in this locality and in cases of intraventricular pressure.

3. The sheaths of the nerve are derived from the membranes of the brain, the outer having also a connection with the periosteum lining the orbital canal. These sheaths are in close relation with one another by means of numerous connective-tissue processes throughout their course, and the innermost sheath enters intimately into the structure of the optic nerve, besides sending a special, large process to accompany the central blood-vessels, and run in the axis of the nerve. Ultimately, the sheaths join the coats of the eyeball at the optic nerve-entrance, where they are associated with the fibrous processes forming the lamina cribrosa. We thus have the possibility of a direct transmission of an inflammation, of the meninges or of the orbital periosteum, along the sheaths to the fibrous framework of the nerve itself; which latter may be attacked at the lamina cribrosa, at the en-

trance of the blood-vessels, at the optic foramen, or along its course in the orbit.

4. The inter-vaginal spaces of the nerve are in connection more or less intimate—(*a*) With the meningeal cavities of the brain; (*b*) with one another; (*c*) with the lymphatic spaces around the nerve-fibre bundles; (*d*) with the lymph-channels of the surrounding orbital tissue. The fluid circulating in the lymphatic system of the nerve may therefore contain inflammatory material, primarily derived from within the cranium, or possibly from the orbital tissue, and thus an inflammation may be communicated to the nerve framework. Again, serous fluid or blood effused in the meningeal cavities may find its way into the sheath-spaces, and injure the nerve by direct pressure.

5. The absence of a primitive sheath possibly renders the nerve-fibres more vulnerable in the post-bulbar portions, while, in the intra-ocular portion of the nerve, the naked axis-cylinders are directly exposed to the action of the lymph.

6. The narrowness of the optic foramen is liable to cause further constriction in an already existent œdema, while, in like manner, the disposition of the lamina cribrosa tends to promote a similar effect by its pressure on the blood-vessels and lymphatics. Finally, it must be borne in mind that we can detect inflammatory and atrophic changes in this nerve, which might readily escape notice in other cranial nerves.

1. Inflammation of the Optic Nerve. *Pathology.*—The optic disc or papilla, or intraocular end of the nerve, is the part commonly affected; and then the inflammation generally stops abruptly at the lamina cribrosa, but may exceptionally extend a short way beyond this structure as an 'ascending neuritis.' In other cases, an inflammation, beginning in the nerve-trunk, may travel downwards and involve the papilla secondarily, constituting what is called a 'descending neuritis.' 'Papillitis' is a useful term for the condition in which the papilla is involved, the expression 'optic neuritis' being retained as the generic term for inflammation of any part of the nerve. When the inflammation attacks the nerve-trunk behind the eyeball, we speak of it as a 'post-bulbar neuritis.' In many such cases no papillitis is ever manifest. All forms of neuritis are probably interstitial in nature, yet the early stage of a severe papillitis is unaccompanied by affection of the connective-tissue, the changes merely consisting of venous hyperæmia, œdematous infiltration, and hypertrophy of the axis-cylinders. If the inflammatory process stop short at this stage, and recovery take place, we may ultimately get a healthy disc and retention of normal vision.

In an interstitial inflammation we have, at first, cellular infiltration and swelling of the vascular connective-tissue framework, and, subsequently, hypertrophy of this structure; so that the nerve-fibre bundles become reduced in size from pressure, and either finally disappear or undergo grey degeneration (post-papillitic atrophy). In the later stage of a papillitis, the walls of the blood-vessels are thickened, the adventitia being increased, and the middle coat of the arteries often considerably sclerosed. The surrounding retina is frequently affected for some distance, changes of a similar nature to those in the papilla occurring in the nerve-fibre layer (papillo-retinitis). As previously observed, optic neuritis does not necessarily affect the nerve in its entire thickness. In some cases the periphery is mainly involved, and we have the condition known as 'perineuritis.' In other cases, the inflammation is limited to the central part of the nerve affecting the fibres going to the fovea centralis and neighbourhood, as in the variety called 'axial neuritis.' As a rule both nerves are affected, and similarly, though not necessarily to the same degree, nor at the same time. Unilateral optic neuritis is generally dependent on a local cause, such as orbital cellulitis; but it may also occur in association with intracranial tumour, &c.

Ophthalmoscopic Appearances.—We must be extremely cautious in diagnosing positively the slighter departures from the normal vascularity of the papilla, since its colour varies considerably in health in different individuals, and it is also subject to temporary hyperæmia from vasomotor influences. It is always desirable to employ the direct method of ophthalmoscopic examination (*see* Ophthalmoscopy); but especially so when the apparent changes are insignificant; and we must invariably examine both eyes. The condition called 'active hyperæmia' is recognised by a slightly increased, general vascularity of the papilla, its tint being of a more pronounced red than is normal, but the relative size of arteries and veins remaining unaltered. The edge of the disc may be less sharp than usual; but it is not obscured, and there is no swelling. We find it as a result of prolonged exertion of the eyes by

artificial light, also in muscular or accommodative asthenopia, and from the irritation of foreign bodies, &c. In 'passive congestion' of the papilla we not only have increased redness, but also dilatation of the veins, the arteries being of normal size or slightly diminished. Between a simple congestion, with the characters just mentioned, and a fully-developed papillitis or 'choked disc' there are many gradations, marked by more or less swelling, blurring of the edges, and obscuration of the larger vessels. These gradations may simply be stages in the development of a high degree of papillitis, or any one of them may be the final condition where the affection of the papilla is of less severity.

In advanced papillitis the appearances are the following:—The edge of the disc is obscured and, while its general vascularity is greatly increased, there is a loss of translucency, with a greyish haze dulling the usual bright reflex. The whole papilla is distinctly swollen above the level of the adjoining retina, and the physiological cup is obliterated. Numerous straight vessels radiate from it on every side, coursing over its obscured edge. The larger vessels, especially the arteries, are frequently hidden at their origin on the papilla, and again in their course over it or just outside it. Frequently, small hæmorrhages occur either on or in the vicinity of the disc. Smooth, opaque, white spots occur on the disc or on the surface of the adjoining retina, concealing completely what they cover. The veins are enlarged, dark and tortuous, and the normal light-streak is absent. The arteries are usually somewhat narrowed. The retina, especially near the disc, is frequently cloudy over smaller or larger areas. The swelling of the papilla and the obscuration of its margin are to be explained by the action of several distinct factors—viz. vascular congestion, œdema, changes in the connective-tissue (swelling and proliferation of nuclei), escape of leucocytes, and degenerative changes in the nerve-fibres, accompanied by swelling and irregular enlargements. The striation near the margin of the disc is due to the presence of dilated vessels, running between the swollen nerve-fibres. The increased vascularity is at first inflammatory, but, later, it is partly owing to secondary interference with venous return; this latter is also the cause of the enlargement and tortuosity of the veins, and of the occurrence of the hæmorrhages. The opaque white spots are due to fatty degeneration of the nerve-fibres, and to aggregations of leucocytes.

As the papillitis diminishes, we find the redness of the papilla disappearing, while the swelling becomes reduced both in height and extent. The veins may, for a time, be more distended than before, but generally all the vessels are ultimately much narrowed. The edge of the disc again becomes distinct, the outer margin coming first into view. Around it there is frequently a pale zone, the result of changes in the retinal pigment. The disc itself is opaque and woolly-looking at first, but it gradually becomes smoother; its surface is occupied by newly-formed fibrous tissue which conceals the lamina cribrosa. In the stage of atrophy, the disc is usually of a brilliantly white colour, and the larger vessels are frequently bordered by opaque white lines. In cases of post-bulbar neuritis, the resulting atrophy is frequently the first ophthalmoscopic sign of the disease, but occasionally we have simple passive congestion or even considerable papillitis preceding the atrophic condition.

Symptoms.—Not only do we usually have no ocular pain or photophobia, but there may not even be any complaint of loss of vision. Indications of intracranial disease often lead us to examine the eyes, and thus to discover well-developed ophthalmoscopic signs of neuritis, in cases where there have been no local symptoms. Vision may remain perfectly good for some time; indeed, in exceptional cases, papillitis may occur and disappear again without its ever being impaired. Usually, however, loss of sight is a prominent symptom. It sometimes occurs rapidly, but never suddenly, and one eye is generally attacked a little before the other. If amblyopia occur quickly in an early stage of the papillitis, it is usually not due to the inflammation, but to pressure of a tumour or distended third ventricle on the chiasma or optic nerve. The form of the amblyopia varies according to the kind of the neuritis. In that due to an ordinary papillitis we have a gradual failure of central vision, with progressive diminution of the visual field from the periphery. The contraction usually begins on the nasal side, extends gradually all round, and, after the fixation point has been invaded, we may still have a small eccentric outer field. The colour vision in such a case may be lost out of proportion to the amblyopia, but the kind of failure is very irregular. In many cases of post-bulbar neuritis—in the axial form for example—we have the amblyopia first appearing as an impairment of central vision, while the periphery of the field re-

mains perfect. The loss of colour vision is here characteristic; the power of distinguishing red and green in a small central area being often lost in the very beginning of the affection. In some of the post-bulbar cases there is deep-seated pain in the orbit, excited or aggravated by pressing the eyeball backwards.

Causes.—Intracranial disease is by far the most common cause of papillitis. All tumours of the encephalon, irrespective of their nature, position, or size, are apt to produce it; but it is relatively rarer in tumours affecting the cortical motor area and the medulla, and most frequent in those of the cerebellum and base. We also find it in association with meningitis (especially traumatic and tubercular basilar), with cerebral abscess, and sometimes with chronic cerebritis without gross lesion. Injuries to the head may cause optic neuritis either through meningitis, effusion of blood (within the skull or within the nerve-sheath), hernia cerebri, or possibly through a laceration of the brain. It occasionally accompanies internal hydrocephalus, or aneurism of the internal carotid artery within the skull. In many orbital affections we are liable to get optic neuritis: (*a*) in orbital tumours, especially when situated in the immediate vicinity of the nerve; (*b*) in intraorbital inflammation, such as periostitis and caries of the walls, orbital cellulitis and erysipelas, whether traumatic or idiopathic; (*c*) in congenital malformation and hyperostosis of the skull, from narrowing of the optic foramina. In (*a*) there is usually protrusion of the eyeball; in (*b*) the papillitis is seldom of high degree; in both (*a*) and (*b*) the neuritis is nearly always one-sided. Papillitis has also been observed in association with acute myelitis, and in cases of injury to and caries of the spine in the cervical region.

Occasionally, we get papillitis occurring alone in cases of Bright's disease, but usually we have here a peculiar form of retinitis in combination with it. In chlorosis, and in progressive pernicious anæmia, we may meet with papillitis or papillo-retinitis, and also, more rarely, in leucocythæmia. In the anæmia following repeated large losses of blood, for example in hæmatemesis, papillitis has been described, but more commonly we get post-bulbar neuritis in such a condition. In these latter cases, the neuritis has been ascribed to the hydræmia, which according to Cohnheim may in itself excite inflammation in the vascular walls. Papillitis occasionally occurs in association with menstrual disturbances, such as sudden suppression or habitual irregularities, and at the climacteric period. Acquired syphilis may be the cause of optic neuritis, either through meningitis or a gummatous growth, the latter being situated either within the skull, at the optic foramen, or on the nerve-trunk; the neuritis is mainly post-bulbar, and generally one-sided when the gumma is in one of the last two situations. A temporary 'hyperæmia' of the papilla has also been described as occurring in a considerable percentage of cases of syphilis during the secondary stage, attributed to a 'cerebral irritation or hyperæmia.'

In diabetes mellitus we get an axial neuritis, and, from the similarity of the symptoms in chronic poisoning by lead, alcohol, tobacco, and bisulphide of carbon, a similar affection of the optic nerve probably also exists in these latter affections. In the more acute cases of poisoning by these agents, slight papillitis or simple congestion of the papilla may be observed. Papillitis or post-bulbar neuritis sometimes occurs in patients suffering from acute exanthematous diseases (typhus fever, scarlatina, variola) and from malarial fevers. An acute post-bulbar neuritis or papillitis without definite known cause is occasionally met with. A certain number of such cases has been ascribed to a rheumatic periostitis at the optic foramen or to rheumatic inflammation of the nerve-sheath, in as far as there is a history of the arthritic diathesis, and often of a chill preceding the ocular symptoms. Other obscure cases seem due to an hereditary predisposition, and occur usually about the age of twenty, and almost exclusively in males. Optic neuritis is sometimes merely caused by an extension of an inflammation from a neighbouring tissue in the eyeball, and it has also been observed in an early stage of sympathetic inflammation, before the occurrence of iritis.

The *prognosis* in all cases of optic neuritis must be guarded, in reference to the final condition of the vision. The ophthalmoscopic appearances presented are of less service to us, in this respect, than a knowledge of the cause of the disease. We may have a papillitis with good vision leading ultimately to complete atrophy and blindness; while again, we may have a papillitis with the barest perception of light (as in occasional post-bulbar cases), followed by almost perfect recovery of sight. The prognosis is relatively more favourable where the cause is removable or amenable to remedies; thus, cases dependent on syphilis, menstrual disturbances, or anæmia may

recover without serious permanent changes under early suitable treatment. Similarly, an axial neuritis from chronic poisoning by tobacco, alcohol, &c., is speedily checked by removal of the cause; but the impairment of vision may remain, if atrophy of the affected fibres has already taken place.

Treatment.—The cause of the neuritis must if possible be removed, or attacked by the remedies most likely to prove serviceable. Where not contra-indicated or manifestly useless, mercury and iodide of potassium should be employed as a matter of routine, the latter being given in full doses. Rest in its widest acceptation is to be insisted upon. The direct treatment of the neuritis itself is unsatisfactory. Dry or wet cupping by means of Heurteloup's artificial leech to the temple, and blisters to this region or behind the ear may be tried. The application of ice to the forehead has also been recommended.

2. Atrophy of the Optic Nerve.—*Pathology.*—Whether the atrophy be the result of changes within the eyeball or behind it, the nerve is invariably affected ultimately in its entire length. The nervous elements of the trunk are involved in all true cases, and there is a corresponding loss of function. The histological condition of the atrophied nerve varies somewhat, according to the nature of the pathological process producing it, and different appearances may be presented in sections through different parts of the same nerve-trunk. Thus, in *atrophy the result of a neuritis* we find the usual post-inflammatory changes at the seat of the inflammation, while the rest of the nerve may present the appearances found after a simple or non-inflammatory atrophic process. As previously mentioned, neuritis leads to hypertrophy of the interstitial connective tissue; the consequent contraction of the meshes in which the nerve-fibre bundles lie subjects the latter to pressure, interfering at first with their function, and ultimately with their vitality. The nerve-fibres involved finally either break down and are removed, or they undergo grey degeneration; in the former case, the diameter of the nerve is much reduced from contraction of the fibrous tissue.

In the case of a neuritis at or near the intraocular end of the nerve, the walls of the central blood-vessels are thickened, and their lumen is diminished—partly in consequence of this change in their walls, but mainly from the pressure exerted by the hypertrophied connective-tissue. In *simple atrophy* there is seldom much increase of connective-tissue. The nerve-fibres lose their white medullary sheath by a process of granular fatty degeneration, while the axis-cylinders are usually retained, but converted into fine indistinct fibrils. There is, consequently, little change in the size of the nerve, which presents the appearance of a translucent, grey, gelatinous-looking cord. This 'grey degeneration,' as it is called, is the most common form of simple atrophy. According to some authorities, this degeneration is really dependent upon a 'medullary neuritis.' It may be *diffuse*, affecting the whole nerve uniformly; or *insular*, and varying much in extent in different sections. Occasionally, however, we find considerable thickening of the connective-tissue framework due to a sclerosis, which, though not clearly traceable to an inflammation, is probably the result of a very chronic form of neuritis. In other cases of simple atrophy, the smaller blood-vessels of the nerve-trunk are found immediately surrounded by masses of a peculiar, gelatinous-looking material, between which lie the degenerated nerve-fibres. There is little increase in the connective-tissue in this form, but the normal arrangement of the trabeculæ is destroyed. In the great majority of cases both nerves are affected, though one may be considerably in advance of the other. Unilateral optic atrophy is to be explained by the one-sided nature of the preceding inflammation or other local cause.

Causes.—All cases of atrophy of the optic disc may be divided broadly into two great classes—(*a*) *inflammatory* and (*b*) *non-inflammatory* or *simple*. (*a*) Those due to inflammation are traceable either to a papillitis, a post-bulbar neuritis, or to an inflammation of the choroid or retina. (*b*) Simple atrophy may be primary or secondary. The *primary* form is usually the result of a grey degeneration, commences independently of any local cause, and is characterised by the occurrence of visible atrophic changes consentaneously with gradual failure of vision. In the *secondary* form, the loss of vision precedes the atrophy. *Primary* atrophy not infrequently occurs in association with disease of the central nervous system, especially with locomotor ataxy, but occasionally also with cerebral atrophy, mania, general paralysis of the insane, congenital idiocy, disseminated sclerosis, and lateral sclerosis of the cord. When found uncomplicated with other nerve-lesion, the remote causes assigned are the same as those which are given for the occurrence of grey degeneration in the central nervous system; and it would therefore seem probable that, due to the

action of certain causes, grey degeneration may occur independently in the brain, spinal cord, or optic nerves, and may be confined to one or other of these situations. Accordingly, we find male adults of the neuropathic disposition, from thirty to fifty, predisposed to this form of atrophy. The more immediate causes mentioned are severe bodily fatigue and hardships, especially exposure to cold and insufficient nourishment, grief and anxiety, mental excitement and exhausting brain-work, irregular habits of life, sexual excess, &c. Frequently no cause can be assigned.

The *secondary* form of simple atrophy includes all those cases where an interruption of conductivity in one part of the nerve leads to subsequent atrophic changes in the remainder, as in cases of injury where the nerve is cut across or torn through. Secondary atrophy may also arise from interrupted blood-supply (as from embolism), and from mechanical pressure (as from tumour, inflammatory exudation, bone-spicules, foreign bodies, &c.). Strictly speaking, the changes in many of the inflammatory cases are also of this nature; a localised neuritis leading to secondary atrophy in the rest of the nerve-trunk. Syphilis is a productive cause of optic atrophy and may induce any of the inflammatory forms above mentioned, or may lead to a secondary atrophy (as from the pressure of a gummatous exudation at the optic foramen, &c.). We frequently also get a specific history in cases of simple grey degeneration.

Ophthalmoscopic Appearances. — All forms of optic atrophy are recognisable by the ophthalmoscope sooner or later, inasmuch as the intraocular end of the nerve is always ultimately involved. The elements of the optic disc which undergo the atrophic change, are the nerve-fibres and the capillaries. Atrophy of the capillaries is to be diagnosed by the pallor produced, while nerve-fibre atrophy is ophthalmoscopically recognisable when an atrophic excavation exists. This latter, however, is often absent, since the space formerly occupied by nerve-fibres may be filled, or more than filled, by connective-tissue growth. We judge of the atrophy chiefly, therefore, by the *colour*, and much caution must be exercised in the observation, as the disc varies considerably in this respect, in different individuals, within physiological limits. It is particularly unsafe to diagnose pathological pallor of part of the disc, unless the vision be correspondingly affected. The colour of the atrophied disc may be white or grey, according to the amount of fibrous tissue present. Not infrequently it is of a bluish or greenish tint, probably from the presence of a thin film of connective tissue in front of its surface. Variation in tint alone is generally inadequate for a conclusion as to the causation of the atrophy, in so far as similar anatomical changes in the nerve may be the result of a neuritis and of a simple atrophy.

The *excavation* in atrophy comes quite up to the margin of the disc all round, and is to be recognised by a change in the level of the vessels. It is never very deep, and slopes gradually backwards from the edges, so that the condition might be termed 'saucering' in contradistinction to the deep, steep-sided 'cupping' found in chronic glaucoma. Its occurrence and its depth are determined—(*a*) by the size and form of a previously existing physiological cup; (*b*) by the degree of wasting of the nerve; (*c*) by the amount of new connective-tissue formed; and (*d*) by the contraction which has taken place in this latter. At the bottom of the 'saucer' the lamina cribrosa may be visible over a large area, or it may be quite concealed by the newly-formed tissue. Usually, the edge of the disc is well-defined, and the normal scleral ring is traceable all round. The central retinal vessels are in some cases much diminished in size; in others only very slightly, if at all. Apart from cases of embolism, the reduction may be caused by changes in the vascular walls, pressure on the artery from connective-tissue hypertrophy, or by atrophic changes, in the inner layers of the retina, interfering with the circulation through the larger branches which run there.

In the post-papillitic form of atrophy, the disc is usually white; its margin is distinct, but often irregular-looking from a loss of pigment due to choroido-retinal changes; the central vessels are often bordered by opaque white lines, and are considerably reduced in size; the excavation is absent or slight, and the lamina cribrosa is invisible. In the atrophy consequent on choroido-retinal changes, the disc has generally a peculiar opaque, yellowish-red, 'waxy' appearance, and the retinal vessels are greatly diminished in size and sometimes in number. In the partial atrophy from axial neuritis, the pallor is confined to the temporal half of the disc. For a description of the form of atrophy due to increased intraocular tension, *see* GLAUCOMA.

Symptoms.—The most prominent symptom in cases of optic atrophy is failure of vision. The nature of this failure has been

already described in cases of atrophy secondary to neuritis. In atrophy from choroiditis and retinitis the failure is usually gradual, central vision often remaining fairly acute while the rest of the field has become amblyopic. In the secondary form of simple atrophy the vision often fails suddenly; sometimes only one-half of the visual field is lost, as in some cases of pressure on the chiasma. In primary atrophy, the loss of vision begins gradually and proceeds slowly and continuously. Besides the central failure, there is marked contraction of the visual field, sometimes occurring in a uniform, concentric matter, but more frequently in the form of sector-shaped defects, usually situated above and to the outer side of the fixation point. Affection of the colour-sense is almost constant, green being generally the colour first confused, while later, perception fails for red, blue, and, lastly, yellow. In the final stage of atrophy all colour-distinctions are lost, but there is no constant relation between the degree of the loss of colour-sense and the amount of the amblyopia. The pupils are usually wide in post-papillitic atrophy, small in spinal cases, and often of medium size in other forms. *See* Amblyopia; Amaurosis; Perimetry.

The *prognosis* is unfavourable in all cases of true optic atrophy, but it is relatively less so where the atrophy is dependent upon some cause which is either removable, or which may pass away spontaneously. In some of the post-papillitic cases, also, considerable improvement takes place, if the sclerosing process do not lead to excessive pressure on such nerve-fibres as may have escaped destruction by the inflammation. In very exceptional cases we may get a restoration of normal vision under treatment, the disc remaining in the condition of white atrophy. In marked contraction of the visual field, and in cases of long-standing amblyopia, little or no improvement is to be expected. In cases of primary atrophy, almost complete blindness usually occurs in from one to three years.

Treatment.—Where the atrophy is dependent on some general condition or toxic influence, the treatment must be regulated accordingly. Nervine tonics are said to be occasionally useful. Where the atrophic process has not gone too far, the continuous current is sometimes beneficial. One pole should be applied over the closed eyelids and the other over the supra-orbital nerve, the current being broken pretty frequently and the poles transposed. The smallest number of cells which gives the physiological light-flash on making and breaking the circuit should be employed, and the whole sitting should last about five minutes and be repeated daily for at least a month. If no improvement take place in this time, either in central acuity or in visual field, this treatment may be abandoned. If any marked benefit result, the current should continue to be employed at intervals. The patient is quite capable of carrying on the treatment for himself, after having once been properly instructed.

Tumours of the Optic Nerve.—The intraocular end of the nerve may be the seat of large colloid outgrowths from the vitreous lamina of the choroid. It may also be affected secondarily in sarcoma of the choroid, or in retinal glioma, the former spreading along the sheath and fibrous framework, the latter in the medullary substance of the nerve. The nerve-trunk (including its inner sheath) may be the original seat of tumours, or it may be involved secondarily by the extension of growths arising in the outer sheaths or in the orbital tissue around. The most common form of tumour proper to the nerve is the myxo-sarcoma. It leads to proptosis, papillitis or simple atrophy, and early blindness; the movements of the globe are usually good, and there is little or no pain. The intracranial part of the nerves and the chiasma are especially liable to gummata, and the chiasma may also be the seat of a deposit of cheesy tubercle. In most cases of tumour of the optic nerve, excision of the eyeball and tumour will be required. *See* Eyeball, Excision of the; Orbit, Tumours of the.

Injuries to the Optic Nerve.—The optic nerve may be injured in any part of its course, either as the result of a blow, stab, gunshot wound, or fracture of the sphenoid bone. A powerful blow on the side of the eyeball may cause the nerve to be torn away at its entrance into the globe. A stab or thrust into the orbit may cut or tear the nerve; or, again, may merely bruise it, cause an extravasation of blood within its sheath, or sever the central vessels outside its trunk. If a foreign body penetrate deeply, it may produce a fracture of the orbital walls, not infrequently breaking off and forcing backwards the clinoid process of the sphenoid bone, and thus leading to injury of the nerve. Similarly, gunshot wounds may implicate the nerve either in its orbital or intracranial course, and pellets or fragments of metal may penetrate the eyeball and become embedded in the papilla. Fracture of the base of the skull, as from a fall or severe blow on the head, occasionally causes injury to the optic nerve at the

optic foramen, or behind it if the clinoid process be displaced. Sudden complete blindness of the corresponding eye is usually the result of any severe injury to the nerve. If the solution of continuity be complete, permanent blindness is the consequence; if incomplete, we may get restoration of vision in part of the field. If the nerve be simply bruised or pressed upon, sight may be restored; but secondary changes may occur in such a case, leading to ultimate atrophy. The ophthalmoscopic appearances differ according to the position of the injury. If the central artery be cut or torn through, we find changes in the fundus similar to those met with in embolism of the central artery. In other cases, the disc remains normal in aspect until the atrophic process reaches it, when it gradually assumes the appearance of an ordinary secondary atrophy with normal vessels. The treatment of the recent injury must be based on general surgical principles. Later on, if the continuity of the nerve has been preserved, the measures recommended above in optic atrophy may be of some avail.

R. Marcus Gunn.

ORBIT, Diseases of the.—Abscess of the Orbit may be caused by blows on the eye or the adjacent parts, causing an effusion of blood into the orbital cellular tissue; or by any violence producing fracture of the orbital walls; or by penetrating wounds of the orbit; by the lodgment of a foreign body in the cellular tissue of the orbit; or by the extension backwards of a suppurative inflammation of the lids or of the tissues in immediate contiguity with the eye, no matter how induced. Orbital cellulitis, brought on by any cause, may terminate in abscess of the orbit. Caries, necrosis, or orbital periostitis may lead to abscess of the orbit.

Abscess of the orbit may be either *acute* or *chronic*.

Acute Abscess of the Orbit is marked by the rapidity with which the inflammatory symptoms are developed—deep-seated pain in the orbit extending around the brow, worse at one time, better at another, but never absent, and steadily increasing in severity. Any pressure on the eye, or even moving it, aggravates the pain. The eyelids become red, shining, and œdematous, and the conjunctivæ of the lids and globe vascular, swollen, and chemosed. The eye now begins to protrude slightly beyond the level of the other, and this protrusion increases with the inflammatory exudations until, at last, the pus makes its way to the surface. The displacement of the eye is usually not directly forwards, but more or less downwards and outwards, or downwards and inwards, according to the part of the eye on which the abscess presses. With the increasing protrusion of the globe the sight may become impaired, from the strain which is exerted on the optic nerve. The orbital fold of skin above the lid becomes obliterated, and the upper lid so swollen and stretched in front of the bulging eye that it cannot be raised by the patient. Over the most prominent part of the swelling a careful examination with the fingers will detect fluctuation. The most usual spot for the pus to point at is rather to the inner side of the interval between the supra-orbital ridge of the orbit and the upper border of the globe. Occasionally, the suppuration is more or less confined to one or other side of the orbit, and it may then point at either the inner, outer, or lower border of the eye. When the abscess is small, there may be little or no displacement of the eye. With all these local symptoms there is always considerable constitutional disturbance. The skin is hot and dry, the patient has occasional rigors and frequently night sweats, he is restless, and his sleep is broken from pain.

Chronic Abscess of the orbit is distinguished by the slowness of the development of its symptoms, and frequently by the absence of any severe pain. It often happens that the patient does not even seek advice, until an increasing protrusion of the eye with some diminution of vision excites alarm.

The diagnosis of chronic abscess of the orbit is sometimes difficult, and it may be confounded with a sarcoma or some soft orbital tumour, the elasticity of which closely resembles fluctuation. When there is doubt, an exploratory incision should be made into the tumour, and the surgeon should be prepared to act at once on the information it will afford him. If it be an abscess, the incision should be enlarged sufficiently to give free exit to the pus; but if it should prove an orbital tumour, it should, if practicable, be removed without any further delay.

Treatment of Orbital Abscess.—As soon as it is clear that pus has formed, a free opening should be made into the orbit for its escape. The site for making the incision should be that spot where there is the most distinct swelling and fluctuation, and where the pus has a tendency to point. In making the incision into the orbit, it is a wise precaution to place one finger of the

left hand on the lid so as to feel the globe, and to pass the knife between the nail of the finger and the edge of the orbit, as, if the incision is carelessly made, it is quite possible to wound the eye. The best knife for the purpose is a Beer's or Sichel's cataract knife, as the point is very sharp and the blade very thin, and with it the incision can be made easily and with safety. After the incision has been made and the pus allowed to escape, a strip of oiled linen should be inserted a short distance into the wound, to prevent the lips uniting; or a small india-rubber drainage-tube may be placed in the wound. A warm linseed-meal poultice should then be applied. The strip of linen or the drainage-tube should be changed daily for two or three days, when they may be removed. It is only necessary to continue the linseed-meal poultice for about forty-eight hours, when a fold of lint, soaked in a solution of carbolic acid about 1 part in 100 of water, may be applied and covered with oiled silk. In most cases the cavity of the abscess soon closes, and the patient makes a good recovery. It occasionally happens, however, that the wound from the incision only partially closes, and a long sinus remains, from which a slight purulent discharge continues to drain. When this is the case, and when no fragment of necrosed bone can be detected by a probe to account for it, the use of a stimulating injection, such as Zinci sulphat. gr. ij. ad f℥j., or Zinci chlorid. gr. j. ad f℥j., thrown into the sinus with a glass syringe twice a day, will often prove of great benefit. If, however, a portion of dead bone is felt with the probe, time must be given to allow of its becoming detached, or at least partially loosened from the living structure; and then, after enlarging the orifice of the sinus, it may be removed with a pair of fine sequestrum-forceps, first using, if necessary, a gouge or an elevator, or a pair of fine cutting bone-forceps to separate any portion of bone which may be holding it.

Periostitis of the Orbit may occur in two localities—(1) in the circumferential ridge of the orbit, and (2) in the walls of the orbit.

(1) When the ridge of the orbit is the part affected, the periostitis is generally due either to a blow on the edge of the orbit, or to some constitutional defect in the patient, as struma, when a portion of the bone, or of the periosteum covering it, without any apparent cause inflames. In either case an abscess forms, which continues for a long time to discharge a little pus and gradually contracts to a sinus, at the bottom of which a piece of necrosed bone may be felt with a probe. Ultimately a scale of bone is exfoliated and the part heals, leaving a depressed scar, which is adherent to the subjacent bone.

(2) Periostitis of the walls of the orbit is generally *chronic*, and due to syphilis, although it undoubtedly may arise from injury, such as penetrating wounds of the orbit or foreign bodies within the orbit. Syphilitic periostitis of the walls of the orbit usually leads to the formation of nodes or the effusion of lymph beneath the periosteum. These nodes are not common, but when they do occur they often suppurate, and a portion of the subjacent bone either exfoliates or becomes carious. The most frequent position of a syphilitic node adjacent to the orbit is on the frontal bone, just over the brow, and rather to the outer side.

Acute periostitis of the orbit rarely occurs, but when it does it is generally due to injury—either blows, possibly causing fracture of the walls of the orbit; or penetrating wounds; or the lodgment of foreign bodies in the orbit.

Treatment.—As chronic periostitis which is not due to injury is almost invariably dependent on syphilis, in many cases dating back many years, the most useful medicine is the iodide of potassium, which should be given in the first instance in doses of from gr. iij. to gr. v. three times a day; but if these fail to do good, the dose may be increased to gr. viij. or gr. x. To relieve pain and favour the absorption of the effused lymph, an ointment of Extract. belladonnæ gr. lx., Unguent. hydrarg. ʒvij. may be rubbed into the brow daily. If the pain be very severe, opiates may be given at night, or, if preferred, a subcutaneous injection of from gr. $\frac{1}{6}$ to gr. $\frac{1}{3}$ of the acetate of morphia. If these remedies fail, the following mixture may be ordered—Hydrarg. perchlorid. gr. j.; Potassii iodid. gr. lx.; Tinct. calumbæ f℥ij.; Aquæ destillat. ad f℥vj. Dose—Two teaspoonfuls in a wineglass of water three times a day.

If the node within the orbit should soften and pus be formed, an opening should be made to give vent to it; and if a chronic discharge continue, and this be found dependent on a piece of dead bone not yet detached, the sinus should be syringed out once or twice a day with a weak solution of carbolic acid, about ♏iij. ad f℥j. As soon as the probe detects that the bone is loosened, the sinus should be enlarged and the exfoliated portion removed with a pair of forceps.

Necrosis and Caries of the Orbit.—Necrosis of a portion of one of the orbital bones is generally induced by an injury, or by an acute orbital abscess. Caries is usually produced by some constitutional taint, such as syphilis or struma. Both caries and necrosis may follow orbital periostitis.

Treatment.—For necrosis, time should be given to allow the dead portion of the bone to become detached from the living structures; and then, guided by a probe, passed along the sinus by which the discharge escapes, an incision should be made down to the necrosed bone, which should be removed with a pair of fine sequestrum forceps.

When there is caries, the object of the treatment is to obtain healthy action in the carious bone, and thus produce cicatrization. The remedies must be both constitutional and local. If there be a syphilitic taint, the iodide of potassium, gr. iij. to gr. v., combined with ferri et ammon. citrat. gr. v. in water, may often do good, or the same doses of the iodide combined with gr. x. of the bromide of potassium may be given; or if these fail, other anti-syphilitic remedies may be tried. When caries is due to a strumous diathesis, cod-liver oil, and the syrup of the iodide or hypophosphite of iron will generally do good, especially if the patient can at the same time obtain sea air and a good nutritious diet. George Lawson.

ORBIT, Injuries of the.—Fracture of the Bones of the Orbit may be produced by blows on the head or face, and either the roof, the inner wall, or the floor of the orbit may be fractured.

If the ethmoidal cells have been broken, there is frequently emphysema of the lids and surrounding parts, which is caused by the patient forcibly driving the air through the broken cells when he blows his nose. Fracture of the orbit is frequently associated with fracture of the anterior fossa of the base of the skull, when the presence of blood beneath the conjunctiva is sufficient to indicate that the fracture has extended into the orbit.

There is one form of fracture which is confined to the walls of the orbit, and which is very fatal. It is what may be termed a punctured fracture, and is commonly produced by a forcible thrust in the orbit with a sharp or semi-blunt instrument, such as the points of a pair of scissors, the stem of a long tobacco-pipe, the end of an umbrella, of a stick, or a foil. This accident has also been occasioned by a child falling on a piece of slate-pencil which it had in its hand. The orbit is penetrated, and the end of the stick, or whatever it may be, is thrust against the roof or the upper part of the inner wall, which in some cases it simply fractures, whilst in others it breaks its way through the bone and penetrates the substance of the brain.

Even when the bones are broken but not penetrated, the sharp splinters usually create such an irritation of the brain and its membranes as to place the life of the patient in great jeopardy. When, however, there is in addition to the fracture a punctured wound of the brain, death is almost certain. It occasionally happens that a portion of the body which has penetrated the orbit and entered the brain has been broken off short, and the fragment which has been left behind has either not been detected during life, or, if discovered, could not be removed. The writer has seen both these conditions occur; in one case a piece of stick which had penetrated the brain through the orbit, and been broken off on a level with the bone, was only discovered at the post-mortem examination; and in a little child whose orbit had been penetrated by a piece of slate-pencil upon which it had fallen, the end of it was broken off flush with the roof of the orbit and could not be seized with forceps and withdrawn, for it broke under the pressure of the blades each time it was caught between them. One curious fact connected with these punctured fractures of the orbit is, that the severe nature of the injury is often overlooked; the external wound may be small, the immediate symptoms may be trifling, and the exact injury is not even surmised. The patient may be able to continue work for some hours, or even two or three days, before urgent symptoms oblige him to desist. Orbital cellulitis and suppuration may then come on, coupled with meningeal or cerebral irritation, and the patient may pass rapidly from slight delirium into complete coma, and die in a period varying from a few days to two or three weeks.

Treatment.—Absolute rest, both mental and bodily, in all cases in which fracture of the orbit is suspected, should be strictly enjoined. The patient should be kept in bed, and cold-water dressing or an ice-bag should be laid over the brow of the injured side; the bowels should be freely acted on by a purgative; and, if pain in the head come on, leeches should be applied to the temple and repeated if they do not give the desired relief. All stimulants should be forbidden, and only a limited diet be

allowed. If the fracture be a penetrating one, the end of the stick, or whatever it may be, should be carefully examined to see if any part of it has been broken off, and the wound should be also examined with the view of ascertaining if there be a foreign body within the orbit. If a foreign body be detected, it should be removed as soon as possible. If orbital cellulitis should come on, a free incision should be made into the cellular tissue of the orbit, so as to give vent to all inflammatory exudations before pus has actually formed. A good opening will frequently give immediate relief to the patient. When there is acute inflammatory action, the cold applications must be stopped, and fomentations of lead lotion—about one drachm of the liquor plumbi subacetatis to half a pint of hot water—be applied on absorbent cotton-wool, and covered with oil-silk; or a warm linseed-meal poultice.

Foreign Bodies in the Orbit.—The lodgment of a foreign body in the orbit is a serious accident, as it involves a risk to the eye, and often places the life of the patient in jeopardy. The dangers are both immediate and secondary.

The immediate effects which may arise from a foreign body in the orbit are—(1) In its passage into the orbit it may injure the eye; (2) it may wound the optic nerve and cause blindness, without injuring the globe; (3) it may fracture the wall of the orbit, or it may penetrate the orbital wall.

The secondary effects which a foreign body in the orbit may produce are—

(*α*) If the foreign body has escaped notice, and been allowed to remain buried in the orbit, it may excite orbital cellulitis and abscess. This may induce a general inflammation of the eye, which may end in impairment of vision, or in destruction of the eye from suppuration.

(*β*) As the result of the orbital inflammation, a portion of the bones of the orbit may become necrosed; or the inflammation may extend backwards along the orbital periosteum to the membranes of the brain, and destroy life by meningitis, tetanic convulsions, or abscess of the brain.

A foreign body may enter the orbit at any part around the eye, but it generally passes in somewhere between the upper or inner side of the eye and the roof or inner wall of the orbit. If small, it usually buries itself in the loose fat of the orbit, but, if large, it will occasionally become fixed by either penetrating the globe, or by becoming wedged between the globe and its muscles, or by the end of it entering one of the ethmoidal or frontal sinuses, or by penetrating into the antrum.

It has occasionally happened that a foreign body has been lodged in the orbit and one of the adjacent cavities, without the patient having suffered any great inconvenience from its presence. Mr. Brudenell Carter has related a case in which a large piece of an iron hat-peg was impacted in the orbit and the antrum of the opposite side, and remained there for a number of days without the patient being aware of its presence. It was then extracted, and the man made a rapid recovery without any impairment of the sight of the eye. In February, 1869, the writer extracted from a patient, æt. 28, the iron breech of a muzzle-loading gun, which had been impacted for twelve years in the right frontal sinus and upper part of the nose. The patient recovered without a bad symptom. In 1877 the writer extracted a piece of stick from the orbit of a child æt. 3, which had penetrated the orbit seven weeks previously, and had produced orbital cellulitis and suppuration.

Treatment.—Whenever there is reason to believe that there is a foreign body in the orbit, an attempt should be made to find and remove it. To this rule, however, there are exceptions, as when the foreign body is a small shot, or a fine scale of metal which may have flown off from a rivet or a chisel, and passed into the orbit without injury to the eye. The almost sure impossibility of finding a small fragment of metal in the fat of the orbit forbids the attempt to search for it. The presence of small shot or small pieces of metal rarely produces symptoms of irritation, whilst an extended trial to find them might induce orbital cellulitis with abscess.

Having decided that there is a foreign body in the orbit, the following operation for its removal may be performed:—The outer canthus should be freely divided, either by a pair of scissors or with a scalpel, to allow of the upper lid being completely turned up, or the lower one drawn down, according to the locality in which the foreign body is lodged. The reflection of conjunctiva beween the lid and the globe is then to be divided over the spot where the foreign body is suspected to be lying. A probe or the little finger may then be passed through the wound into the orbit by the side of the eye, and the object being felt, it may be seized and drawn out with a pair of sequestrum-forceps. If the foreign body has become entangled with one of the

recti muscles, or from any other cause one of these should interfere with its easy withdrawal from the orbit, it is better at once to divide the muscle with a pair of scissors as close as possible to the globe, rather than use any force to overcome the resistance it may be causing. The lids are then to be replaced, and closed with a light compress of lint and cotton-wool, and fastened in position with a roller.

INJURIES TO THE OPTIC NERVE. *See* OPTIC NERVE, Diseases and Injuries of the.

GEORGE LAWSON.

ORBIT, Tumours of the.—Tumours of the orbit may be considered under four headings—

I. Tumours which originate within the orbit.

II. Congenital tumours of the orbit.

III. Tumours which have their origin at some site beyond the eye or the orbit, and which by mere growth have extended into the orbital cavity.

IV. Tumours which primarily originate within the eye, and afterwards extend into the orbit; or which recur in the orbit after the eye, the primary seat of the growth, has been excised.

Each of these classes may be considered in detail.

I. TUMOURS WHICH ORIGINATE WITHIN THE ORBIT.—The presence of an orbital tumour is usually indicated by a change in the position of the eye, which is more or less protruded, and generally also displaced in one or other direction, either upwards or downwards, inwards or outwards, according to the locality of the orbit from which the growth springs. All sight may be destroyed by the pressure of the tumour on the optic nerve, or, if there be great protrusion of the eye, by the stretching of the optic nerve. It is, however, often astonishing to what an extent the eye may be projected and the optic nerve stretched without producing great impairment of sight; and how the lost sight is often regained after the eye has been restored to its proper position by the removal of the growth.

To examine an eye which is protruded the patient should be placed in a chair with his head thrown backwards, whilst the surgeon, standing behind him, raises the two upper eyelids with one finger of each hand, and at the same time directs the patient to look downwards towards his feet. From this position, above and behind the patient, the surgeon can glance down the face and contrast the level of the two eyes with each other, and compare the prominence of the protruded eye with the brow and the side of the nose. In this manner a correct estimate may be made of the extent and the direction of the protrusion. When the proptosis is slight, it is often difficult to determine whether the protrusion is real or only apparent, as any œdema of the lids or of the conjunctiva will give a prominent appearance to the eye. Having formed an opinion of the degree of the proptosis, a careful examination should next be made, with the fingers, of the space between the globe and the margin of the orbit, to ascertain if any projecting edge of a tumour can be felt, and if so, to endeavour to obtain some information as to its nature by noting whether it is elastic, hard, or fluctuating.

The tumours which originate within the orbit and external to the eye are:—(*a*) Orbital sarcomas, growing from the periosteum of the orbit. (*b*) Tumours of the optic nerve. (*c*) Scirrhous tumours of the orbit. (*d*) Bony and cartilaginous tumours of the orbit. (*e*) Fibrous tumours of the orbit. (*f*) Cysts of the orbit.

(*a*) ORBITAL SARCOMA.—*Spindle or round-celled sarcoma* usually grows from the periosteum of the orbit, starting first at one point, and then extending itself so as frequently to involve the greater part or the whole of the periosteum. The disease first manifests itself either by some proptosis of the eye, or by diplopia caused by some slight displacement of the globe, or by pressure on the ocular nerves producing palsy of one or more of the ocular muscles, or by pressure on the optic nerve inducing some defect in sight. As the growth advances, the bulging of the eye increases until it is protruded beyond the lids. When the eye by its prominence has lost the protection of the eyelids, the cornea, from exposure, will inflame and ulcerate, and the eye will be destroyed. In some cases, the tumour as it grows will force its way between the globe and the orbit, and it can then be both seen and felt as a hard mass pressing forward beneath either the upper or the lower eyelid, according to the locality in which it has extended itself.

Prognosis.—In all cases of orbital sarcoma the prognosis is unfavourable, as the disease is very apt to recur, and distant internal organs to be invaded by it. If, however, the growth be completely excised at a moderately early stage of the disease, and the chloride of zinc paste be freely applied, a good chance of recovery is afforded the patient. The writer has had several cases of undoubted orbital sarcoma which

he has thus treated, and the patients have lived some years without any recurrence or manifestation of the disease elsewhere.

(*b*) Tumours of the Optic Nerve are rare. *See* Optic Nerve, Diseases and Injuries of the.

(*c*) Scirrhous Tumour of the Orbit is a rare affection, and it has been doubted whether true scirrhus ever does occur in the orbit. The writer has had two cases of scirrhus of the orbit under his care. The first case was in a woman from whom he removed a scirrhous tumour of the orbit, and at the same time a secondary scirrhous tubercle in the skin in front of the ear and lying over the parotid gland. After excising the tumour he freely applied the chloride of zinc paste, and the whole of the bones of the orbit were detached in one piece, and are to be seen in the museum of the Middlesex Hospital. The operation was performed in February, 1866, and the patient up to the present time, January, 1885, has continued well and free from any recurrence of the disease.

The second case was also in a woman in the Middlesex Hospital. She had a tumour of the orbit which caused great proptosis. The same treatment as in the preceding case was adopted, and portions of the orbital bones exfoliated. The parts healed up, and the patient left the hospital apparently well. A few months afterwards it was found that she had a scirrhous tumour in each breast. It is probable that these tumours existed at the time of the operation on the orbit, and that she had not noticed them. About twelve months afterwards the patient died at her own home with all the symptoms of secondary cancer in the abdominal viscera. There was no return of the disease in the orbit.

Treatment of Sarcomatous, Scirrhous, or Recurrent Tumours of the Orbit.—If the tumour is small and grows from the periosteum near the margin of the orbit, it may be dissected out and the eye, if possible, saved. It is, however, only in exceptional cases that this course can be adopted. As a rule, it is necessary first to enucleate the eye, and then to proceed to excise the tumour, and this is most conveniently done with a pair of small but strong scissors, curved on the flat, and a pair of toothed forceps. Having excised as much of the tumour as can with safety be removed, the actual cautery should be freely applied to those parts of the growth which may still remain, and to all the bleeding points. When all hæmorrhage has ceased, the chloride of zinc paste, the formula for which is given below, spread on small pieces of lint, should be laid evenly over the whole surface from which the tumour has sprung. A small pledget of cotton-wool should then be placed in the orbit, and over this a fold of dry lint, which is to be held *in situ* by a bandage tied firmly around the head. Before the patient awakes from the anæsthetic, from one-sixth to one-third of a grain of the acetate of morphia should be injected subcutaneously into the arm, to dull the severe pain which usually follows this proceeding.

Where the writer has excised the eye with the orbital tumour and has been able to save the conjunctiva which covered the globe, he has adopted the following method of applying the chloride of zinc paste, in order to avoid the sloughing of the eyelids which so generally happens from the caustic extending to them.

After the eye and tumour have been excised, pressure is to be made in the orbit until all bleeding has ceased. The mouth of the conjunctival bag, from which the eye has been enucleated, is now to be held open with two pairs of forceps, whilst the chloride of zinc paste spread on lint is plastered round the sides of the orbit. A small piece of cotton-wool is next introduced to keep the strips of lint *in situ*, and the mouth of the conjunctival bag is closed over the whole by a single continued suture. A layer of oiled lint is then placed over the conjunctiva, and upon this the lids are closed and kept in position with a compress of lint and a roller. In this way he has destroyed all that was required without affecting the lids.

On the day following the operation the bandage may be removed, and if there is much tension of the lids from the stuffing within the orbit, some of the cotton-wool may be gently drawn out, and, a piece of clean lint having been laid over the parts, another bandage should be lightly applied. The remainder of the cotton wool should be taken away on the second day, and a little fresh absorbent wool laid loosely within the orbit to absorb the discharge, as soon as suppuration commences. This dressing should be repeated daily, but the pieces of lint, on which the chloride of zinc has been applied, should not be removed until suppuration has quite loosened them from the surface against which they were placed. After about ten or twelve days the sloughs will separate from the orbit, and if any suspicious-looking granulations spring up, they should be touched with the solid chloride of zinc or with the potassa cum

calce. The writer has three times seen epileptic convulsions follow within thirty-six hours after the operation, but they have in each instance ceased shortly after the removal of the cotton-wool and chloride of zinc from the orbit. The fits did not recur, and the patients perfectly recovered. If convulsions should occur, the chloride of zinc dressing should be at once removed and the cavity be syringed out with a little dilute acetic acid, about one drachm to the ounce of water.

In removing tumours from the orbit, it should be remembered that the orbital plate of the frontal bone is frequently thin and soft from the pressure of the growth against it. Special care should therefore be taken during the operation to avoid applying force with any instrument against the roof of the orbit. Twice the writer has been present when brain-substance has been brought away with portions of the tumour. On each occasion there is no doubt that, in places, the orbital plate had completely disappeared before the pressure of the tumour, which had grown through it.

The following is the formula for making the chloride of zinc paste :—

Pasta Zinci Chloridi. (*Ph. Middlesex Hospital.*)

This paste is prepared by first making the Liquor zinci chloridi cum opio as follows :—

Zinci chloridi, ʒxvj.; Pulveris opii, ʒiss.; Acidi hydrochlorici, fʒvj.; Aquam bullientem ad Oj.

Macerate the opium in twelve ounces of the boiling water for twelve hours, add the acid and filter, then dissolve the chloride of zinc in the filtered liquid and make up to twenty ounces with distilled water.

To this, flour is added, to render it of a proper consistence, as follows :—

℞ Liquoris zinci chloridi cum opio . . . . fʒj.
Farinæ tritici . . . gr. cxx.

Mix smoothly in a mortar, and heat over a water-bath until of a proper consistence.

(*d*) Bony and Cartilaginous Tumours of the Orbit are of two kinds—1. Those which are attached within the orbit by a small bony pedicle. They may be composed entirely of bone, or of both bone and cartilage. These growths may be as large as a walnut, and yet from their slender connection with the orbit they have been easily detached. 2. Those bony tumours which grow within the orbit, but which have a broad base, and occasionally extend through the orbital bones into the cranial cavity. Some of these growths are of an ivory hardness.

Treatment.—In all cases of bony tumour of the orbit an exploratory examination should be made, but with the understanding that the operator has discretionary power to endeavour to remove the growth, or to leave it, as he may deem advisable. Without such an exploratory operation, it is impossible to decide whether the tumour is attached to the bony walls by a thin pedicle or a broad base. The writer has, on several occasions, found that the tumour, although rather large, and apparently fixed to the orbital walls, had only a small pedicle, and was removed without difficulty. On the other hand, he has found the tumour with such a broad base that he decided to leave it, rather than run the risk of fracturing the orbit by an attempt to remove it. On one occasion, with a small chisel he succeeded in splitting off from the inner side of the orbit a small bony tumour, which had a base three-fourths of an inch long and a quarter of an inch wide. The patient did well, and the tumour did not recur.

A very instructive case of a large orbital and intracranial ivory exostosis is reported by Mr. Tweedy in the *Royal London Ophthalmic Hospital Reports*, vol. x. p. 303, in which he succeeded in removing the orbital portion of the growth by a drill worked by a powerful Archimedean screw. He says : 'By means of drills of various sizes, I managed to bore a large number of tunnels in various directions through the base of the growth, parallel with the upper and inner walls of the orbit. I then cut through the narrow bony septa between the borings with a stout carpenter's chisel. When the chisel had made its way deep enough to act as a wedge, I gave a few energetic blows with the mallet, and succeeded in breaking off the whole of the orbital portion of the growth. When this was accomplished, the orbital cavity seemed almost normal in size and shape, though it was obvious that a large mass, forming the base of the growth, still remained behind.'

The patient did well until one month after the operation, when head-symptoms came on, and he rapidly died comatose. On the post-mortem examination it was found that the greater part of the exostosis was in the left anterior cranial fossa. It had originally sprung from the left frontal sinus, and had grown chiefly upward.

In all operations for orbital tumours the surgeon should be provided with small bone-forceps, a bone-chisel, a gouge, an elevator, and a small Archimedean drill.

(*e*) Fibrous Tumours of the Orbit are not common, still they do occur and it is of importance to recognise them, as the prognosis is much more favourable than in the sarcomatous growths which form the majority of the orbital tumours. The fibroid tumour grows from the periosteum of the orbit, to which it is frequently attached by a pedicle of less dimensions than the mass of the tumour; in some cases the pedicle is very small. When completely removed with the pedicle and the portion of the periosteum from which it springs, the probability is that the tumour will not return; but this entire removal of the growth is often difficult, and sometimes impossible to be accomplished from the attachment to the periosteum being far back in the orbit. In some cases, therefore, the growth recurs, and probably from a small portion of it having been left behind at the time of the operation.

There is, however, another form of fibroid tumour which may occur in the orbit, and which is recurrent, but not necessarily in the site from which it first grew. It may reappear in other localities, generally selecting for itself some fibrous expansion from which to sprout. The writer has met with only one case of this kind; it is reported in full in the *Royal London Ophthalmic Hospital Reports*, vol. vi.

Symptoms and Treatment.—In the cases which the writer has seen there has been some proptosis of the eye, and the tumour has made its way forward between the globe and the orbit, and bulged into the lid. The diagnosis of the nature of the tumour cannot be made before the operation, although a certain amount of mobility under the fingers suggests that the growth may be fibroid.

In such cases the tumour may frequently be removed without excising the eye. An incision should be made through the lid near the margin of the orbit, so as to expose freely the surface of the tumour, and then with a little care the tumour may be isolated and traced backwards to the part from which it springs, and be detached with a portion of periosteum, if near the anterior surface of the orbit; or if it springs from deep in the orbit, its pedicle may be divided with a pair of scissors. The wound of the lid may be then united with one or more fine sutures.

(*f*) Cysts of the Orbit are far less frequent than the solid orbital tumours. They are of various kinds—(1) Serous cysts; (2) hydatid cysts; (3) dermoid cysts.

(1) Serous Cysts within the orbit are so rare that it is probable that some of the cases which have been described as serous cysts have really been hydatid. A very interesting case of serous cyst in the orbit was recorded in the *Royal London Ophthalmic Hospital Reports*, vol. i., by the late Mr. Poland.

(2) Hydatid Cysts of the Orbit are comparatively rare, yet many cases have been recorded. Lawrence, in his *Diseases of the Eye*, relates the case of a man, æt. 42, who was under his care in the London Ophthalmic Hospital in 1820, with protrusion of the globe. By an incision into the orbit he removed half a teacupful of hydatids. In the *Royal London Ophthalmic Hospital Reports*, vol. iv. Mr. Hulke has also recorded a case of hydatid cyst in the orbit.

The writer has had two cases of hydatid cyst in the orbit. The first case, recorded in the *Clinical Society's Trans.*, vol. ix., was remarkable from the 'choked optic disc,' which was produced by the pressure of the hydatid cyst on the optic nerve in the orbit, and the fact that the great engorgement of the optic disc disappeared after the cyst was evacuated by puncture. The second case is recorded in the *Royal London Ophthalmic Hospital Reports*, vol. x.

Symptoms.—Proptosis of the eye, and a tumour which can be felt with the fingers projecting between the edge of the orbit and the globe, more or less rounded in outline, with a smooth surface, and imparting to the fingers a sense of fluctuation; impairment of sight, rapid growth of the tumour with pain, which is frequently recurrent in its early formation, and no inflammatory action.

The shape and feeling of the tumour would indicate that it was a cyst, whilst the rapidity of growth, the pain in its early stages, with the absence of inflammatory action, would suggest that the tumour might be an hydatid. No positive diagnosis can be formed without an exploratory puncture either with a fine knife or a trocar. It occasionally happens that an hydatid tumour will remain stationary for some years and then take on rapid action, but this is not the usual course. These tumours generally develop steadily, and with increased growth there is an increased protrusion of the eye.

Occasionally, an hydatid tumour will inflame and suppurate spontaneously, and then all the symptoms point to orbital abscess.

For *treatment* see below, *Treatment of Cysts of the Orbit.*

(3) Dermoid Cysts of the Orbit are extremely rare. A very remarkable case of the kind was recorded by Mr. S. Barnes, surgeon to the Devon and Exeter Hospital in the *Medico-Chirurgical Transactions*, vol. iv. p. 316.

The usual situations for dermoid cysts adjoining the orbit are—at the upper and outer margin, and at the lower and inner edge of the orbit, just over the nasal process of the superior maxillary bone. They are congenital, and although to the touch they appear superficial, they are really deeply placed, lying in a depression of the bone beneath the orbicularis and often very adherent to the surrounding parts. They are filled with sebaceous material, and contain numerous hairs. These cysts, when large, will sometimes extend deeply into the orbit, and their removal then is frequently attended with considerable difficulty.

Treatment of Cysts of the Orbit.—In all cases, if practicable, the cysts should be removed entire. A free incision should be made over the most prominent portion down to the cyst wall, when it can often be enucleated; or, if not, it may be carefully dissected away from its surrounding attachments. When, from the position of the cyst in the orbit and the prolongations of it between the orbital muscles, it is found impossible to get it completely away, the cyst should be freely opened, and either an india-rubber drainage-tube or a piece of lint dipped in carbolic oil should be inserted into its cavity, to keep the cut edges from uniting and to allow of the free escape of all inflammatory products. The cavity should be washed out daily with a weak solution of carbolic acid.

In hydatids of the orbit, a free incision should be made into the tumour, and, after the fluid has escaped, the finger should be introduced into the cavity, and if possible the whole cyst be turned out; but, failing to accomplish this, the wound should be kept open by a large drainage-tube, and the cavity washed out daily with a solution of carbolic acid, about 1 in 80 parts of water.

II. Congenital Tumours of the Orbit are developmental growths. They originate during embryonic life *in utero*, and continue to grow after birth.

The following is an abstract of the report of the only case of this kind which has come under the writer's care. In May, 1882, he excised the eye of a child only two days old, on account of a congenital tumour of the orbit, which had completely extruded the eye from between the lids. The little patient was taken to the Royal London Ophthalmic Hospital, suffering from complete exophthalmos, which was congenital, and evidently due to an orbital tumour. The eye was removed, and for a time the patient did well. The child lived into the middle of the August following, and was in fairly good health until within two days of its death, when convulsions came on, which were followed by coma. The post-mortem and microscopical examinations were made by Mr. Milles, then curator of the museum. The following is an abstract of his report:—A large tumour was found projecting from and filling up the right orbit. On opening the skull, the upper surface of the brain and its membranes were quite healthy. On the under surface there was a distinct impression in the right middle lobe, produced by the projection of several cysts from the sphenoid bone. There was well-marked basic meningitis, confined chiefly to the right side. The tumour seemed to have originated in the body of the sphenoid bone, and to have grown forwards, filling up the cavity of the orbit, and pushing the eye in front of it. The tumour was pretty solid, but contained numerous cysts in its substance. Under the microscope, the tumour was found to consist of several varieties of tissue in different stages of development. The most noticeable were patches of hyaline cartilage of a spherical or oblong shape; these were often surrounded by a zone of spindle cells, with a distinct gradation from cartilage cells. Numerous cysts of all sizes were scattered through the tumour. The walls of the cysts were usually lined by pavement epithelium. In places, small cysts were seen to be projecting from the walls of the larger ones. The more solid part of the tumour consisted of masses of round cells like embryonic tissue, spindle cells, and more fully developed fibrous tissue. There was evidence of formation of glandular structure at several parts. The microscopical examination showed that the tumour was evidently one of embryonic origin, with an attempt to develop into the lower forms of connective tissue and gland-structure.

Mr. T. Holmes has recorded in the *Pathological Transactions*, vol. xiv. p. 248, the successful removal of a congenital tumour of the orbit, from a child æt. seven weeks. On examination, the tumour was found to consist of 'a large mass of substance much resembling udder, of a hard uniform feel and white colour—not in any

respect resembling malignant disease.' Numerous cysts, containing thin serum, had been laid open. Other smaller solid masses lay in the neighbourhood of the principal tumour. Under the microscope the solid portion of the tumour showed nothing except fibrous tissue and simple nuclei.

III. Tumours which have their origin at some site beyond the Eye or the Orbit, and which by mere growth have extended into the Orbital Cavity.—These growths include tumours which spring from the antrum, the frontal sinus, the lacrymal canal, or from some portion of the bones which help to form the base of the skull, as the naso-pharyngeal polypi. They will be found described under their respective headings.

The other tumours of the orbit are distension of the frontal sinus from pent-up secretion and pus (*see* Frontal Sinus, Diseases of the); pulsating exophthalmos, or so-called Orbital Aneurism; venous nævi of the orbit (*see* Nævus).

IV. Tumours which originate within the Eye, and afterwards extend into the Orbit; or which recur in the Orbit after the Eye, the primary seat of the growth, has been removed:—(*a*) Sarcoma and melanotic sarcoma of the choroid; (*b*) glioma of the retina.

(*a*) Sarcoma and Melanotic Sarcoma of the Choroid are essentially the same, the only difference being the addition to the latter of pigment, which is scattered in varying quantities between the sarcomatous cells. The identity of sarcoma and melanotic sarcoma is illustrated by the changes which sometimes occur in the growth of the tumour. Whilst confined within the globe, the sarcoma may be deeply coloured with pigment, but, having burst through the sclerotic, the tumour may grow with increased rapidity, and the extra-ocular portion remain white. Although a large number of the sarcomas which spring from the choroid are pigmented, yet the writer has excised many eyes in which the growth was white.

The early symptoms of sarcoma of the choroid are usually not noticed by the patient, unless the growth originate near the yellow spot of the retina, when an impairment of sight first draws attention to the eye. This is often discovered suddenly from the sound eye being accidentally closed, when it is noticed that a portion of the field of vision is more or less defective. This impairment of the field is due to a commencing detachment of the retina from the pressure of the growth behind it. With the advance of the tumour the field of vision becomes more contracted, the area of the blind portion increases, the acuteness of vision of the rest of the retina diminishes, until ultimately the eye becomes blind. During the early development of the symptoms there is no pain; it is only when the growth has attained a sufficient size to exercise pressure on the lens, ciliary body, and iris that pain is produced. When once started, the pain increases with the growth, and becomes excessive when the globe is distended by it.

It is seldom that the patient seeks advice until there is some detachment of the retina from the pressure of the growth behind it. That the case is not one of simple detachment of the retina may be sometimes determined at once by the ophthalmoscope, when the vessels of the detached retina may be clearly recognised, whilst behind the semi-transparent retina a series of vessels which are not retinal, but which belong to the new growth, may be made out. In the *Royal London Ophthalmic Hospital Reports*, vol. iv., is recorded a case in which Sir W. Bowman was able to distinguish the vessels on the surface of the tumour from the vessels of the detached retina in front of it. It is, however, only in an advanced stage of the disease that this means of diagnosis can be available. The most important point in diagnosing a detachment of the retina caused by a tumour of the choroid is the state of the tension of the eye. As the disease advances there is generally an increase in the tension of the eye, and this glaucomatous state is associated with pain, which may vary from a slight sense of aching to an acute neuralgia in the eye, and extending over the brow and forehead. An eye with failing sight, a partial detachment of the retina and an increased tension, is very suggestive of an intraocular tumour, even though the growth itself cannot be seen with the ophthalmoscope.

It is often impossible to diagnose the glaucomatous condition which is induced by an intraocular tumour from an ordinary attack of glaucoma, as the accession of pain is frequently sudden, and, when seen by the surgeon, the media may be so dull that the fundus of the eye cannot be seen; and the distended episcleral vessels and more or less dilated pupil, with increased tension of the globe, present all the appearances of a case of subacute glaucoma.

Such cases have frequently been treated by iridectomy, and the true cause of the tension has been only discovered when

the eye has been afterwards excised from the iridectomy having failed to give any relief.

As the tumour grows, it gradually fills the globe and displaces the structures within the eye which are in front of it. The retina is extensively or completely detached, and the lens is pressed against the iris, and the iris bulged towards the cornea. Frequently the globe loses its normal shape, and dark bulgings are seen in the ciliary region. The tumour next makes an exit for itself. Either the cornea grows dull, then ulcerates, and through the opening the tumour protrudes; or else it forces its way through the sclerotic, either in the ciliary region or in a more posterior part of the eye. Having escaped from within the globe, the tumour seems to grow with an increased vigour; if it has burst through the globe anteriorly, its surface after a time ulcerates and bleeds, and assumes an appearance which has given to it the name of 'fungus hæmatodes.'

The attacks of hæmorrhage increase in frequency with the advance of the disease, until at last the patient sinks, worn out with pain and loss of blood. If the tumour has escaped through the sclerotic posteriorly, it grows rapidly in the cellular tissue of the orbit, and protrudes the eye; and this protrusion is sometimes to such an extent that the cornea will ulcerate and suppurate, from the exposure caused by the lids being unable to close over the eye.

Prognosis of Sarcoma of the Eye.—The prognosis depends very much on the period of the disease at which the eye is removed. If the disease be detected early and the eye be at once excised, there is a reasonable hope that there will be no recurrence in the orbit, and that years may elapse before there is a recurrence in any of the internal organs; indeed, that the patient may live many years and die of some other disease before any secondary deposits have taken place in the liver, lungs, or other organs. When the eye has been removed at an early period of the growth, the operation often seems to create a pause in the progress of the disease, which may extend over a variable length of time—certainly in some cases over ten years. Patients may die from secondary sarcomatous deposits in the liver and other organs ten and twelve years after the eye has been excised for an intraocular tumour, and without any recurrence in the orbit.

Dr. Knapp, in an excellent treatise on intraocular tumours, mentions several cases of a prolonged freedom from recurrence of the disease after the eye had been excised. 'Prof. Dor's patient, fifty-six years of age, had in the year 1858 first noticed a blank portion in the field of vision of his right eye. The enucleation was made in January, 1860, whilst in a state of glaucomatous inflammation. The eyeball was slightly enlarged in its dimensions; the tumour, a melanotic, tough, fusiform-celled sarcoma of the choroid. . . . Nine years after the operation the patient was perfectly well.' Further on Dr. Knapp says:—'Professor Weber reported in the *Med. Naturhistorische Verein*, in Heidelberg, that both of the cases of choroidal melanosis were still perfectly well—one thirteen, the other twenty years after the operation. Mr. Hulke excised the eye of a gentleman in April, 1862, for a white spindle-cell sarcoma of the choroid, and the patient nine years afterwards was in perfect health.' These cases, no doubt, are rather exceptional, but still they sustain the hope that, if the eye be excised at an early stage of the disease, no recurrence may take place, or certainly that the patient may enjoy an immunity for many years.

When recurrence of the sarcoma occurs internally, there is scarcely an organ in the body which may not be involved by the secondary deposits. The liver, the lungs, the kidneys, the lumbar glands, the heart, and the brain may all become the seat of sarcomatous deposits.

In the museum of the Middlesex Hospital there is a series of preparations of secondary melanotic deposits in the different internal organs, which were taken from the body of an elderly female patient who had had a primary melanotic sarcoma of the choroid of the left eye. The right ventricle of the heart contained a mass of the secondary black sarcomatous deposit, which occupied the whole thickness of the wall and projected into the ventricular cavity. Both lungs and pleuræ were studded with the same black deposit; the seventh rib was the seat of a similar deposit. The liver and kidneys were affected, like the lungs, with large black deposits, and the spleen was the only internal organ that appeared healthy. In the sheath of the rectus there was a melanotic mass, the size of a pigeon's egg, which seemed to have no attachment. Throughout the body many of the glands were infiltrated with pigment, and were thus visible through the skin, though only slightly enlarged.

Treatment.—Excise the eye as soon as possible after the tumour of the choroid has been detected; even though the tumour be

no larger than a pea, and the sight of a portion of the retina good, yet there should be no delay. The earlier the eye is removed, the better for the patient. If the tumour has burst through the coats of the eye and has extended into the orbit, the chloride of zinc paste should be applied as recommended under *Treatment of orbital sarcoma*. The mode of application of the chloride of zinc must depend on the extent of the tumour in the orbit and the degree of apparent infiltration of the tissues with it. When the tumour has only just burst through the globe, and can be removed in its entirety, a thin layer of the paste spread on thin linen or cambric will probably be sufficient; but when the extension of the tumour into the orbit has been large, the chloride of zinc paste must be applied freely.

(*b*). Glioma of the Retina is a disease of early life, and, in the writer's experience, is limited to early childhood. The writer has seen cases in which it was congenital, and he has not met with a case of retinal glioma which originated in a child beyond the age of five years. In appearance a glioma very closely resembles brain-substance; it is soft, of a white or yellowish white colour, and springs from the connective-tissue (the neuroglia) of the retina.

In structure it consists of a finely granular or amorphous intercellular substance, in which are embedded spherical, roundly oval, and occasionally spindle-shaped cells. It is usually of rather slow growth, extending over a period of from one to two years before it completely distends the globe and bursts through the sclerotic or cornea. As it grows, portions of it undergo fatty degeneration and become so soft as to be almost fluid, whilst other parts become chalky or calcareous. The disease spreads by infection, which travels along the optic nerve, and after death a similar growth is frequently found in the brain in direct communication with the optic tracts. In a child who had been under the writer's care, and had died from a recurrent glioma, a tumour was found within the skull, which had extended backwards from the mass within the orbit, and pressed upon, but was not connected with, the brain. The preparation is in the Middlesex Hospital Museum, and the case is reported in the *Transactions of the Pathological Society*, 1884–5. Glioma seldom produces secondary deposits in the abdominal or thoracic viscera; but Knapp has recorded one case in which there were secondary gliomas in the liver, lungs, and diploë of the bones of the cranium. (Knapp *On Intra-Ocular Tumours*.)

Glioma is very recurrent, and is very apt to appear in the other eye after the eye in which it started has been removed, and also to recur in the orbit. There are exceptions to the recurrence of glioma after the diseased eye has been removed. In 1872 the writer excised the right eye of a child, æt. two years and eight months, on account of a glioma of the retina, and after more than seven years there was no return of the disease.

Symptoms. — Dilatation of the pupil with diminution of sight. In the early stage of glioma there is no pain. The disease is usually first discovered by the nurse or the mother noticing a bright yellow reflex from the fundus of the globe, and then, on closing the sound eye, it is found that the affected one is almost, if not completely, blind. The refracting media are generally so clear that the tumours can be easily seen. As the disease advances there is increased tension of the globe, and then the eye becomes painful and the child restless, frequently crying and starting in its sleep. The lens and the iris are pushed towards the cornea, and the pupil becomes dilated and inactive. At a later stage of the disease the lens becomes cloudy and the cornea dull, and the tumour bursts its way through the globe and forms a fungating mass, from which there are frequent recurrences of hæmorrhage; and the child dies, either worn out by pain and exhaustion, or from meningitis caused by an extension of the disease within the skull. If the eye be examined with the ophthalmoscope when the disease is in a comparatively early stage, the glioma will be seen occupying a limited portion of the retina, and with blood-vessels on its surface which clearly belong to the new growth. In the immediate locality of the tumour the retina is detached, and this detachment increases with the advance of the disease.

Treatment of Glioma.—Excise the eye as soon as the disease is discovered, and, should the two eyes be affected, both should be excised, provided the sight has been already destroyed. The removal of the two eyes in such a case would afford the only chance of recovery, whilst at the same time it would save the child much ultimate suffering. The writer has on many occasions removed the second eye for the sole purpose of procuring some temporary relief from the excessive pain induced by the over-distended globe, and when there has not been the slightest prospect of arresting the

disease. In each case the operation gave immediate and perfect relief. Even if the disease should recur rapidly in the orbit, the child is greatly benefited by having had the eye removed, as the growth of the tumour in the orbit is comparatively painless when the resistance caused by the eye has been taken away. GEORGE LAWSON.

ORBITAL ANEURISM.—*Symptoms.* If the term 'orbital aneurism' were strictly interpreted so as to embrace instances of circumscribed and diffused aneurisms, arterio-venous communications, and aneurism by anastomosis affecting vessels only within the limits of the orbital cavity, the space necessary for their description would be very small. There are on record very few genuine cases of aneurisms of vessels within the orbit. But in the immediate neighbourhood of the orbit there are large blood-vessels, whose morbid conditions affect the circulation within the orbit and the eye, and give rise to aneurismal symptoms that find here a characteristic outward and visible expression, by which they become cognisable to the clinical observer, and arouse the serious solicitude of the patient.

Aneurismal affections and morbid conditions of blood-vessels within the orbit, within the cranial cavity immediately behind the orbit, and possibly in the pterygoid and spheno-maxillary fossæ, give rise to symptoms essentially similar. The common features, variously combined and modified in different cases, are protrusion of the globe or exophthalmos; pulsation of the protruding globe, palpable to the touch and often visible to the eye; a soft pulsating tumour at some point of the orbital margin, usually above the eye, beneath the inner part of the orbital arch, but occasionally at the outer side, sometimes below the eye at the lower and inner angle; bruit and noises in the head; distended veins on the conjunctiva and on the lids and forehead; chemosis; obliteration of the hollow beneath the orbital arch; pain; paralysis of orbital muscles and iris; and cessation or lessening of the bruit and noises in the head, recession of the globe, and diminution of the swelling and abolition of pulsation by pressure on the corresponding carotid artery. The most characteristic symptoms are the presence of a pulsating tumour at the orbital margin and pulsation of the protruding eyeball. Hence, the terms 'pulsating tumour of the orbit,' 'pulsating exophthalmos,' and 'vascular protrusion of the eyeball,' are sometimes employed to describe cases in which these phenomena are conspicuous. The advantage of these terms is that they do not express any theory of causation; the disadvantage is that they are not individually and universally applicable to all cases in which the diagnosis of aneurism may fairly be made. Pulsation of the eyeball, vascular protrusion of the globe, and a pulsating tumour may each in their turn be absent, without contra-indicating the diagnosis of 'orbital' or 'intra-orbital aneurism,' a phrase in itself open to objection for the expression of a group of aneurismal symptoms, whose cause lies far more frequently behind the orbit than in it.

It will be as well to premise that cases of orbital aneurism sometimes arise spontaneously, and sometimes are the direct result of injury—in other words, are divisible into two groups, the idiopathic and traumatic.

Pathology.—There have been at least fourteen post-mortem examinations of cases of so-called orbital aneurism, with the following results:—

1. In one bilateral case (Guthrie's), an aneurism of the ophthalmic artery was found in each orbit.

2. In three idiopathic cases (Baron, Gendrin, Nunneley), there was a ruptured aneurism in the cavernous sinus.

3. In four traumatic cases (Nélaton (2), Herschfeld, Schlaefke), there were arterio-venous communications between the carotid and the cavernous sinus.

4. In four cases—one traumatic, three idiopathic (Bowman and Hulke, Aubry, Œttingen, Morton), there were blocked orbital veins and cranial sinuses.

5. In one idiopathic case (Nunneley), there was an old aneurism of the ophthalmic artery within the cavernous sinus.

6. In one idiopathic case (Wecker and Richet), there were dilatation and atheroma of the carotid.

The two latter observations are not satisfactory, and the first leaves much to be desired. The fourth or venous group is important, and may be said to require support by future observers, who will work with the knowledge that arterio-venous communications are frequent causes of the symptoms of orbital aneurism, but may be readily overlooked at post-mortem examinations superficially conducted, and so completely explain the aneurismal symptoms both in idiopathic and traumatic cases; and that thorough examination of both carotids and both internal maxillaries should be made if all scepticism as to the absence of arterial lesion is to be placed out of court.

Post-mortem examinations have further proved that—

(*a*) Thrombosis of the cavernous sinus and ophthalmic vein may be present without occasioning the essential symptoms of intra-orbital aneurism. Exophthalmos, œdema of the orbit, hyperæmia, photophobia, dilated immovable pupil, paralysis of the muscles of the eye, and diminution of vision are the evidences of this condition.

(*b*) Aneurism of the internal carotid in the cavernous sinus may be present without giving rise to the essential symptoms of intra-orbital aneurism. The same remark will probably be found applicable to aneurisms of the ophthalmic artery at its origin from the internal carotid. The orbital symptoms, noted in cases of aneurism of the internal carotid in the cavernous sinus, have been sometimes only symptoms due to pressure on the nerves, especially the third, fourth, and fifth, such as ptosis, dilated and fixed pupils, impaired or uncertain movements of the eyeball, diplopia, defective sight; and sometimes superadded to these, symptoms due to obstruction to the return of venous blood, œdema of the lids and conjunctiva, hazy and ulcerated cornea, and injection of the sclerotic and conjunctiva. The other symptoms have been violent pains in the head and at the back of the orbit, continual headache or heaviness of the head, unrelieved by treatment, and singing or other noises in the head.

(*c*) The cavernous sinus may be obliterated without giving rise to the essential symptoms of intra-orbital aneurism.

With regard to the nature of the reported cases—more than 100 in number—the following statements may be made:—

1. Beyond question, the great majority of the traumatic cases have been instances of endocranial arterio-venous communications, due to wound or rupture of the internal carotid artery in the cavernous sinus.

2. Beyond question, the great majority of the idiopathic cases have been instances of endocranial arterio-venous communications, due to rupture of an aneurism of the carotid or of an atheromatous carotid, in the cavernous sinus.

3. The occurrence of a circumscribed aneurism of the ophthalmic artery, or one of its branches, as a cause of the same symptoms as were exhibited in the cases of arterio-venous communication, rests, at present, solely on the laconic report of Guthrie, who gave no account of the condition of the cavernous sinuses and internal carotid arteries. Moreover, aneurism of the ophthalmic artery in the orbit is a very rare affection. Small aneurisms are occasionally found, with the ophthalmoscope, on the branches of the arteria centralis retinæ.

4. Diffused aneurisms of the ophthalmic artery have not been shown to have given rise to the symptoms of 'orbital aneurism.' In 1859 M. Demarquay divided the cases of intra-orbital aneurism into two categories—the traumatic and the idiopathic. The traumatic he regarded as dependent upon a rupture of the ophthalmic artery, followed by an effusion of blood and the formation of a diffuse aneurism, which he called a 'primitive diffuse aneurism'; whilst in the idiopathic cases he supposed that there existed, first of all, a circumscribed aneurism of the ophthalmic artery, which was suddenly ruptured and became diffuse at the time of the commencement of the symptoms, and this form of aneurism he called 'consecutive diffuse aneurism.' M. Demarquay's views were adopted by some authorities, but they have not yet been shown to be even partially true. In no one case have the symptoms of intra-orbital aneurism been proved to be due to a tearing across of the ophthalmic artery, at or near the optic foramen.

A few cases of pulsating sarcoma have crept into the lists of cases. Freer's case was one of fungus hæmatodes. Critchett's was a pulsating sarcoma, and so in all probability was Szokalski's case. Van Buren's sarcoma case is included in some lists.

The *Differential Diagnosis* of the various morbid conditions of blood-vessels within and behind the orbit, and of the affections which may be mistaken for them, will best be established by a summary of the distinctive features of each.

1. *Traumatic arterio-venous communications between the Carotid Artery and Cavernous Sinus* will be preceded by the history of an efficient lesion, such as a bullet wound or shot wound, a punctured wound, or a blow or fall sufficient to occasion a fracture of the base of the skull. Occasionally, the communication will be on the side opposite to the seat of injury in the orbit; usually, the two will correspond. At first, the aneurismal symptoms may be masked by the general symptoms of injury to the head. As a general rule, they are fully developed within nine months of the accident preceding the affection. More than half the cases exhibited all the symptoms within two months. Some of the cases were not seen till a much later period, but, from the history, it is clear that all the symptoms were well established a few weeks after the

injury. In one or two cases only was there an interval of years. The primary symptoms present some variations. In some, a blowing, roaring, or singing noise, or beating in the head, is stated to have been heard either immediately or soon after the injury. In a few, congestion of the conjunctiva and chemosis, with or without loss of power in the ocular muscles and inaction of the pupil, preceded exophthalmos, pulsation, and bruit; so that in two or three cases the patients seemed to be affected with simple conjunctivitis. Exophthalmos is said to have preceded the pulsation and bruit in about half the cases, and was noticed within the first six weeks in a similar proportion.

Doubtless, the interval between the infliction of the injury and the occurrence of the typical symptoms is due to blocking up of the aperture in the artery by coagulum, or pressure on the cavernous sinus and ophthalmic vein by coagulum, which subsequently undergoes absorption or disintegration. Hence, in the early stage, the only symptoms may be some swelling and redness of the conjunctiva, with slight proptosis, due to obstruction of the venous current; but, as soon as the aperture of communication has become clear, noises in the head, bruit, and pulsation in the eyeball will declare themselves. In some cases, a partial rupture may occur and become complete after a variable interval, or weakening of the coats by injury may lay the foundation for ordinary aneurism. As soon as the arterial blood finds its way freely into the cavernous sinus, it will be propelled into the ophthalmic vein, or veins superior and inferior and their tributaries, giving rise to pulsation of the eyeball and the development of a pulsating tumour or tumours at the margin of the orbit, soft, lobulated, compressible and repressible, obliterating the hollow beneath the arch. Pulsation of the eyeball may disappear when the pulsating tumour has developed itself. Congestion of conjunctiva and chemosis will tend to increase. A large pad of infiltrated mucous membrane will project between the lids.

The pulsating tumour will require time for its development, and before the dilated ophthalmic vein or veins become evident at the margin of the orbit, the pulsation may be communicated to the eyeball, so that pulsating exophthalmos will take precedence of the appearance of a pulsating tumour or tumours. In process of time, a tumour will commonly appear at the inner third of the orbital margin, and the distension of the veins may gradually extend to the tributaries of the main trunk thus reaching the forehead, the bridge of the nose, and the inner angle of the opposite orbit as well as the lower eyelid. The constant pulsations of the ophthalmic vein may wear a furrow in the bone. With the ophthalmoscope, prominence of the disc, hæmorrhagic spots, and dilated and pulsating retinal veins will be observable. A vibratory thrill in the pulsating veins is a frequent but not constant phenomenon. The bruit is often peculiar and distinctive. It is a continuous bruit, with *redoublement* or reinforcements during the arterial pulse; and, added to this, is a high, plaintive, whistling note, caused probably by the rushing of the arterial blood through a small hole in the carotid, designated by French authors the *bruit de piaulement* or *miaulement*, from its likeness to the mewings of a cat, and audible, perhaps, only in front of the eye over the course of the dilated ophthalmic vein. If the pulsating tumour or tumours are tapped or punctured, arterial blood will issue.

Nerve-lesions may be due either to the same injury by which the artery was wounded or to pressure on the nerves by effused blood and blood-clot. The optic nerve may be torn in a fracture of the base, or the sixth nerve divided by the foreign body which causes a wound of the carotid. Impairment of vision, at a later period, may result from alteration in the circulation or loss of transparency of the media. Ptosis, dilated pupil, and external strabismus from pressure on the third nerve, are not uncommon.

In some cases, the opposite orbit and eye become affected by the passage of arterial blood, from the cavernous sinus on one side through the circular sinus into the opposite cavernous sinus and ophthalmic vein. The arterial blood may also find its way through the emissary veins into the pterygoid plexus, and so, the writer believes, into the temporal veins and into veins on the floor of the orbit, which pass through the spheno-maxillary fissure. When one channel is blocked up another is opened. This explains the recurrence of the disease, in some cases, on the side opposite the seat of injury after subsidence or cure by ligature on one side, and the recurrence on the outer side of the orbit after cure on the inner. A long-neglected case of aneurismal varix may attain a wide development.

2. *Idiopathic arterio-venous communications between the Internal Carotid and*

Cavernous Sinus occur usually quite suddenly, from the rupture of an aneurism of the internal carotid or rupture of a diseased internal carotid, as it lies in the cavernous sinus. In the majority of cases, the disease commenced with pain or noise in the head, or some peculiar feeling on the affected side; in a few gradually, with or without attacks of premonitory pain. Five cases occurred during pregnancy in women who had borne several children. In all the attack occurred quite suddenly, with violent pain and noise in the head variously compared to a 'sudden snap,' the 'cracking of a whip,' 'the report of a pistol overhead,' 'a blowing noise,' and 'a steam hammer;' whilst in six other females not pregnant (three being over sixty years of age), in whom the attack was equally sudden, the several sensations experienced were described as 'something appearing to give way,' with or without a crack like that of a gun, 'a kind of crowding feeling,' 'a strong buzzing,' 'a violent pain in the eye or temple,' and 'something queer in the head.' Two of these patients were aroused from sleep by the pain and noise, in two the affection began as they were getting up as usual in the morning, and the others as they were pursuing some ordinary occupation, such as washing, taking off shoes, rubbing in a liniment, returning from a drive, and sitting down to work. One woman, during an effort of childbirth, felt an 'unusual rattling in the eye,' and perceived that the eye was driven from the orbit; whilst another attributed the affection to an effort made during her last confinement, five years previously. One man felt a deep-seated pain in the eye and singing in the ear, as he was aroused from sleep. Another perceived one morning, after a fit of coughing and without any premonitory symptoms, that the eye was projecting from the orbit.

After the pain and noises, the next symptoms to appear are generally exophthalmos and swelling of the lids and conjunctiva. In extreme cases, the eye may be almost extruded from the orbit. Paralysis of orbital muscles, pulsation of the eyeball, the development of pulsating tumours out of the ophthalmic vein and its branches at the orbital margin, with thrill and the characteristic bruit, dimness and sometimes loss of sight, dilated and fixed pupil, eversion of the lower lid and increase of the conjunctival pad (forming a bright-red tumour projecting between the distended eyelids), pain, often constant and acute, at the bottom of the orbit, and noises in the head, will soon be superadded to the earlier symptoms. Arterial blood would issue if the pulsating tumours were punctured. As in the traumatic series, the affection may spread to the opposite eye, or commence in the opposite eye after cessation or cure on the same side by ligature of the carotid.

3. *Circumscribed aneurism of the Ophthalmic Artery* would probably, as in Guthrie's case, cause pulsating exophthalmos without a pulsating tumour appearing at the orbital margin, and the bruit might be distinctly intermittent.

4. *Traumatic rupture of the Ophthalmic Artery* in the orbit would, in all probability, be accompanied by tearing across of the optic nerve, and be followed by protrusion of the eyeball and immediate and irreparable loss of vision. There are no facts to guide us in regard to rupture of a true aneurism of the ophthalmic artery in the orbit.

5. The distinctive features of *Aneurismal Varix* within the orbit remain to be determined. A single case of varicose aneurism of vessels within the orbit has been reported.

6. *Obstructed Cranial Sinuses and Orbital Veins* have not yielded symptoms sufficiently distinctive from aneurismal varix of the ophthalmic vein, due to wound or rupture of the internal carotid, to be distinguished. There is one probable means of diagnosis—viz. puncture of the pulsating and dilated ophthalmic vein. In aneurismal varix, arterial blood would issue; in blocked sinuses, &c., venous blood might be expected to appear. Puncture, however, does not exercise a beneficial influence on the part.

7. *Vascular Tumours of the Orbit* are of various kinds, all shading into each other. There are erectile tumours, consisting either of capillary vessels or of a cellular, reticulated, and spongy tissue, containing either arterial or venous blood, and often surrounded by a capsule of condensed connective tissue. These cavernous tumours have neither pulsation nor bruit. Yet they dovetail into the cases of pulsatile arterial nævus, in which a souffle existed with doubtful pulsation. There appear to be cases also of pulsatile venous nævus. Then, there are venous or varicose tumours formed of dilatations of the ophthalmic vein or its branches, owing to some obstruction to the return of venous blood. If formed by the ophthalmic vein, they will be prominent at the upper and inner part of the orbit, and yield similar sensations to those afforded by the pulsating tumours found in cases

of intra-orbital aneurism, in so far as this, that they will be peculiarly compressible and repressible, but will have neither bruit, pulsation, nor thrill. They will increase in size in expiration and stooping, and diminish in inspiration and the erect posture. Pressure on the internal jugular vein should cause them to swell. These tumours may originate after injury.

8. The true '*Cirsoid Aneurism*' or '*Aneurism by Anastomosis*' is composed of vessels elongated, varicose and tortuous, very thin-walled, and more like veins than arteries in structure. The dilated vessels collected together form pulsatile thrilling tumours, soft and compressible. The vessels are usually described as arteries; but it is admitted that the dilatation may invade the arterioles and capillaries, and even spread to the veins, and there can be little doubt that many of the large pouched and pulsating vessels of a cirsoid aneurism or aneurism by anastomosis are in reality pulsating veins. This being so, it is difficult, if not impossible, to point out any marked external differences between aneurism by anastomosis in its extreme development and aneurismal varix, and it is no wonder that Travers, Dalrymple, and others adopted this view of intra-orbital aneurism. The chief difference consists in the fact that in one case there is no arterio-venous communication, and that in the other this communication exists. No proof has been afforded as yet that 'aneurism by anastomosis' in its extreme development occurs in the orbit as a separate affection. It may spread to the orbit from the face or head; but further observations of a much more precise nature than those of Dr. Morton will have to be made to establish the affection in the orbit. On the other hand, arterio-venous aneurisms rest on so immovable a pathological basis, and attain so wide a development in severe cases, that this diagnosis naturally occurs to the mind in all cases where pulsating veins are found. In Brainard's traumatic case there was a loud blowing sound over the orbit and more or less over the head, the veins of the face were prominent, the arteries of the head and neck pulsated with unnatural force, thrill was heard over the whole head, there was an elastic and pulsating swelling at the upper and inner part of the orbit and root of the nose, and the small vessels of the forehead and side of the nose pulsated with a peculiar thrill. If aneurismal varix holds good for this case, it holds good for the severe cases of orbital aneurism which have been reported as examples of 'aneurism by anastomosis,' and the writer is inclined to believe that other cases of cirsoid aneurism following an injury really belonged to aneurismal varix.

9. *Pulsating Sarcoma* of the orbit (previously described as encephaloid cancer) has many features in common with arterio-venous communications, or idiopathic and traumatic aneurismal varix. Loss of vision, exophthalmos, pulsation, noise in the head, and bruit ceasing when the carotid of the corresponding side is compressed, are symptoms of sarcoma and symptoms of aneurism. Its onset is often obscure, and the case will be still more obscure if the orbital tumour exists alone and if its development has followed an injury. Moreover, the sarcomatous tumour, projecting outwardly, may yield a soft, semi-fluctuating sensation, peculiarly liable to deceive even the experienced practitioner. In M. Lenoir's case, the carotid artery was tied, under the impression that the affection was aneurismal. The disease had followed a fall on the back of the head, and the only symptoms of differential value were the light whispering character of the bruit, the irreducibility of the tumour, and its extension towards the temporal fossa. Pulsation may be present without bruit, and the diagnosis will then be more obvious. In Mr. Nunneley's case of 'cancer of the orbit' the carotid artery was tied, and checked the progress of the disease. Here the diagnosis was rendered probable by the existence of multiple tumours, and by the continuation of the orbital tumour into the zygomatic fossa. By attention to this latter point, the character of the bruit, &c., the writer was able to diagnose malignant disease in a case in which it had been proposed to tie the carotid artery for suspected aneurism, and to ensure the abandonment of the proposal. Ligature of the carotid has several times been practised by American surgeons. In one or two cases a fatal result occurred; in others a combination of ligature with extirpation of the growth proved successful. Ligature checks for a short time the progress of the disease, but it is only to be advised in exceptional cases.

10. A *Meningocele* of small size may project at the internal angle of the orbit and be mistaken for a nævus or erectile tumour. This happened in M. Guersant's case, which was seen by many Fellows of the Surgical Society of Paris, who agreed in recommending treatment by thread setons. Cerebral symptoms supervened, and the child soon died. It was found, at the post-mortem examination, that the tumour was composed of a small portion of brain-substance

covered by the membranes of the brain, which had passed through the fronto-ethmoidal suture, and appeared at the inner angle of the orbit.

11. In Graves's disease, pulsation of the prominent eyeballs is absent. Derangement of the sympathetic system, or a morbid state of the lenticular ganglion, has no known connection with the production of symptoms resembling those of aneurismal varix of the ophthalmic vein.

12. The distinctive features of thrombosis of the orbital veins, aneurism of the carotid in the cavernous sinus, and aneurism of the ophthalmic artery before it enters the orbit, may be gathered from what has been stated above under the head of pathology.

Treatment.—In a small proportion of both traumatic and idiopathic cases, the symptoms of orbital aneurism have subsided in the course of weeks, months, or years by simple means, such as attention to diet and abstinence from stimulants, application of cold, exhibition of drugs like belladonna, veratrum viride, ergot, and digitalis, and mechanical compression of the pulsating tumour. To oppose the expectant treatment, we have Nélaton's case dying from hæmorrhage from the nose only, mechanical treatment having been employed; and Scott's case, saved from a similar fate by prompt ligation of the carotid. To these we must add several cases, in which the symptoms were aggravated after the lapse of months or years. The surgical means of treatment at our disposal are local compression of the tumour, digital and instrumental compression of the common carotid, galvano-puncture, subcutaneous injection of ergotine, injection of coagulating fluids into the pulsating veins, ligature of vessels within the orbit, with or without removal of the pulsating mass, and ligature of the carotid artery or arteries.

Local compression produced some benefit in three cases, and was either useless, too painful, or injurious by increasing the chemosis and congestion, in seven others.

Instrumental compression has failed in several cases. Glascott, however, in 1883, related a successful instance in a traumatic case. A man, forty-two, fell down an open hatchway. The night after the accident he noticed a whizzing noise in his head, which continued. A month after the accident his left eye began to protrude. When first seen, the upper lid was swollen, conjunctiva chemosed, and vision very much reduced. The ocular and conjunctival veins were enormously distended and varicose, and the retinal veins were enlarged and tortuous. At the inner superior angle of the orbit a large vessel was seen pulsating. On applying a stethoscope, a quarter of an inch above the supra-orbital notch, a loud blowing murmur was audible, synchronous with the cardiac systole, and was not continuous. Patient was put on ten grains of pot. iodide, and compression of the left carotid was maintained by the patient with a compressor, made of a wooden knitting needle with its head protected by a firm pad. Compression was kept up by the patient for two minutes at a time, every quarter of an hour. Compression, begun on September 30, was kept up till December 21. The large vessel at the superior inner angle had ceased to pulsate. No pulsation was detected anywhere in the orbit, nor any bruit. There was old clot at the bottom of the anterior chamber, and there was no perception of light.

Digital compression of the common carotid was first practised by Gioppi. It failed in ten traumatic cases, and cured three out of six idiopathic cases. It may either be continuous or intermittent, and it is worth noticing that in the three successful cases (Gioppi, Scaramuzza, and Galezowski), as well as in Glascott's case, just related, it was only practised for a short period in the twenty-four hours, and not for many minutes at a time. In Gioppi's case, as compression caused faintness, it was only employed, for a minute or two at a time, by the convalescent patients in the ward, the patient herself, and the pupils. Pulsation and noises ceased at the end of the fourth day. In Scaramuzza's case digital compression, employed very cautiously on account of aortic disease, was practised for not more than five or six turns, the total period of compression being only seven hours twenty minutes. The eye had then entirely re-entered the orbit, and pulsation had ceased. In M. Galezowski's case, compression was practised every two or three days for fifteen or twenty minutes, afterwards increased to forty-five or sixty minutes daily. Marked relief followed each sitting, and, at the end of a month, the movements of the globe had returned, the eyelid was raised, and the chemosis was gone. An interruption of the treatment for about a fortnight took place; then it was recommenced, and continued for more than two months every two or three days. A month later, the protrusion had almost entirely disappeared, the patient heard no bruit, and none could be heard on auscultation over the cranium.

Digital compression of the carotid should not be practised, by any one person, for more than ten or fifteen minutes at a time without relief. It is by no means easy of efficient application by inexperienced assistants, but it is a valuable method of treatment, free from danger when applied with due precautions, capable of occasionally effecting a cure, especially in idiopathic cases, and serves as a valuable preparation for ligature by establishing anastomosing channels, and preventing disturbance of the cerebral functions subsequently to ligature.

Galvano-puncture is not well suited for application to a thin-walled aneurismal varix of the ophthalmic vein. It has twice failed in a traumatic case. M. Pétrequin's patient died after ligature and subsequent galvano-puncture, but whether from the former or latter method, or the combination of the two, is not clear.

Injection of ergotine subcutaneously was practised in the case of Schiess-Gemuseus and Socin, and produced nausea, vomiting, œdema, and increase of the tumour. There are no rational grounds for expecting success from this procedure.

Injection of a coagulating fluid into the pulsating tumour has been practised four times. In two traumatic cases (Bourguet and Desormeaux) a solution of the perchloride of iron was used and effected a cure, vision being restored. In Brainard's case, the lactate of iron effected a cure after the failure of ligature, but the eye was lost. Brainard had previously tried the effects of the lactate of iron in solution on a dog without ill effect, and he had also used it on the human subject, injecting it into the veins at the bend of the elbow. Each of the veins into which it was thrown was obliterated after a time, and converted into a fibrous cord. He considers that, while the perchloride of iron is a foreign substance causing coagulation of the blood, and is apt to be followed by gangrene and suppuration, lactate of iron is composed of elements which are natural elements of the blood, and acts by gradually causing thickening of the coats of the veins, converting them into fibrous cords and thus obstructing the circulation. In the writer's case, the quantity of perchloride injected (5 drops) proved to be insufficient to effect complete coagulation.

Injection of coagulating fluids in arterio-venous aneurism stands on a different footing from injection of a nævus, as the blood-current in the veins is reversed. It is only adapted for aneurismal varix of the ophthalmic vein and its branches, outside the orbit. It is more painful than ligature and probably involves more risk to vision, as it may set up inflammatory mischief in the loose areolar tissue round the veins, which may spread to the cornea. It may also effect so much coagulation as to interfere with the requisite supply of blood for the maintenance of the ocular tissues. When injection is practised, pressure on the carotid should be maintained during the operation.

Taking account of those cases only of which the writer knows some of the particulars, *ligature of the common carotid* has been practised 56 times in 54 cases, the right carotid having been tied 21 times and the left carotid 33 times. In two cases the side is not stated. Of the 54 cases, 21 were idiopathic and 32 traumatic — the nature of the other case not being known to the writer. Of the 21 idiopathic cases in which ligature was practised, 12 were affected on the right side and 9 on the left; 4 died and 17 recovered. Two of the patients who died were females advanced in years, and both had atheromatous arteries. One, aged sixty-five, died on the sixteenth day from secondary hæmorrhage and cerebral disturbance; the other, aged sixty-three, died in fifty-two hours from cerebral causes only. A third (Critchett's) case was of a malignant nature, and the patient succumbed, some months after the operation, from repeated hæmorrhages from the orbit. The fourth patient, a female, aged only twenty-three, operated on by Dr. Morton, died suddenly, the day after the operation, from inflammation at the base of the brain. Of the 17 patients who recovered, 13 were cured of the aneurismal affection, vision being restored in 9, lost or not regained in 3, and not mentioned in the others. In 3 partial benefit resulted, vision being lost in 1, impaired in 1, and not mentioned in the other. In 1 (Frothingham's) the aneurismal affection subsided for a time. Pulsation returned in fourteen days. Three years later the disease was again urgent. The eyeball was enucleated and the tumour removed, and the patient recovered.

Of the 32 traumatic cases 5 died and 27 recovered. The ages of the patients who died were respectively seventeen, twenty-two, forty, thirty-three, and forty-two. One of the five was subjected to galvano-puncture subsequently to ligature, and the cause of death is not stated. In 3 cases the cause of death appears to have been pyæmia, 1 recovering from the operation, but returning to the hospital and dying at the end of three months. The

fifth patient (Dr. Morton's) died rather suddenly, from serous apoplexy, during the night after the ligature. Of the 27 patients who recovered after ligature of one carotid, only 17 were cured of the aneurismal affection of the orbit, 1 subsequently to injection, vision being lost or not regained in 6, and the bruit being noted as persisting in 4. In 8 of the 17 the cure was in all respects complete. In 1 the common and external carotid arteries were tied on the side affected. In 5 the operation was unsuccessful; 2 were subsequently cured by ligature of the opposite carotid, and 1 by injection of lactate of iron. In 5 partial benefit resulted, the symptoms being diminished but not removed in 3, and being removed for a time only in the others. In Velpeau's case, the symptoms were removed altogether on the left side but returned on the right. In Knapp's case, ligatured by Dr. Sands, the symptoms returned; the exophthalmos increased, the cornea sloughed, and the eye was lost by panophthalmia. The eye was enucleated and a large pulsating ophthalmic vessel (evidently the vein) ligatured at the apex of the orbit. The patient recovered. One case (Flatten's), whose nature is not known to the writer, was cured.

Taking the two sets of cases together, we have a total of 54 cases. Out of this number there were 8 deaths, for one death was unconnected with the operation, 5 failures to cure the disease, 9 partial successes and temporary removal of the symptoms. Of the 5 cases in which the operation failed, 2 were cured by ligature of the opposite carotid and 1 by injection. Of the 31 cases cured, vision was restored in 20, lost or not regained in 9. The bruit persisted certainly in 4, and probably in others not examined with the stethoscope.

The two cases in which both carotids were tied occurred in America. In one case, the interval between the operations on the two arteries was thirty days, in the other fourteen months. Vision appears to have been improved in the former case, but it had been lost and was not regained in the other.

Ligature of the common carotid is at present the most successful and satisfactory means of treating orbital aneurism. It should not be practised on patients advanced in years, or on those with heart-disease or evident atheromatous degeneration of arteries. The two cases operated on over sixty years of age succumbed, and if we deduct these as well as Pétrequin's case, in which the subsequent galvano-puncture may have been the real cause of death, there were 5 deaths in 54 cases, or rather 56 operations. One of the 5 deaths did not take place till three months after operation, and can scarcely be regarded as directly caused by it. Two of Morton's cases died suddenly within twenty-four hours, and were probably not in a fit state for operation, having already some inflammatory affection at the base of the brain. If these last three cases are included, the death rate would be about nine per cent.; if excluded, it would be under four per cent. The percentage of absolutely successful cases or cures would be about fifty-five.

Return of the symptoms after ligature may take place in three different ways. In cases of arterio-venous communication, the symptoms may return on the same side from want or deficiency of coagulation of the blood in the ophthalmic vein, carotid artery, and cavernous sinus, or clot may form temporarily and be washed away. Secondly, the symptoms may return either on the opposite side or in the outer part of the same orbit, after being cured on the inner side. Obliteration of the ophthalmic vein may have occurred on the side originally affected, but, the arterio-venous opening still remaining patent, the arterial blood is either pumped into the circular sinus and the cavernous sinus and ophthalmic vein on the other side, or through the emissary veins into the pterygoid plexus, and so may reach the same orbit again through the sphenomaxillary fissure. If there are two ophthalmic veins, one may be obliterated and the other become correspondingly enlarged, or both may expand together. Thirdly, in cases of true aneurism, the affection, which seems to have been a return on the opposite side, may be in reality the formation of an aneurism *de novo*. Although ligature of the carotid seems to offer the best chance of recovering useful vision, when vision is impaired or threatened, it is by no means an infallible remedy. If vision is lost or nearly lost before operation, it will rarely be regained; if only impaired it will probably improve, but there are one or two cases in which sight was lost subsequently to ligature.

The causes of loss of vision in cases of orbital aneurism both before and after treatment deserve attention. In some traumatic cases, the optic nerve may be torn across at the time of the accident; in some idiopathic cases, the damage to its structure may occur from pressure of a circumscribed aneurism or pressure of blood-clot when an aneurism is ruptured. Pressure on the ophthalmic nerve may occasion, directly or

indirectly, ulceration of the cornea. Vision has been lost in cases treated simply, treated by digital compression, treated by injection, and treated by ligature. The cornea has grown hazy after ligature and recovered itself; it has ulcerated after ligature, and the eyeball has atrophied more than once; it has ulcerated and healed before ligature, and it has ulcerated before ligature and healed afterwards. Vision, almost lost before injection of perchloride of iron, has been regained afterwards; injection has also been followed by ulceration of cornea, severe inflammation of the eye, loss of the humours and collapse of the globe. In all cases, vision rests on a precarious foundation, and it is impossible to predict positively whether the treatment recommended will succeed in preserving or restoring it in any particular case. Delay in treatment certainly endangers vision. The altered conditions of nutrition render the preservation of transparency in the media and of the integrity of the retina precarious, whilst treatment involves the possibility of excessive coagulation in the vessels, and interferes with a due supply of blood. On the whole, the evidence appears to be in favour of early resort to ligature, as affording the best prospect of restoration or preservation of sight. In case of failure of ligature on one side, the question of ligaturing the opposite carotid will present itself for consideration, and may be answered by first ascertaining the effect of digital compression of the vessel. Ligature of the opposite carotid will also have to be compared with other available methods, such as coagulating injections.

Ligature of the aneurismal ophthalmic vein at the apex of the orbit might be feasible and successful, in selected cases.

Ligature of pulsating vessels in the orbit has been attempted or practised on three occasions. In 1860 M. Passavant, diagnosing a traumatic aneurism of the lacrymal artery in a girl of nine, who had been wounded by a knitting-needle thrown at her in a rage by her sister, attempted to reach and tie the vessel by dissecting the soft parts from the external wall of the orbit, and resecting the bones sufficiently to allow the finger to penetrate behind the globe. At the apex of the orbit, very deeply and on the inner side of the optic nerve, the finger encountered the pulsations of an aneurismal pouch, but all attempts to tie it were vain. The child remained after the operation in the same state as before.

Arterio-venous aneurisms of vessels within the orbit are almost unknown. In 1875 Mr. Lansdown of Bristol reported 'a case of varicose aneurism of the left orbit cured by ligature of the diseased vessels.' A few cases have some claims to be regarded as instances of 'aneurism by anastomosis.' Noyes, in an idiopathic case occurring in 1881, tied the angular artery (?) and exposed a protruding pulsating vessel at the inner and lower side of the orbit. The latter was then cautiously dissected up and traced into the cavity of the orbit, until it reached the groove for the infra-orbital nerve, where it dipped down. A ligature was put about this end and the vessel excised. It proved to be a vein and was larger than a crow-quill. In eighteen days both ligatures came away. In fifty days the patient was discharged. Pulsation ceased, and the eye returned to its place. Three other cases, in which the eye and the pulsating vessels have been enucleated, were operated on by Frothingham, Knapp, and Morton respectively.

WALTER RIVINGTON.

ORCHITIS. *See* TESTIS, Diseases of the.

OS CALCIS, Excision of the.—It is not uncommon to meet with cases in which the os calcis alone of the tarsal bones is the seat of degenerative disease; and when any large part of its central tissue is softened, or a considerable portion of its surface is carious, the bone may with great advantage be dissected out from its connections with the rest of the tarsus, and a most useful foot be left.

Operation.—The best method of removing the os calcis is that recommended by Mr. Holmes. An incision is made on a level with the upper border of the bone, commencing at the inner edge of the tendo Achillis, and passing forwards to a point a little in front of the calcaneo-cuboid joint, which lies midway between the outer malleolus and the base of the fifth metatarsal bone. The incision should be made down to the bone, and divide the tendo Achillis. Another incision is then to be drawn across the sole at a right angle to the first, and at a point corresponding to the calcaneo-cuboid joint; it should stop short of the outer border of the grooved or internal surface of the os calcis, so as to avoid the posterior tibial vessels. The flap thus formed is dissected up and the calcaneo-cuboid joint freely opened; then the connections of the calcaneum with the astragalus are divided. The bone should next be levered out of its bed to some extent with an elevator, and grasped with the lion-forceps, by which it

is to be turned aside, so that the soft part can be carefully cleared from its inner side. Any remaining ligamentous attachments being now divided, the bone can be pulled away.

The operation will be much facilitated by the use of an Esmarch's bandage, which enables the position of the joints to be more easily seen. The flaps are to be brought together with sutures, a drainage-tube inserted, and the limb placed upon a splint, with the foot at a right angle to the leg. The gap left by the removal of the bone fills up with dense fibrous tissue. The tendo Achillis takes a fresh attachment, and as a rule a perfectly useful foot results, the only deformity in which is a slight elevation of the heel.

Many surgeons prefer to dispense with the sole incision altogether, and prolong the horizontal cut on the inner side of the foot to a point corresponding with the calcaneo-cuboid articulation on the outer side. The advantage of this method is that the scar is not exposed to pressure.

Another method of removing the os calcis is that of turning back a flap from the heel, such as is made in Syme's amputation, the incision running from the tip of the outer malleolus to a corresponding point on the inner side of the foot; the joints are then opened and the bone dissected out. This, however, is a much less convenient plan than that first described.

The subperiosteal method is tedious, and does not seem to give better results than the ordinary operation.

J. Warrington Haward.

OS INNOMINATUM, Fracture of the. *See* Pelvis, Injuries of the.

OSMIDROSIS. *See* Hyperidrosis.

OSTEO-ANEURISM.—It is doubtful if this term ought still to be preserved; for all the cases of pulsatile tumours of bone which have been recorded of recent years, since the general use of the microscope, have proved, when this method of investigation has been adopted, to be central sarcomata. A large proportion of the myeloid and round-celled sarcomata, growing in the cancellous tissue of bone, pulsate distinctly, and, before the microscope was employed for the examination of these tumours, were often described as osteo-aneurisms, on account of their pulsation and the apparent absence of anything more solid than blood-clot. But in the outlying parts of such tumours, new-growth, of the sarcomatous type, has, of recent years, always been found.

Under Tumours of Bone a clinical description of these endosteal growths is given, to which the reader is referred for further information. Their pulsation seems, in most cases, to be due to the large number of new and dilated vessels which they contain. In some of the myeloid sarcomata numerous cystic cavities are found, filled with blood in different degrees of consistence, into which the enlarged vessels probably open; but the growth is so soft and diffluent that an accurate examination of the centre can very rarely be undertaken. The more solid tissue in the outlying and peripheral parts of the growth is that which is generally examined, to demonstrate the nature of the tumour; and this examination, as stated above, has almost invariably proved that the growth is one of the sarcomata, most frequently the myeloid or round-celled.

A vascular tumour has also been described as occurring in the flat bones, such as those of the skull in young children, resembling in its general structure the arterial erectile growth that is occasionally seen in the soft parts of the face and scalp.

H. H. Clutton.

OSTEO-ARTHRITIS.—A chronic disease of the joints, occurring usually in persons past maturity, and giving rise to extensive changes in the shape and texture of the articular tissues, with corresponding interference with function.

The striking features of this disease are the altered shape of the joint surfaces, which are worn away in some parts and irregularly nodulated in others; the softening and destruction of ligaments, allowing displacement of the bones; the loud and easily felt crepitus on movement; and the progressive loss of mobility.

The disease is seen chiefly in ill-nourished persons of declining years, and is said to be more common in those of rheumatic ancestry or predisposition. But it may be observed in younger persons who have been subjected to depressing influences or to injury, and is occasionally met with in children. When it does occur in the young, the disease is extensive in its distribution and comparatively rapid in its progress. The writer has seen two very severe cases in female children before puberty.

The disease often seems to have its origin in injury, a sprain or blow upon a joint eliciting the first symptoms; yet the predisposing diathesis is doubtless also essential for its production, because the inflammation started by the injury leads to

results entirely different from those of ordinary traumatic arthritis, and, moreover, other joints besides the injured one subsequently become affected.

Osteo-arthritis is probably one of the few joint-diseases which commence in the articular cartilage. The earliest changes are observed in this tissue, which loses its proper smoothness and pearly grey colour, and becomes roughened, of dull yellow tint, wasted, and worn away at the points of greatest friction; while, at the same time, irregular and nodular thickening occurs at its edges, where least subjected to pressure. After a time the synovial membrane becomes vascular and thickened, and there is sometimes considerable effusion into the joint. Fluid distension of the joint is not, however, usually of long duration, nor is it a prominent symptom in this affection. As the disease progresses the cartilaginous outgrowths ossify, and similar formations occur about the margins of the joint-surfaces, especially at the insertion of tendons; at the same time, the wearing away of the cartilages exposes the bones, the ends of which become flattened out and the articular cavities enlarged, while their surfaces become hard, dense, and polished.

The neighbouring ligaments and tendons become softened, stretched, wasted, or completely destroyed; so that, in addition to the great alterations of shape which the bony outgrowths and flattening out of the joint-surfaces have produced, more or less displacement occurs. Moreover, some of these cartilaginous or bony formations may become detached into the cavity of the joint, and thus give rise to a so-called 'loose cartilage.'

The *symptoms* of course differ with the stage of the disease, and it is important to remember that the affection varies greatly in its rate of progress. At the commencement, aching pain and stiffness and crackling in the joint are the chief characteristics, to which, after a variable time, are added nodulation and displacement of the joint-surfaces, and alterations in the axes of the limbs.

It is the rapid occurrence of these later changes, especially after injuries, which gives rise, sometimes, to suspicions of fracture and to the erroneous diagnosis of partial dislocation. In the shoulder, the long tendon of the biceps may be completely divided, the glenoid cavity much enlarged, and the head of the humerus altered in shape, so that the natural outlines of the joint are not recognisable; and movement, which is too free in some directions and restricted in others, is accompanied by loud crepitus. It is easy to see that these are conditions which, especially if they ensue upon an injury, may be misinterpreted by the sufferer, and possibly by his attendant.

So also in the wrist, the osteal changes may simulate displacement of the carpal bones; and in the hip-joint the flattening of the head of the femur, the shortening of its neck, the enlargement of the cavity and roughening of the margin of the acetabulum, and the destruction of the round ligament give rise to symptoms which may be mistaken for intra-capsular fracture.

It is well to bear in mind then, that in elderly persons, and in those predisposed to this disease, a fall on the hip, a fracture of the lower end of the radius, a sprain of the knee or a blow on the shoulder, are injuries which, amongst others, are frequently followed by the development of osteo-arthritis.

Treatment.—In the treatment of osteo-arthritis it is of the first importance to improve the nutrition of the patient, which will almost always be found defective. When, therefore, injuries such as those alluded to occur in elderly persons, or in those prematurely senile, or who are ill-nourished or suspected to have any predisposition to osteo-arthritis, a generous diet, in which oil and fatty food should have a large share, should be given during the treatment of the injury; while, at the same time, the nutrition of the injured limb should be promoted by warmth, friction, and other suitable measures.

In the early stages of the disease, warm douches, friction with oleaginous liniments, soft, warm supports to the joints, applied so as not to interfere with the circulation nor with moderate use of the limb, are the appropriate local treatment. Cod-liver oil, sulphur, arsenic, or guiacum may be given internally. If, in spite of such measures, the disease is progressive, it is worth while for the patient to seek one of the sulphurous spas, where the treatment is often productive of great benefit.

In the advanced stages of the malady, attention to the general nutrition and the maintenance of warmth are the chief aids, but the local changes are of course irremediable. *See* Chronic Rheumatic Arthritis; Charcot's Disease.

J. Warrington Haward.

OSTEOID CANCER. *See* Carcinoma.

OSTEOMA.—Osteomata are tumours composed wholly of bone, and attached by their bases or peduncles to some part of

the bony framework of the body. In some rare instances they have been found in the soft parts as distinct and discontinuous tumours, but these are exceptions with which there is not space here to deal. Under EXOSTOSIS will be found a description of osteomata which grow from or are attached to the different parts of the skeleton; and under JAWS, Diseases of the, the forms of osteoma of which these bones are the frequent seats have been described. Tumours composed of other tissues, in which ossification is present, will be found described under ENCHONDROMA and SARCOMA, those only in which ossification is complete being spoken of as osteomata.

H. H. CLUTTON.

OSTEOMALACIA.—Osteomalacia is a disease of the fully formed adult bones, in which bending or fracture of one or more of the osseous structures is liable to occur, with considerable deformity. Under FRAGILITAS OSSIUM will be found a description of the various forms of atrophy in which fracture is likely to take place, and which at times have been mistaken for osteomalacia.

Causes.—Very little has been ascertained as to the definite causation of this disease, but the circumstances predisposing to its occurrence (or, to speak more certainly, the circumstances under which it most frequently arises), are well known. Mr. Durham, in the *Guy's Hospital Reports*, 3rd series, vol. x., 1864, has carefully analysed Litzmann's cases, which number 131, and has added the particulars of 14 other cases, making a total of 145. The most striking feature in this analysis is the fact that out of a total of 145 there were 132 females and only 13 males, and 'of the females 91 were first affected during pregnancy, or very shortly after childbirth.' As regards the time of life, 'the great majority began to suffer when between twenty-five and thirty-five years of age.' The situation of the disease is also remarkable, for, in those cases connected with pregnancy, the pelvis and the lower part of the spine were the first to give any indication of the disease, and, in those unconnected with pregnancy, the symptoms very early manifested themselves in the lower extremities. After discussing the various circumstances in the life-histories of these patients to which the disease has been at times attributed, Mr. Durham thus expresses his own opinion:—'In the histories of all, without exception, mention is made of the existence of some influence or other, or of some combination of influences, well known to be capable of producing great general depression of the nervous system.' It would be out of place here to discuss the many theories that have been propounded to explain the reason why the bones should be so extensively diseased, whilst the rest of the tissues remain to all appearances unaltered. Nor is there space to enumerate the chemical theories which have been advanced, by different authors, to explain the absorption of the inorganic constituents of bone and the appearance of salts of lime in the urine. Suffice it to say, that lactic and phosphoric acids have each been considered to be the means of this alteration in the condition of the bones.

Pathology.—Osteomalacia consists essentially in a softening of the bone-tissue. The earthy matter is in the first place absorbed, leaving the organic matrix with only a faint indication of its lacunæ and canaliculi. The appearance is similar to that which is produced when bone is soaked in hydrochloric acid for a microscopical specimen. This change is first seen in the bone next the Haversian canals and medullary spaces, while the central portions of the trabeculæ have still almost the appearance of healthy bone. The decalcification proceeds more rapidly in one direction than another, and often produces semicircular excavations like Howship's lacunæ in rarefying ostitis. The central portions of the trabeculæ are gradually affected in a similar manner, while the parts already decalcified become soft and jelly-like. The Haversian canals thus gradually enlarge till the compact substance resembles spongy bone, and this again is transformed into a soft gelatinous tissue without any osseous trabeculæ at all. This process goes on till the whole of the interior of the bone is converted into a substance resembling jelly, leaving, however, a thin layer of the cortex beneath the periosteum unaffected. The fact that this outermost layer of the cortex, which is often not thicker than cardboard, remains unaffected, deriving, as it does, its nourishment from the periosteum, lends support to the theory that the disease starts in the medullary cavity. The vessels, no longer contained in rigid walls, allow their blood to escape, so that a reddish brown semi-fluid pulp is produced, resembling that of the spleen. This parenchymatous hæmorrhage is a very constant phenomenon in osteomalacia. Microscopically, this pulp is found to contain numberless blood corpuscles, cells of various shapes and sizes, but

mostly small, a considerable number of oil-globules, and granular matter.

The *symptoms* are at first somewhat obscure, the patient complaining only of pain, which is nearly always described as rheumatic. It is deep-seated and increased by pressure and motion; but there is nothing very definite in its character by which one can tell the onset of the disease. General lassitude and inability to make any exertion are commonly complained of, but it is not possible to say that osteomalacia is present till some very obvious deformity points out, only too clearly, the nature of the affection. Diminution of stature, and a peculiar gait in walking, may also at times be observed, the latter being apparently induced by a feeling of want of security. But all these symptoms could, at most, only arouse the suspicions of the medical attendant. The real state of the case is eventually revealed by the discovery of one or more bones becoming bent or broken from some very trivial accident. Or, possibly, the practitioner may first be made aware of the condition of the bones by an examination of the pelvis during parturition. The iliac and pubic bones are not infrequently the only parts at first affected. The promontory of the sacrum is thrust forward by the weight of the body, while the sides of the pelvis are made to approximate from the same cause acting upon the two femora. The pelvis thus assumes the beaked shape so characteristic of the deformity in this disease. It is needless to point out the serious obstacle which this condition of the pelvic outlet causes to the safe delivery of the child. Cæsarean section is, in many cases, the only resource of the obstetrician. The bones, being soft, however, have been bent and altered in shape by the hands of the medical attendant, and delivery effected through the vagina.

The spine also is oftentimes very seriously deformed, and chiefly by the great increase of its natural curvatures, which may be so much exaggerated as to assume somewhat the shape of the letter S. The ribs also may bend or break from the action of the respiratory muscles and the use of the upper extremities. They commonly yield and bend outward not far from the spine, and are again thrust forwards just outside the sternum; and between these two points, at the axillary line, they are bent inwards. The arms are thus lodged in trough-shaped hollows, and tend to compress the lungs within the chest. The bones of the extremities have also been bent and broken in many places, allowing the feet to touch the head in some extraordinary instances. We may thus have, in extreme cases, the most exaggerated deformities of the skeleton of which the human body is capable. But it is quite possible for the disease to be confined to the pelvis and the lower part of the spine, as has been shown in the statistics quoted above. The urine has almost always contained an excess of lime-salts, pointing to the conclusion that the inorganic constituents of bone are eliminated through the kidneys. Fever has also been noticed towards the termination of many of the cases, but in the early stages it has generally been absent.

It is impossible to give a very definite or decided opinion as to the mortality of osteomalacia. A very large proportion of the deaths have occurred during parturition from the mechanical difficulty to which the deformed pelvis has given rise. But it does not appear that the disease itself directly causes death. The patients are necessarily confined to bed, and as a consequence their vital powers are considerably diminished. They are thus exposed to intercurrent maladies, which may at any time prove fatal in such enfeebled constitutions as are necessarily produced from the conditions of the disease. Provided the thorax and spine are not involved, the patients may live a very long time in their crippled and bedridden condition. But if the ribs give way and cause compression of the lungs, or the softening of the bodies of the vertebræ interferes with the integrity of the spinal cord, a fatal termination may quickly supervene and cut short a long and tedious complaint. If none of these casualties occur, the patient may eventually die of exhaustion and simple failure of the vital powers, in a manner similar to that seen in extreme old age.

Recovery or obvious improvement is stated to have occurred in 22 out of the 145 cases already quoted from Mr. Durham's article. But they appear to have been nearly all connected with pregnancy, and the disease was confined to the pelvis and the lower part of the spine. How far such cases of osteomalacia are really capable of recovery, further experience is required to show.

Treatment.—There is very little to be done in the way of treatment. In the early stages, freedom from anxiety, absolute rest, good diet, and general tonics such as iron, quinine, and cod-liver oil, should be recommended. Salts of lime would seem only to be capable of doing harm, for the system

is trying, through some error of nutrition, to get rid of what is already present in the tissues, as is evidenced by the condition of the urine; and to throw more upon the organs already overburdened with these salts, only tends to increase their difficulties. Should a definite fracture occur, it must be treated on ordinary principles, in the expectation that it will unite, as it generally does in the early stages of the malady. In extreme cases, there is really nothing that can be recommended to arrest the progress of the disease.

H. H. Clutton.

OSTEOMYELITIS is an inflammation of the medullary canal and the tissue lining the cancellous parts of bone. It may be divided into acute and chronic osteomyelitis. Of the acute there are two very distinct varieties.

Simple acute Osteomyelitis is generally caused by some definite injury to the bone, as in fractures or gunshot wounds. The inflammatory exudation takes place as it does in other tissues, and may undergo the same changes of resolution, suppuration, or organization. It occupies the tissue lining the cancellous framework of bone and, in simple fractures, forming the internal callus which will be found described in the pathology of this form of injury. In compound fractures, and after amputation, it often terminates in suppuration or necrosis of a limited portion of the cancellous tissue. This simple form of inflammation, confined as it is to a small portion only of the medullary canal, gives rise to no symptoms to distinguish it from the particular injury of which it plays only a secondary and unimportant part. The treatment may be gathered from what is said, in the following sections, as to the best means of preventing the diffuse form of the disease.

Acute diffuse Osteomyelitis is a much more serious complaint, corresponding to the acute diffuse periostitis which it sometimes accompanies. They are both thought by many surgeons to be infective or due to some specific virus. This is the form of inflammation which is generally meant when the term osteomyelitis is used, the simple inflammation being usually omitted from consideration, as having only a pathological interest.

Causes.—An *idiopathic* form of this disease, which is described as occurring in other countries, is very rare in England, except in so far as it may accompany and be a part of acute diffuse periostitis. The *traumatic* variety is, however, well known in civil practice in England, and is especially dreaded by military surgeons in time of war.

Amputations, compound fractures, and gunshot injuries involving bone are the cases in which it is prone to occur. Decomposition of the discharges of a wound communicating with the medullary canal is undoubtedly, in most cases, the essential cause. It is, consequently, much less common in the present day, when so much is done, and that successfully, to prevent putrefaction and decomposition of wounds. Erysipelas and hospital gangrene and like infective inflammations may attack the medullary canal, but are scarcely likely to do so unless the discharges are in a septic condition. The state of things which then arises does not differ clinically from the disease we are now considering.

Pathology. — The simple mechanical process, by which this form of osteomyelitis takes place in a decomposing, suppurating wound, is easy to understand, without looking for a specific virus as an explanation. The patulous, thin-walled veins, lying embedded in such a rigid inelastic material as bone, at the bottom of a deep and suppurating wound, may very easily become distended with pent-up inflammatory exudation, which, for want of a ready outlet, may decompose and give rise to that septic mischief which we know and recognise as one of the chief constitutional signs of osteomyelitis. From the part thus affected the inflammation may spread to the adjoining medullary tissue, and the products of this inflammation, finding no outlet, may so arrest the circulation as to cause necrosis, or decompose and still further spread the mischief. Finally, the whole of the medullary canal, from one end to the other, may be affected in this way. Putrefaction of a wound may thus be alone responsible for a diffuse osteomyelitis, without the intervention of a specific virus. The veins filled with decomposing septic material may very easily give rise to embolic pyæmia, for they cannot collapse, and thus quickly become thrombosed. The thrombus softens from decomposition, and particles becoming detached enter the circulation, to be arrested in a distant part of the body. The patient may, however, especially after an amputation, where there is a more open surface for the escape of the inflammatory and decomposing products, live through these dangers. More or less extensive necrosis is then almost certain to follow, involving the cancellous tissue and the inner layer of the compact bone. The

long ferrule of bone, withdrawn in the form of a sequestrum from a stump some months after an amputation, is the common and most favourable result of this diffuse osteomyelitis.

Symptoms.—Deep-seated swelling of the soft parts covering the bone affected, whilst the skin remains almost in its natural condition; severe, dull, aching pain and much tenderness on pressure, are the chief local symptoms. Profuse discharge of dirty-looking, offensive pus from the wound or stump, increasing in quantity as time goes on instead of becoming less, as it should do under healthy conditions, would add to the probability of the medullary canal becoming inflamed and the source of all the trouble. Where the bone is exposed and capable of being examined, the periosteum will be found swollen, vascular, and detached from its connections. It may also be seen, as in the case of the skull, to be dry, yellow, and dead. If the medullary canal can be examined with a probe, as in the case of a stump, it will be found soft and yielding. But, oftentimes, there will be nothing by which to distinguish such a case from simple septicæmia or pyæmia. In fact, little can be said in most cases from the local symptoms; and we judge rather from the signs of septic mischief that there must be some source of infection. If the appearance of the stump be not inconsistent with some deep-seated mischief in the bone, we think it not improbable that the medullary tissue, although invisible, is the source of such severe constitutional symptoms. Fever of a septic type, with profuse sweats and much depression, are the principal features of this condition to which we are alluding. The temperature will probably be very high, between 103° and 105° Fahrenheit. Rigors may also occur and be frequently repeated. All the symptoms of pyæmia and septicæmia may become established, and the patient sink from rapid poisoning, or linger on with multiple pyæmic abscesses.

Treatment.—In the case of wounds and operations involving bone, let the disease itself be avoided by thorough cleanliness, and by that most perfect form of cleanliness—Listerism. If this be carried out in principle, although possibly not in absolute detail, decomposition will be prevented, and an almost absolute guarantee will be obtained that the mischief has not entered through the wound.

Other superficial and insignificant wounds may, however, be the channel through which septic poisons enter the circulation, and then decomposition may ensue in spite of all antiseptic precautions. We are not now speaking of those cases in which acute diffuse periostitis (or acute necrosis), with accompanying osteomyelitis, takes place without any wound whatever.

Granted then that putrefaction has occurred and the symptoms of osteomyelitis have ensued, what treatment is to be adopted to arrest its progress and prevent the onset of pyæmia? The two diseases are so liable to glide insensibly into one another, that whatever is done must be done quickly. First and foremost, a free outlet must be given to any pent-up discharges. In the case of a stump, the openings should, if small, be enlarged, and a drainage-tube be introduced. In the case of a compound fracture, an effective counter-opening may be required, so that the pus may escape as fast as it is formed. Then the question arises whether more than this can be done.

Amputation has been resorted to, with good results; but it must be done early, before pyæmia has become fully established, or the operation will be of no practical use. Some surgeons have asserted that, if amputation is performed, it is useless to do less than remove the whole bone—that is, to do exarticulation at the hip if the case be one of osteomyelitis of the femur. The writer of this article has, however, seen good results after removal of a portion of the bone, where the whole was not diseased. If amputation has been resolved upon, the decision as to the amount to be removed should rather rest upon the condition found upon examination of the end of the bone. If, after its exposure and examination with the finger, the periosteum is found extensively retracted, and the probe introduced into the medulla encounters nothing but pus and dead bone, the whole of the shaft should, if possible, be removed. When the probe comes rapidly upon sound and bleeding medulla, a portion only of the shaft need be taken away. Should, however, the sawn surface be still unhealthy, another section must be removed. In the case of the femur of an exhausted patient, it might be desirable, in the more extensive variety above-mentioned, to saw through the bone just outside the joint or through the trochanters.

Another and less severe operation has of late been suggested, and certainly deserves a trial in any case in which, for some reason, amputation is unsuitable. It consists in scraping out the whole of the diseased medulla and introducing iodoform into the canal. As far as general treatment

is concerned, the same rules apply here as in other exhausting febrile diseases. The patient must be supported with a stimulating, nutritious diet, and every method tried to keep his flagging powers from failing.

Chronic Osteomyelitis.—Chronic inflammation of the medullary tissue takes place most frequently in conjunction with chronic ostitis and periostitis. *See* Ostitis. It produces, however, no symptoms in these cases, except such as are common to the general inflammation of the whole thickness of the bone. The results of this condition are well seen in the filling up of the medullary canal in osteosclerosis. It sometimes takes another form, and terminates in suppuration or necrosis of a small portion of the cancellous tissue, producing the disease known as chronic Abscess of Bone. H. H. Clutton.

OSTEO-PLASTIC RESECTION. *See* Joints, Excision of.

OSTEOPOROSIS.—Strictly speaking, osteoporosis is a spongy, porous condition of bone resulting from rarefying ostitis. The specimens in our museums are mostly enormously thickened skulls, in which the increase in size is almost entirely due to a development of finely porous and reticulated bone. In fact, their appearance is exactly similar to the condition described under Ostitis Deformans, and conveys the impression that if the history were complete, or if the whole skeleton could be examined, these thickened skulls, which were labelled many years ago as osteoporosis, would now be described as cases of ostitis deformans.

Besides the general effect produced by this disease, which is described elsewhere, a bone may become osteoporotic from local causes. An aneurism, or a tumour which only secondarily presses upon, but has not started in, the substance of a bone, may induce a local osteoporosis. But the term is more generally applied to the condition alluded to above, which arises without known cause, and affects many bones at the same time and in the same manner. H. H. Clutton.

OSTEO-SARCOMA. *See* Sarcoma.

OSTEOTOMY. — *Definition.* — Osteotomy, in its broadest acceptation, may be defined as the process of making a section of bone. It is, however, generally employed in a much more restricted sense, the term being applied to such divisions of bone as have been proposed and undertaken for the relief of deformity, for the rectification of badly united fractures, and for the straightening of limbs which are fixed in bad positions by ankylosis.

Instruments.—When a surgeon is about to perform an osteotomy, his attention is directed towards the kind of instruments required, and the success of the operation depends in great measure on their proper selection. A variety of instruments has been employed, but the choice practically lies between the saw and instruments of the chisel order. Some surgeons prefer the saw to the chisel, as they believe that it is much more easily used, and they state that it is equally efficient. Langenbeck believed that the bone-*débris* left by the saw in the wound was apt to excite irritation which led to suppuration; and though this result does not necessarily follow, still, as it is an element of risk, it is better to avoid it. In the selection of an instrument, the desideratum is to secure one which will effect the osseous division with the least disturbance of the soft parts. When the saw is introduced by a subcutaneous wound for the performance of an osteotomy, there is the danger of laceration of the soft parts on either side of the bone while the saw is in action, besides the likelihood of air being pumped into the tissues by the to-and-fro movement. The chisel is not liable to these objections. Once the cutting edge is passed through the soft tissues to the bone, there is nothing further to fear; it in no way lacerates the soft parts, and it makes a fine, clean, osseous incision without leaving *débris*. It is, however, a most powerful instrument, and its proper selection and method of use are highly important to a successful issue of the case.

The instruments used by the writer are of two kinds, the chisel and the osteotome, the former being of the same form as the carpenter's, though different in temper; the latter being shaped like an attenuated double inclined plane. The chisel is used for paring, shaving, and cutting out wedges of bone, such as removing a cuneiform portion from the tibia in anterior curvature. The osteotome is used only for making simple incisions, or wedge-shaped openings, without removal of bone. It is advisable that anyone wishing to use these instruments should practise on the subject or on the bones of animals, so as to familiarise the hand and acquire the necessary dexterity. The surgeon should himself see that the instruments are scrupulously clean, before he uses them on the living body. If they are used while dirty, they will pro-

bably clean themselves in the wound, leaving in the soft parts or on the bone the foreign substance, and so possibly inoculate the tissues with decomposing matter. The only other instruments required are an ordinary sharp-pointed scalpel, suitable for penetrating the tissues to the bone, a couple of blunt hooks, and a mallet of hard wood, such as lignum vitæ.

The Operation.—The patient ought to be placed fully under the influence of an anæsthetic, and this should be maintained during the performance of the operation, and until the limb is securely fixed in splints. After the patient is fully anæsthetised, the limb is rendered bloodless. This is best done by the application of a bandage of elastic webbing, applied from the distal extremity of the limb to above the seat of operation, and then fixed at the most convenient point on the proximal aspect. The limb is then placed on a sand pillow. The sand pillow used by the author is eighteen inches by twelve; the case being filled with sand just sufficiently to enable it to be shifted from one part of the bag to another, without leaving any portion empty—a moderate fulness without distension. The sand is moistened just before the operation, to prevent the escape of dust and to produce greater cohesion between its particles, so that it will more readily retain the form or mould imparted to it. It is then covered with a sheet of jaconet or other waterproof material, and laid on a table. The limb is then embedded in the pillow in the manner suitable for the particular operation.

In order to introduce either the saw or the osteotome, a wound in the soft parts must be made. This wound ought to be a sharp, clean, single incision, produced by one stroke of the instrument wherever this is practicable. Dissection ought to be avoided, the situation in which the incision is to be made being chosen so as to get to the bone as directly as possible. The direction of the incision should be in a line with that of the muscular fibres about to be penetrated. The situation of the wound in the soft parts ought to be selected so as to avoid cutting, not only the larger vessels, but also the smaller ones, when this can be done. As to the extent of the incision, this depends greatly on the surgeon, whether he wishes to see what he is doing, or whether he can trust to the tactile sensations conveyed through the instrument to his hand, as a sufficient guide. If the latter, the wound need only be large enough to admit the osteotome; if the former, it would require to be a couple or more inches in length, according to the depth of the tissues. When a surgeon commences to practise osteotomy, it would be well for him to make a large incision, one sufficient to enable him to examine the bone with the finger, or even to see the bone; in this way he performs his operation with more confidence, and the extent of his incision is an element of safety, inasmuch as it provides a ready exit for discharge—blood or serum—which otherwise might be pent-up in the parts, causing distension. After he has gained a little more experience, the osteotome may be used as a probe (the saw will never answer this purpose), the sensations conveyed through the instrument being sufficient to enable the operator to ascertain all that can be known by the introduction of the finger. When the operator has reached this stage, all that is necessary is to make an incision which will enable the osteotome to reach the bone—from half an inch to an inch long, according to the breadth of the blade. By operating in this way the tissues are much less disturbed, there is less effusion of blood or serum, and much less need of drainage.

In removing wedges of bone, the wound must be larger. But, in operating upon the tibia, the incision need not be larger than the base of the wedge to be removed, as the skin moves freely over the surface of the bone, and may be shifted up or down to suit the convenience of the operator. When small wounds are made, the knife ought to remain *in situ* until the saw or the osteotome is introduced by the side of it to the bone, the knife acting as a guide. When the osteotome has reached the bone, it should be turned in the direction in which the osseous incision is to be made, care being taken while doing this not to denude the bone of periosteum.

The osteotome ought to be used in such a way as to direct its cutting edge away from any important soft structures, which it may be necessary to avoid. As the osteotome has blunt sides, it may be used to lever the soft tissues aside, keeping, meanwhile, the cutting edge of the instrument in close contact with the bone. After a little practice, the osteotome acts as a probe, and when once the tactile impressions conveyed through this instrument are cultivated, it becomes a delicate indicator of the state of the bone, the precise relation of the osteotome to it, and the extent of the osseous incision. But when the osteotome has been embedded in the bone for an inch or two, its delicacy of touch is lost, and it no longer remains a precise indicator of what is in

contact with its cutting edge. This is due to the manner in which the sides of the instrument are pressed on and caught by the bone; the amount of lateral pressure varying according to the amount of the osseous tissue through which the instrument passes. This may be easily rectified by introducing a finer instrument by the side of the thicker one first used, and withdrawing the latter. The finer instrument is then placed in the osseous groove made by the thick one, but, being a more attenuated wedge, its sides are not pressed on, so that it acts as an indicator of the kind of tissue in immediate contact with its cutting edge. This can be repeated, in a thick bone, by the substitution of a third instrument of still greater acuteness.

When using the osteotome, it ought to be grasped firmly in the left hand, steadied by the inner border resting on the patient's limb. The surgeon ought to cut to, instead of from, himself. Thus, if the surgeon is operating on the inner side of the left limb, he ought to stand on the left side of the patient, and cut towards himself. If the surgeon, instead of following this instruction, should hold the osteotome loosely, a slightly uneven blow with the mallet would outweigh his grip, and might cause the instrument to slide along the surface of the bone, peeling the periosteum, or causing a more unpleasant accident, such as penetration of an artery. When the chisel is placed in position, the mallet may then be brought into requisition, being used by the right hand. When the external shell of bone is felt to have given way, it is not advisable to attempt to complete at once this particular portion of the section, because the instrument is apt to be caught. In order to avoid impaction, the entire superficial portion of the section ought to be completed in the first instance, so as to permit a little movement of the instrument in the direction of its breadth; and by making a series of such movements, after each impulse given by the mallet, there can be no fixity. The osteotome or chisel ought not to be pressed against the bone transversely to its breadth, as it is possible that it may be broken or twisted by so doing. The bone itself may be splintered longitudinally by such pressure. In no instance should the osteotome or chisel have a breadth greater than the diameter of the bone about to be cut, otherwise the soft structures at either side are apt to be injured. When a large wedge is to be removed, it is better to do this in several pieces—first a small superficial wedge, then a shaving of each side until the desired extent is reached. The form of normal bone, as it appears in section, may be of some use in guiding the direction of osseous incisions; but this cannot be absolutely depended on in the case of distorted bones, as their contour is often greatly altered. It may be borne in mind that rachitic bones have a tendency to become flattened, sometimes in one direction, sometimes in another, and that when the bone is curved, the concave portion has the thicker wall as a rule.

Osteotomy for the Relief of Ankylosed Hip-joint, when at an Angle producing Deformity.—In such cases, the neck of the femur is divided so as to enable that bone to be brought down into a straight line with the body. Adams performs his operation with a saw, and thus describes it: 'The left thumb is placed firmly, so as to compress the soft tissues solidly against the bone, at a point situated at the centre of the top of the great trochanter, and the breadth of one finger above. At this point the narrow-bladed knife is pushed in till it reaches the neck of the femur, at a right angle across the front of which it is then carried. The knife is then gently moved to cut a space for the easy insertion of the saw, which, traversing the course of the knife, reaches the front of the neck of the femur and gradually cuts it completely through. The surgeon cuts until he feels that the saw is free of the bone, and moving in the soft tissues only, behind the bone.' The neck of the femur may also be divided by the osteotome, that instrument being introduced at the same place as is indicated above, and with a few blows of the mallet the division is completed. In certain cases, where this operation of division of the neck of the femur cannot be performed on account of the femur being firmly held by cicatricial tissue, or where the muscles and tendons surrounding the joint are much contracted, or where the neck of the femur is altered by absorption or by deposition of bone, Mr. Gant divides the femur immediately below the lesser trochanter. By doing so the limb is restored to the straight position, but is apt to be made somewhat shorter.

Osteotomy for Ankylosis of the Knee-joint.—When angular ankylosis of the knee-joint is present to such an extent as to render the limb useless for walking, or only permits the toes to reach the floor, the limb may be rendered straight by osteotomy. This operation must not be performed so long as there is any active disease

present in the joint. In this case, the femur may be divided at the same level as for genu valgum; only, the anterior portion of the bone ought to be divided completely over its whole breadth, so as to permit of straightening from behind forwards. If the deformity has assumed nearly that of a right angle, it is possible that this linear osteotomy may not be sufficient to rectify the whole deformity. Under such circumstances, instead of removing a wedge from the femur, it is better to make another linear osteotomy just below the tuberosity of the tibia, or a little to the proximal side of this. When the deformity is great, it is better to have recourse to gradual straightening after the operation, as the sudden strain of complete straightening, on the vessels of the popliteal space, might lead to bad results. The limb may be safely straightened so long as the tibial vessels at the ankle pulsate freely. The straightening ought to be completed during the first week, if possible.

Osteotomies for Genu Valgum. — Ogston's operation is as follows:—The knee is flexed as fully as possible. A long tenotomy knife is introduced flatly two or three inches above the inner condyle, and pushed downwards, forwards, and outwards, until the point is felt in the intercondyloid space. The cutting edge of the tenotome is then turned downwards, and the soft tissues are divided to the bone as its withdrawal is effected. Adams's saw is then introduced along the groove formed by the knife, and the inner condyle is sawn through, from above downwards, for about three-quarters of its thickness. The fracture is completed by forcibly straightening the limb, the loose condyle slipping upward over the sawn surface. This operation may also be performed by the chisel instead of the saw. Professor Ogston has recently expressed a preference for the operation about to be described.

Macewen's Operation for Genu Valgum.—The limb being rendered bloodless, is placed on a sand pillow, where it is securely held by two assistants. One assistant, standing on the opposite side of the table from that of the operator, places his right hand on the thigh, while the other, standing at the foot of the table, places his right hand on the upper part of the tibia. The operator sponges the seat of operation with 1-20 carbolised watery solution; the spray is then directed on the part. A sharp-pointed scalpel is introduced on the inside of the thigh, at a point where the two following lines meet—one drawn transversely, a finger-breadth above the superior tip of the external condyle, and a longitudinal one drawn half an inch in front of the adductor magnus tendon. The scalpel here penetrates at once to the bone, and a longitudinal incision is made sufficient to admit the largest osteotome and the finger, should the surgeon deem it necessary. Before withdrawing the scalpel, the largest osteotome is slipped by its side until it reaches the bone. The scalpel is withdrawn, and the osteotome, which was introduced longitudinally, is now turned transversely in the direction required for the osseous incision. In turning the osteotome, too much pressure must not be exerted, lest the periosteum be scraped off. It is then convenient to pass the edge of the osteotome over the bone until it reaches the posterior internal border, when the entire cutting edge of the osteotome is applied, and the instrument is made to penetrate from behind forwards, and towards the outer side. After completing the incision in that direction, the osteotome is made to traverse the inner side of the bone, cutting it as it proceeds, until it has divided the uppermost part of the internal border, when it is directed from before backward towards the outer posterior angle of the femur.

In cutting on these lines there is no fear of injuring the femoral artery. The bone may be divided without paying heed to this order of procedure, but it is better that the operator should have a definite plan in his mind, so that he may be certain as to what has been divided and what remains to be done. The writer is persuaded that accidents have happened by not paying heed to this. In using the osteotome, the left hand in which it is grasped ought to give, after each impulse supplied by the mallet, a slight movement to the blade—not transversely to its axis, but longitudinally—so as to prevent any disposition to fixity which it might assume. After the inner portion of the bone is divided, a finer instrument may be slipped over the first, which is then withdrawn; and even a third, if necessary, may take the place of the second when the outer portion of the bone comes to be divided. Whether one or more osteotomes be used depends much on the resistance met with. If the tissue is yielding, one may suffice; if hard or brittle, two or three will effect the division more easily, and with less risk of breaking or splitting the bone longitudinally. In the adult, the dense circumferential layer of bone resists the entrance of the osteotome at the outset, but several strokes cause the instrument

to penetrate this superficial dense portion, when it will pass easily through the cancellated tissue. After a little experience, the surgeon recognises, by touch and sound, when the osteotome meets the hard layer on the outer aspect of the bone. If it be considered desirable to notch or penetrate this outer dense part of the bone, in doing so the osteotome ought to be grasped firmly by the left hand, the inner border of the hand resting on the limb, so as to check instantly any impetus which may be considered too great. It is better to snap or bend this layer rather than cut it. When the instrument is to be altered in position, it ought not to be pulled out in the ordinary way, as it is then liable to be removed from the wound in the soft parts, as well as from the bone. Instead, let the left hand, with its inner border resting on the limb, grasp the instrument, while the thumb is pressed under the ridge afforded by the rounded head, and gently lever the osteotome outwards by an extension movement of the thumb. In this way the movement may be regulated with precision. It is desirable to complete all the work intended by the osteotome before removing it from the wound.

When the operator thinks that the bone has been sufficiently divided, the osteotome is laid aside and a sponge, saturated in 1–40 carbolised watery solution is placed over the wound. While the surgeon holds the sponge he, at the same time, employs that hand as a fulcrum; with the other he grasps the limb lower down, using it as a lever, and jerks, if the bone be hard, or bends slowly, if the bone be soft, in an inward direction, when the bone will snap or bend as the case may be. The limb is then brought into a straight line. A sponge, saturated in 1–40 watery solution, is placed over the wound, and kept in position by a gauze bandage. This is retained until the opposite limb is operated on. After the wound is thus protected, the elastic webbing controlling the circulation is removed, and the limb is held by an assistant, who practises extension meanwhile. After the other limb has been operated on, it is similarly treated while the first is being dressed. Before applying the dressing, any redundant cellular tissue, which may protrude from the wound, ought to be removed by a pair of scissors curved on the flat. The wound is then dressed antiseptically and placed in a special splint. The splint is a modification of the half box, the outer portion being carried up, like a long splint, to about the level of the third or fourth rib, and projecting beyond the posterior splint at the foot. This projection is fixed in the clamp of a bed-rest, and so the whole limb and splint are kept motionless and steady.

Although osteotomy may be performed without antiseptics, there is an element of risk in so doing. The writer uses strict Listerian precautions in his operations, with the addition of a little iodoform on the inner dressing, when it has to remain on the wound a fortnight or longer. He is further of opinion that, when suppuration ensues after an antiseptic osteotomy, it is almost always due to irritation produced by violence (which is never needed and ought to be avoided), either to the bone or to the soft parts, especially the latter. In cuneiform osteotomies on the tibia, where the wound, both in the soft parts and in the bone, is larger than in linear osteotomies, and consequently more exposed to contamination, the writer has never had suppuration.

WILLIAM MACEWEN.

OSTEOTRITE.—A mill-headed instrument invented by Mr. John Marshall, for smoothing the walls of bony cavities, and for enlarging bony sinuses.

OSTITIS.—Ostitis, or inflammation of bone, is often meant when the word periostitis is used. Inflammation rarely attacks either the periosteum, the compact tissue, or the medulla alone, but clinically the distinction is of value, inasmuch as it indicates the part which is primarily or principally involved. Neither the periosteum nor the medulla is free from inflammation in ostitis, but by the word ostitis the compact tissue of bone is indicated as the primary seat of disease. It most commonly affects the shaft of a long bone, and by preference the tibia or femur.

Causes.—Injuries of various kinds are probably the most common exciting causes of ostitis. Fractures, simple and compound, gunshot wounds, amputations, contusions, burns, and extreme degrees of heat or cold may give rise to it. Injuries of a less serious kind may also be the exciting cause of ostitis, in a subject already inclined to such inflammation. The predisposing causes are syphilis, both hereditary and acquired, struma, and tubercle; both of the latter, however, generally terminate in caries. It also occasionally follows rheumatism and typhoid fever.

Pathology.—In simple ostitis the bone, periosteum, and medulla become more vascular. The Haversian canals enlarge, whilst inflammatory exudation takes place in the connective-tissue around its vessels. The

periosteum is swollen and infiltrated with serum and leucocytes, and is easily separable from the bone, whilst the medullary tissue is similarly engorged. The osseous lamellæ are eroded from absorption, forming Howship's lacunæ, and the notches thus made are filled with embryonic connective tissue. A large number of multi-nucleated cells, called 'osteoclasts,' are found in this tissue, which are supposed to play a not unimportant part in the absorption of bone. In this condition the process is called *rarefying ostitis*, but, coincidentally with this rarefaction, new bone is being formed in the outlying parts beneath the periosteum and in the central canal. The small nucleated cells that take part in this new formation are called 'osteoblasts.' In simple ostitis the two processes are at first constantly going on together. Then, the subsequent changes will vary according to the intensity of the inflammation. Under favourable circumstances the inflammatory new-formation may undergo resolution, and the bone return almost to its natural condition; as a general rule, however, the bone remains somewhat larger from the amount of new material which has been formed around the inflamed area, and becomes, possibly, somewhat denser.

Condensing Ostitis or *Osteosclerosis.*—As a further development of the same process the ostitis may terminate in osteosclerosis. The inflammatory exudation in the connective tissue surrounding the vessels in the Haversian canals may organise into new bone, and thus fill up the spaces that had been previously formed, and even still further encroach upon these narrow channels till the bone becomes denser and harder than in the normal condition. This condensation may develop to such an extent as to convert the bone into a tissue as hard as ivory. The vessels may even be completely obliterated, as a consequence of the obstruction to the circulation, and the death of a considerable area of bone may in this way take place. The periosteum at the same time develops new bone as is shown under PERIOSTITIS, so that the original bone is increased in size as well as in density. The medullary canal is also encroached upon, and its cavity almost obliterated. This condensing ostitis or osteosclerosis is essentially a very chronic process, and may occur, especially in syphilis, without the preceding stage of rarefying ostitis.

Abscess.—Rarefying ostitis may also terminate in suppuration, the inflammatory exudation, as in other tissues, forming granulations and breaking down into pus. This is the ordinary termination of ostitis around a piece of dead bone and in compound fracture. It also not infrequently occurs in simple ostitis of the cancellous tissue, producing the well-known chronic ABSCESS OF BONE which is more fully described under that title. The inflammatory products may also, under certain circumstances, be so quickly formed as to compress the vessels in the Haversian canals and cut off the circulation from a part of the bone, thereby causing its death. The subsequent changes are described under NECROSIS.

Symptoms.—Inflammation of the compact tissue of bone is a chronic affection, beginning slowly and insidiously with obscure dull aching pains, which are worse at night and in wet weather. It may make considerable progress without giving any appreciable sign, except the persistent pain at night, which generally comes on in the evening whilst the patient is sitting over the fire, or getting warm in bed, and keeps him awake for many hours. On examination of the part complained of, it is often found that the bone is already somewhat larger than its fellow, and tender on pressure. As the disease almost always has its seat in the shaft of one of the long bones, especially the femur and tibia, these obscure, persistent, aching pains in any of the limbs should lead to a careful examination of the bone in its whole length. The enlargement will not be absolutely uniform, so that the irregularity can be easily detected by grasping the bone between the finger and thumb, and feeling it in this way from one end to the other. In syphilis, the corresponding bone on the opposite side of the body will be very often found in a similar condition. Tenderness on pressure will vary considerably, according to the sensitiveness of the patient and the stage of the disease. At first it is often well marked, whilst later on it is much less perceptible. There is not often much, if any, swelling of the soft parts, except in the case of wounds and compound fractures. But occasionally, and this chiefly in the tibia, where the bone is superficial, there may be some slight œdema and 'pitting' on careful pressure. Of course in the case of abscess of bone, which, however, does not generally affect the shaft, the condition is different, and will be found described under chronic ABSCESS OF BONE.

Treatment.—Iodide of potassium, in gradually increasing doses, should always be tried. Five, ten, or even fifteen grains may be given three times a day, if the

smaller doses produce no diminution in the severity of the pain. Generally, however, the patient is greatly relieved in quite the early stage by the smaller doses, and this effect is produced in most cases whether the patient be the subject of syphilis or not. In some few instances that have come under the writer's notice, where syphilis was undoubtedly present, the addition of mercury in the form of pil. hydrargyri, gr. v. nightly, has produced a more lasting and permanent improvement, after iodide of potassium alone had failed to accomplish more than a temporary diminution of pain. The application of blisters will also sometimes give relief. Painting with the strongest iodine liniment, or rubbing the affected part with mercurial ointment may be tried, and will occasionally prove serviceable, but iodide of potassium is, as a rule, the most potent remedy where the disease has not become fully established. Unfortunately, in the chronic cases, where the bone has become thickened and enlarged in spite of the treatment employed, nothing can be done to effect a completely successful result. If there be little or no pain, the patient has some inconvenience from the size of the bone and its weight, but he generally learns, in the course of time, to put up with this discomfort. On the other hand, should the pain continue to be a source of serious annoyance, linear osteotomy or the application of the trephine to the most tender spot, will often give the most marked relief. A simple incision through the periosteum is sometimes sufficient, especially in the early stage of the disease, where other less severe measures have failed to effect any improvement. In the later stages, linear osteotomy is probably the best operation, as it gives relief to a larger area of bone than the simple removal of a circular piece by the trephine. The bone should be thoroughly exposed by the knife to the extent of three or four inches, and a groove be cut in it with a chisel or a Hey's saw, till the medullary canal is reached. The bleeding that necessarily ensues relieves the engorged bone, mitigates for a very long time, if it does not entirely remove, the pain, and lessens the chances of subsequent suppuration or necrosis. H. H. Clutton.

OSTITIS DEFORMANS.—Sir James Paget's description of this disease, in the *Medico-Chirurgical Trans.*, vol. lx., 1877, is the first in which the symptoms and history are collected together in a definite form, under the name of ostitis deformans. To him, indeed, we owe the fact that, since the publication of the above paper, one more obscure bone-disease has been reclaimed from the unclassified group of osseous deformities, which still remains in our museums with an incomplete life-history.

Cause.—Nothing whatever is known as to its etiology. Neither syphilis, rheumatism, gout, scrofula, nor tubercle can be said to have a direct influence in this respect, for there is no clear history of these affections running through any considerable proportion of the recorded cases. In three out of the first five cases reported by Sir James Paget, cancer made its appearance late in life. But in seven others, recorded by the same author in vol. lxv. of the *Medico-Chir. Trans.*, 1882, cancer was not found to be associated with any one of the cases.

Pathology.—It would seem to be a form of chronic inflammation, beginning in old age or after middle life, and affecting principally the long bones and those of the skull. In Sir James Paget's words: 'The bones enlarge and soften, and those bearing weight yield and become unnaturally curved and misshapen.' While increase in size and alteration in shape are the principal external features of the disease, the texture of the bone is not less altered. The normal osseous tissue is replaced by a finely porous substance which, though reticulated and porous, is yet denser than it naturally should be. The strength of this bone is evident, and one can scarcely conceive it possible that bone in this condition could bend, especially when its enormous increase in size is taken into consideration. Such specimens only come under our observation quite late in the course of the disease. It is, therefore, probable that, at an earlier date, the bones atrophy and soften, and then become bent from the weight of the body; and that, subsequently, they undergo those hypertrophic changes which we see so largely developed in the advanced condition of the disease, at which they usually arrive before simple old age or some intercurrent malady terminates the patient's existence.

A splendid specimen of a whole skeleton, obtained by Mr. J. R. Lunn, is described and graphically depicted in *St. Thomas's Hospital Reports*, vol. xiii., 1883. The microscopical appearances, described by Dr. Sharkey, show that the principal feature in the change is one of rarefying ostitis. The complete skeleton, now in the museum of St. Thomas's

Hospital, is quite a unique specimen, and its coarse anatomy is most beautifully shown in the engravings illustrating the paper in the Reports above mentioned.

The *symptoms* are first noticed, as stated above, after middle life or in old age. 'The most characteristic,' according to Sir James Paget, 'are the loss of height, indicated by the low position of the hands when the arms are hanging down; the low stooping, with very round shoulders and the head far forwards with the chin raised, as if to clear the upper edge of the sternum; the chest sunken towards the pelvis, the abdomen pendulous; the curved lower limbs, held apart and usually with one advanced in front of the other, and with both knees slightly bent; the ankles overhung by the legs, and the toes turned out.' The bones forming the vault of the cranium are generally enlarged, and there is frequently a history of larger hats being worn than formerly. The upper part of the spine is bowed and quite fixed in this position, so that, in stooping, no movement can be detected between the spinous processes. The ribs are crowded together and immoveable. The breathing, therefore, becomes entirely diaphragmatic, in a manner exactly similar to the condition which is seen in spondylitis deformans. The difference between the two diseases is, however, sufficiently distinct to make confusion impossible. In spondylitis deformans, the immobility of the spine and ribs is alone observed, combined possibly with general osteo-arthritis. But there is no enlargement or curvature of the long bones, and the skull is entirely unaffected.

On examining the lower limbs in ostitis deformans, the shafts of the long bones will be found very large and unnaturally curved, as if they had at some period of the disease yielded to the weight of the body. Other bones may also be very much enlarged, such as the clavicle, humerus, radius, or ulna, and of these the clavicles are more frequently affected than any of the others. The deformities are generally symmetrical and well-marked.

The patients oftentimes, especially at the commencement of the disease, complain of pain, which is described as rheumatic, in the lower limbs and spine. But, as a rule, there is no pain in the head, even when the skull is considerably enlarged, nor is the mind in any way altered. The general health remains unaffected, and beyond the difficulty in walking and the breathlessness on any exertion, the disease does not cause any great distress. Life does not therefore seem to be materially shortened.

Treatment.—There is no indication for any special treatment. Iodide of potassium, useful as it is in some chronic diseases of bone, has been found to be quite powerless to check the progress of the affection, nor does it seem to relieve the pain of which such patients occasionally complain. H. H. Clutton.

OTALGIA—Ear-ache. See *Circumscribed Inflammation of the External Meatus*, under Ear, External, Diseases of the.

OTITIS. See *Acute Catarrh*, under Ear, Middle, Diseases of the.

OTORRHŒA. See *Acute Purulent Catarrh*, under Ear, Middle, Diseases of the.

OVARIAN TUMOURS.—There are several diseased conditions of the ovary which may require the aid of the surgeon, but ovarian tumour is by far the most common, and it is also the most important, because, if left to nature, it leads almost inevitably to a lingering and painful death.

Causes.—But little is known as to the causes which produce ovarian tumour. The position occupied by the ovary; its liability to displacements, which must greatly interfere with both its nerves and blood-vessels; the changes in its position which result from enlargement of the womb, or from improper retention of the contents of the bowel or of the bladder; changes in its tissues which result from the general condition of the blood during the course of the specific fevers; spread of inflammation from the peritoneum, and last, but not least, the changes it undergoes from youth to age, during the formation, maturation, rupture and cicatrization of the Graafian follicles, are all causes predisposing to disease. How it is that some of these conditions induce mere inflammatory changes in the ovary of one person, whilst in another they produce an enormous development of cysts; why these cysts differ so much in their macroscopic and microscopic appearances; and why their place is sometimes taken by a dermoid tumour, and more rarely by a solid fibroma or sarcoma, remain matters of theory and speculation.

Given the predisposing cause, such as change in position affecting the circulation or innervation of the organ; or change in the condition of the blood circulating through the ovary, and it seems very probable that heredity may have much to do with the

result, producing by the same disturbing causes different diseased conditions in different individuals.

Pathology.— Admitting the imperfect knowledge which we possess as to the causation of ovarian tumours, it is not surprising that there is great difference of opinion as to their pathology. The reader who wishes to study this subject, must refer to some of the special works in which the theories are set forth and discussed at length; here we have only space to refer to them very briefly.

Changes in the Graafian follicle are admitted by most observers to be one cause of cyst-formation. Some seem to regard the follicle as almost the sole parent of the various forms of cysts, while others give it a very secondary place, and deny that cysts formed from it ever attain any considerable size. Degenerative changes in the true and false corpora lutea, degenerative changes in the blood-vessels or in the ovarian stroma, the persistence of the rudimentary structures and elements of the fœtal ovary, all have their advocates as important factors in ovarian pathology; while some of those who have been most painstaking and laborious in their investigations, believe that the commoner forms of ovarian cystomata are neoplasms of epithelial and glandular formation.

Probably each and all of these various theories have their share of truth. In an organ so remarkable in its structure and development; in its reproductive function; in the vicissitudes due to its situation and surroundings, and in its atrophy and decay; we may be prepared to find a great variety of morbid changes, rather than a repetition of any one process. The examination of a large number of ovaries in early stages of disease, and of a larger number of tumours of considerable size, with a correlative consideration of the clinical history and symptoms of the patients from whom the specimens were taken, has convinced the writer that, while all the processes referred to have their share in the formation of ovarian tumours, change of type in the cells lining the follicles, with invasion of the stroma by the resulting new-formations; colloid degenerations of the stroma, of the walls of the blood-vessels, and of the cicatrices of the corpora lutea; are —somewhat in the order in which they are given—the most common pathological processes at work in the formation of the ovarian cystomata. The more the cells lining the cysts tend to revert to immature epithelial types, and the more the cells forming the stroma of the tumours tend to revert to immature connective-tissue, the more nearly the tumours approach malignancy. The fact that it is difficult or impossible to say which tumours are malignant and which are not, even when their tissues are submitted to microscopic investigation, should make surgeons very careful how they recommend tapping, or any operative interference short of early and complete removal of the tumour.

The dermoid tumours form about seven per cent. of the cases, and are distinctly of two kinds, benign and malignant; the former being usually associated with some of the other forms of cystic disease, are by far the most common; the latter, of which only a few specimens have been described, are nearly solid, the dermoid structures being mingled in strange confusion with carcinoma or sarcoma. Much has been written about these dermoid ovarian tumours, and the most fantastic theories have been advanced as to their origin, which is, however, probably in no wise different from that of dermoid cysts in other parts of the body, the greater frequency of their occurrence in the ovary being due to two causes—first, the special liability of the organ to originate tumours, and second, the fact that it contains cells which are capable of producing, under certain conditions, all the structures found in the body. The same causes which produce from the ordinary cells cysts or solid growths, produce from the cells which we call ova, more complex structures. The same cells which, under the stimulus imparted by the spermatozoon, produce the perfect individual, under the stimulus imparted by disease produce many or most of the structures which go to form the perfect individual, but in an imperfect form, both as to actual structures and as to their relative arrangement.

Fibromata and sarcomata are occasionally met with, but are rare, and this is not surprising, when we consider that the physiological function of the ovary is the production of cysts (the Graafian follicles). Small fibrous growths are not uncommon in ovaries in an early stage of cystic degeneration, and they appear to arise from proliferation of the cicatricial structures of the corpora lutea, and, probably, the larger specimens occasionally met with have the same origin, the tendency of the individual deciding whether a simple fibroma results from the increased growth of the cicatricial tissue, or whether some one or other of the more malignant sarcomata is produced.

Symptoms.—The early symptoms of the growth of an ovarian tumour, whether

of the cystic or solid kind, are very indefinite, and often there are no symptoms, until the growth has attained a considerable size. In some patients, scantiness of the menstrual flow, amounting, in rare cases, to amenorrhœa, will herald the commencement of disease, and pelvic pains or discomforts will lead to a vaginal examination, when the affected ovary will be found enlarged, and dislocated into the pouch of Douglas. In other cases, increase of the flow at the menstrual periods, and their prolongation, will lead to the discovery of the disease. This is especially the case in elderly women who have passed the menopause; and a return of the catamenia either irregularly or regularly, in such cases, should always lead to a suspicion of some ovarian disease, and to a careful examination of the pelvic organs. This is not sufficiently known, and many patients are made miserable by the fear that such discharge is an indication of uterine cancer, instead of being a symptom of a readily diagnosed and curable disease. Inability to walk without discomfort or pain, constipation, difficult or painful micturition, pain over the ovary, and pain or numbness in the leg on the affected side are also among the commoner symptoms, while the increase in the size of the affected ovary is still so slight that it can only be detected by the most careful bi-manual examination.

Diagnosis.—In this early stage, differential diagnosis will have to be made between organic disease of the ovary and mere enlargement due to congestion or inflammation, and it is usually quite impossible to make a certain diagnosis. Fortunately, it is not necessary for the surgeon to interfere thus early, and simple soothing treatment is equally good for either condition, and will often clear up the doubt; mere congestion or inflammation yielding to such treatment, and the ovary returning to its proper size and place.

When an ovarian tumour becomes sufficiently large to fill the pelvic cavity or rise into the abdomen, the symptoms which are present in its earlier stages usually disappear, and the time has arrived when the surgeon is called upon to make an accurate diagnosis, and decide whether the tumour shall be removed. While the tumour is still in the pelvis, it is often extremely difficult to diagnose with certainty between ovarian tumour, fibro-myoma of the uterus (especially the sub-peritoneal and pediculate forms), collections of serum, pus, or blood in the Fallopian tubes, extra-uterine fœtation, serous effusion into the cellular tissue, hæmatocele, pelvic abscess, or some of the rarer forms of pelvic tumour. The history of the case, especially as to menstrual irregularities and variations of pulse and temperature, must be carefully inquired into, without, however, giving it undue weight; for nothing is more misleading than the history of symptoms given by a stupid or unobservant patient. If the tumour be mobile, fairly separable from the uterus, the catamenia regular, and the patient free from febrile disturbance, the case is probably either ovarian or pediculate fibro-myoma, and a little patience, while watching the rate of growth and any variations in the consistence of the tumour at different times, will soon enable the surgeon to decide between them. If the tumour is fixed, and there has been fever, it is often much more difficult to decide; an experienced touch will rarely, however, in such a case have difficulty in excluding pelvic cellulitis, abscess, or hæmatocele, for in each of these there is a gradual shading off from the tumour to the surrounding tissues, and a fixing of the other contents of the pelvis, which is very different from the mere fixing by peritoneal adhesion of a tense cyst or of an elastic solid growth. The history of cellulitis, abscess, and hæmatocele is usually sufficiently marked to confirm the opinion formed by touch.

The diagnosis of the various forms of distension of the Fallopian tubes is a matter of much greater difficulty, and cases are met with in which both tubes are greatly distended with pus, forming considerable tumours, and even rising high up into the abdomen, in which absolutely no serious symptoms have been observed, either by patient or medical attendant, till the tumours have been detected by their size. In such rare cases there is no choice but to wait for further development of the tumour, or to make an exploratory operation, and as each case must be decided on its merits, it is useless to attempt to give general rules. It is necessary, however, to remember how grave may be the risk of waiting too long in a case of tubal pregnancy, of large pyo-salpinx, of pelvic abscess, or of suppuration in the uterine wall; the latter a very rare condition, but one that is occasionally met with.

When the tumour has attained considerable size, and occupies a large portion or the whole of the abdomen, the differential diagnosis may still have to be made from some of the conditions named above, such as large abscess or hæmatocele, and extra-uterine fœtation, or other form of tubal cyst;

and a large number of other diseases must also be added to the list of those which may be mistaken for ovarian tumour. Solid tumours of the ovary are still more difficult to distinguish from uterine outgrowths (fibro-myomata), and some of the large soft uterine tumours give an elastic impulse so like fluctuation, that the most experienced surgeon may be deceived by it, and may mistake such a tumour for an ovarian cyst. A careful use of the uterine sound, while an assistant moves the abdominal tumour, will usually clear up the doubt, except in cases in which the uterine body is so closely adherent to, and incorporated with, an ovarian cyst, that the latter is practically a uterine tumour. In such cases an exploratory incision can alone decide.

It is rarely difficult to distinguish between ascites and cyst, but in cases in which the latter has ruptured, or has discharged much of its contents into the peritoneum through a tapping puncture, the diagnosis is difficult. In such cases it is sometimes advisable to draw off the peritoneal fluid by aspiration or tapping, and then the tumour, if present, is more easily handled and diagnosed. In ordinary cases the position of the dull area, and a careful observation as to whether the fluctuation wave extends beyond it, will decide between free and encysted fluid, but all sorts of exceptions to these general rules are met with. For example, a flaccid, broad ligament cyst will often very closely simulate ascites, the position of the dulness following the changes of position on the part of the patient; so also a cyst with its borders overlapped by adherent intestine, may readily be mistaken for free fluid, or for peritoneal fluid partially encysted. The rule usually given as to the dulness in ovarian dropsy being more to the one side than the other is, in the majority of cases, fallacious; comparatively small tumours frequently occupying a central position. In deciding whether fluid be free in the peritoneum or in a cyst, the most important point to note is, whether the line of dull percussion and the limit of fluctuation exactly correspond; if they do it is nearly certain that it is in a cyst, and changing the position of the patient, without varying the relation of the dull and clear areas, will confirm the diagnosis.

The best way to arrive at a diagnosis in a case of abdominal tumour, is to place the patient on the back with the head and shoulders well supported by pillows, the hands laid at rest on the shoulders, and the knees raised. The abdomen should then be thoroughly exposed, and the patient made to breathe through the mouth, the lips and teeth being kept well apart. This relaxes the muscles and enables the surgeon to tell at once, by palpation, where it is soft and natural. The healthy parts should first be thoroughly palpated and percussed, because in passing from the normal to the abnormal, a correct impression of the disease is much more likely to be obtained than by the reverse process. Having carefully mapped out the abnormal structure, and noted its relations to the surrounding and healthy parts, the patient's position should be changed in various directions, and the same process repeated in each. During this procedure, anyone with experience will probably have made up his mind as to the nature of the tumour; but it will be well nevertheless to continue the investigation by excluding the possible growths one after another, till the one he has diagnosed is reached. It is undoubtedly true that the first and rapidly formed diagnosis of an experienced surgeon is often the most correct; but nothing is ever lost by care, and serious error is frequently avoided.

In deciding that a tumour is ovarian, ascites of various kinds, phantom tumours, obesity, malignant or simple enlargements of the liver; distension or tumour of the gall-bladder, solid enlargements and cystic tumours of the spleen; tumours of the omentum and mesentery, sub-peritoneal cysts; distensions, cysts, or solid tumours of the kidney, distension of the ureters, distension of the bladder; hydatids of liver, spleen, kidney, omentum, mesentery, or parietal peritoneum; accumulations (for instance, hair) in the stomach; fæcal accumulations in the bowel; the various forms of extra-uterine pregnancy, hydramnios, accumulations in the Fallopian tubes, fibro-cysts, and solid fibro-myomata of the uterus; peritoneal and retro-peritoneal hæmatocele, pelvic abscess, abscess of the ovary or of the uterine wall, cysts in connection with the spinal cord; and last, but not least, ordinary pregnancy, should each and all be passed rapidly through the mind. Of course the experienced surgeon will do this almost by intuition, without the onlooker noting the steps of the process; but the student, and the practitioner who has but few opportunities for examining such cases, will make fewest mistakes and learn most, who spends some time and care over a diagnosis *by exclusion*. Even the most experienced would often save themselves from discreditable mistakes, and their patients from serious calamities, by a little more method in their examinations. All said and done,

there will still be cases of abdominal tumour which will defy the ingenuity of the most skilful, and only be certainly diagnosed by exploratory incision.

Treatment: aspiration or tapping.—Before passing to the operation for the radical cure of ovarian tumour, it is necessary to say a few words about aspiration and tapping. It is occasionally advisable to perform one or other of these operations and remove fluid from the peritoneum, in order to give temporary relief to lungs, heart, or kidneys, or to enable an abdominal tumour which is surrounded by fluid to be more accurately examined. The chemical and microscopical examination of the fluids thus obtained may throw important light upon their source, but these examinations, even by experts, cannot be trusted to alone for the formation of a diagnosis, but must be carefully compared with the symptoms and physical signs present in the case.

It has long been the fashion to advise one or more tappings in ovarian tumour or dropsy, and to claim it as a curative operation in parovarian and broad ligament cysts; there are, however, immediate dangers attending this apparently trifling operation, and a more extensive knowledge of the nature of ovarian cysts and their contents shows that the more remote dangers are still more to be dreaded. Among the former are fatal hæmorrhage into the cyst, acute peritonitis from escape of unhealthy cyst-contents into the peritoneum, inflammation and suppuration of the cyst-wall and serious adhesions to other organs; among the latter, the growth of malignant disease in the parietes or peritoneum at the tapping puncture, or its still wider diffusion over the peritoneal surfaces. The apparently simple cysts are as likely to cause these latter disasters as those in which the malignant elements are more clearly discernible, and the parovarian and broad ligament cysts are very often the seat of a form of papilloma, which, with opportunity, readily diffuses itself over the peritoneum. When it is considered that tapping cannot cure an ovarian cyst, and but rarely cures any other, and that it exposes the patient to all these dangers, it must be admitted that the surgeon best consults his patient's well-being and his own reputation, who resolutely refuses either to tap or sanction the tapping of these cysts. As tapping of the peritoneum is not only justifiable but advisable in certain cases, and as tapping of an ovarian or broad ligament cyst may occasionally be necessary, in consequence of special complications, or of the obstinate refusal of the patient to submit to the major operation, it may be well to say a few words about it.

If the surgeon tap with 'Listerian' precautions—and no wise man will perform the operation without them—the patient should be laid on her side with the abdomen overhanging the edge of the bed, and protected by towels or india-rubber sheeting from chilling and wetting by the spray. Then, if the fluid be in the peritoneum, a lancet should be pushed boldly through the linea alba, and a conical and blunt-ended trocar, with holes at the sides, rapidly introduced through the puncture as the lancet is withdrawn; if a cyst is to be tapped, the lancet puncture should only penetrate the skin, and a sharp-ended trocar, such as Thompson's, should be used for the cyst, as it is less liable than the lancet to wound any large vessel in the cyst-wall. When the peritoneum or cyst is empty, the trocar should be quickly withdrawn, while the finger and thumb of the left hand compress the point of puncture and prevent the entrance of air; a small pad of antiseptic dressing should then be placed over it, and a larger piece of adhesive plaster, and the patient turned on to her back, and the abdomen supported by a flannel bandage or soft towel, secured by a few safety-pins. The patient should be kept on her back for twenty-four hours, or longer in the case of a cyst, to avoid weeping from the puncture. No squeezing or pressure on the parietes should ever be allowed during tapping, or air in large quantities may be sucked in. It is quite needless to apply a sheet or a many-tailed bandage round the patient during the evacuation of the fluid if the side posture, with the head and shoulders nearly on a level with the body, be adopted. In such antiseptic tapping a good-sized trocar, from a quarter to half an inch in diameter without any tubing on it, may be used, and the canula can readily be cleared by a probe if necessary, and the entrance of a little air disregarded. If, however, antiseptic measures are not adopted, it will be safer to use the aspirator, with the finest needle that will evacuate the fluid, and the greatest care to exclude air. Even in this case the needles should be carefully oiled with carbolic oil, or other antiseptic, as the most rapidly fatal septicæmia has been known to follow the use of a dirty trocar in tapping an ovarian cyst.

J. Knowsley Thornton.

OVARIOTOMY.—The operation for the removal of an ovarian tumour has

been, from its early days, termed Ovariotomy, and though Oöphorectomy would have been a more correct description of the procedure, the old term has become so famous that it can never be discarded; and Oöphorectomy has now become thoroughly associated with a different class of operations, which have been described in so far as they differ from Ovariotomy.

Preparation of the Patient.—It is essential that the bowels should be acting regularly and well, and that the secretion of urine be free. To ensure this, mild aperients should be given for a few days before operation, and fifteen grains of citrate of potash well diluted three times a day. It is rarely necessary to restrict or alter the diet, but patients are better altogether without, or with very little, stimulant, and with red meat only once a day for some time previously. If the operation be in the morning, at nine or ten o'clock, the bowels should be well cleared over night by a simple enema, and at about five or six the patient should have a good breakfast-cup of strong beef-tea or soup, and nothing more before the operation. If the operation is to be in the afternoon, the enema should be given either before breakfast or a couple of hours before the operation, and the patient should have a light breakfast at the usual hour, and the cup of beef-tea about noon. Whether the patient has passed water or not, the catheter should be passed immediately before the operation. The best dress is the ordinary night-dress, with a short flannel jacket, and stockings on. The room where the operation is to be performed should be arranged while the patient is in another, and the instruments should be covered up, so that she does not see them when she comes in. It is far better for her to walk quietly into the room and lie down on the operating table before the anæsthetic is given; but only the surgeon, the anæsthetist, and the nurse should be present till she is unconscious. This plan not only saves time, but avoids the necessity for carrying the patient from the bed to the table during narcotism, which is always objectionable, and especially so in cases with a greatly distended abdomen, and impeded circulation and respiration.

The particular anæsthetic must be left to the taste of the individual surgeon. Chloroform, given by a Junker's inhaler, answers well in most cases.

Preparation of the Room, Instruments. Sponges, &c.—The room should be light, airy, and quiet, and should be thoroughly cleaned the day before, and all dust should be wiped away with a damp cloth, but there is no necessity to remove carpets, curtains, &c., and make it bare and cheerless.

The patient should be laid on her back, the head and shoulders well supported by an inclined plane of pillows, and the feet towards the window. The table should be long enough to hold her comfortably, not too wide—about 2 feet, and high enough to avoid much stooping on the part of the operator. When a single ordinary table is not at hand, two light deal dressing-tables answer very well, the lower one placed slantways across the window, and the upper one across its upper end, so that the two form the letter ⅃ placed upside down towards the window. The legs of the tables should be tied together to prevent their slipping apart, and the patient, when nearly unconscious, should be secured to them by a broad strap firmly fastened just above the knees, and by soft leather wristlets with a connecting strap under the table. In the window stands a small oblong table large enough to hold the spray-producer, the instrument-trays, and the dressings.

The operator stands on the right side of the patient, with his right hand within easy reach of this table, so that he can take up each instrument quickly as he requires it; this is much better than trusting to an assistant or nurse to hand things, for no two brains can work like one, and it is often important to take the right thing without loss of time. The chief assistant stands opposite to the operator, and, at his right hand, on the projecting upper part of the operating-table, is placed a large basin full of warm 1–40 carbolic lotion with the clean sponges in it. The nurse stands beside this basin, and squeezes out the sponges as they are wanted. No towel should ever be used for this purpose, and the sponge should touch nothing but the hands after it leaves the lotion. The anæsthetist stands at the patient's head, and if another assistant is wanted (which is rarely the case) he stands at the operator's left hand. The operator should have a basin of warm 1–40 lotion, with a sponge in it, near him on a chair. The spray bottle should be filled with 1–20 lotion, the instrument trays with warm 1–40 lotion, so that all the instruments are well covered. Ordinary tin pudding-trays, 14 inches long by 6 inches wide, and 2 inches deep, will be found most convenient. Two of these will hold all the instruments necessary for the most complicated abdominal section. The instruments should all be arranged each in its own place in the trays, and the lotion poured over them half an hour before the

operation begins. The silks used for ligatures and sutures should be soaked in 1–20 lotion for at least an hour before use. The nurse who stands by the sponge-basin holds an empty basin for the dirty sponges, takes them and washes them well in a large footpan of warm water, and then replaces them in the 1–40 lotion, from which she or the assistant squeezes them, and hands them to the operator.

The preparation of the sponges is very important. New sponges require much knocking or beating in a pillow-case while dry, and many washings in warm water, or in water slightly acidulated with hydrochloric acid to get rid of the sand. They are then dried, and, if no sand can be knocked out of them, they are placed in 1–20 carbolic lotion for twenty-four hours. After they have been used, they are washed in warm water with common washing soda, to remove all blood and grease, then several times in plain warm water, then in 1–10 solution of sulphurous acid; this whitens, softens, and disinfects them, and after being well wrung out of it they are ready for use. They should be placed in the warm 1–40 lotion from which they are used, at least half an hour before the operation.

The abdomen of the patient should be well washed with warm 1–40 lotion by the nurse before she comes into the room, and covered with a moist napkin wrung out of the lotion; this is covered with a piece of mackintosh, and kept in its place by the flannel bandage to be used after the operation, pinned with three safety-pins. This flannel bandage is made of fine flannel lined with soft calico, the latter sewn over the edges all round, so that the flannel does not touch and irritate the skin. It is used all through the progress of the case, to keep the dressings in place, and give the parietes firm support.

When the patient is unconscious, a large piece of mackintosh, with an oval window cut in it, the edges of the opening smeared round with carbolised adhesive plaster, is applied to the abdomen. This apron should be large enough to cover the whole patient, and keep everything clean and dry. The abdomen and outer surface of the apron, the hands and arms of the operator and assistants, are well wetted with 1–40 lotion, without any after-drying, and the spray is turned on.

The instruments necessary for an ovariotomy of average difficulty are: two sharp, straight bistouries, and one with a probe point, a director, Adams's eye-hook, a pair of ordinary artery catch-forceps, twelve or more pairs of Wells's small pressure-forceps, a vulsellum, two pairs of Nélaton's cyst-forceps, a long-bladed temporary clamp, two curved perineum needles in handles, one long straight needle (five or six inches long), a pair of smooth-ended uterine polypus-forceps for passing the sponges into the pelvis, flanks, &c., a pair of blunt-ended scissors curved on the flat, a scissors-handled needle-holder and twenty straight needles threaded in pairs on No. 1 silk, eighteen inches long, for the abdominal sutures, and a large cyst-trocar; also No. 0 or 1 Chinese silk for fine ligatures, and No. 3 for tying the pedicle; these should be wound on reels, and should have been in soak in 1–20 phenol lotion for at least an hour.

Each instrument, as it is used, is taken out of the solution in the trays, and replaced in them when it is done with, or till it is wanted again. It is a common thing to see bloody instruments laid about on blankets, towels, &c., quite out of range of the spray, then taken up and used again without washing in the lotion, and the operator is indignant if he is told that he is careless, and is surprised if his case does not run an aseptic course.

Operation.—The incision through the skin and the abdominal wall, down to the fat over the peritoneum, should be made rapidly with a few bold sweeps of the knife; then, the assistant sponging the wound, each bleeding point is secured by a pair of pressure-forceps. The peritoneum is then to be opened, and this is easy enough in an ordinary case, as the tumour can be seen through it; but where there is adhesion more care is required, or the cyst-wall may be incised, or omentum, intestine, or bladder injured. For picking up a delicate peritoneum Adams's eye-hook will be found very useful, and it is a far safer instrument to use for this purpose than the ordinary artery-forceps, which is often employed, as with it the omentum or intestine is very likely to be picked up and incised along with the peritoneum. As soon as the peritoneum is opened to the extent of the external incision, the cyst should be tapped and emptied. Frequently the adhesions are first separated, but this is bad practice, because if they are separated while the parietes and cyst-wall are both stretched by the fluid, all the little vessels in them bleed, and very serious hæmorrhage may occur out of sight during the subsequent emptying of the cyst; whereas if the cyst be first tapped, the contraction of both parietes and cyst-wall closes the smaller vessels. Moreover, the cyst, when flaccid,

can be separated from adhesions bit by bit, each vessel being secured by temporary pressure-forceps or by permanent ligature, as it is torn or cut. If there are more cysts than one to empty, the trocar may be pushed on from the first into the others till they are all emptied, but great care must be taken not to push it through the cyst-wall against intestine. When the tumour is more solid, the trocar should be removed, its hole of entry enlarged, and the hand introduced to break down the septa.

As soon as the tumour is sufficiently reduced in size by one or other process, the operator should explore the peritoneum round it with his hand, to see if there are adhesions, and to learn the seat and character of the pedicle. Before doing this, he should carefully wash his hands in the basin of lotion by his side; for, if his hand has been in the cyst, he may carry cells into the peritoneum, which will set up new growths there. The frequent washing of the hands during an operation of this kind is also important, to avoid the introduction of blood, &c., into the recesses of the peritoneum. If there are no adhesions, the cyst should be slowly and carefully extracted till it is all outside, and the pedicle fully exposed, its place in the abdomen being taken by a large, flat, soft sponge, freshly wrung out of the warm lotion.

The operator now grasps the pedicle between the left thumb and forefinger, gathering in his grasp all the large veins in its outer part, but avoiding the Fallopian tube; manipulating the pedicle between the nails of the finger and thumb till he gets a small spot clear of any vessel, he transfixes with an ordinary, fine, short, straight needle, threaded with a single No. 3 Chinese twist ligature, and with this ties all the veins (pampiniform plexus) in the outer part of the pedicle. If the patient be young and full-blooded, it is well to pause a few minutes and let the arterial blood go on pumping into the cyst till it is well injected; this is a neat and cleanly way of bleeding the patient if it seem advisable. If, on the other hand, the patient be already very weak and anæmic, this *outer-edge* ligature should be applied last. The *outer-edge* ligature being tied, another non-vascular spot in the pedicle is manipulated between the finger and thumb, and through it a long-handled, curved perineum-needle, armed with a double No. 3 ligature, is passed, the outer loop is tied in the groove formed by the *outer-edge* ligature, but includes a greater thickness of the pedicle; care being taken that the ligatures interlock, the inner loop is then also tied, and it includes the Fallopian tube and the chief arteries. In broad, thick pedicles, two or three such transfixions may be necessary, and in this case one loop should be tied, then the untied ligature is re-threaded into the needle together with a third silk, and they are passed through the pedicle; the second loop of the first transfixion is then tied, care being taken that it locks with the last silk which was introduced with it, and thus a perfect chain is formed, and slipping of ligatures is impossible, while bleeding from the transfixion punctures is also prevented. The pedicle on the distal side of the ligatures is now seized on its inner and outer borders with a couple of pairs of pressure-forceps, and the tumour is cut away about three-quarters of an inch from them; a shorter stump is not safe, and a longer one being imperfectly nourished is likely to lead to trouble, such as adhesion to intestine, &c., or even to inflame and suppurate or slough.

After the tumour is cut away, the assistant holds up the stump by the two pairs of forceps, and a separate No. 3 ligature is tied round the whole for greater security. These pure silk ligatures absorb more slowly, but as perfectly, and with quite as little irritation as catgut. If the operator prefer to use the actual cautery, the tumour should be held up by the assistant, while Baker Brown's cautery-clamp, with the ivory non-conductors downwards, is applied and firmly screwed up; the tumour is then cut away, leaving a good inch of tissue outside the blades of the clamp. This stump is then slowly burnt away with the cautery-irons at a very dull red heat; when it is burnt off level with the blades they are unscrewed and slowly opened, and if sufficient time and care have been taken, the part between the blades will be found in its whole thickness decolorised and translucent, like a piece of horn; if any points bleed the clamp must be screwed up, and the irons reapplied, or it may be necessary occasionally to ligature a vessel or two. When released from the clamp the stump should be allowed to drop quietly back into the pelvis, and care should be taken not to disturb it in any after sponging which may be necessary. The cautery needs more time and care than the ligature, is not nearly so universally applicable, and requires greater experience in its use; but, where it can be used, results are excellent, and as a theoretical method it is certainly perfect. It should never be used after ligature by the ordinary method, as it destroys the vitality

of the distal part of the stump, and may lead to sloughing. No directions need be given for applying the clamp, as that is a clumsy contrivance which has deservedly passed into obscurity.

Cases are met with in which the base of the tumour is so situated between the layers of the broad ligament, or so pushes its way under the peritoneal covering of the uterus, or of the pelvic floor, that cautery and ligatures are alike inapplicable, or at least ligatures can only be applied after much previous enucleation. When this is the case, an incision should be made through the peritoneal capsule of the tumour, and careful enucleation practised with the fingers. It is well, if possible, so to direct this process as to isolate, at an early stage, the parts of the broad ligament which would form the pedicle in an ordinary case, and then to transfix and tie them in the usual way. After this the chief blood-supply of the tumour is under control, and the rest of the enucleation may be more rapidly and boldly made. Shreds of capsule which bleed should all be secured temporarily in pressure-forceps, and ligatured with or without transfixion, after the tumour is completely shelled out. Usually, the capsule falls together and no oozing occurs, but sometimes this is troublesome from a large surface, and Paquelin's cautery, or solid perchloride of iron, may be applied. The latter is, on the whole, the most satisfactory, if applied with the precautions to be given hereafter in describing its use for oozing from adhesions.

In performing these enucleations, the operator must always bear in mind the fact that the capsule is often the pelvic parietal peritoneum, and that he is consequently brought into dangerously close relations with bladder and ureters, rectum and sigmoid flexure, or cæcum and appendix vermiformis (the latter is very frequently adherent in these cases, and, as it bleeds very much when torn, requires careful handling, and often repair with a fine needle and silk). The large iliac vessels are also occasionally incorporated with the capsule.

When much enucleation is required, it will be necessary to have many more pairs of the small pressure-forceps in the trays, and two pairs of Wells's large curved pressure-forceps, two pairs of the same straight, and a few pairs of the square or T-shaped forceps introduced by the writer, will be found very useful. The above instruments, together with assorted sizes of Keith's glass drainage-tubes, with pure rubber sheet for fixing over them, and a Wells' tapping trocar or a small aspirator, and some No. 4 Chinese silk ready soaked, should always be at hand for a specially difficult case.

If there are extensive adhesions to parietes, omentum, mesentery, intestine, or other viscera in the case of an ordinary pediculate cyst, it is better to separate them bit by bit as the cyst is extracted, applying pressure-forceps to the bleeding points, and protecting omentum or bowel by towels wrung out of warm lotion. Then, after the tumour is entirely removed, the adhesions can be dealt with. In some few cases this method may be advantageously departed from, and the pedicle ligatured in two places and divided between the ligatures, before the adhesions are separated.

Adhesion to bowel or other viscus, which is so firm that it cannot be separated without tearing, should be treated by cutting a piece of the tumour out, and leaving it adherent till the rest of the operation is completed; when it should be carefully scraped and pared down as closely as possible, in order to leave nothing but the peritoneal and fibrous coat, and to avoid epithelial new-growth.

In some rare cases, it will also simplify the extraction of the cyst if it be seized from within and turned inside out; but the cases in which these special manœuvres are useful can only be learnt by practice.

As soon as the pedicle is secured, the pouch of Douglas and anterior *cul-de-sac* should be sponged out, and the flat sponge changed for a clean one. The adhesions should then be dealt with. If there be much torn omentum, which has been adherent to the tumour, it is well to secure the whole of it by a chain of fine silk ligatures some little distance above the torn parts, and cut all away; this saves time, and omentum which has been closely adherent is very likely to be infected by cell-growth from the tumour, and is better removed, as it may be the seat of recurrence of a malignant growth. The bleeding points in the parietal peritoneum should be secured with fine silk ligatures, applied, as far as possible, with a fine needle passed under the mouth of the vessel; oozing surfaces may be touched over with the cautery (Paquelin's), or with perchloride of iron. If the latter be used, the surfaces to be touched should be dried with a sponge, then a small sponge, well wrung, should be smeared lightly with the solid perchloride, and firmly pressed against the oozing surfaces till the oozing stops; a large, flat sponge should be spread under

the surfaces thus treated, to prevent any of the acid serum, which runs away immediately after the application of the iron, getting on to the intestines. Oozing surfaces in the pelvis are treated in the same way, the intestines being first drawn out of the way and protected by sponges. Sometimes, tincture of iodine will answer, but its action is not so powerful as that of the iron. Mesenteric and intestinal adhesions should be secured by transfixion with fine silk, and sometimes a bleeding surface may be treated by running a fine silk in and out through the peritoneal coat, and tying it up like a bag's mouth. If the intestine or bladder be wounded, the wound should be sewn up by a fine, continuous silk suture, introduced through the peritoneal coat so as to invert the peritoneal edges. When all bleeding has ceased, the peritoneum should be again carefully sponged out, special care being taken to cleanse the pelvis, the anterior *cul-de-sac*, and the loin pouches. The pedicle is then drawn up and examined, and the forceps which were placed on it just before the tumour was cut away, are removed.

The flat sponge being still in, the sutures are introduced, straight needles about two and a half inches long, threaded at each end of a No. 1 Chinese twist ligature eighteen inches long, being used, and introduced from within outwards with the aid of the needle-holder. Each needle is passed just through the edge of the peritoneum, and then carefully through all the various structures forming the abdominal wall, and out through the skin about a quarter of an inch from the edges of the incision. The sutures should be introduced a little more than half an inch apart, the top and bottom sutures taking up the angles of the incision in the peritoneum. When the sutures are all in place, a small sponge is passed into the pelvis beside the pedicle, and, if it comes out dry and clean, the flat sponge is withdrawn, and the sponges and small pressure-forceps are carefully counted. The number of forceps and sponges in use should always be known, both by operator and nurse, before the operation, and no sponge should ever be torn by anyone during its progress.

In tying the sutures, great care should be taken to bring the skin edges accurately together, and they should not be tied too tightly, or a thin and puckered cicatrix will result, and the danger of ventral hernia from a weak scar be increased. A pad of carbolic gauze, six or eight layers thick, and large enough to overlap the edges of the incision an inch all round, is now applied, the surface next the wound being first wetted with the lotion; over this two or three similar larger pads, and then one with a piece of pink mackintosh under its outer layer; this outer dressing should not be broader than four inches, and long enough to overlap the top and bottom of the wound by about two inches. Straps of adhesive plaster are then applied over the whole abdomen; they should be from one and a half to two and a half inches broad, and long enough to support both loins well. If the abdomen has been greatly distended, cotton-wool pads are applied over the dressing but under the strapping, to fill up the hollows and give firm elastic support. A folded towel is applied outside the plaster to overlap the lower edge of the dressing, and form a firm support to the wound, and over this the flannel bandage, already described, is pinned. The patient is then carefully lifted into bed and laid on her back, the head and shoulders well supported by an inclined plane of pillows, and a good firm pillow placed under the knees. The bed should be guarded across the centre by mackintosh and a many-fold draw-sheet.

After-treatment.—The temperature is taken in the vagina, and the pulse noted; as soon as the patient rouses up and begins to feel pain, twenty drops of laudanum in an ounce of water are injected into the rectum, and this injection is repeated two, or perhaps three, times in the first few hours. If the weather be cold, a hot bottle is placed at the feet. The patient should be lightly but warmly covered, a single blanket next the night-dress, then the sheet, and two, three, or more blankets over this according to the season. For the first twenty-four hours or more, if there is sickness, nothing is given by the mouth but little pieces of ice, or a teaspoonful of tepid water, or plain soda-water. About six hours after the operation, or sooner if the patient be very weak, three ounces of strong beef-tea are injected into the rectum. The beef-tea should be made without salt, and injected just warm enough to be liquid. This injection is, in ordinary cases, repeated every three hours (every two if the patient be very weak), and every six hours twenty drops of laudanum are added. Before each injection, the female pipe of a Higginson's syringe is placed in the rectum, with the bottom of an ordinary soap-dish under it, so that the flatus and refuse may pass away; it remains in ten minutes, and then the fresh injection is given. The injections are continued in this way for the first few days, and gradually stopped as the

patient begins to take sufficient nourishment by the mouth.

When all chance of sickness is over, a little milk and soda-water (equal parts) is given each hour, then a little bread and milk; then, if these are well borne, a little clear beef-jelly with bread, and about the third or fourth day a cup of weak tea, with bread and butter, night and morning, and a little boiled sole for dinner. Then, gradually, chicken, minced chop, &c., &c. If sickness or retching is troublesome, a tumbler of water, as hot as it can be drunk, sometimes with the addition of a teaspoonful of sal volatile, should be given. If there be peritonitis, with bilious or dark vomiting in quantity, a long red rubber rectum-tube should be passed into the stomach, and a thorough washing out with warm water, or warm water slightly carbolised, made at intervals of from six to twelve hours, till the fluid ceases to accumulate. Liquid nourishment and stimulants, if necessary, may be given between the washings out, and much will be absorbed till the stomach begins to distend again. In some cases, large quantities of dark green, purple, or black fluid can be got rid of in this way, and a patient's life saved. In ordinary cases, the temperature rarely rises above or even to 101° F.; but if it should rise much above this, especially if the pulse quicken also, some pounded ice, tied up in a piece of mackintosh, should be kept on the head till the temperature falls to normal. If more severe hyperpyrexia is present, the india-rubber coil ice-water cap should be applied. In either case, when once used, ice should not be taken on and off, or serious brain-mischief may be induced. Ice should never be put on after the operation, till the skin is acting well.

Rapid rise of temperature before the skin acts is rarely of consequence, but if it continue with a freely acting skin, it should be checked. In very rare and extreme cases even the ice-water cap is not sufficient, and it will be necessary to pack the limbs or the whole body, except the abdomen, in cold, wet sheets. If the cold pack is applied, the arms should first be wrapped in wet towels, then iced water should be squeezed over them from a sponge as they dry, and if the temperature still rises, the legs, and, if necessary, the trunk, should be treated in the same way. The temperature should be taken at least every hour in the vagina in these cases, as the cold sometimes causes great and sudden depression. If there be any trouble in the downward passage of the flatus, or any threatening of intestinal obstruction, a mixture of Liq. morph. hydrochloratis ℥x. and Liq. atropiæ ℥ij. in a teaspoonful of water, should be given every three or four hours till the distension is relieved.

If the refuse from the rectal feeding be offensive, or if too much comes away, a couple of grains of quinine, in a dessert-spoonful or table-spoonful of port wine, should be added to each injection. Septic mischief may result from the retention of a quantity of putrid beef-tea in a rectum which has become sore and irritable.

In all ordinary cases, the dressing should remain undisturbed for a week or eight days; it should then be taken off, the wound moistened with warm 1–40 lotion, and all the sutures be removed. A smaller gauze dressing, with the same method of strapping, is then re-applied for another week, at the end of which time the wound will be found firmly healed, if care has been taken in approximating the skin-edges. Straps, six inches long, are then all that is necessary, and these should be changed every week or ten days by the patient after her return home, for at least two months, to secure a thoroughly firm, linear cicatrix, and avoid all chance of ventral hernia.

The catheter is generally necessary for the first few days, and with some patients till the bowels have acted, or till they can sit up. Some patients will pass their urine almost from the first. The nurses should be made to use silver catheters with a stilette, and to keep them scrupulously clean, and also in cases in which there is any vaginal discharge, to sponge with a little weak carbolic lotion before passing the catheter. Almost all fresh nurses produce cystitis by clumsy use of the catheter, and it is a great misery to the patient, often leaving an irritable bladder for weeks after everything else is well.

The bowels will usually remain quiet for a week, but may be moved a day or two earlier in some cases. The nurse should pass her finger into the rectum as soon as the patient feels any uneasiness, and if there are hard fæces, she should inject 4 oz. of warm olive oil, leave it in for four or five hours, and then give a simple water, or soap and water, enema of a pint and a half; it is better to give two or three small enemata till the bowel is clear, than to over-distend it at first. After the bowels have been once cleared, an enema should be given every second morning till they act of themselves.

The patient should have a good fitting elastic abdominal belt, and this should be

put on at the end of the fortnight, after the second dressing, when she may be allowed to get on to the couch. Hospital patients are generally quite well enough to go to a convalescent home from the eighteenth to the twenty-fourth day after operation. Sometimes, convalescence is retarded by phlegmasia or thrombosis, just when they first begin to move about. This is often a cause of a good deal of pain, and sometimes of sharp rise of temperature; it rarely troubles them more than a few days or a week, if they are kept quiet in bed with the leg rolled up in cotton-wool. It is good for the patient to remain on her back for the whole of the first fortnight, and until she gets on to the couch; but, if the back be tender, she may be allowed to lie over on the side, well supported with pillows, a little earlier. It is, of course, impossible to discuss at length the treatment of the complications which may arise. In aseptic cases they will be few, and opium and ice will be found all-powerful in subduing them.

In cases operated upon antiseptically, drainage will not be necessary in more than two per cent. When it is thought advisable to use it, Keith's modification of Koeberle's glass tube answers best. It should be long enough to reach to the bottom of the pelvis, and just protrude from the lower angle of the wound, with its mouth covered with a carbolised sponge; or it may be put through a hole in a small pure rubber sheet, the antiseptic dressing being applied closely round its mouth, and the sheet filled with carbolised sponges and fastened up. Whichever plan is adopted, it will be necessary to expose the mouth of the tube, under the spray, every six or eight hours at first, and then night and morning, and clear it with a glass syringe, to which a piece of red rubber tube is attached. When once introduced, it should be kept in till the serum from it is colourless and ceases to overflow into the sponge. It is a good plan to introduce a suture across the tube-opening at the time of operation, and leave it loose, to be tied up when the tube is withdrawn, otherwise the tube-opening causes a weak place in the cicatrix, which is liable to lead to ventral hernia.

In cases operated upon without antiseptics, the tube will be much more often required, probably in from ten to fifteen per cent. of any ordinary run of mixed cases (i.e. simple and difficult). It must not be forgotten, however, that the tube, though useful for the escape of material which may putrefy and cause trouble, is also a distinct source of danger, especially in non-antiseptic hospital cases, for it forms an open channel through which infective particles may find their way into the deepest recesses of the peritoneum. There is another element of danger in its use, and that is the matting of intestines round it, leading to obstruction, either immediate or remote.

If there is reason to suppose that an accumulation of putrid serum has gathered in the peritoneum, in any case where the tube has not been used, it may be advisable to puncture the pouch of Douglas through the vagina, with a Cock's trocar, and leave the canula in, retained in place by a Wells' spring; or a suture may be taken out at the lower angle of the wound, and a grooved director pushed down into the pelvis, behind the uterus. These proceedings are, however, rarely successful, as the blood-poisoning has generally gone too far before the accumulation is suspected, or before the surgeon can make up his mind to interfere.

When a patient, after ovariotomy, leaves the surgeon's care, she should be cautioned to keep quiet during the first menstrual period, as hæmatocele from the pedicle is occasionally met with. The mention of this recalls a subject which may be named here, though it would more properly have found a place in the preparation of the patient for operation. It has long been the fashion to advise that ovariotomy, and similar operations on the uterus and its appendages, should be performed shortly after the conclusion of a menstrual period. This is a mistake; the best time to operate is from a week to a few days before the period comes on. A little consideration will show that this is theoretically as well as practically advisable. A metrostaxis, or false period, frequently follows the operation within twenty-four or forty-eight hours, this being especially the case when both ovaries are removed, and when the ligatures are tied very close to the uterus (i.e. on a short pedicle). Just before this metrostaxis comes on, there is often pain, fever, and general upset; but as soon as the flow is established, a normal pulse and temperature are common. Theoretically, the nearer the proper time for menstruation, the more likely it will be to come on without disturbance, and this is found to be true in practice. Patients may even be operated upon during menstruation, without affecting the flow; but this is not advisable for many reasons. Young and middle-aged women, who have had both ovaries cleanly removed, rarely menstruate

again, but some have an occasional metrostaxis, which is preceded by a good deal of general constitutional disturbance. The majority of them also entirely lose sexual appetite; indeed, the exceptions are so rare that it may be presumed that, in these cases, a small portion of ovarian tissue has been left behind, or a third ovary has escaped notice. Patients who have had both Fallopian tubes cleanly removed, and the ovaries left behind, continue to menstruate regularly. J. Knowsley Thornton.

OXALATE of LIME CALCULUS. *See* Calculus, Urinary.

OXALURIA. *See* Urine.

OZÆNA. *See* Nose, Diseases of the.

P

PALATE, Diseases of the. — The palate, owing to its structural continuity with the alveoli and gums in front, and its connection posteriorly with the tongue and pharynx by means of the pillars of the fauces, is liable to implication by the extension of disease from these parts; whilst, on the other hand, morbid processes originating in the palate may spread to the neighbouring portions of the mouth, fauces, or pharynx.

It is necessary to recollect that the palate, with the posterior pillars of the fauces, constitutes a septum between the nasal and buccal passages, which by the contraction of the palato-pharyngei becomes complete during the act of deglutition, and then cuts off all communication between the two cavities; and that its structural and functional integrity is essential for perfect articulation, suction, and deglutition. Hence, the chief symptoms induced by lesions of the part are usually dependent upon impairment of these physiological acts.

The diseases of the palate are—(1) congenital malformations (*see* Cleft Palate), (2) inflammation, (3) ulcers, (4) necrosis, and (5) tumours.

1. Inflammation may consist of a simple phlegmon of the soft parts; or, in the case of the hard palate, may involve the periosteum and bone.

(α) *Phlegmonous inflammation* is rare except as a result of extension from the tonsils and other adjacent parts. In the velum palati it is accompanied by considerable swelling; but this sign is absent in the hard palate, owing to the intimate adherence of the mucous membrane to the bone. It may terminate in abscess.

(β) *Syphilitic Angina*, which coincides in period with the early cutaneous manifestations, is usually most marked in the palate. It appears as a diffuse redness, with more or less swelling of the mucous membrane of the fauces, and is often of so little intensity that it may be entirely unnoticed by the patient; but occasionally it assumes a parenchymatous form, and may lead to abscess-formation or even to sloughing of the soft parts. It may also become chronic, lasting two or three months.

(γ) *Osteo-periostitis* may arise from traumatic causes, extension of alveolar inflammation, or from syphilitic or tubercular cachexia. The disease is indicated by a local swelling, at first hard, then fluctuating; and there is more or less pain (slight in the syphilitic form) in mastication and deglutition. Should abscess supervene, the bone usually perishes, and its bared surface may be felt through the opening of discharge. The separation of the sequestrum may leave a temporary or permanent fistulous communication between the mouth and nose.

2. Ulcers.—The principal forms of ulceration of the palate are of syphilitic, tubercular, or epitheliomatous origin. Simple ulcers are rare except as a result of local injury, and present no special features of interest.

Syphilitic ulcers may be superficial or deep, as in the rest of the bucco-pharyngeal tract. *See* Stomatitis. The former is common in the early secondary stages of the disease; the latter belongs to the tertiary period, and results from the breaking down of a gummatous infiltration. The deep ulcer appears late, from five to eight years after the primary lesion, and is generally single. If situated upon the hard palate it is nearly always central, and involves the bone; if the soft palate be the point of attack, great destruction and deformity may result, sometimes complicated with adhesions to the posterior wall of the pharynx. In rare instances the tertiary ulcer may spread to the base of the cranium. The sore has the usual characters.

Tubercular ulcers are most frequently developed in childhood. They usually reach the palate by extension from the posterior pillar of the fauces, and are associated with tubercular disease elsewhere. The lesion generally makes its first appearance in the form of small tubercles, which project slightly above the surface:—these break down into a number of erosions which soon fuse into an irregular ulcer of little depth characterised by festooned borders, and a yellowish base covered with pale granulations. The sore thus formed tends to travel slowly in a serpiginous course, but seldom leads to serious destruction.

Epitheliomatous ulcers are excessively rare as primary lesions of the palate, but may extend to the part from the gum or tonsil (q.v.).

3. Tumours.—In addition to inflammatory, tubercular, and gummatous swellings, the palate is subject to a considerable number of true tumour-growths, which may be briefly enumerated as follows:—

Cysts, mucous and dermoid; Fibroma; Enchondroma and Osteoma; Myxoma; Lipoma; and Adenoma.

The glandular tumour is by far the most common of the palatal neoplasms. It is often found upon the hard palate, generally implicating its lower wall on one or other side, and may reach the size of an egg or even attain larger dimensions. It is soft and elastic to the touch, painless and insensitive, and causes no symptoms beyond the inconvenience attached to its encroachment upon the buccal cavity. Structurally it follows the type of the salivary glands; it is invested by a capsule, and is united to surrounding parts by a somewhat loose connective tissue. The glandular elements of the soft palate may undergo hypertrophic changes, by which the thickness of the velum becomes greatly augmented, a condition which is probably analogous to the enlargement of the lip in strumous children.

Erectile tumours are almost confined to the hard palate, but the velum may be implicated by a nævus extending from the inner surface of the cheek. Papillomata, in the form of small, usually pedunculated growths, are not very infrequent, and are most commonly attached to the posterior border of the soft palate and to the uvula.

Sarcoma is rare. The tumour is usually of the round-celled variety, but in one instance was found to consist of fusiform and myeloid cells.

Epithelioma is rarely developed primarily in the palate, but may involve the part in association with the tonsils and nasal fossæ, &c. The thyro-hyoid and carotid glands become affected at an early period of the disease.

Treatment.—The treatment of inflammatory and ulcerative affections of the palate should be conducted on the same principles as in other parts of the mouth. *See* Stomatitis. Of the tumours, the cysts, fibromata, enchondromata, myxomata, and lipomata, all of which are rare, may ordinarily be removed with the knife. Adenomata are, as a rule, most easily enucleated with the finger-nail or curette. Erectile tumours are best attacked by means of coagulant injections or galvano-puncture. Papillomata may be cut off with the thermo-cautery scissors. Sarcomata, if not too extensive, may be excised. Epithelioma and carcinoma are seldom met with in a condition susceptible of any but alleviative treatment; but if small may be removed, or their destruction may be attempted by means of the galvano-cautery.

The chief danger attached to the operative treatment of palatal tumours is the ingress of blood into the trachea, an accident especially liable to occur when the patient is under the influence of chloroform or ether. Fortunately, the surgeon is now provided with a local application which renders it possible to dispense with general anæsthetics in many cases. The use of a solution of cocaine painted upon the surface, or injected into the substance of the part to be subjected to operation, will commonly allow the painless removal of the growth while the patient retains consciousness and is able, in some degree, to guard the air-passages. Should it, however, be absolutely necessary to induce general anæsthesia, or should the danger of asphyxia threaten despite the absence of unconsciousness, the operation may either be performed while the head hangs down over the end of the operating table, so that the blood passes into the nares; or the back of the fauces may be plugged after a preliminary tracheotomy.

William Anderson.

PALATE, CLEFT, The Mechanical and Surgical Treatment of. *See* Cleft Palate.

PALMAR ARCH, Wounds of the. Special interest attaches to wounds of the palm on account of the liability to injury of one or other of the palmar arches, the superficial being that most frequently

involved. When the wound is extensive, it may be possible to secure the divided ends of the vessel, but the most serious difficulty is met with in the cases of small punctured wounds dividing the artery, such as are caused by a penknife or piece of glass. If the puncture is found to run in a direction towards the artery, and if constant or recurrent hæmorrhage ensues, as the nature of the parts does not allow of the enlargement of the wound, other methods of stopping the hæmorrhage must be resorted to. Of these, pressure systematically applied will generally be attended with success. The wound having been cleansed, and all bleeding being temporarily arrested by compression of the brachial artery, the fingers should be separately bandaged, and a graduated compress carefully applied over the wound. The bandage securing this should be carried up the arm, and should also fix two oblong pads placed over the radial and ulnar arteries, so as to limit, but not entirely check, the amount of blood passing through them. A splint should then be applied to the forearm, and the fingers so bent over it as to relax the palmar fascia. The limb should be raised as high as possible. The patient lying in bed, this can be effected by pillows, or better, by a pulley and counterpoise. No hæmostatic solutions should be used, on account of the danger of sloughing of the tissues. If, after a fair trial, these measures do not succeed in restraining the bleeding, it will be necessary to ligature the brachial artery in the arm, or the radial and ulnar in the forearm. The choice of operation should be guided by carefully ascertaining whether digital compression of the two latter vessels entirely controls the hæmorrhage. If there be any doubt on this point, it is wiser to ligature the vessel in the arm, since the interosseous and median arteries may largely supplement the vessels of the forearm.

A *palmar aneurism* is formed when the vessel is divided or punctured, and remains open after the superficial wound has closed. The blood is poured out into a circumscribed cavity, which is limited by lymph effused from the surrounding tissues; and the tendency of the effusion is to spread either towards the ball of the thumb or towards the ulnar side of the palm. The symptoms are identical with those of traumatic aneurism in other parts, but the treatment here should not be to lay open the sac and ligature the divided ends of the vessel, but to apply pressure as above directed, and this measure will in most cases effect a permanent cure. Should it fail, however, it will be best to apply the same rule as in the case of wound of the arch, to determine the selection of the artery to which a ligature should be applied.

JOHN H. MORGAN.

PALMAR FASCIA, Contraction of. *See* DUPUYTREN'S CONTRACTION.

PANNUS. See *Trachomatous Keratitis* under CORNEA, Inflammation of the.

PANOPHTHALMITIS. *See* EYE, General Examination of the.

PAPILLOMA.—Under the general designation of papilloma are comprised numerous conditions of the skin and mucous membranes, which, if of the skin, are usually of a dense, horny, non-sensitive character; or, if of the mucous membrane, are often highly vascular and sensitive. Among the affections comprised in these two groups are included corns, moles, common warts, condylomata, mucous tubercles, and verrucæ of the genital organs, which may be regarded as vegetations or excrescences arising, for the most part, from the stimulation of acrid discharges or other less pronounced forms of irritation. All are forms of hypertrophic papillary structure, which may subside on the cessation of the cause, or are readily curable.

It is a question whether the term 'papilloma' should be given to these, or should not rather be reserved for the comparatively rarer outgrowths which may be found on the skin and mucous membranes, such as the horny excrescences of the scalp, and the coarse, fringe-like vegetations seen in the axilla, flexures of the groins and scrotum, or around the anus; or for those similar growths on mucous surfaces which occur in the mouth and larynx, or as the so-called villous tumour of the bladder, and the highly vascular polypoid-looking growths which cover the rectum.

Cause.—Excepting, of course, congenital moles, papillomatous affections are all alike directly due to some form of irritation—usually some stimulating secretion—which may be of a specific nature—or they may be the result of pressure, as in corns, or of friction of neighbouring parts. In the majority of cases the source of irritation is at once apparent, but in others it is not clear, and one may find only some predisposing cause, such as residence in the tropics or an abnormally moist skin.

Pathology.—All papillomata are essentially hypertrophies, and, since a papilla has a definite structure, and is not merely

a tissue, such homogeneous texture as is seen in lipoma and fibroma cannot be expected in these affections; hence the hypertrophy may, as it does indeed, involve more markedly different strata of the papillary structure under differing conditions.

In construction the papillary type is nearly always readily recognisable, in spite of the excess of dense cuticle overlying the papillæ. The microscopic characters are also, as a rule, very distinctive and well-marked at the free surface; whilst at the base, in some of the larger chronic growths, an amount of connective tissue embracing closely packed cells generally exists.

Whilst quite benign as a general rule, it is well to remember that apparently simple warts, especially on the scrotum, face, and hands, may, as the result of long-continued irritation, become cancerous.

Symptoms and Diagnosis.—The warty character and raised surface distinguish papillomatous growths of the skin from any form of tumour or ulcer; and although on any mucous surface where they are found —rectum, bladder, or larynx—their external characters vary, yet the peculiar outstanding fringe-like surface exists in all. *See* Villous Tumours.

Treatment.—Putting aside the conditions which have a venereal origin, to be treated as part of a general complaint, all plans for curing papillomatous affections should proceed, in the first place, on the principle of removing the cause when such exists. If the affection does not disappear upon the cessation of the cause, it must be dealt with radically, either by caustics, escharotics, or ligature, if small and localised; larger growths, and especially any whose bases are indurated, should be somewhat widely removed by the knife, scissors, or even écraseur. Alfred Willett.

PAQUELIN'S CAUTERY. *See* Cautery.

PARACENTESIS. — Paracentesis means literally a pricking through, and the term is employed to signify the tapping of a cavity by means of a puncture, as opposed to the evacuation of its contents by means of an incision. It is generally confined to tapping the abdomen, the pleura, the pericardium, or the ventricles of the brain.

Paracentesis may be performed either with the aspirator or with a trocar and canula, the latter being often specially adapted for the cavity which it is required to puncture. The method of using the aspirator will be found under Aspiration; with regard to the use of the trocar, a few general points may here be stated. First, it is sometimes thought advisable to make a minute preliminary puncture through the skin with a scalpel, in order to facilitate the introduction of the trocar; but, if the instrument be sharp, and if the canula do not project beyond the neck of the trocar, this precaution, which involves increased pain to the patient, is, in most cases, wholly unnecessary. Secondly, it is of importance, during the process of tapping, to guard against the entrance of air, which, in the case of any of the cavities under consideration, may happen from powerful respiratory movements on the part of the patient. This accident may be guarded against, in some cases, by keeping up firm pressure upon the surface of the part which is to be emptied; but it may be more securely attained, in the case of the chest or abdomen, by employing a canula to which an india-rubber tube is attached, the other end passing beneath the surface of some antiseptic fluid, contained in a vessel placed below the level of the patient's body.

A convenient arrangement is that in which the trocar forms the end of a piston hermetically fitting into the canula, which is prevented by a stop at the outer end of the latter from being completely withdrawn; the part to which the caoutchouc tube is fixed leaving the canula at some point in its side. The trocar, on being withdrawn to the utmost possible extent, does not allow the entrance of air into the canula, and the fluid flows out through the lateral opening. This instrument presents the disadvantage of being rather difficult to clean, which leads to the observation that it is a matter of the greatest importance that, whatever instrument be used, every part of it should have previously been thoroughly washed with a strong antiseptic material (carbolic acid lotion, 1 to 20, is the best). For it may easily happen that an instrument, which in the ordinary acceptation of the term is clean, may introduce the causes of putrefaction into the cavity operated upon, and may change a simple and aseptic serous effusion into a collection of stinking pus, thus endangering the health, or even the life, of the patient. Thirdly, it is well to draw the skin slightly to one side before making the puncture, so that the track made by the instrument may ultimately be valvular, and the leakage of fluid after its withdrawal may thus be prevented. Fourthly, the slight pain of the puncture may, if it is thought advisable, be prevented by freezing the skin of the part either by the application of ice and salt, or with the ether spray.

Paracentesis Thoracis.—The description of paracentesis thoracis will be found in great measure in the article Empyema. Paracentesis, as opposed to free incision, is, however, seldom to be recommended for the evacuation of pus from the thoracic cavity, and in its application is chiefly confined to cases of serous effusion. If the aspirator be employed, it is well to use one in which a gradual exhaustion can be practised (the bottle aspirator), as opposed to the original instrument of Dieulafoy; it being unadvisable to run the risk of producing, by sudden exhaustion, the rupture of some small vessel in the lung, and so giving rise to a hæmothorax. For the same reason, it is best to employ a canula and trocar and not a perforated needle, so that, on withdrawing the trocar, the lung is free from the risk of being wounded. By a suitable arrangement of stopcocks (namely, by interposing a three-way tube into that leading from the canula to the bottle), it is easy to convert the aspirator into a syphon, and so empty the chest without risk of producing undue negative pressure. It should be remembered that, in performing paracentesis thoracis, it is not intended to empty the chest. In the first place, it is generally impossible to do so; in the second, it is not necessary, because the removal of part, sometimes even of a comparatively small quantity of a serous effusion, is usually followed by the complete absorption of the rest; and thirdly, the removal of a very large quantity may occasionally lead to dangerous collapse.

The rule is to continue the evacuation, if the patient's pulse and general condition remain good, so long as it takes place readily, producing no cough; but to stop at once if there be any cough or the slightest appearance of blood in the fluid drawn off. The aspirator in most cases answers the purpose extremely well; but if it be decided to employ a trocar and canula, either because the fluid contains flakes of lymph which do not readily flow through a fine tube, or for any other reason, such an instrument as that mentioned above may be used; or one which is flattened may be found more convenient, if the ribs be naturally close together, or if they have been approximated by contraction of the chest. It is not only important to see that the canula fits close round the neck of the trocar, but also to take the precaution of plunging it with one thrust through the thoracic parietes, regulating the distance to which it is made to enter the chest by placing the index finger at a suitable spot on the side of the canula. In this way, the accident of separating the pleura from the ribs and pushing it before the trocar—a not uncommon one—is effectually avoided. If neither of the instruments described be at hand, an efficient arrangement for preventing the entrance of air into the chest may be made by attaching a piece of muslin, folded as when used for a petticoat-tube, to the end of the canula. During the puncture it is held round the trocar, and afterwards, whilst fluid escapes readily from it, it is impossible for air to find its way back through it.

It may be mentioned here that Mr. R. W. Parker, with a view of more completely removing the fluid than is otherwise possible, has suggested and put in practice the plan of puncturing the chest at another point with a fine needle, which communicates, by means of an india-rubber tube, with a bottle containing cotton-wool or some other means of purifying the air that passes through it. In this way purified air enters the chest as the fluid escapes, and the hydrothorax is converted into a pneumothorax, the air being, as was hoped, subsequently absorbed. Sufficient experience has not yet been obtained to warrant the recommendation of this procedure.

The spot to select for puncturing the chest is a matter of small consequence, only it is advisable not to go too low, for fear of injuring the diaphragm. About the sixth or seventh space, just in front of the posterior fold of the axilla, is usually found the most suitable position.

Paracentesis Abdominis may be performed with the aspirator or the trocar; or another method may be employed, which was suggested by Dr. Reginald Southey—viz. the introduction of several minute perforated needles, through which the fluid escapes *guttatim*. These are left *in situ* for a considerable time, and it is maintained that the effusion can, by this plan, be removed with less chance of collapse than is involved in the more rapid processes, and without entailing any risk of consequent peritonitis.

If either of the other plans be adopted, a few precautions are necessary. First, it should be ascertained that the bladder is empty, so that the instrument may not pass into this viscus instead of into the peritoneal cavity; secondly, it must be demonstrated that there is dulness at the point selected, so that it may be certain that no coil of intestine is punctured, as may happen, even though the peritoneal cavity be full of fluid, if the bowel be bound to the abdominal wall by adhesions; thirdly, a wide, many-tailed

bandage should be made to encircle the abdomen, the ends of which should be firmly tightened by assistants standing upon each side of the patient, a hole having been previously cut in it opposite the point to be punctured. In this way the flow of the fluid is encouraged if the simple trocar be used, and the tendency to collapse of the patient, from the sudden diminution of pressure, is prevented. After the completion of the operation the bandage is not removed, but its ends are firmly secured on the front of the abdomen, after previously carefully sealing the puncture with collodion to prevent the possibility of leakage, such leakage being not unlikely to lead to peritonitis.

The spot usually chosen for puncture is in the middle line, midway between the umbilicus and the pubes, though circumstances may arise in which other situations are more advisable.

Paracentesis Capitis is performed for chronic hydrocephalus; it is not an operation from which, to judge by experience, much, if any, advantage is to be gained, the fluid almost always, if not invariably, collecting again with more or less rapidity. It is, however, a proceeding which, if carefully performed, appears to involve little or no risk to the patient. The fluid is usually in the distended cerebral ventricles; but the distension is so great that the brain substance covering it is much thinned, and it is therefore found at a very short distance from the surface. A fine exploring trocar is the right instrument to employ, and an ounce or two of fluid should, as a rule, be the limit of the amount withdrawn. The writer has, however, in one case adopted the plan of purposely leaving the puncture unsealed, so that the fluid might drain away after the manner of paracentesis abdominis by Southey's tubes; but, although no mischief in this case resulted, he is not disposed to recommend the plan to others, for on carrying out the principle a step further, and introducing a single horsehair into the puncture, a sharp attack of meningitis was the result. It would obviously be unwise, in dealing with such a delicate organ as the brain, to withdraw a large amount of fluid suddenly, and, *a fortiori*, to employ the aspirator for the purpose. The surgeon may select any point, away from the position of one of the sinuses, where the bony part of the skull is absent. Such spots are usually plentiful in cases of chronic hydrocephalus in young children, and a convenient place will be found, at a short distance from the middle line, in one of the usually widely gaping limbs of the coronal suture. It is needless to say that in older children, where the skull is completely ossified, the operation is neither called for nor admissible.

Paracentesis Pericardii is an operation which has suggested itself to many surgeons and physicians, but has not till comparatively recently been much used. Trousseau was in favour of employing the bistoury for the operation, but it can hardly be doubted that it is more safely performed with a fine exploring trocar or the aspirator; for it must be remembered that, although the pericardium is for a considerable extent uncovered by lung, the pleura on the left side reaches almost, if not quite, as near to the middle line as on the right side. Thus, unless the instrument is passed quite close to the sternum in the fourth or fifth interspaces, it must almost necessarily pass through the pleura, if this be not already obliterated by adhesions; and, although the passage of the aspirator needle will be probably productive of no evil consequences, the admission of air into the pleura, which will almost necessarily follow the use of the bistoury, would be an unfortunate and serious complication. The instrument is to be passed then close to the sternum in one of these spaces, or at such a distance from it as to avoid the internal mammary artery, which is coursing downwards behind the costal cartilages, and it should be directed obliquely upwards and outwards so as to avoid puncturing the heart. Dr. S. West strongly recommends the fourth interspace, at one inch from the end of the sternum, but the third, the sixth, the seventh, and the eighth have been selected, and in three cases at least the pericardium has been reached on the right of the sternum. It may be mentioned that simple puncture of the heart with a needle is not likely to be followed by any serious consequences, as is shown by the fact that it has been occasionally done accidentally, and sometimes purposely, for the sake of producing contraction of the ventricle in apparent death from chloroform. In Dr. Samuel West's case, and in some others, a drainage-tube was inserted into the pericardium, and the patients recovered; in one case the opening was made through the pleura, which had previously been incised for the evacuation of an empyema. Rickman J. Godlee.

PARAMETRITIS. *See* Pelvic Cellulitis.

PARAPHIMOSIS is the retraction of the prepuce behind the glans penis, where it becomes fixed owing to the constriction

of the preputial orifice. In childhood, the deformity is caused by the retraction of a long foreskin with a contracted orifice. In adults, this may also be the cause, and paraphimosis is not infrequently brought about during coitus. It may also arise as the result of venereal infection. The extension of a balanitis to the preputial mucous membrane having inflamed and thickened the prepuce, a successful attempt is made to retract it behind the glans, when it is found impossible at the moment to replace it. It is obvious that the tight, constricting band of the preputial orifice behind the glans, is the immediate cause of the return of blood from the part being prevented. Œdematous swelling soon comes on, and in cases where relief has not been soon afforded, ulceration or even sloughing of the glans has been known to take place. It is of importance to recognise the exact spot at which the constriction is situated. Immediately behind the glans is a furrow, deeper on the dorsal aspect. In paraphimosis there will be noticed behind this furrow a fold of swollen mucous membrane, and then another and deeper sulcus. This second sulcus represents the mucous membrane of the preputial orifice, and is the site of the constriction.

The *treatment* should be directed to secure immediate reduction. In ordinary cases this may be effected as follows: oil the glans penis well, then lock the forefingers of both hands above and behind the glans, and the middle fingers below. With both thumbs make steady pressure on the glans, at the same time endeavouring to slip the prepuce forward by traction with the fingers. The operation is a painful one, and in children it may be needful to administer an anæsthetic. Should this manipulation fail, an attempt should be made to reduce the swelling by the application of an elastic band wound firmly round the glans. On this being rapidly unwound, it may be possible to slip the prepuce over the diminished glans.

When, however, it is found impossible by these means to reduce a paraphimosis, recourse must be had to incision. Remembering the description given above as to the point of constriction, a vertical incision half an inch long should be made at that spot with a curved, sharp-pointed bistoury. The constriction immediately yields, sometimes with a snap, and reduction is effected with ease. The after-treatment consists of injections of carbolic or boracic acid lotions, and warm fomentations if pain and swelling should continue. PAUL SWAIN.

PARONYCHIA. *See* WHITLOW.

PAROTID TUMOUR.—The tumours growing in the substance, or upon the surface, of the parotid gland, most commonly met with, and to which the name of 'parotid tumour' is usually applied, are of a cartilaginous nature. But, mixed with the cartilage is usually a variable amount of soft embryonic connective tissue (myxoma), together with fibres enclosing spaces wherein are contained cells resembling those proper to a lymphatic gland.

These tumours are irregularly lobulated in shape and of firm consistence, giving a sense of elasticity to the touch, with here and there softer portions. They are enveloped in a dense capsule, and usually embedded in, and closely adherent to, the substance of the parotid gland. Sometimes they are freely movable upon the parts beneath, but more often they are covered by the fascia of the parotid, and have made their way between the lobes of the gland, which may be partially absorbed by their pressure. Thus, while the greater part of the tumour may project beneath the skin, in front of or behind the lobe of the ear, there may also be processes extending deeply behind the ramus of the jaw, even down to the styloid process and carotid sheath; and the facial nerve or some of its branches, and the external carotid artery and jugular vein are often adherent to or surrounded by some part of the growth.

These tumours increase slowly, and do not often attain a very large size; they are non-malignant, and are troublesome chiefly because of the deformity they produce, and the pressure upon and displacement of adjacent structures.

Occasionally, however, parotid tumours are met with which recur after removal, or even exhibit malignant characters; these are usually softer, of more rapid growth, and with a tendency to early adhesion to the skin.

The only *treatment* applicable to a parotid tumour is removal; and this should be done early, so as to avoid, as far as possible, the dangers incident to its extension among the deeper tissues of the part. A free incision should be made over the posterior border of the tumour, and this may be joined, if needful, by another passing forwards at a right angle to the first. The capsule of the tumour should be opened to a corresponding extent, and the dissection kept as much as possible within it, for the capsule generally separates the tumour from the important adjacent struc-

tures. When, however, the tumour extends deeply, the dissection will always be difficult and require much caution, especially in following the processes of the growth which extend behind the jaw and in the direction of the styloid process.

The facial nerve or its branches may, however, be so intimately connected with the tumour that it will be impossible to avoid its division. But the resulting facial paralysis is not necessarily permanent. If the ends of the nerve can be found, they should be brought together by a fine catgut suture, and the function of the nerve may be re-established. If, however, any considerable portion of the nerve is removed, or if there be much suppuration in the wound, the paralysis will persist. Every care should, therefore, be taken to secure immediate union of the wound, the edges of which should be carefully adjusted with fine sutures, for the vascularity of the tissues of the face and neck favours the rapid healing of even extensive wounds.

J. Warrington Haward.

PATELLA, Dislocations of the. There are five dislocations of this bone: viz. *outwards*, *inwards*, *upwards*, *by semi-rotation* (edgeways), and *by complete version*.

Dislocation Outwards is the most common, and it may be *incomplete* or *complete*. When incomplete, the inner articular facet rests upon the cartilage of the external condyle, and the outer edge projects. When complete, the bone lies to the outer side of the anterior prominence of the external condyle. It is especially frequent in knock-kneed persons, which is to be explained as follows: Owing to the oblique direction of the rectus muscle from origin to insertion, during contraction it tends to displace the patella outwards, a tendency which, under normal conditions, is counteracted by the anterior prominence of the external condyle. With genu valgum the obliquity of the muscle is increased, and the prominence of the condyle no longer suffices, under these conditions, to prevent the patella from being displaced outwards. Occasionally it is produced by violence, or it may be *congenital*, and then is often associated with talipes or other deformity. A slight twist inwards whilst dancing, in a person of lax fibre with knock-knee, is often sufficient to cause this dislocation. It is, usually, easily reduced by pressure when the limb is raised. In cases of difficulty, violent flexion has sometimes been found to succeed after other means have failed. The joint should afterwards be kept at rest till the synovitis has subsided, and a knee-cap, with a spring to support the patella in position, should be worn when the patient commences to walk.

Dislocation Inwards is much less frequent than dislocation outwards, and is more often due to direct injury. It may, however, be caused by muscular action, especially where there is a tendency to genu varum. It may be *complete* or *incomplete*. In the latter case the inner edge projects, and the outer articular facet is applied to the inner condyle. Reduction is, usually, easily effected in a manner similar to that recommended for dislocation outwards, and as a rule little ill-result follows; but in one case, recorded by Key, suppuration and death resulted, though there was no external wound.

Dislocation Upwards occasionally occurs as the result of a sudden powerful contraction of the quadriceps extensor muscle, whereby the ligamentum patellæ becomes ruptured. In more than one case to which the writer has been called, under the belief that this accident had occurred, he was able to distinguish the extreme tip of the patella attached to the upper end of the ligament, and the case was, therefore, really a fracture. The treatment should be precisely the same as for fracture of the patella, that bone being held down by some mechanical contrivance until firm union of the ligament has taken place.

Dislocation by Semi-rotation. — In this very rare but interesting dislocation, the patella becomes rotated on its vertical axis, and so fixed between the condyles that its surfaces are directed laterally and its edges antero-posteriorly. It would appear to be brought about by a stage in rotation beyond that which prevails in the case of incomplete lateral dislocations; and either edge may be directed backwards and fixed between the condyles. The inner edge is more frequently posterior, and this is what one would anticipate from the greater frequency of the dislocation outwards. It has occurred in children of thirteen and fifteen, as the result of muscular action, but more often results from direct injury, and this has happened on several occasions during horse exercise. The leg is usually extended or slightly flexed, and the edge of the patella makes an unmistakable prominence in front of the joint. Reduction has, sometimes, been effected without difficulty by pressure and extension; in other cases, this method has completely failed, and the bone has been replaced by forcible

flexion. The extreme difficulty occasionally experienced, even after division of the extensor tendon and ligamentum patellæ, points to some other cause than muscular action as producing the fixation; but these cases appear to have been before the days of chloroform. Should all other means fail when the patient is under an anæsthetic, the writer would not hesitate, under proper antiseptic precautions, to make a small incision into the joint on the side of the patella, and there introduce a metal lever to raise the bone into position. His experience of antiseptic incision of the knee-joint, for the removal of loose cartilages and for knock-knee, quite justifies him in recommending this method under the restrictions stated; but without such care it would be hazardous, in illustration of which Wolff's case may be mentioned. This surgeon made a long open wound in front of the joint, in order to divide the extensor tendon and the ligamentum patellæ. He failed to replace the bone, and the patient died from suppuration of the joint.

Dislocation by Complete Version.—As dislocation by semi-rotation is one stage further than incomplete lateral dislocation, so complete version is a further twist on the vertical axis beyond semi-rotation. The articular facets of the patella are directed forwards, and its anterior surface faces the condyles of the femur, whilst the tendon above and the ligament below are twisted, and stand out as cords beneath the skin. Castara has related a case which occurred in a girl of seventeen, the patella being twisted from within outwards; and Sue has mentioned a case in which the rotation was from without inwards. Castara readily reduced his case by simply twisting it round with his finger and thumb. In cases of difficulty, the methods already described for dislocation by semi-rotation may be tried. R. Clement Lucas.

PATELLA, Fracture of the.—This bone is most commonly fractured in males between the ages of twenty and fifty, though cases are occasionally met with in the young, and in persons advanced in life. It is much more common in men than in women.

Causes.—Though sometimes the result of direct violence, as of a fall on the knee, a kick, or a blow, it is most frequently produced by muscular action. When the knee is flexed to an angle of about 110°, the patella is mounted on the most prominent part of the condyles of the femur, in a position which, while it greatly increases the leverage of the quadriceps, leads to so severe a strain when this powerful group of muscles suddenly contracts, that the bone frequently snaps across, a little below the middle. The fall which many believe has caused the fracture is, in fact, merely its result. Observant persons, indeed, have often reported that during a violent muscular effort they both heard and felt the bone snap, and that then, losing all power in the limb, they fell to the ground. Transverse fracture may occur at any level, sometimes so near the ligamentum patellæ that the lower fragment is so small that it can scarcely be felt; sometimes near the upper limit of the bone. Occasionally, the quadriceps extensor not only produces a transverse fracture, but those of its fibres which are attached to the sides of the bone lead to vertical fracture and wide lateral separation of the fragments. When the result of direct violence, the fracture may be vertical, oblique, or comminuted and stellate. Morris mentions a case of incomplete fracture involving only the articular aspect of the bone. Compound fracture is rare, and is probably always due to direct violence.

In the great majority of cases, fracture of the patella extends into the joint, though, when it is seated at the lower non-articular portion of the bone, the soft parts may shut it off from the synovial cavity. The amount of separation of the fragments depends on the degree to which the aponeurotic structures at the sides of the patella are torn. When these escape injury separation is slight, but when, as is often the case, they are extensively lacerated, and when effusion occurs into the joint, the gap between the fragments becomes proportionately great. Immediately after the injury the knee-joint frequently becomes distended with serum and blood, and considerable extravasation may occur into the soft parts about the front and sides of the knee. Synovitis following the accident may add to the swelling of the joint. Suppuration very rarely takes place. Necrosis following fracture of the patella is a very rare event, though a few examples of it have been recorded.

Symptoms.—In the majority of cases the local symptoms are plainly marked, but occasionally they are so obscure that the injury may be easily overlooked. In transverse fracture, the fragments are generally separated by a distinct interval, which is increased on slight flexion of the limb, a movement, however, which should be used only in doubtful cases, and then with the greatest gentleness. When pressed from side to side in opposite directions, the frag-

ments can be felt to move on each other, or when one is tilted by pressure on its lateral border, the other is found to remain at rest. In transverse fracture with little separation, or in vertical or stellate fracture, the fragments may be moved on each other and crepitus be sometimes obtained. On tracing its borders, irregularity in the outline of the bone may be detected. Though the patient usually loses all power in the limb at the moment of the accident, and finds that any attempt at movement causes severe pain, it must not be forgotten that many cases are on record in which persons, with recent fracture of the patella, have been able not only to extend the leg but to walk for some distance, and even to walk upstairs upon the limb. Care must be taken not to mistake for the evidences of fracture either (*a*) the ridges and irregularities that are sometimes to be felt in a thickened bursa patellæ resulting from repeated attacks of inflammation; or (*b*) the hard edges of an effusion of blood following a blow and soon becoming firmly coagulated in the meshes of the periosteum; or (*c*) the sensation of crepitation which may be produced by the presence of recent blood-clot in the bursa; or (*d*) the altered shape of the bone resulting from osteo-arthritis. In some instances, fracture of the patella has been mistaken for mere traumatic synovitis, and has been detected only when effusion into the joint has been absorbed.

Transverse fracture of the patella is rarely united by bone. The possibility of this form of repair, however, is proved by many museum specimens in which a section across the line of fracture has been made. Generally, when separation is only moderate, the fragments are connected by a thick and broad ligament which occupies the interval between them. When the ends are wide apart, a band may extend between them consisting either of newly organised material more or less substantial, or of part of the thickened capsule, blended perhaps with the walls of the bursa patellæ. In many instances the fracture remains ununited, and the joint is closed in front only by the integuments. Although, when the patient leaves the surgeon's hands, the fragments are close together or are separated only by a slight interval, the uniting band may, with subsequent use of the limb, gradually stretch, so that a gap of from an inch to four or even six inches is formed.

A patient, who has once sustained fracture of the patella, is very liable to a repetition of the accident in the same or the opposite limb. In re-fracture, the bone generally gives way above or below the uniting ligament, but in some cases the ligament itself is torn. Instances are on record, in which the same patella has been broken at as many as four different levels. Occasionally, both patellæ are broken at the same time. In some cases repair leaves the knee-joint stiff, and the patella fixed by fibrous adhesions to the condyles; no attempt, however, involving any force, should be made to restore movement by flexion, lest in doing so the union of the patella should be weakened.

Treatment.—The objects to be aimed at are the approximation and retention of the fragments in position, and a quiescent condition of the extensor muscles. When the joint is distended with effused blood and serum, or when acute synovitis has come on, no retentive apparatus can at first be used. The knee should be fully extended, and the limb raised to an angle of about 140° with the trunk. The joint should be covered with an ice-bag, or with evaporating lotion. In order to reduce swelling, some advise that the joint should be aspirated. This, however, although it has often been safely done, and although its effect is to allow the fragments to fall towards each other, is a proceeding which certainly is not essential, for the generality of cases do well without it; nor can it be regarded as free from the chance of an occasional serious mishap. It should, therefore, at least be reserved for cases in which the separation of the fragments is very considerable.

As soon as the joint will safely bear it, means should be taken to bring the fragments together. Owing to the prolongation of some of the fibres of the quadriceps tendon downwards over the superficial aspect of the patella, the upper fragment is prone to be tilted so that its broken surface, instead of presenting directly towards the lower fragment, looks upwards and forwards, and so that the interval between the ends is V-shaped, with its base outwards. Hence, although the fragments may be in firm contact on their deep aspect, they still show a gap in front, which it is often difficult or impossible entirely to remove. But this is not very material, for experience abundantly shows that, while bony union is very rare even when the fragments seem closely in contact, in the great majority of instances in which the ends are separated only by a moderate interval (less than three-quarters of an inch—and the space can usually be reduced to these limits), such firm ligamentous union will occur that the patient re-

tains almost perfect use of the limb. This ligament, indeed, is so strong that, in any subsequent injury, not it but the bone itself at some other level usually gives way.

In Steavenson's method, which is often successful, the limb is placed in a back splint, and the fragments are drawn together by two elastic bands, one of which passes from a hook at the inner side of the back splint below the knee, upwards over the superior fragment, and then returns to a hook on the outer side of the splint below the knee, while the other band passes in an opposite direction, is similarly fixed, and acts on the lower fragment. Another plan is the following:—A broad piece of stout moleskin strapping is cut, at one border, into the shape of a horse-shoe, with the ends prolonged. This is applied to the thigh so that its concavity surrounds the upper fragment, and is fixed by a bandage. The limb is now placed on a well-padded McIntyre or wooden back-splint, with a footpiece. The lower fragment is next fixed by a pad of lint, and with strapping passed around the limb and splint together. A bandage is then carried upwards over the limb and splint from the foot to the level of the lower fragment, and another is applied in a similar way to the thigh. To the two ends of the moleskin pieces of webbing are now sewn, and these are connected with india-rubber accumulators, which in their turn are fastened to a loop of webbing passed round the footpiece of the splint. By tightening this loop the upper fragment can be drawn down. It is best to introduce a pad beneath the concave edge of the moleskin, so as to avoid ulceration of the skin.

Malgaigne's hooks enable us to act directly upon the fragments, drawing them more closely together than any other method, and some surgeons still employ them. Their use, however, has been followed by diffuse inflammation round the patella and even by suppuration of the knee-joint, ending in some cases fatally, in others in ankylosis. Nor do they by any means ensure bony union. Hence, they have never come into general favour, and cannot be here recommended. In a serviceable modification of Malgaigne's plan two thick pieces of moleskin plaster cut out at their margins to fit the patella are applied, the one above and the other below the fragments, and the hooks are fastened into and made to draw upon these instead of being fixed into the patella itself.

The operation of opening and wiring the fragments together, first practised upwards of five-and-twenty years ago, has lately been advocated and practised by Sir J. Lister and others. In speaking of this proceeding, a line must be drawn between recent and old cases. (*a*) In recent cases the fragments are no doubt generally brought easily together, and, as a rule, the operation is attended with no serious complication; while in many instances, so far as examination shows, bony union is obtained. It may also be allowed that in a successful case much time is saved. The objections, however, to the operation are: (1) that a very satisfactory result is generally to be obtained without it, so good indeed that the patient is conscious of no impairment of the limb; (2) that bony union after it can by no means be guaranteed; (3) that it entails, as some cases have already only too plainly demonstrated, the risk of suppuration of the joint and other very serious complications. These objections are, in the eyes of the great majority of surgeons, fatal to the adoption of this method. (*b*) In cases of old fracture, with retraction of the fragments, it has been found difficult or impossible to bring them into contact, in consequence of the shortened condition of the quadriceps extensor. In some instances, even though the extensor has been completely divided, the fragments could not be brought together; in other cases, though adjustment was accomplished, no bony union occurred. In short, the prevailing opinion in regard to this operation is that in cases of recent fracture it is uncalled for; while in many cases of old fracture it is often impossible to carry it out in a satisfactory manner.

Refracture must be treated in the same manner as the primary injury. Unfavourable as the prognosis appears at first sight, the result is often very satisfactory, and it is surprising to see how fully the power of the limb is retained, even when the patella has become by repeated fractures divided into three or four fragments, united by intervening ligamentous bands. A source of weakness, after fracture of the patella, lies in the great atrophy which occurs in the quadriceps muscle. Something may be done to reduce the amount of wasting by hot douching and shampooing, and the use every morning and evening of a mild continuous electric current (six or eight cells).

Much difference of opinion exists as to the time during which, after fracture of the patella, some apparatus should be worn to prevent flexion of the joint. This period, however, must doubtless vary with the case.

When not only the patella has been broken, but the fibrous structures at its sides have been widely torn across, so that considerable separation has occurred and the uniting ligament is weak and apt to stretch, the knee ought to be kept in a straight position for six months; while in instances in which separation has been slight, and a strong and short ligamentous band has formed between the fragments, some flexion of the limb may be allowed after three months. Each case, however, must be watched to see whether the band is yielding and the gap between the fragments increasing, it being remembered that, in many instances in which union was close when the patient was dismissed, a gap of from four to six inches has gradually formed. Much, too, will depend on the patient's calling. If this involves the carrying of heavy loads, or is otherwise physically laborious, the extended position must be maintained much longer than would otherwise be necessary. A convenient apparatus for maintaining extension consists of a pair of antero-posterior leather splints, accurately moulded to the lower half of the thigh and upper half of the leg, and strengthened by light steel supports. The splints may be prevented from slipping by two narrow steel prolongations, fitting into tubular sockets in the sides of the heel of the boot. An excellent appliance, long used at the Middlesex Hospital, consists of a strong-laced leather knee-cap made in two pieces, one extending eight inches or more up the thigh, the other six inches or more down the leg, and connected with each other by steel rods on the outer and inner sides. These rods are jointed opposite the knee, the joint being so constructed that the amount of flexion which it allows, and which is at first very limited, can be gradually increased.

In cases of vertical or oblique fracture of the patella, the limb must be raised in the extended position, and the fragments readjusted and maintained in place by pads and circular turns of a bandage. In many cases, however, of these fractures, separation is so slight that all that is necessary is to keep the limb at rest in the position just mentioned, and supported on a back-splint for four or five weeks, when the patient may be allowed to resume exercise gradually, the knee being at first guarded by a light back-splint, to prevent flexion.

HOWARD MARSH.

PEDICULI.—The presence of pediculi, or lice, upon different parts of the body, gives rise to a disease called phthiriasis, which differs somewhat according to the locality. It is in reality a form of eczema dependent on the local irritation of the pediculi, and it differs according to the habits and situation of the pediculi which give rise to it. There are three kinds of lice which generally attack the body: pediculi capitis, corporis, pubis. The symptoms, which vary in the case of each of them, together with the diagnosis and treatment, which depend on a knowledge of their habits, must be considered separately.

PEDICULI CAPITIS.—*Symptoms.*—As a rule, the patient complains of soreness and great irritability of the head; or the glands in the occipital region especially, and also those in front of the ear and at the side of the neck are swollen and even suppurate, giving rise, at first sight, to the notion that the patient is strumous. But the hair is matted together, especially at the roots, with thick crusts and scabs, and a very slight examination will reveal the presence of eczematous patches and small erosions on the scalp. Sometimes, especially in women with long hair, the erosions are deep and inflamed, and the skin is pigmented under the long hair in the neck. If this be lifted up, the pediculi will soon proclaim their presence by their active movements.

Diagnosis.—An examination of the individual hairs will complete the diagnosis, if anything further be required. Fastened to them, usually close to their roots, will be found the nits or eggs (small grey masses about the size of a small pin's head). One only, as a rule, is found on each hair; if more than one is present, those nearest the root are the newest, and if the nits are situated more than an inch from the head, it is quite certain that the disease has existed for some time, as the hairs have had time to grow considerably since the nits were deposited upon them. It is important to observe the exact way in which the nits are attached to the hairs, for without such knowledge they cannot be thoroughly removed. Around the hair will be found an elongated ring, which is cemented to the hair, and to the outside of which the nit is attached. For this examination a small magnifying glass should be employed. The pediculi themselves are small grey insects, having their habitat near the hair-roots, where they are warmest and safest. They are about $\frac{1}{10}$ of an inch in length, and capable of very active movements. They escape from the nits about nine days after these have been deposited. Nine days later they are full-grown, and in about nine more are capable of reproduction.

Treatment.—From the above description it is obvious that the treatment must be directed, not only towards killing the lice, but likewise to the destruction of the nits. The simplest plan, by far, of effecting this object is to shave the head, which plan leaves nothing but the eczema to treat. This is readily cured by any simple emollient, such as vaseline, zinc ointment, or one part of liq. plumbi subacet. and two parts of olive oil. If, for any reason, it is desirable to retain the hair, one of the following methods will be found to succeed admirably: a linseed-meal poultice mixed with carbolic acid (1 in 40 parts of water) readily kills the lice, without running the risk of letting any of them escape. The same end can be effected by washing the hair with plenty of soap and carbolic acid (1 in 40), or by applying equal parts of petroleum and olive oil, with enough Peruvian balsam to mask the smell. To get rid of the nits which still remain behind, daily washing is necessary, together with the use of a fine-toothed comb after the roots of the hair have been moistened with a little vinegar. The effect of this application is to loosen the little rings before described, by which the nits are attached to the hairs, and they can then be gradually drawn off the hairs by the aid of a fine comb, just as a ring is withdrawn from one's finger. This process should be carried on for at least a fortnight after the last louse has disappeared, after which time there is no fear of any more eggs being hatched.

Pediculi Corporis.—*Symptoms.*—The chief symptom of this disease, as of the first, is, essentially, intense itching, but it is limited to the body, as these lice do not invade the head. The skin is marked by long scratches, caused by the nails of the patient, by wheals, papules, and even sores. In the worst cases the whole skin is dark and pigmented, from the extravasated blood which has become altered in the subcutaneous tissue, and the course of the lymphatics is marked out by lymphangitis. It is scarcely possible, with care, to mistake the disease for anything else; it has been, however, confounded from its colour with Addison's disease; from its wheals, with urticaria; and, from its scratches and ulcers, with impetiginous eczema.

Diagnosis.— To come to an absolutely certain conclusion, the clothes must be searched, as in them it is that the louse resides; the body is only his happy hunting-ground. Wherever there are folds in the clothes, e.g. just below the armpits, round the waist or the neck, the greatest traces of his ravages will be seen, whilst in the axillæ and on the contiguous surfaces of the buttocks where the clothes never touch, no traces of the scratching are to be seen. It is essential that every article of clothing should be carefully examined, as, sometimes, an old flannel belt or truss may be the lurking place in the cleanest of individuals. The pediculus corporis or P. vestimenti, as it should be more properly called, differs from P. capitis in being larger and more active; the head is elongated and more oval, the antennæ larger, and the colour dirty white with blackish margins.

Treatment must be directed rather to the clothes than to the skin. If the clothes are boiled or baked, all the symptoms will speedily disappear. If these precautions be taken, it is not necessary to destroy the clothes. The treatment of the skin, if any be required beyond a warm bath, is the same as that prescribed in the case of P. capitis.

Pediculi Pubis.—*Symptoms.*—Itching, as in the preceding cases, is the most prominent symptom. It is more constant though not so violent as in P. corporis; and the scratches are more like those on a person affected with scabies.

The *diagnosis* is readily effected by searching for the louse, which is shorter and broader than P. capitis, has a fiddle-shaped head, and resembles a miniature tortoise. The two front pairs of legs are used for walking, whilst with the claspers on the hinder he sticks tight to the hairs. The nits are situated so near the base of the hairs that it is best to shave them to ensure a complete cure. The pediculus pubis will affect the whiskers, beard, moustache, eyelashes, and chest of hairy men, but never invades the clothes or even enters the head. It should be borne in mind that this affection, though usually caught during coitus, may be contracted in other ways.

The *treatment* which is commonly adopted is to rub in ung. hydrargyri, continuing the treatment as each fresh lot of nits is hatched. Occasionally, however, in delicate skins this produces a violent attack of eczema, rendered oftentimes all the more violent by the additional application of the ointment, under the impression that the extra irritation is caused by the pediculi and not by the ointment. No fear of such a disaster need be entertained if equal parts of ung. hydrarg. ammon. and lard are employed, or petroleum prepared as in the case of P. capitis. Much irritation may be avoided by sprinkling a little chloroform on the affected parts, and then washing off the

stupefied lice, after which the ointment, &c., may be trusted to prevent the nits from doing any further harm.

W. Bruce Clarke.

PELVIC ABSCESS. — Abscess may form in the pelvic cavity of a female subject as the result of several disorders, particulars of which are to be found in works upon obstetrics and diseases of women. Inflammation of the connective tissue of the pelvis, generally termed pelvic cellulitis or parametritis, is probably the most frequent cause of pelvic abscess. Pelvic peritonitis or perimetritis is a less frequent cause of the same complication.

Although specific discharges seldom, if ever, set up suppuration around the bladder and urethra in women, they may lead to pelvic cellulitis or peritonitis, and thus indirectly cause abscess. In such a case, the surgeon must lay more stress upon a history of child-bearing or abortion than on the recent or present existence of gonorrhœa in the same patient. For it is questionable whether gonorrhœa, in single women, is so frequent a primary cause of severe pelvic peritonitis as has been asserted; but it is a certainty that the same disease may set up pelvic peritonitis of the worst type if the patient be delivered, or have an abortion during its existence. Thus, in venereal out-patient practice in hospitals, a large proportion of sterile women with gonorrhœa may be watched for months, but pelvic peritonitis and pelvic cellulitis will not be found to be common among these cases. Let the surgeon turn to the gynæcological department of the same hospital, and he will not fail to observe numerous cases of pelvic peritonitis and cellulitis, and not a few in the suppurative stage; nearly all the cases will be in married women who have had children or miscarried, and a history of gonorrhœal infection will, unfortunately, be found in a large proportion. Noegorrath's theory of the frequent relation of gonorrhœa to sterility does not come within the scope of the present subject, but it should be noted that in many sterile cases there may have been an overlooked early abortion.

Carelessness in the use of the sound, and cutting operations about the cervix uteri, may be the cause of suppurative pelvic cellulitis or peritonitis. Here, again, the presence of gonorrhœa would greatly increase the dangers of these minor operations. The suppuration of a morbid but non-inflammatory deposit in the pelvic cavity is another cause of abscess. Under this head must be included two very different conditions, pelvic hæmatocele and extra-uterine fœtal cysts. The suppuration of a portion of ovarian cyst, adherent to the pelvic structures, is not infrequent, especially in the case of dermoid cysts. The abscesses set up by fœtal and dermoid cysts often burst into adjacent cavities, especially the bladder and rectum, and seldom point above the groin.

Symptoms and Diagnosis.—The premonitory symptoms of suppuration are the same in the female pelvic structures as elsewhere. *See* Abscess. They are often masked or overlooked in this particular kind of abscess. Women may complain of feeling suddenly hot or suddenly cold when simple, non-suppurative, inflammation is spreading in the pelvic connective tissue or in the peritoneum, and sudden rises of temperature often occur under these circumstances. Nevertheless, rigors and rise of temperature will always give grave suspicion of abscess, when occurring in any of the diseases mentioned above as predisposing to suppuration. When these symptoms have occurred, the diagnosis of the abscess by touch is far from being easy. It is generally surrounded by a wall of indurated inflamed structures, so that until it has pointed and is about to burst, none of the characteristic fluctuation can be detected. Parametric abscess often forms in the hard irregular inflammatory deposit which rises out of the pelvis in bad cases of pelvic cellulitis. Dr. J. Matthews Duncan has shown how such abscesses may extend into the thigh, the iliac fossa, the psoas muscle, or even as high as the kidney. This must be taken into account when abscess is detected in those regions in any adult female, single or married; and the surgeon must not mistake persistent lumbar pain, due to the pelvic disease, for evidence of spinal caries. A tender fluctuating swelling presenting in Douglas's pouch or above Poupart's ligament, after general symptoms of suppuration, is, after all, the only trustworthy evidence of pelvic abscess.

The *diagnosis* of abscess from the two chief inflammatory pelvic diseases, in their earlier stages, can only be proximately effected by a very careful unravelling of the history of the individual case. In pelvic cellulitis or parametritis, abscess may form at any stage, sometimes very early, whilst, when once the disease in question has occurred, the patient may, many years after its onset, suffer from a 'residual abscess,' formed in or about the residues of former

inflammations. In pelvic peritonitis or perimetritis, abscess appears to present generally in Douglas's pouch. Fluctuation in that pouch, in cases of perimetritis, may indicate a collection, not of pus, but of serum ('serous perimetritis'). The sudden onset of pelvic hæmatocele distinguishes it from pelvic abscess, and the collection of effused blood tends to become harder and less painful, whilst the reverse will occur where abscess has formed. Nevertheless, diagnosis is often obscured in cases of suspected hæmatocele. The catamenial history must be taken into account when an extra-uterine fœtal cyst is suspected; on the other hand, an abscess never begins with frequent attacks of metrorrhagia and crampy pains without fever. When a fœtal cyst is diagnosed, and rigors set in, suspicion of its suppuration becomes very reasonable. When an ovarian tumour exists, it is often impossible to diagnose suppuration around, from suppuration within, its pelvic portion. Pelvic abscesses being fixed, may be thereby distinguished from distended Fallopian tubes and incipient ovarian tumours.

Prognosis.—The course of abscess, in cases of extra-uterine gestation and pelvic hæmatocele, is generally very irregular and uncertain; and it may be laid down as a rule, that pelvic abscess following pelvic cellulitis or pelvic peritonitis is a most troublesome disease, always tedious in its course, and never unattended by danger. The anatomical relations of the abscess prevent early or safe pointing, and, the abscess walls being rigid, especially in parametric cases, collapse is impossible, and fistulous tracks in the groin or genito-urinary passages may remain for years. The probability of a residual abscess, or of fresh acute attacks of suppurative inflammation behind the first abscess, is very strong. Rupture of the abscess into the peritoneal cavity is rare though not unknown. The abscess-cavity in an ordinary case, where the opening is external, may harbour septic material, with the usual disastrous results. Pelvic abscess most frequently opens in the groin, the rectum, or the vagina. This subject will be considered in connection with treatment. It frequently happens that, in the course of a pelvic abscess, there is a more or less temporary arrest of the formation of pus, whilst that already formed may partially dry up. It is clear that chronic abscess in this condition is a constant source of danger, when situated amongst the pelvic viscera, though far less serious in many other situations on the trunk or extremities. It may give rise to all the results which follow non-suppurative forms of pelvic inflammation. The inflammatory process may suddenly extend, fresh abscesses forming, or, still more frequently, fresh adhesions of viscera. We say fresh, since it is rare that any severe form of inflammatory disease of the pelvic peritoneum or cellular tissue is unattended, from the first, by such adhesions.

Abscess, from suppuration in or around an extra-uterine fœtal cyst, places the patient in great danger from the risk of escape of pus into the peritoneum. It may burst into the vagina, and thus allow of the 'birth' of the relics of the fœtus sometimes entire, more frequently piecemeal. The suppuration of the pelvic portion of an ovarian cyst is a subject that does not come entirely within the scope of this article. The suppurating cyst may rupture into the vagina or peritoneum, and always complicates the case most seriously.

Treatment.—Pelvic abscess is a disease which it is difficult to treat satisfactorily. The difficulty in ascertaining where the abscess will point, and the still greater difficulties due to the usual rigidity of the abscess-walls, are the chief sources of trouble in treatment. The commonest form of pelvic abscess is seen in cases of pelvic cellulitis after childbirth, and it generally bursts in the groin. When the complexity of the anatomical structures between the integument along Poupart's ligament and the pelvic connective tissue is remembered, it is not surprising that the pointing process is often tedious. The widespread induration, which can be felt over the region of the abscess, explains how impossible it must be for the abscess-wall to collapse with readiness. When symptoms occur indicating pelvic suppuration after childbirth, the surgeon must look out for any softening in the hard mass, which can generally be felt in one groin; but must not forget that the abscess may burst through the integuments over the iliac fossa, above the ilium, in the thigh, or near the anus. It has been known to find its way through the obturator or through the great sciatic foramen. Lastly, these 'parametric' abscesses may burst into the rectum or vagina. On the other hand, in pelvic peritonitis, from any cause whatever, abscesses tend to burst into the rectum or vagina: rarely into the general peritoneal cavity or the bladder.

Guided by these considerations, the surgeon must be watchful in cases of pelvic cellulitis, and test by gentle digital examination the relative softness of the

exudation in the direction of the groin and in the pelvic cavity. Bimanual palpation is sufficient for the purpose, and the uterine sound should be eschewed. When the abscess points in the groin it may be opened by a free incision, and the pus allowed to flow out. It is not advisable to press on the abscess from the vagina or from the abdominal walls, as there is an especial risk of admitting a quantity of air into the rigid-walled collection of pus. A drainage-tube is an absolute necessity, and the cavity should be frequently washed out with antiseptic solutions. Iodoform gauze pads make a good dressing. The process of closing is often much protracted.

When the abscess points into the rectum or vagina, the surgeon must not be eager to employ the aspirator. It is a dangerous instrument, though it still has the reputation of being safe for this purpose. Free incision and thorough drainage will be needed. It is impossible to employ full antiseptic precautions under these circumstances. Care must be taken that the tube be carefully fixed, and antiseptic solutions must be injected gently, lest some weak part of the abscess-wall be damaged; for abscesses in the direction of the rectum and vagina are often not so thick-walled as those pointing towards the groin. An iodoform bougie may advantageously be retained in the vagina during treatment, if the abscess have opened into that passage.

In cases of pelvic peritonitis the same treatment is needed; the abscess nearly always bursts into the rectum or vagina. When pelvic peritonitis occurs from no evident cause, such as childbirth, abortion —criminal or otherwise—or unsuccessful operations about the pelvic region, the surgeon must be prepared for surprises. On bursting of an abscess, fœtal bones or masses of amorphous osseous tissue, hair, or sebaceous material, may escape with the pus. Independently of the general treatment of extra-uterine fœtation and dermoid ovarian cysts, the surgeon's duty in such a case is to enlarge the opening very carefully and to extract the solid structures, which, after exposure of this kind, are more likely to set up complications than before. Antiseptic injections will then be very much needed. *See* Extra-Uterine Fœtation; Ovariotomy.

In conclusion, the surgeon, in treating any case of pelvic abscess, must never fail to remember that it represents other morbid conditions, which he must seriously take into account.

Alban Doran.

PELVIC CELLULITIS.—This disease is termed 'parametritis' by several contemporary writers of high authority, chiefly from their objection to the word 'cellulitis' as unclassical. As the same writers, however, are those who rightly insist on the complete difference between this disease and 'perimetritis'—as they invariably term 'pelvic peritonitis'—it appears hardly advisable to employ terms so similar in sound, and therefore so liable to be confounded.

Pelvic cellulitis signifies inflammation of the cellular tissue of the female pelvis. Its pathology is that of cellulitis elsewhere, subject to local anatomical peculiarities. Hence, the surgeon must remember the relation of the fasciæ and peritoneum, and of the pelvic organs to the true cellular tissue of the pelvis. He should also bear in mind the anatomy of the lymphatic glands in the pelvis. The writer has repeatedly detected distinct enlargement of one of the obturator glands in the early stage of pelvic cellulitis. The enlarged gland may be felt by passing the finger up the lateral aspect of the vagina, then slipping it forwards along the tendinous origin of the levator ani muscle. When the anterior part of the attachment of that muscle is reached, the enlarged gland will be distinctly felt. A day or two later, should the disease have made progress, the gland will be embedded in inflammatory deposit, and its outline can no longer be defined.

Pelvic cellulitis is essentially a disease incidental to parturition. It is far less frequent in pregnancy, but is not rare under circumstances independent of the impregnated state. It generally arises in the cellular tissue around the cervix uteri. Pathologists often explain this fact by noting the abundance of this tissue in that region. The true reason is the frequency with which the cervix is exposed to injury involving its deep tissues, for such injury is probably the direct exciting cause of inflammation in the surrounding structure. Hence, damage to the cervix during parturition, the passage of a sound, or operative measures in its neighbourhood may all be causes of pelvic cellulitis. Septic material, entering a wound in the cervix, evidently produces similar effects to septic wounds in the neck or finger. The cervix is surrounded by a dense network of lymphatic vessels, as well as by cellular tissue. This explains the wide diffusion of the inflammatory process in the course of this disease. Cellulitis, beginning around the cervix, may certainly run its course without evidence of any complication involving the peritoneum.

When, however, it is set up in the very scanty cellular tissue between the body of the uterus and its peritoneal investment, it is hard to understand how the peritoneum can remain unaffected. Thus, it is frequently complicated with pelvic peritonitis, although that disease is probably caused, as a rule, by passage of septic material through the Fallopian tube into the peritoneal cavity. For the relation of gonorrhœa to pelvic inflammations, *see* Pelvic Abscess.

Symptoms. — Pelvic cellulitis almost invariably begins with those general symptoms observed in all other forms of cellulitis. Some women pay little heed to the early rigors and feverishness, which they attribute to sitting in a draught, or to a cold. It is certain that young subjects may continue to indulge in social pleasures involving active exercise, and that many older women will work hard for their families, until the disease has made great progress and produced prominent objective symptoms. The medical attendant will then be able to elicit little more history than that the patient has been recently confined, or has undergone some 'minor' gynæcological operation, and that she has not felt quite well for a day or two. As a rule, however, there is much feverishness, and distinct rigors occur, with sharp pain in the pelvis. The pulse is rapid and softer than in pelvic peritonitis, and whilst the abdomen is less frequently tender than in that disease, vaginal examination gives far more pain. A hard immovable mass rapidly forms either on one side of the cervix, in front of it, or all round that part of the uterus. In all cases, it tends to spread laterally and upwards. This swelling, though not so circumscribed as a tumour, has boundaries which may be readily defined on bimanual palpation. In this respect it differs from pelvic peritonitis, where a distinct resistant surface is generally detected behind the cervix, yet no circumscribed swelling can be made out. For the diagnosis from hæmatocele *see* Pelvic Hæmatocele.

The hard mass of cellular tissue infiltrated with inflammatory products may project above the brim of the pelvis, so as to be plainly detected on pressure over the iliac fossæ, without introduction of the hand into the vagina. This condition can never occur in pelvic peritonitis. At this stage, suppuration or sloughing may occur. The uterus is firmly fixed in the pelvis, often from a very early stage. The disease tends to become chronic, especially if the patient rise too soon after the more acute symptoms have subsided. In this case, indurated areas of cellular tissue remain, and render the patient subject to fresh attacks of inflammation.

Prognosis.—Pelvic cellulitis is seldom fatal. In the severe and sudden attacks which follow childbirth, the patient feeling very ill and anxious, will, as a rule, rest and obey advice. Hence, under such circumstances, complete recovery may occur in a few weeks, the indurated mass disappearing entirely. In sickly or careless subjects, abscess is very liable to form. The chronic forms are insidious, and often cause complications.

Treatment.—When the surgeon detects the indurated masses of infiltrated cellular tissue, he must carefully seek for evidence of suppuration. For the line of treatment to be followed if abscess form, the reader is referred to Pelvic Abscess. As long as there is no evidence of suppuration the patient must be left alone. Perfect rest in bed is absolutely necessary, and often proves in itself a complete remedy. Poultices over the iliac fossæ and hypogastrium give great comfort. The rectum should be cleared of scybala by an enema, and an occasional saline purgative may be given, provided that evidence of peritoneal complications be absent. Above all, the patient must be kept in the recumbent posture for a week or two after the symptoms have disappeared. Alban Doran.

PELVIC HÆMATOCELE.—If blood escape from a pelvic organ it will flow in the direction of least resistance, and in this respect will imitate inflammatory exudations in the same region. As the inflammatory process is, however, very different from hæmorrhage, it is evident that the escape of blood into the cellular tissue of the pelvis cannot be precisely compared to inflammation of that tissue, which can offer great mechanical resistance to the blood; whereas its very substance is rapidly softened and otherwise altered by inflammation, so that it can no longer resist distension by exudations. Hence, hæmatoceles in the pelvic cellular tissue are rare, and cannot form large masses of semi-solid consistence; and many such masses, which once would have been considered as collections of coagula distending the cellular tissue, are really intra-peritoneal hæmatoceles.

In the pelvic peritoneum, as in the cellular tissue, hæmorrhage and inflammation must differ greatly. The former may be sudden, and then can go on freely,

with little mechanical check and imminent danger to the patient's life. When less violent or rapid, the blood will undergo the changes which always occur when that fluid escapes from its natural channels. The irritation of the fluid and its coagula, or, more likely, some morbid process existing previous to the hæmorrhage, and possibly its cause, sets up local peritonitis, and adhesions may form, cutting off the collection of blood from the rest of the peritoneal cavity. Lastly, the collection of blood may gradually disappear after undergoing well-known changes, or, under unfavourable conditions, it may become decomposed or excite suppuration in neighbouring parts. The surgeon should never overlook the fact that one of these unfavourable conditions may be uncalled-for surgical interference, or careless after-treatment when such interference may have been necessary.

Causes.—Any disease or accident, likely to cause hæmorrhage into the pelvis, may give rise to pelvic hæmatocele. During the process of ligature of the pedicle of a large ovarian cyst, a varix frequently forms on the proximal side, in the abundant cellular tissue found below the limits of the peritoneum in these cases, and it is highly probable that a true hæmatocele may form under these very circumstances. The writer has seen over a hundred cases where the proximal portion of the pedicle was found to be greatly distended with blood. No evil effects followed; hence it was impossible to prove, though reasonable to suspect, that in some of these cases the swelling was hæmatocele, and not simply varix. Extra-uterine fœtation is the cause of the most serious form of pelvic hæmorrhage, and, when the bleeding is slow, a true pelvic hæmatocele may form.

The most frequent cause of pelvic hæmatocele is the rupture of some vessel, during the congestion of the pelvic viscera associated with the process of menstruation. Hence, the surgeon should never neglect to make most careful inquiries into the menstrual history of any case of solid or fluid deposit in the pelvis of a patient; and when a patient with such a deposit complains, before leading questions have been put to her, of an attack of severe pain during a menstrual period, the evidence in favour of hæmatocele is very strong. The source of the hæmorrhage is a much-disputed point, but it may arise from rupture of a vessel in the broad ligament, in the ovary itself, or under the mucous membrane of the Fallopian tube, or the tube may burst and bleed; lastly, most authorities maintain that the hæmorrhage may arise in the uterus and flow into the pelvic peritoneal cavity through the tubes.

Symptoms.—There is no disease that is occasionally so clear, and generally so obscure, as pelvic hæmatocele. A sudden attack of pain in the hypogastrium during a monthly period, followed by a swelling at the seat of pain, are the most characteristic symptoms. If the pain be preceded by a cessation of the menstrual flow, and succeeded by its reappearance for a day or two, the evidence of hæmatocele is still stronger. Distinct anæmia, with absence of fever for several hours or more after the onset of the attack, is also highly characteristic. The swelling, under favourable circumstances, will often become rapidly smaller, so as to leave little or no trace of its existence in a few weeks, and this without any history of escape of pus from the vagina, bladder, or rectum, or any symptoms of rupture of a cyst into the peritoneum. The surgeon must bear in mind this frequent course of a hæmatocele, for he is often called in some time after the acute symptoms have subsided. On the other hand, inflammatory changes may occur around the effused blood, and greatly obscure diagnosis. In the earlier stages, vaginal examination will often lead to the detection of a fluctuating swelling in Douglas's pouch or elsewhere in the pelvis; whilst, later, the swelling becomes firm and solid. This is often pointed out as the chief diagnostic sign, pelvic inflammatory exudations being hardest when most recent. But pelvic examination is not always easy at the onset of an attack of hæmatocele, nor does the surgeon generally see the case at that stage. As a rule, several of the symptoms above described will exist, but will be more or less masked, either by secondary complications or by a disease of which the hæmatocele is an effect.

Diagnosis.—The symptoms of pelvic abscess and pelvic cellulitis will be found in the articles on those diseases. Their onset is less sudden than the symptoms of hæmatocele; the phenomena of inflammation or suppuration exist from the first, and there is no necessary, though very often an accidental, connection with a menstrual period. The catamenial history is very important in diagnosis between simple hæmatocele and rupture of an extra-uterine fœtal sac. *See* Extra-Uterine Fœtation. Retroversion of the pregnant uterus may produce sudden pain with shock, but bimanual palpation will show the true nature of this condition. When the effusion is chronic, it may be mistaken for old in-

flammatory deposit, or even malignant infiltration, especially when the cervix uteri is lacerated and everted, and a sanious discharge flows from the uterine cavity. The physical characters of the swelling and the importance of the menstrual history have already been noted.

Prognosis.—When the early symptoms are very marked, the disease may be rapidly fatal, since the hæmorrhage is then considerable; and when they abate, it must be remembered that they may recur at the next period. A large proportion of typical cases recover, especially when rest has been enforced. The collection of blood may undergo suppuration or decomposition, producing characteristic symptoms.

Treatment.—It is certainly good surgery to leave most cases of pelvic hæmatocele alone, but there always remain some in which active treatment is necessary. When the surgeon is summoned directly the acute symptoms appear, the abdominal pain will induce him to explore the abdomen, and the swelling will be detected; and it need hardly be added that he must explore the pelvic cavity by bimanual palpation. The detection of a fluctuating swelling, almost invariably in Douglas's pouch, certainly should not induce him to puncture it. Perfect rest for several days must be enforced, opiates will in many cases prove beneficial, and ergot should be administered in small doses at intervals of six or eight hours. A good preparation of that drug for this purpose consists of half a drachm of the ammoniated tincture, with twenty minims of rectified spirit, to be taken in a wineglassful of water. It is less likely to decompose than the liquid extract freely dissolved in water, and thus keeps its strength for days. If the symptoms of internal hæmorrhage be very marked, the surgeon may, after full deliberation, be induced to take upon himself the grave responsibility of abdominal section, with a view of securing the bleeding vessels. Such a course is certainly justifiable if he have some experience in abdominal surgery; but it must not be forgotten that to handle the uterine appendages, when they are not enlarged, especially when they are embedded in coagula, is a far more difficult task than to remove an ovarian cyst. If the hæmorrhage be found to proceed from the ovary, that organ must be amputated, and when the blood is seen flowing from a rent in one of the ovarian veins, that vein must be secured; but, as a rule, the hæmorrhage will best be checked by removal of the entire appendages on the affected side. No operation of this kind should be attempted until there is strong evidence that the source of the hæmorrhage is not in the uterine cavity. *See* Oöphorectomy.

When the case is more chronic, the patient must be careful to refrain from exertion during each period, when the bleeding may recommence. Should the swelling remain undiminished in size, it must not be interfered with without due deliberation. Indeed, it is best to leave it alone altogether, unless symptoms of suppuration or decomposition of the clot make their appearance. Abscess may form near a hæmatocele and acquire communications with it, ultimately bursting on a free surface, either in the rectum or in some part of the genito-urinary tract. When any such complication is suspected, the swelling may be opened in its most dependent portion. The aspirator is unadvisable; a large trocar is best for the purpose, and it is not safe to break down the clot with the finger, as thus adhesions may be torn, endangering the peritoneum and neighbouring organs. Should the abscess have burst, the aperture in the mucous membrane of the vagina or rectum must be cautiously enlarged, if the mixture of pus and coagula cannot escape freely. The vagina should be frequently washed out with antiseptic lotions, thrown up with gentleness and caution. Alban Doran.

PELVIS, Injuries of the.—These are contusions and fractures. *Contusions* of the pelvis are not different in effect from similar injuries in other parts of the body; therefore no special description of their symptoms or treatment is requisite. They sometimes cause considerable extravasation of blood. If this be subcutaneous it cannot be mistaken, and in most cases is speedily absorbed; but if absorption be tedious, aspiration and compression may be employed. If the extravasation be beneath the gluteal fascia it may be mistaken for an abscess, but the temperature chart of the patient will show whether acute suppuration is occurring or not. In doubtful cases, aspiration may be used to decide the nature of the case.

With respect to fractures, the pelvis may be regarded as a girdle of bone; for the articulations at the sacro-iliac synchondroses and the symphysis pubis are so close and rigid, that separation of these parts may be practically regarded and treated as fracture, although it is technically a dislocation. Each of the component bones of the pelvis may be fractured independently of the others.

Fractures of the Os Innominatum.—The anterior and superior part of the ala of the ilium may be fractured by falls against some hard surface, or by severe blows, or by the patient being run over. If uncomplicated, it is not of much importance. The patient will experience pain on movement, especially in changing from the recumbent to the sitting, or from the sitting to the erect position, or in violent expiration, such as coughing, sneezing, &c. The local pain and the mobility of the fragment will indicate the nature of the injury. Rest in the recumbent posture, and the application of a well-adjusted pelvic belt, with the interposition of cotton-wool for the protection of the skin over bony prominences, will suffice for treatment.

In young persons, the epiphysis of the crista ilii is sometimes partially detached by violent muscular efforts. The history of the case, the local pain, and the exclusion of all other possible causes, must serve as indications for the diagnosis of this rare accident. The treatment will be the same as for fracture of the ala of the ilium. The anterior superior and inferior spinous processes of the ilium are occasionally detached by violent action of the sartorius and rectus femoris muscles. The treatment will be rest in the recumbent posture. Probably some local but unimportant deformity will result.

Fractures of the Acetabulum are attended with more serious consequences. Sometimes, a fall on the feet from a height will result in fracture of the upper margin of the acetabulum and dislocation of the femur on to the back of the ilium. The recurrence of the dislocation after reduction will indicate the nature of the injury, which must be treated, after reduction of the dislocation, by the application of a long splint and extension by a weight and pulley, as in fracture of the thigh. Permanent shortening of the limb will probably result.

Sometimes, the floor of the acetabulum is detached from the rest of the bone and driven into the pelvic basin. The head of the femur may be impacted in the opening. This injury may result from falls on the great trochanter or on the feet. If in such an accident the head of the femur be impacted, the shortening of the limb and the immobility when the patient has been anæsthetised might suggest, in the absence of any other cause, the nature of the injury. But if there be no impaction, a certain diagnosis would appear to be impossible. These cases are, however, very rare, and the general symptoms would indicate the necessity of rest and, probably, of extension by weight and pulley.

The os innominatum may be fractured into its three component parts. This may be caused by a fall on the great trochanter, or possibly on the head. The writer has seen two instances of this fracture which appeared to have been caused by falls on the head. Since the base of the skull can certainly be fractured in consequence of a fall from some height upon the feet, it is not improbable that the innominate bone may be fractured by being forced against the femur, as well as by the femur being forced against it. To adopt Koenig's apt illustration, the head of a hammer can be driven on to the handle, or the same result may be obtained by striking the reverse end of the handle, vertically, against some resisting surface. This fracture of the innominate bone is usually complicated by other fatal injuries. If not, union may result, as museum specimens prove, which have subsequently been obtained from subjects who had previously sustained this injury. Permanent lameness would be inevitable. The diagnosis of the injury would be very difficult. Mobility of the fragments would render it certain, but the fragments are usually interlocked. The general symptoms would indicate rest and, probably, extension of the corresponding lower extremity, as the most suitable treatment.

The Sacrum may be fractured by blows, kicks, or falls from a height in a sitting posture. Such a lesion involves risk of inflammation of the membranes of the spinal cord, or of injury to the sacral nerves and paralysis of the parts supplied by them. The treatment would consist in rest in the horizontal position, with careful adjustment of pillows so as to prevent any pressure on the part. It occurs very rarely. The writer has seen one instance of it. A sailor had fallen from a mast on deck, in a sitting posture, and, unfortunately for him, on a cocoa-nut. His sacrum was extensively comminuted. The accident happened at sea. Several months later he was admitted into the London Hospital under Mr. Curling. He had several fistulæ over the sacrum and in the perineum leading to necrosed bone, and, as fæces escaped by many of these, the rectum had certainly been implicated in the injury. The condition of the patient prevented any attempt at operative interference, and he was discharged as incurable.

The Coccyx may be fractured by similar causes or in parturition. The patient will experience pain in movement and during

defæcation. The introduction of a finger into the rectum will detect any malposition of the fragment. When this has been reduced, the patient must be kept at rest until union has taken place.

The Pelvis, regarded as a bony girdle, may be fractured in consequence of severe compression, as by the passage across it of the wheel of a heavily-laden vehicle, or in some railway or similar accident. Solution of continuity usually occurs at both sacro-iliac synchondroses, the symphysis pubis, and the horizontal rami of both pubic bones, immediately internal to the ilio-pectineal eminences. The ascending rami of the ischia are also often broken. In some cases the force acts diagonally, so that only one synchondrosis is torn open, and the horizontal ramus of the opposite pubic bone fractured at the usual place. More rarely, the injury may be limited to the bodies and crests of both pubic bones. This may possibly result from spasmodic contraction of the abdominal muscles, as well as from direct violence. The history of the case, the inability of the patient to walk, and pain on attempting to move the lower extremities will indicate the nature of the injury. Slight pressure on both alæ of the pelvis may detect mobility, or cause great pain to the patient. Absence of both these signs, and especially of the latter, might encourage the surgeon to hope that it was a case of contusion rather than fracture. Minute investigation as to the extent of the injury is not advisable. The injury, if uncomplicated, and if not immediately fatal from shock, would not be of much greater importance than other severe fractures. But it is almost always complicated by serious visceral lesions.

Attention should at once be directed to the condition of the bladder and urethra. A full-sized silver catheter should be cautiously introduced, if possible, into the bladder and, if the urine be tinged with blood, should be tied in, and connected with a receiver containing carbolised water by an exhausted india-rubber tube, so that the urine may flow at once from the bladder into the receiver. But if the urethra be torn across, or if the bladder be ruptured, the appropriate treatment for these lesions must be adopted. *See* Bladder, Rupture of the; Urethra, Injuries of the. Laceration of the liver, spleen, kidneys, or intestines, injuries to the thorax, or fractures of the bones of the upper and lower extremities, are frequent complications. The prognosis is very unfavourable, and the treatment, so far as the fracture of the pelvis is concerned, will consist in rest, with support from suitably adjusted pillows.

Jeremiah McCarthy.

PEMPHIGUS (*Synon.* Pompholyx).—A rare disease of the skin, characterised by the appearance of bullæ in successive crops on any part of the cutaneous surface, and occasionally on the adjacent mucous membranes. Nothing is known with certainty as to its causation; it is met with in all climates and at all seasons of the year, is more frequent in children than in adults, and is perhaps a little commoner in men than in women; it is not contagious. The persons attacked by it are sometimes exhausted by chronic diseases of various kinds, or by insufficient food and bad hygienic conditions, but it often occurs in those whose general health appears to be perfect; it is sometimes congenital, or nearly so, and has been observed to be hereditary on rare occasions. It is probable that the nervous system is directly or indirectly implicated, and evidence is accumulating which favours this view; thus mental suffering, hysteria, sciatica, epilepsy, and insanity have been noted as antecedents, and a case of herpes zoster, which followed nervous injury, has been observed to become transformed into generalised pemphigus (pemphigus neuriticus). Pregnancy and parturition have often been noted as associated conditions; and, further, pyæmia, chronic Bright's disease, and other states in which toxic matters are absorbed into or retained in the blood, have been considered as causes. It is probable that, in many of the above instances, the bullous eruption which occurs should not be admitted as true pemphigus. The blebs which appear in leprosy and syphilis should certainly be excluded. See *Herpes Gestationis* and *Herpes Iris* under Herpes; *Erythema Exudativum*, &c., under Erythema.

Pathologically, the disease may be placed among angioneuroses of the skin, a loss of tone of the blood-vessels, with more or less inflammatory disturbance, being accompanied or immediately followed by a rapid effusion of serum which raises the epidermis in a blister; hence the bullæ of true pemphigus, being due to a sudden epidermic cleavage, are unilocular, and their roof is formed by the whole epidermis, the floor consisting of the corpus papillare of the corium with a few adherent remains of epidermis, chiefly of the deepest (cubical) layer. More rarely, the splitting takes place immediately below the stratum granulosum,

the parts above which then form the roof. This form of bulla, which is not due to inflammatory changes in the epidermis, is thought to depend on a diminished power of resistance to pressure by fluids in the cells of the stratum spinosum (Malpighii), and the whole process has received the name *Acantholysis*. The bullæ which form as a result of inflammation arise in a different manner: by gradual changes in the cells of the rete, leading to vacuolation and vesiculation of individual cells, the vesicles gradually enlarge and become confluent with their neighbours, so as ultimately to give rise to irregularly loculated large cavities containing serum; in short, an inflammatory bulla is no more than an accidentally gigantic vesicle. The contents of the bullæ of pemphigus are serum, with more or less admixture of coloured corpuscles and leucocytes; the fluid contains a trace of urea, and its reaction is at first neutral and subsequently alkaline. Necropsies of pemphigus have revealed no constant visceral lesions; but, recently, sclerotic changes in the spinal cord, and degeneration of the peripheral nerves at the seat of eruption, have been noted.

The greatest variability in the size, aspect, and distribution of the bullæ, in the duration of the disease, and in the severity of the symptoms, is characteristic of pemphigus, and hence authors have overloaded medical nomenclature with a superabundance of terms. It is not necessary to recognise more than two forms, pemphigus vulgaris and P. foliaceus; these are well marked, but the multitude of other names only deserve incidental mention as subvarieties.

1. Pemphigus Vulgaris.—As already stated, the bullæ appear in successive crops, and may arise upon any part of the surface of the skin; they are perhaps commonest on the limbs, when they are roughly symmetrical. They are developed either upon reddened discoid spots or, more commonly, upon normal skin, and either retain their original size or grow, and sometimes become confluent. An outbreak of blebs is sometimes associated with pale red spots and wheals, which die away without giving rise to bullæ. A fully developed bulla is characterised by a rounded or oval shape, which becomes irregular when confluence has occurred; its size varies from that of a pea to a hen's egg or more; the base is surrounded by a faint and narrow erythematous zone; the walls are tense and shining, and the whole blister projects considerably above the surface, sometimes as much as an inch. The contents are at first transparent and colourless, turning to citrine yellow; later, they become turbid and milky from admixture of pus-corpuscles; sometimes the colour varies from pale cherry to dark red, owing to admixture of blood (P. hæmorrhagicus), not necessarily in severe cases. In about three days to a week a bulla has either gradually shrivelled and dried up without rupture, or, less frequently, it has burst; in either case, a thin crust of old epidermis with dried exudation, and blood, if present, occupies its site, and after its detachment leaves a bluish-red macula corresponding to the base of the bleb; this is usually completely covered with young epidermis, and gradually fades away after becoming slightly pigmented. The bullæ appearing simultaneously vary in number from a few to a hundred or more, and may be distributed irregularly over a wide surface (P. disseminatus) or grouped (P. confertus). In rare cases a central bulla is surrounded by a more or less distinct ring of others (P. circinatus), and irregular serpentine figures may be produced by confluence (P. gyratus, serpiginosus); occasionally only a single bulla of large size appears at a time (P. solitarius). It is usual for fresh bullæ to make their appearance before the crusts and maculæ due to the previous outbreak have faded; therefore, in a characteristic case, stains, crusts, and blisters are present at the same time.

The interval separating the outbreaks is variable; sometimes, it is so considerable that an incautious observer may conclude the disease to be at an end, and at others, crop after crop appears with barely appreciable intermission (P. diutinus). The constitutional symptoms vary with the extent of skin affected, the frequency of the outbreaks, and the duration of the disease. An outbreak of some severity begins with shivering, malaise, and fever, the rise of temperature being sometimes considerable, but usually very moderate and of short duration; in mild cases the temperature is normal (P. apyreticus); during the continuance of the eruption, thirst, loss of appetite, and above all loss of sleep, are prominent symptoms, the latter being due to the itching, tingling, or burning, which are more or less marked. Itching is sometimes very severe. The bullæ are then destroyed by scratching, leaving excoriations. There is much associated urticaria and brown pigmentation, and eczema may appear as a complication.

In favourable cases, the disease may be at an end in from two to six months, the bullæ becoming fewer and fewer with each

attack, and finally ceasing to be produced. The patient may then remain free for the rest of life, or fresh attacks may occur after many months or even years. In children, the whole process is more active and rapid and the fever higher, so that in some cases an end is reached in from two to three weeks (P. acutus, febrilis). In one or two instances a similar rapid course has been noticed in adults, but in the vast majority the disease is chronic. In rare cases, the successive crops of bullæ make their appearance in the same situations on each occasion (P. localis); they are then few in number, and are chiefly limited to the backs of the hands and feet and the extensor surfaces of the arms and legs, very much in the positions of psoriasis. In the writer's experience such cases are congenital or nearly so, and extremely chronic, lasting for many years in spite of treatment; they are further characterised by the development of traumatic bullæ, a blow or other injury being followed by the appearance of a bleb, which is often hæmorrhagic. Both in these and in ordinary cases in which the eruption appears on the hands and feet, the nails often become affected in a characteristic manner. Apparently a bulla forms immediately under the nail, which becomes detached from the matrix, and of a dead white colour; it is ultimately shed, and the new nail is rough, irregular, and badly developed. Severe cases of pemphigus are characterised by copious eruption, large size and confluence of the blebs, severe itching and burning, and very short remissions between the outbreaks; exhaustion and a fatal result may follow, although this is fortunately by no means invariable. The gravest cases are marked, in addition, by rupture of the bullæ, leaving excoriated or ulcerated surfaces (P. malignus) on which sloughs may form (P. gangrænosus). Cases of this kind are extremely rare. When the mucous membrane of the mouth is attacked, bullæ cannot be recognised on inspection, as they rupture at once, and the epithelium is soon detached in white flakes, under which a rounded excoriated spot is left. The process may extend to the pharynx and cause much difficulty and pain in swallowing, increasing the gravity of the prognosis. The mucous membrane of the conjunctiva and vagina may also be affected.

2. Pemphigus Foliaceus.—This exceedingly rare affection is distinguished by the imperfect development of the bullæ, which are flaccid, contain a small quantity of thin turbid fluid, and rupture with the greatest ease; the adjoining epidermis becomes undermined and loosened, so that detachment occurs over a considerable area. The affected cuticle separates from the skin incompletely, and becomes shrivelled and rolled up at the edges, presenting an appearance which has been likened to flaky pie-crust. The subjacent corium is red and excoriated, the fluid oozing from its surface drying up into thin varnish-like crusts, under which a new epidermic layer has no time to consolidate, as it is at once again detached by a continuance of the process as fast as it is formed, and has then not sufficient power of resistance to form a bleb, but is shed as a thin scale. The process gradually extends until the greater part, or even the whole of the skin, is implicated. The surface then shows no bullæ, but is traversed by fine cracks, between which there are thin, flaky, more or less adherent crusts or raw oozing spots, and a nauseous odour exhales from the skin; the hair falls off largely, the eyelids become ectropic, and the nails thin and brittle. The patient loses appetite, suffers considerable pain, especially on movement, and gradually becomes emaciated and cachectic. Fever, which is slight at first, becomes gradually continuous, exhaustion supervenes (more rapidly when the throat is affected), diarrhœa may set in, and a fatal termination usually results. The disease may appear as such, or may develop from a long-continued pemphigus vulgaris, and is always exceedingly chronic, usually lasting many years. Although the prognosis is extremely grave, occasional instances of recovery have occurred.

Diagnosis.—The diagnosis of pemphigus does not depend upon the recognition of bullæ, which may form under a great variety of conditions, but upon the fact that they are chronically recurrent, appearing in successive crops, and that the great majority arise upon normal skin. If this be borne in mind, there will be no difficulty in distinguishing the disease from bullous urticaria, vesicating erythema, erythema (herpes) iris, and erysipelas. Bullæ may occur in scabies and in eczema, but the history and concomitant lesions of these affections are such as to render the diagnosis easy. In anæsthetic leprosy the bullæ are merely part of a constitutional disorder, with well-marked symptoms of its own, while syphilitic bullæ dry up into thick crusts, covering an ulcerated surface. The blisters which are due to friction, as from rowing or from ill-fitting boots, and those which arise from burns and scalds,

need barely be alluded to, while those which are produced by the fraudulent application of blisters and irritants to the skin are soon detected, in a suspicious case, by isolation and watching. Pemphigus foliaceus, after bullæ have ceased to be produced, may bear a close resemblance to general eczema rubrum, from which, however, it differs in the history, in the character of the fluid secreted, which is much thinner in pemphigus and does not stiffen linen, and in the greater severity of the constitutional symptoms. Some cases of pityriasis rubra (exfoliative dermatitis), and even of nearly universal psoriasis with flaky desquamation, have a very similar appearance; but, again, the history, the absence of bullæ at any previous period, the dryness of the surface exposed, and the much more profuse and easy detachment of thinner paper-like scales, will be sufficient distinctions.

Treatment.—The treatment of pemphigus differs according to the stage of the disease. When there is high fever, the patient should be kept in bed and the strength supported by fluid and nutritious food, with stimulants if necessary; a saline mixture with a small dose of antimonial wine (℥v. to x.) may be at first administered, but should not be long continued, to avoid depression; as the temperature falls quinine should be given, or it may be employed from the first; opium, to allay irritation and procure sleep, is a valuable remedy. As soon as a normal temperature is reached, arsenic should be begun and steadily continued. Although it is not curative in all cases, there can be no doubt that it gives good results in the great majority, if persevered in for a long time, and in full doses—say ℥x. of liquor arsenicalis three times a day, gradually reached; even larger doses may be given if it does not disagree, especially in combination with a little opium. When the patients are emaciated and anæmic, cod-liver oil and iron should be always employed, the latter with quinine as a rule. The local treatment is very similar to that employed for a burn—viz. the application of linimentum calcis on rags and envelopment of the parts in cotton-wool. A carbolic lotion or other anti-pruritic may be used when there is much itching, but the copious application of a dusting powder of starch and oxide of zinc, or of oleate of zinc, is to be preferred, as it is less troublesome and equally soothing. If the bullæ are closely packed, they may be pricked as soon as they appear, to relieve tension, and this should also be done if they show a tendency to spontaneous rupture; but in ordinary cases no such interference will be necessary. The thin crusts, which form by the desiccation of the blebs and their contents, should not be detached, but allowed to come away spontaneously. If any excoriated surface be left, it should be protected by zinc ointment, or some more stimulating remedy may be applied if it does not heal readily. Very small bullæ may be sometimes checked in their growth or caused to abort, by being painted over with a solution of nitrate of silver in spirit of nitrous ether (gr. xv. to f℥j.) as soon as they make their appearance. When the mucous membrane of the mouth and pharynx is affected, a mouth-wash of chlorate of potash should be used, or the parts may be painted with honey of borax; if the affection is so severe as seriously to interfere with swallowing, the employment of nutrient enemata may be necessary for a time. The treatment of pemphigus foliaceus is unsatisfactory; quinine and arsenic may prove serviceable, but nearly always nothing can be done beyond supporting the patient's strength by good food and stimulants, and the employment of local palliative measures, among which the chief is the continuous warm or tepid bath; in this patients may be kept for months with comfort and advantage. JOHN CAVAFY.

PENIS, Amputation of the.—This operation may be performed by the écraseur, by the galvanic cautery, or by the knife. The use of the écraseur presents little advantage, and can only be advised in exceptional cases, when there is reason to expect a tendency to severe hæmorrhage. The galvanic cautery, when it can be had, is a most effective instrument for this operation, care being taken not to use the wire at too great a heat, or to divide the tissues too rapidly, as in either case hæmorrhage is likely to occur. When the amputation is completed, the urethra should be slit up for about half an inch with a pair of fine blunt-pointed scissors, and the edges attached by fine silk or catgut sutures to the skin and corpora cavernosa.

By far the most common method of amputating the penis is, however, with the knife. The old plan of removing the organ by a single sweep of the knife, and then slitting up and securing the edges of the urethra, has certainly the advantages of great simplicity and rapidity of performance, and in some cases, where the extension of the disease requires that the amputation should be performed as high up as possible, it is still to be recommended. But an im-

provement has been made in the operation with the object of securing the projection of the urethra beyond the stump, and thus avoiding the exceedingly troublesome retraction of the passage, which was not infrequently the result of the old operation. The steps of this operation are as follows: A tape is first firmly tied round the root of the penis, or Clover's clamp is applied at the same spot, by which means the operation is rendered bloodless. The penis is then drawn well forward by the left hand, care being taken not to overdo this, and thus leave too little skin to cover the stump. The next step in the operation is so to cut through the corpora cavernosa and the corpus spongiosum as to leave the latter, with the urethra, projecting half an inch beyond the former. This may be effected in two ways. First, by introducing a narrow straight bistoury between the corpora cavernosa and the corpus spongiosum, turning the edge of the knife upwards, and dividing the corpora cavernosa by a single sweep. The corpus spongiosum is then cut through by a downward sweep of the knife, half an inch nearer the glans. The other method, which is perhaps on the whole the easier, is as follows:—A full-sized catheter is introduced in order to define accurately the position of the urethra. A circular incision is then made through the skin only. The corpora cavernosa are next divided from above downwards, care being taken not to wound the corpus spongiosum. This accident will be prevented by the presence of the catheter acting as a landmark. The catheter is now withdrawn, and the corpus spongiosum, being put well on the stretch, is divided half an inch lower down.

Whichever method is adopted, the operation is completed by slitting up the urethra on the dorsal aspect, its lower edge being stitched to the skin below, and the upper portion to the corpora cavernosa. Fine curved needles in a needle-holder will be found most convenient, and very fine silk or catgut for the sutures. Before the tape or clamp is loosened, careful search should be made for the open mouths of all vessels. The arteries of the corpora cavernosa, the dorsal arteries, and the artery of the septum may generally be seen and at once secured. The pressure is then taken off, and any further bleeding points secured. The surface of the wound should be well dusted over with iodoform, and the parts dressed with lint steeped in a 1-40 solution of carbolic oil. The whole should be covered by a wad of tenax, secured in its place by a T-bandage. The after-treatment is of the simplest: for the first few days care should be taken to prevent the urine, as much as possible, from passing over the raw surface of the wounds. The free use of iodoform, or an ointment made with iodoform, eucalyptus, and vaseline, is the best dressing. The fine sutures that have been inserted may be left to themselves.

It occasionally happens that the disease has so far advanced as to necessitate a more severe and complicated operation than either of those already described. In fact, it may be needful to remove the entire penis, including the attachment of the crura to the pubic arch. This operation, suggested by Mr. A. Pearce Gould, is thus performed. The patient being placed in the lithotomy position, an incision is made with a scalpel along the whole length of the raphé of the scrotum. Then, with the finger and the handle of the scalpel, the interspace between the two halves of the scrotum is separated down to the corpus spongiosum. A catheter is then passed down to the triangular ligament, serving as a guide for the passage of a knife between the corpora cavernosa and the corpus spongiosum. The catheter is now withdrawn, and the corpus spongiosum with the urethra is cut through.

The next step is to complete the separation of the urethra from the penis, and to carry the separation as far back as the triangular ligament. The removal of the penis is then effected by prolonging the incision, first made in the median line, round the root of the penis, dividing the suspensory ligament, and exposing the insertions of the crura. These attachments are separated from the pubic arch by a periosteal elevator. The orifice of the urethra is then slit up for half an inch, and its edges stitched with fine sutures to the skin at the posterior extremity of the scrotal incision. The rest of that incision, after all vessels have been secured, is then brought together with sutures, ample means of drainage being afforded. The result of this operation is that the urethral orifice is kept behind the scrotum, and the urine is prevented from dribbling over the skin of the surrounding parts.

PAUL SWAIN.

PENIS, Diseases of the.—For congenital malformations, see *Epispadias* under ECTOPIA VESICÆ; HYPOSPADIAS; PHIMOSIS.

Cancer of the penis is for the most part epithelial in its character. Cases of carcinoma of the corpora cavernosa are occasionally met with, but very rarely. Epithelioma of the penis assumes one of two

forms. It may appear as a flat, tubercular mass, with a hardened base, situated on the glans or in the sulcus formed by the junction of the glans with the prepuce, or on the inner surface of the prepuce itself. It may also commence in the urethra. After a time the surface of the tubercle cracks, and exudes a fetid serous discharge. Ulceration now sets in, spreading rapidly upwards on to the penis, and thence, if the disease is not dealt with, to the scrotum and perineum. The base of this ulceration is greyish in colour and uneven, the edges being frequently everted. The other form of epithelioma assumes the character of a warty growth, and is, in fact, in its early stages, somewhat difficult to distinguish from the ordinary warts which are so frequently found on and around the glans and beneath the prepuce. The presence of a hard base, of ulceration with its attendant fetid discharge, and a tendency to hæmorrhage at the slightest touch, will leave little doubt as to the malignancy of the disease.

Another confirmatory symptom will be the enlargement of the glands in the groin. The rapidity with which the glands are affected varies with the situation of the original disease. If the epithelioma is situated on the corona glandis or beneath the prepuce, the moisture of the parts seems to favour the progress of ulceration, and, under these circumstances, the glands become more rapidly involved in the disease. On the other hand, an epithelioma on a more exposed part of the penis will affect the glands with less rapidity. One other difficulty of diagnosis may occur—viz: whether, in its earlier stage, the disease may not be simply the induration of a syphilitic sore. Doubt as to this, however, cannot long remain. The history of the case, and the failure to obtain improvement under specific treatment, will reveal the true nature of the case. The age, too, of the patient will be an important aid to diagnosis. Epithelioma of the penis is seldom found before the age of forty-five, and from that to seventy is the period of life when it more usually occurs.

Causes.—It is asserted that congenital phimosis is a predisposing cause of epithelioma, owing to the irritating effects of the retained secretions. The fact that the Jewish community is peculiarly free from this disease seems to favour the statement. Venereal warts, chancres which remain long unhealed and are subject to much irritation, the induration in the scar of an old chancre, may each and all of them lead to epithelioma. Injuries to the penis, especially laceration of the frænum, may also be the starting-point of the disease.

Treatment.— In few diseases is the policy of delay more to be deprecated than in epithelioma of the penis. As soon as the condition comes under notice, even if there is considerable doubt as to its real character, removal of the disease should be at once undertaken. In the case of warty growths, they should be destroyed with nitric acid, or the portion of skin from which they sprout should be excised with the knife. So, too, the tubercular form of the disease should be freely excised, provided the surrounding tissues be not too infiltrated. If the patient is the subject of phimosis, the prepuce should be at once slit up and the diseased surface exposed. *See* Phimosis. Careful search for affected glands should be made, with a view to excision. In fact, it is of the utmost importance to deal with these glands at the earliest possible period. They early become so infiltrated with the disease and matted together that a clean removal is next to impossible, and extensive ulceration of the skin over them soon follows. When the local disease is beyond the chance of removal, amputation of the penis becomes needful, the division of the organ being made as far as possible from the site of the growth, and in advanced cases it may even be needful to remove the entire organ. *See* Penis, Amputation of the.

Tumours of the Penis.—Fatty, nævoid, sebaceous, and fibroid tumours are occasionally met with on the penis, and require no particular description. In the case of the last, the question of recurrence should be considered. Mr. Beck has recorded a case in which he removed a fibrous tumour from the base of the glans penis. It recurred after two years, necessitating the amputation of the organ. A condition of preputial hypertrophy allied to elephantiasis is occasionally met with. Its treatment consists in the free removal of the redundant tissue.

Inflammation of the Corpora Cavernosa.—There sometimes occurs, in men of middle age, a localised, chronic enlargement in the sheath or erectile tissue of one or both corpora cavernosa. Mr. Prescott Hewett has described the condition in the history of a case recorded in the *Clin. Soc. Trans.* vol. vi.: 'In the corpus cavernosum were four nodules, three on the left side and one on the right, varying in size from a pea to that of a French bean; they were perfectly circumscribed, hard to the touch, knot-like, and painless when handled.' These cases seem to be

associated with the gouty diathesis, and occasionally may be traced to some slight injury. They are, in point of fact, cases of phlebitis. There is a general concurrence of opinion that little or no treatment is called for. Thrombosis of the dorsal vein is also met with under similar circumstances, and gradually disappears spontaneously.

Gangrene of the Penis.—Gangrene of the penis is generally the result of some acute inflammatory process. Acute inflammation of the prepuce following on gonorrhœa or chancre, the constriction of a paraphimosis, or the more immediate effect of a ring or ligature placed round the organ, may be the exciting causes. It is generally met with in patients whose health is broken down, and is of the moist variety, though occasionally dry gangrene follows an attack of fever. The treatment should be directed first to remove all constriction, by slitting up the prepuce in phimosis, and relieving the constricting band in paraphimosis. *See* PHIMOSIS; PARAPHIMOSIS. Then, if needful, free incisions should be made into the substance of the penis, and warm applications be continuously employed. Meanwhile, the general condition would require a stimulating and nutritious diet, with the administration of quinine and opium freely. As the time for the separation of the slough approaches, hæmorrhage not infrequently takes place, and, it is needless to say, is but ill borne by the patient already enfeebled by disease. During the process of cure, the contraction of the parts may so affect the urethra as to require attention. It should be slit up for half an inch, and stitched to the neighbouring skin, as directed for amputation of the penis.

Warts on the Penis.—The presence of warty growths on the penis is not infrequent, as the result of venereal infection or want of cleanliness. They are found on the skin outside the prepuce, fringing its orifice, on the mucous membrane between the skin and the glans, on the glans itself at the orifice of the urethra, and even within that canal. They are contagious. The most effectual method of treatment is removal with the scissors. The bleeding is sometimes rather free, but easily arrested by the use of very hot water and compression by strips of dry lint. In less severe cases, simply powdering over with calomel or oxide of zinc, with strict attention to cleanliness, will effect a cure.

Herpes is found on the prepuce and corona glandis as the result of local irritation or gastric disturbance. See *Herpes Progenitalis* under HERPES. PAUL SWAIN.

PERFORATING ULCER.—This affection is not exactly an ulcer. It is usually met with as a sinus-like aperture on the plantar surface of the foot, the sinus, if of any duration, leading down to dead bone. The opening is most frequently single, and situated over the metatarso-phalangeal joint of the great toe; but two or three openings may be met with—e.g. over the heads of the fourth and fifth metatarsal bones. Both feet may be affected. The orifice of the sinus usually gives vent to but slight discharge, is surmounted by but few granulations, is situated in what has been a corn, and surrounded by a flattened whitish-yellow area of greatly thickened epidermis. In addition to necrosed and carious bone, the subjacent joint may be affected, together with other articulations not in direct communication with the sinus. The tissues surrounding the sinus are usually not sensitive, and loss of sensation may be detected over the areas of one or more of the cutaneous nerves of the foot or leg. This anæsthesia may be accompanied by profuse and fetid sweating. More rarely anæsthesia is not observed, but cutaneous hyperæsthesia is present in the leg and foot. But, though the surrounding tissues may be insensitive, the patient is usually crippled by the great pain experienced in walking; he is furthermore liable to attacks of erysipelas and eczema.

Pathology.—In a large number of cases of perforating ulcer some degenerative nerve-lesions may be expected to be at the root of the matter. How many such lesions may cause perforating ulcer is not known; nor, in the case of those which are recognised, is their connection with the ulcer exactly understood. At present we may divide such nerve-lesions into two main classes—peripheral and central. Thus, in some the tibial nerves have been found much thickened with addition of connective tissue in the peri- and endo-neurium, and with multiplication of nuclei. Near the ulcer the ultimate nerve-fibrils are nearly obliterated, and farther from it the smaller fibres, which some authors consider to be sensory and nutrient, are found diminished in number.

In other cases the degeneration would appear to be central. The most interesting of these are the cases where patients with perforating ulcer are found to suffer from the lightning pains and anæsthesia in the lower limbs, the gastric and intestinal crises, the deficient motor co-ordination, and the diminished patellar reflex of locomotor ataxia. Perforating ulcer usually appears in the later stages of this disease; more rarely, it is noticed long before the locomotor

troubles. As this subject becomes better known, it may be expected that this disease may be proved to be associated with other lesions of the cord, spinal ganglia, or nerves, or with compression and laceration of large nerve-trunks. But, as yet, perforating ulcer is involved in much obscurity, and it is greatly to be desired that practitioners who may meet with cases should record them carefully, and, at every possible opportunity of amputation or post-mortem examination, preserve the foot with the nerves and spinal cord for examination.

Treatment.—Long-continued rest, and removal of the diseased bone, may, and often do, bring about a cure; but this is only temporary, the disease returning even after two or three years. When once the condition is declared—i.e. when one or more perforating ulcers with any anæsthesia are present—amputation of the foot should be resorted to. As it is often the terminal portions of the tibial nerves which are chiefly affected, Syme's amputation will in many cases remove the disease; if this recur in the stump, Teale's amputation, sawing the bone in the middle of the tibia, or amputation by lateral flaps through the tubercle of this bone, must be resorted to. Where the patient refuses amputation, or where this step is contra-indicated, imperfect rest and relief from pain will be secured by using a knee-rest and a well-padded shoe.

W. H. A. Jacobson.

PERICARDIUM, Wounds of the.—These wounds may be produced by an external penetrating agent, or by the rough end of a fractured rib or sternum. They seldom occur alone, being generally associated with wounds of the heart, or of some important organ in the mediastina, such as the internal mammary artery, the œsophagus, &c. In those rare cases in which this membrane is alone wounded, the diagnosis can scarcely be satisfactorily established at first. The signs will be those of pericarditis—viz. increased precordial dulness, the pericardiac to-and-fro friction-sound, a small hurried pulse, and generally considerable dyspnœa. The pericardiac friction-sound may become lost if the precordial dulness increases much in extent. This is due to the effusion of blood, serum, or pus within the pericardium; should the case go on favourably, the sound may be heard again after some days from the gradual absorption of these products.

The indications for treatment will be similar to those for wounds of the other thoracic viscera. At first, it will most probably be doubtful whether the pericardium is alone wounded. But as the line of treatment is practically the same, this will not be of any great consequence. These indications will be treated of under Heart, Rupture and Wounds of the.

It may, however, be said here, that there is one condition of uncomplicated wound of the pericardium, in which special treatment is required. The pericardium may become over-distended by fluid, so much interfering with the heart's action as to call for some treatment for its relief. This may be found in tapping. A previous puncture with a subcutaneous injecting syringe having been made, and fluid drawn off from the pericardium by its aid, the bulk of the fluid may be withdrawn either by the aspirating needle and syringe, or by free incision (according to the nature of the fluid, whether serous or purulent), in the fourth or fifth intercostal space. In the latter case a drainage-tube should be used, the treatment of the wound being conducted with antiseptic details. See *Paracentesis Pericardii* under Paracentesis. The prognosis, however, in such cases is exceedingly grave. Comparatively few cases recover, especially where pus is found in the pericardium. In such cases, post-mortem examination generally reveals more or less old blood-clot still existing in the pericardiac cavity, and a certain amount of adhesion between the surfaces of the heart and pericardium.

H. G. Howse.

PERIMETRY.—Besides determining the visual acuity (*see* Visual Acuity), by which we obtain information as to the state of functional perfection of the macula lutea, it is often necessary to ascertain whether the functions of the whole extent of the retina are normal or not. This examination of the 'field of vision' is sometimes called 'perimetry,' and is most accurately made by the aid of an apparatus called a perimeter.

Abnormalities may exist at any part of the field of vision, which may have merely defects in acuity or exhibit breaches in continuity. The interruptions in continuity may be both regular and irregular. The regular manifest themselves by some limitation of the normal extent in one or more particular or, it may be, in all directions; the irregular breaches are more or less blind portions surrounded by normal, or relatively normal, portions of the field of vision. To these the name of 'scotomata' has been given. To make an accurate examination of the field of vision it is neces-

sary to make use of some sort of perimeter. For rough estimates it is often sufficient for the observer to place himself opposite the patient, who, if it be the right eye that is to be examined, is instructed to fix steadily the observer's left, if the left his right eye. If the observer at the same time maintains a steady fixation of the patient's eye, the respective fields of vision in different directions will correspond, so that any movements of the fingers made by the observer and seen by him above, below, or to either side, should also be seen by the patient. In this way we may rapidly determine if there is any restriction, by simple comparison with a normal standard. One precaution only is necessary in the case, more especially when there is a possibility of slight defects only existing: the examination should be made in a shaded room, with an illumination only just sufficient to cause no restriction in the extent of one's own field.

Various different forms of perimeter are in use. Those who have frequently occasion to make examinations of this nature, naturally prefer one which enables them to effect the examination as rapidly as possible; and for this purpose use is made of a self-registering perimeter, by means of which a chart of the field is pricked off as the examination is being made. A cheap form of perimeter can be made by ruling concentric circles on a black board, the radii of which are determined by multiplying the distance of the eye from the centre of the board by the tangent of 10°, 20°, 30°, 40°, and 50°, a chin-rest being fixed, with a support for the lower margin of the orbit, at a suitable distance from it. To measure the field at a further angular distance from the centre, it is necessary to have a semicircular arm of steel or wood with the degrees marked up to 90°, and capable of revolving round the centre of fixation in a plane parallel with that of the board. In all perimeters there is some arrangement, generally a chin-rest, by which the head is brought into such a position that the eye to be tested occupies the centre of a spherical space, and fixes some object at a distance from it equal to the radius of the spherical surface bounding that space; while the extent of peripheral vision, in any direction and for any particular small object, is given by the angular distance to which that object may be moved away from the point of fixation on the spherical surface. It is obvious that rays from all points on this surface cannot possibly enter the eye—practically indeed, only those from some portion of the half of the surface or hemisphere cut off by a plane passing through the eye at right angles to the line of fixation. In practice it is found more convenient to use, instead of a complete hollow hemisphere, a quadrant or semicircular arm, which, by rotation round the line of fixation, generates the hemispherical surface, and at any point along which the test object may be brought. This arm is graduated, so that the angular distance of the test object in any position along it can at once be read off, and there is usually a graduated circle as well, which at the same time gives the meridional position of the arm with respect to the eye. The distance of fixation is most conveniently taken at about one foot. On the charts, a series of radiating lines represent the meridional position of the arm, and a system of concentric circles the graduation of the arm itself.

The normal extent of the field is subject to variation at the upper, and slightly also at the inner, parts, owing to individual peculiarities in size and shape of the eyebrows and nose. The physiological limits may be taken to be as follows: upwards, 45°; upwards and outwards, 50° to 55°; outwards, 90° (often slightly more); outwards and downwards, 80° to 85°; downwards, 70°; downwards and inwards, 60° (variable on account of the nose); inwards, 60°; inwards and upwards, 55°. The extent of the field upwards, and upwards and outwards, is found to be 5° to 15° greater, when the point of fixation is situated 20° or 30° from the centre of the perimeter in the opposite direction, so that we should not always be right in assuming a contraction in this direction, unless no increased measurement resulted from testing with a lower point of fixation.

The determination of the limits for different colours is a matter of much greater difficulty and uncertainty, as the results are influenced by the hue and shade of the colour used, by the size of the coloured objects, and by the quality and intensity of the light under which the examination is conducted. A precaution, that will be found useful in practice, is to have the test objects differently coloured on either side. In this way we are provided with a check on the accuracy of the patient's statements. The most convenient colour to use is some hue of red, as it is for the reds and greens that pathological defects in the colour-sense almost invariably first manifest themselves. If the test colour chosen be examined carefully at the inner side of the field of vision, it will generally be found to change colour. Before becoming absolutely colourless, it will become yellowish,

brownish, or bluish, according to the hue and shade selected, and it is this tint which may with advantage be used for colouring the opposite side of the test object. When the red-green perception is entirely abolished, the limits may be taken for blue or yellow, the vision for which is longer in disappearing. It is, of course, necessary to exclude the possibility of the more usual form of congenital colour-blindness existing, which we should have reason to suspect if the peripheral boundaries for yellow and blue were not restricted.

But the determination of the limits of the field for quantitative and qualitative stimuli does not exhaust the examination of indirect vision; it is important to ascertain whether or not there is any breach in the continuity of the field. Such interruptions or scotomata are usually divided into positive and negative, according as they give rise or not to a consciousness of the interruption. In the one case there is more or less perception of darkness, in the other an entire absence of any visual impression.

The conditions, in which some alteration or restriction of the field of vision occurs, are optic neuritis and atrophy, the functional forms of amblyopia, retinitis, more especially retinitis pigmentosa, embolism of the central artery and thrombosis of the central vein of the retina, opaque nerve-fibres, glaucoma, detached retina, intra-ocular tumours and foreign bodies, choroiditis and coloboma.

Detached retina.—This defect in the field of vision may occur at any part, and has most frequently a more or less indefinite, ill-defined, and irregular boundary. When caused by a tumour, the defect is usually much more sharply defined than in idiopathic detachment. The freshly detached retina generally retains its functions to some extent, so that it is always advisable to make the examination in subdued light, and, of course, under as nearly as possible identical conditions each time. The boundaries for peripheral colour-vision are narrower than the line separating the detached from the undetached portion of the retina.

Retinitis pigmentosa.—The peculiar features are marked concentric limitation with good central vision. The extreme periphery of the retina does not appear to be subject, in the same degree, to the degeneration which constitutes this disease, and we consequently find that, whilst the function of the greater part of the retina is lost, a zone or belt, or it may be only a small temporal portion, retains a part of its light. The state of peripheral vision is very markedly dependent on the intensity of light, a fact which is well known in connection with the most prominent symptom of this disease, viz. night-blindness.

Embolism.—A loss of half the field or a sector-shaped defect in it, *limited to one eye*, however, occurs in embolism of one of the principal branches of the central artery of the retina. The defect is generally in the upper or lower half of the field. In embolism of the main artery, a small peripheral portion of the temporal side of the field retains, often, more or less completely its function. *See* Retina.

Glaucoma.—In this disease Von Graefe showed that the condition of the field afforded an indication of primary diagnostic importance. The limitation which takes place is usually most marked to the nasal side; frequently, indeed, the field inwards and downwards is destroyed to close up to the point of fixation, when the rest remains as yet but slightly constricted and the vision of the centre tolerably good. If the disease has been acute, the operation of iridectomy is generally followed by widening (sometimes very considerable) of the field. The boundaries of the eccentric colour vision are restricted only to the same relative extent as for black and white. *See* Glaucoma.

Hemianopia.—In uncomplicated cases, there are symmetrical defects in both eyes. When to the same side the hemianopia is homonymous. This is by far the most common form, and may be to the right or left, and partial or complete, that is occupying the whole half of both fields, or only sector-shaped, or even insular, portions thereof. The extent to which the function is destroyed in the defective portions of the field varies also greatly, from complete blindness to hemianopia for colours alone. When the defects are to the temporal side in both fields, or to the nasal side in both fields, the hemianopia is heteronymous.

Optic atrophy.—In progressive atrophy there is invariably a limitation of the field. The limitation often takes place all round (concentric limitation), but in other cases the field in one direction is more restricted than in the rest. The restriction is relatively greater for colours. *See* Optic Nerve.

Scotomata occur either in connection with lesions of the retinal elements or independently of gross anatomical alterations, generally owing to some functional intracranial or cerebral disorder. The first may be of traumatic, inflammatory, or vaso-motor origin or be due to malformation. The cause is generally evident on ophthalmoscopic examination. In diffuse retinitis an

annular or ring-shaped scotoma may often be found, either complete or interrupted at intervals, without any corresponding ophthalmoscopic changes. Large or small insular scotomata, not implicating the centre or extending to the periphery, for which no objective lesion can be detected, are occasionly met with. These are often due to hemicrania, a persistence of the amblyopia which is generally only transitory. Central negative scotomata are met with in a class of cases which are almost always, though not exclusively, of toxic origin. *See* Amblyopia. The scotoma, which may be so slight as only to be readily demonstrable for colours, takes the form of a horizontal oval, stretching from the portion of the field corresponding to the position of entrance of the optic nerve to slightly beyond the point of fixation.

The examination of the field often affords the most delicate means of ascertaining the course taken by any disease, especially when of intracranial origin. As to the prognosis attaching to the state of the field, it is good if there be no limitation of the peripheral extent, even although there be a considerable scotoma at the centre, if the limitation takes the form of hemianopia in which the portions affected are sharply separated from those in which the function is retained. If, on the other hand, there be limitation of the field without any apparent cause, the probability of subsequent atrophy and blindness is very great. A good deal of prognostic significance attaches to the time which elapses for the production of a defect in the field. Generally speaking, the limitations, which come on suddenly, are not so liable to end in atrophy as those of slow, gradual invasion. G. A. Berry.

PERINEAL ABSCESS, a collection of pus usually under the deep perineal fascia, occasionally under the fascia or sheath of a corpus cavernosum.

Causes.—In the great majority of cases, the abscess is the result of irritation and ulceration of the urethra behind a stricture; and may immediately arise from suppuration of a follicle or lacuna, due to abscess forming around an ulcer, through which perforation has taken place, and urine in small quantity penetrated into the cellular tissue about the urethra. Sometimes, perineal abscess results from a catheter having lacerated the urethra in its passage; more especially if stricture also exist, when the urine pressed into the wound excites greater irritation in the wounded part. Inflammation of Cowper's glands, an occasional consequence of gonorrhœa, may excite abscess. Lastly, prostatic abscesses point sometimes in the perineum.

It will be seen that abscesses, arising from the above causes, may be divided into those which are connected with the urethra and those which are not; the former set are the more grave, as they contain decomposed urine, and when the abscess has reached the surface they leave urinary fistulæ.

Beginning in causes of irritation behind the triangular ligament, the matter forms deeply, and is directed forwards along the urethra towards the scrotum, or even further into the sheath of the penis before it reaches the surface. Most commonly, if left to itself, it points near the mesial line just behind the scrotum. Occasionally, the abscess empties itself into the urethra, and such a course, though liable to renewed accumulation and repetition of the evacuation into the urethra, is less serious for the patient.

The *symptoms* of perineal abscess are generally as follow:—A patient, the subject of stricture or of chronic inflammation of the deeper portion of the urethra, feels pain and weight in the perineum, with difficulty of micturition. The stream is smaller than usual, and more force is needed to propel it, the immediate cause of this having been an excess of some kind in wine, sexual indulgence, riding, rowing, tennis, &c. Soon, to the sense of weight in the perineum are added throbbing and symptoms of more or less acute pyrexia, restlessness, thirst, and raised temperature. The perineum may be slightly swollen, tender on pressure; in front of the anus, near the bulbous portion of the urethra, a firm, somewhat egg-shaped, deeply-placed swelling may be felt. Fluctuation is only detected when the abscess has burrowed forwards and by the side of the urethra to the integuments.

The *terminations* of this abscess are various. The matter penetrates in different directions, usually in two or more simultaneously.

In these wanderings it may reach the surface at the perineum or through the scrotum, or by evacuation into the urethra or into the rectum, thus producing fistulæ; which, imperfectly emptied, are continually spreading in fresh directions, so as to tunnel the perineum and scrotum in many *culs-de-sac*. During these alternate accumulations of matter and partial evacuations, the patient is much harassed by pain and fever; and when putrefaction occurs, through mixture of the pus and urine, septic infection, indicated by repeated rigors, great rise and

fall of temperature (ranging in the twenty-four hours from 99°·5 or 100° F. to 103° or 104° F.), is the forerunner of death.

The *diagnosis* of a perineal abscess is formed upon the history of preceding urethral disease or injury, on the presence of difficulty and pain in passing urine, and on the detection of a hard, tender, deeply-seated swelling in the perineum.

The *treatment* is, in the first place, to incise through the mesial line and one inch in front of the anus until the collection of pus is reached; evacuation of the abscess being secured, the treatment of the cause of the abscess, such as stricture, must be undertaken when the constitutional disturbance has subsided. But no loss of time in expecting the abscess to point or open itself on the surface should be allowed. The patient's sufferings are thereby only prolonged and his condition made more critical.

BERKELEY HILL.

PERINEAL BAND.—This is a contrivance, formerly much used in combination with Liston's long splint, to maintain extension in fractures of the femur, or in combination with weight-extension in the treatment of hip-joint disease; in the latter case the band is applied to the perineum on the sound side, and tied to the head of the bed. It consists of a soft but firm band, with a tape attached to each end. The middle of the band is applied to the perineum accurately over the tuber ischii, and the ends are carried, one in front of the groin and the other behind the buttock, to the top of the long splint, where they are tied when sufficient extension has been given to the limb.

The perineal band is objectionable on account of its liability to get soiled, its tendency to excoriate the skin, and the difficulty of keeping it continuously over the tuber ischii. Fortunately, however, we are now able to dispense with it altogether, as a far more efficient counter-extending force can be obtained from the weight of the patient's body, when the foot of the bed is raised; the extension being applied by means of a weight attached to the limb.

BILTON POLLARD.

PERINEAL FISTULA. *See* URINARY FISTULA.

PERINEAL HERNIA.—The protrusion takes place between the bladder and rectum in the male, and between the vagina and rectum in the female. The tumour is more often to one side of the middle line than directly in that line. The sac either passes through, or becomes covered by, the levator ani. The contents are usually small intestine, but the bladder has been found in the rupture. The hernia occurs in adults only, and is more frequent in females. It is usually quite readily reduced. The hernia has been inflamed, and has also been strangulated. In the latter condition reduction by taxis has been successful. In no case, apparently, has herniotomy been performed.

FREDERICK TREVES.

PERINEPHRITIC ABSCESS is a common condition, often associated with one or other form of renal disease; indeed, it is a question whether it ever arises independently of the latter. The renal diseases most likely to produce the condition are simple calculous pyelitis, pyonephrosis, or tubercular disease of the kidney. In other words, all the graver forms of suppuration in the organ may give rise to abscess around it by extending outwards until the cortex and capsule are perforated; once the soft, loose, perinephral tissues become inflamed, the process extends more or less rapidly. This suppuration is usually early limited by a plastic deposit at the borderland between the sound and inflamed tissue, so that the abscess is soon distinctly bounded. If this limitation take place close to the kidney, it is often a matter of great difficulty to determine whether the pus lies outside or inside the latter. Fortunately, nowadays, this is not a matter of great importance when the question of treatment alone has to be considered.

In discussing the *symptoms*, it is only necessary to point out the few details in which perinephral abscess differs from pyonephrosis. In the first place, the matter seems to lie nearer to the surface in the loin, as indicated by bulging and fluctuation. With pyonephrosis, the enlargement takes place steadily downwards and inwards towards the umbilicus, and the tumour is sharply defined in this region, while perinephritic abscesses tend to spread backwards and outwards, and are not as distinctly defined to the touch. Urinary symptoms are more frequently absent in extrarenal suppuration than in pyonephrosis; in the former there is very likely to be some amount of inflammation of the psoas muscle, causing flexion of the thigh and pain down the front of the limb. Beyond these the subjective and objective symptoms are identical with those of simple PYONEPHROSIS.

The *treatment* is very simple in uncomplicated cases. It consists in free an-

tiseptic drainage at the point of election behind, as in NEPHROTOMY.

The *prognosis* is good in most cases. After the abscess has been drained thoroughly it soon heals, if it has been opened early, and nothing remains but a little stiffness of the psoas, which soon passes off. But if such a case is allowed to run on untreated, the pus may spread widely across the spine, leading to caries of the latter, or down into the pelvis or front of the thigh, causing much mischief; or it may burst into the cavity of the pleura or peritoneum, or into the intestines. The importance, then, of early diagnosis and free drainage cannot be too much insisted on.

ARTHUR E. BARKER.

PERINEUM, Rupture of the—is a not very uncommon accident occurring during parturition, as the result of too sudden distension of the maternal orifice by the passage of the child's head. The extent of damage inflicted may vary considerably in different cases, the following four degrees of the injury being usually described:—1. Superficial laceration of the fourchette and adjacent portion of the anterior border of the perineum. 2. Rupture of the perineum, not involving the sphincter ani. 3. Rupture extending through the sphincter. 4. Rupture through the sphincter, and involving the recto-vaginal septum. Of these four varieties, the two first constitute what is known as *incomplete* rupture; while the third and fourth illustrate the *complete* form of the injury.

Causation.—Superficial lacerations are by no means rare—as an accident liable to occur, to some extent, in the great majority of first labours. The more serious injury of *rupture* of the perineum, incomplete or complete, usually results from one or all of the four following causes complicating delivery:—1. Extreme disproportion between the head of the child and the maternal orifice. 2. Undue rigidity of parts (especially in elderly primiparæ). 3. Incautious use of instruments. 4. Prolonged pressure from the child's head, inducing sloughing of the tissues, in tedious and difficult labours.

Symptoms.—Superficial lacerations do not, as a rule, give rise to such inconvenience as to render subsequent surgical interference necessary. The *second* variety of *incomplete* rupture, on the other hand, is not unusually followed, in time, by troublesome results consequent upon the loss of support to the vaginal wall, inducing a tendency to prolapse. In the *complete* forms of rupture, the patient's condition is further aggravated by the resulting loss of proper control over the lower bowel, leading to more or less incontinence of fæces. On inspection in such cases, it will be found that the skin surface of the perineum is replaced by a triangular-shaped projection of cicatrised mucous membrane, of which the base blends with the margin of the patulous anal aperture.

Operative treatment may be either immediate or remote in relation to the occurrence of the injury. Whenever possible, the following plan should be adopted as shortly as may be after the completion of delivery.

Immediate Operation.—The patient lying on her side in the usual obstetric position, the nates should be brought close to the edge of the bed, in order that the extent of the rupture may be fully ascertained, for which purpose a good light is essential. The vagina having been temporarily plugged with a sponge, secured by a string in order to facilitate its subsequent removal, the raw surface of the wound is to be thoroughly cleansed with an antiseptic solution. Two or three sutures are next inserted by means of a curved needle, passed at a sufficient depth to ensure firm consolidation of the ruptured tissues. The wound is then carefully dried with a clean sponge, and the surfaces are brought well into apposition by traction on the sutures, which are finally tied in succession from behind forwards. After removal of the sponge, the vagina should be gently syringed out with a warm antiseptic solution, and this must be repeated every four or six hours, according to the amount of lochial discharge. The urine must be drawn off by catheter three or four times daily. The bowels are to be kept quiet by means of opium until the fourth or fifth day, when four ounces of warm olive oil may be thrown into the rectum, and be followed, in a few hours' time, by an enema of plain water. The sutures can be removed as soon as the bowels have acted.

The *remote operation* for the repair of a ruptured perineum is one of a plastic nature, having for its object the coaptation and subsequent primary union of the freshly denuded surfaces of the fissured part. The difficulties of the procedure required will vary according to the extent of the original rupture, whether incomplete or complete, and will also somewhat depend upon the existence, or not, of any serious prolapse of the vaginal wall. A successful result must further be influenced, not only by the amount of attention paid to

the observance of several important details of the operation, but also very materially by the state of the patient's health at the time of its performance. For this reason it should, as a rule, be postponed until the child has been weaned and the health of the mother is fully restored; all sources of local irritation, such as chronic vaginal discharges, hæmorrhoidal conditions, &c., being attended to before anything is attempted.

The operation, usually, is best undertaken about a week after the cessation of a menstrual period. The patient's bowels having been thoroughly relieved by an effectual purgative on the previous day, the rectum should be further cleared by an enema shortly before she is placed upon the table. After induction of anæsthesia, the nates are brought close to the edge of the table and drawn forcibly apart by the hand of an assistant on either side, who at the same time, maintains the patient's knees in the usual lithotomy position. Before commencing, the operator should well syringe out the vagina with a solution of iodine in water, and insert a sponge. Any hairs are then shaved off the labia, and the parts are carefully cleansed.

The following description of the steps of the operation will suffice for either degree of rupture, no rectal sutures, of course, being required when the sphincter remains intact:—

1. A vertical incision is made on each labium along the line of junction of the skin and mucous membrane, extending from a point corresponding to the termination of the nympha down to nearly the level of the anal aperture, where the lateral incisions are next united by a horizontal one, carried across the septum at the junction of the vaginal mucous membrane with that of the rectum.

2. On each side, a triangular flap of mucous membrane is dissected off from without inwards, so as to leave in the middle line a V-shaped portion of mucous membrane, which is next freed, from below upwards, as far as to the level of the upper extremity of the previously denuded lateral surfaces. The apex of this central or vaginal flap should now be held up, by means of forceps, until after the insertion and tying of the deep sutures. In denuding the surfaces, whether with the scalpel or scissors, great care is required to completely remove all trace of mucous membrane. Any bleeding, which is chiefly venous, may, if troublesome, be arrested by the temporary use of pressure-forceps.

3. The rectal sutures are next to be inserted, the number required depending upon the amount of injury sustained by the recto-vaginal septum. The best material for this purpose is fine silkworm-gut, rendered pliable by previous immersion in water. Commencing at the central point of the everted anal margin, the operator passes the needle *from* the rectal aspect *to* the denuded vaginal surface, and thence directly back again through the mucous membrane of the bowel, of which only the extreme edge should be included, with a view to preventing its inversion. Each stitch should be at once firmly tied, and its ends then cut short before the next one is inserted; the only exception to this rule being in regard to the lowermost one, which it is well to leave untied until after the rest of the operation has been concluded.

4. The introduction of the deep sutures is effected as follows:—A sharp curved needle, set in a handle, is entered on the left side opposite the lower external angle of the denuded surface, at about a quarter of an inch distance from the skin-margin, whence it is directed through the remains of the recto-vaginal septum across the bowel, to finally emerge on the right side at a point corresponding with that of its entry on the left. The eye is now threaded with stout silkworm-gut, which is thus passed through as the needle is withdrawn. If possible, the needle should be kept embedded in the tissues throughout its course, the bowel meanwhile being protected from injury by the operator's finger in the rectum acting as a guide. The number of deep sutures required will vary from three to five, of which the second and third ones are to be passed in the same manner as the first, at successive intervals of half an inch. In the introduction of the two highest sutures, the needle, after traversing the inner aspect of the labium, transfixes the triangular flap of the vaginal mucous membrane (above described) before passing onwards through the right labium, to emerge at a point corresponding with that of its entry on the left side.

In cases complicated by extensive prolapse of the posterior vaginal wall, a wedge-shaped portion may, with advantage, be excised from the centre of the vaginal flap, the edges being afterwards adapted by a series of fine sutures knotted on the vaginal surface, with their ends left long in order to facilitate removal.

5. The vaginal sponge is now removed; the passage is syringed out, and the surface of the wound cleansed by means of a

stream of iced water. The patient's knees are brought together again, and the deep sutures are tied firmly in the order of their insertion, beginning with the lowest one, care being taken to avoid inversion of the skin edges. Finally, the lowest rectal suture is secured.

The bladder having been emptied by the catheter, a folded napkin is applied to the perineum and retained by a T-bandage. The patient's knees are then fastened together, and she is placed in bed on her side.

A modification of the usual operation, advocated by Mr. Lawson Tait, is based upon the principle of removing no tissue whatever; and, further, of avoiding transfixion of the skin-edges in the introduction of the deep sutures.

The procedure consists in splitting the remains of the recto-vaginal septum horizontally, by means of curved, sharp-pointed scissors, along the line of cicatricial tissue in front of the opening in the bowel. This incision serves to define the base of a vaginal flap, of which the sides are next freed by cutting vertically upwards upon the inner aspect of either labium. The deep sutures are then passed in the usual manner, excepting that the point of the needle is both entered and brought out upon the raw surface immediately *within* the line of skin-margin. No 'rectal' stitches are employed in cases of complete rupture involving the sphincter and septum; the passage of one or more deep sutures across the rent, avoiding transfixion of the immediate margins of the opening, will be found sufficient to ensure its closure. Finally, two or three superficial stitches are introduced anteriorly to limit the vaginal orifice.

After-treatment.—The diet should be light and chiefly farinaceous for the first few days. The parts are to be kept dry, but, at the same time, scrupulously clean by daily washing with a stream of antiseptic lotion. The catheter must be used as required; or, if desirable, the patient may be allowed to turn over on her face for the purpose of emptying the bladder, after the first forty-eight hours are over. The bowels should be kept confined by repeated small doses of opium during the first three or four days, after which they may be moved by the injection of warm olive oil, followed by a plain water enema.

Daily evacuation should be subsequently secured by the administration of some mild laxative, as compound liquorice powder in tea-spoonful doses each night. Mr. Tait prefers to keep the bowels open from the commencement by the daily use of a small enema. As a rule, the deep sutures can be taken out on the eighth or ninth day, any vaginal sutures being removed at the same time. The rectal stitches may be left undisturbed, provided that their ends have been cut short as directed.

In uncomplicated cases the patient may be allowed to leave her bed at the end of a fortnight. W. A. Meredith.

PERIOSTITIS. — Periostitis may be acute or chronic, and of the acute forms there are two very distinct varieties.

Simple Acute Periostitis is very frequently the result of an injury, such as a blow. Syphilis also gives rise to periosteal nodes, which are in some cases quite acute. It may be seen, too, after acute articular rheumatism, typhoid fever, measles, and scarlet fever. In fact, a simple acute periostitis may arise from any cause which reduces a patient below his natural condition of health.

Pathology.— The periosteum becomes vascular, swollen, and in this condition is very readily separated from the bone beneath. This simple form of inflammation generally ends in resolution, and the parts involved return to their normal condition. But it may terminate in suppuration; and, when this is the case, a simple abscess is formed, which has less tendency to burrow far before making its way through the fibrous layer of the periosteum than in the case of the diffuse form of periostitis. Generally, the abscess heals up without any subsequent necrosis, but occasionally the exposed portion of the compact tissue dies, and is removed by exfoliation.

Symptoms.—An acutely tender swelling forms over one of the more superficial bones, such as the tibia. It is found, on examination, to be fixed and connected with the bone, and to be so tender as to admit of very little handling. There is no general enlargement of the bone itself, and the tumour, although connected with the bone, feels as if it were quite upon its surface. The other signs of inflammation, such as heat and redness, are also present, and the pain, which is generally worse at night, may be very troublesome if the part be in a dependent position. Should suppuration take place, the opening formed by nature or the surgeon's art will lead directly down to the bone, when examined by a probe. The temperature will probably be raised several degrees, especially during the first few days, and will be most marked at night.

Treatment.—Leeches, hot fomentations, and a brisk purge will give most relief, and may possibly arrest the progress of the disease. The part should be raised on a pillow, and strict rest enjoined. If syphilis be the cause, notwithstanding the acute symptoms (for as a rule in syphilis the periostitis is subacute or chronic), iodide of potassium alone will obtain, at any rate, temporary relief, and may be looked upon in the early stage as almost a specific. See *Chronic Periostitis.* But in acute periostitis, not dependent on syphilis, iodide of potassium is scarcely so efficacious as in the more chronic forms of this disease. An incision should be made as soon as fluctuation is detected, and may even be made, with considerable benefit, before this event in cases in which the symptoms continue unrelieved. It should be made through the periosteum on to the bone, and antiseptic precautions should, under such circumstances, be adopted to lessen the chances of necrosis.

The constitutional treatment should not be neglected, especially where the disease has followed upon typhoid fever or any other exhausting illness. In such cases the patient will require tonics and a generous diet, but whilst the temperature is raised, fluid nourishment and an effervescing saline draught will probably be more suitable.

Acute Diffuse Periostitis or Acute Necrosis is a much more dangerous disease than the one just considered, and requires the highest surgical knowledge and skill to bring the patient successfully through his illness.

Causes.—It is commonly seen in young and growing boys at or about the age of puberty, the patient being generally rather feeble and ill-nourished. It is very rarely, if ever, seen in those that have reached adult age. Some slight injury appears, sometimes, to be the immediate exciting cause. But this is oftentimes so slight as to have been scarcely noticed, and may even be entirely forgotten. This is all that is definitely known as to the causation of this very curious and interesting affection. It is only fair, however, to say that there are, at the present time, good reasons for believing that the peculiar characters of the disease owe their origin to an infective organism or specific virus, planted no doubt on a suitable soil, but introduced from without. It is beyond the purpose of this article to discuss the interesting points for and against this view of the disease, and the reader must refer to the recent investigations which have been carried out on animals.

Pathology.—The parts most frequently affected are the tibia and fibula, but any long bone may be the seat of this disease. The flat bones, on the other hand, are very rarely attacked. The inflammation very rapidly terminates in suppuration, and the pus thus formed diffuses itself between the periosteum and the bone over a wide and extensive area. If the inflammation starts in the diaphysis, this stripping of the periosteum stops generally at the epiphysial line. But if it should extend to this line, or start in its neighbourhood, the inflammation may extend into the growing tissue between the shaft and the epiphysis, and then, when the process involves the periosteum from one epiphysis to the other, the whole diaphysis may lie loose in a large abscess-cavity. It is stated that it frequently begins at the epiphysial line, and simultaneously extends down the medullary canal on the inside, and between the periosteum and the bone on the outside. In either case, total necrosis of the whole shaft may be the consequence of this disease. French pathologists assert that total necrosis does not occur without this simultaneous osteomyelitis. The joints, as a rule, escape if the inflammation has begun in the diaphysis, but occasionally the epiphysis itself is involved in conjunction with, or without the shaft, in which case the affected joint may fill with pus, and bring in its train all the dire consequences of suppurative arthritis. Irrespectively of this possibility, pyæmia is especially prone to occur in acute diffuse periostitis. When the periosteum has been stripped from the bone over a considerable area, and incisions are not quickly made, the pus with difficulty makes its way through the fibrous layer of the periosteum; and finally, if still unrelieved, diffuses itself among the muscles, forming oftentimes an enormous abscess before it reaches the surface. There is in such a case no rarefaction of bone as in ostitis, but the bone simply dies *en masse.* When this has taken place, and the pus has been evacuated, the periosteum begins to form new bone, and a large ensheathing case is eventually produced, with cloacæ for the escape of pus. The further history of this condition is described under Necrosis.

The *symptoms* may ensue immediately after an accident or some slight injury, as has been stated under causation, or there may be an interval of a few days before the onset of acute symptoms. But in either

case this history of an injury, trivial though it may be, is so generally given that it cannot be regarded as a mere coincidence.

Shivering or even a rigor, with a temperature of 102° to 104° Fahr., generally ushers in the attack. Headache, loss of appetite, vomiting, and even diarrhœa may also be present. The local symptoms may for a time be in abeyance, and the patient be thought to be suffering from some acute specific disease, especially as the case will probably be that of a child or youth. In two or three days, the local symptoms manifest themselves by pain and a diffused œdematous swelling over one of the long bones, generally the femur, tibia, or humerus.

The *diagnosis* may at the time present some little difficulty—i.e. before the presence of pus can be detected by fluctuation. The question generally arises between such diseases as cellulitis, acute rheumatism, and acute diffuse periostitis. In cellulitis, there has generally been some injury to the integuments by a wound, and the inflammation, starting very soon after the injury, has rapidly spread beyond the next joint; while, in acute diffuse periostitis, the swelling has come on more slowly and been confined to the soft parts covering one bone, and has not passed beyond the neighbouring articulations. In acute rheumatism, on the other hand, the inflammation will be confined to the soft parts near the joint, and on inquiry some other joint will probably be found tender on examination, or to have been so during the illness. Should there still be any doubt as to the presence of deep-seated pus, an exploratory puncture with a narrow-bladed knife can do no harm; and as it is a matter of such vital importance to make the necessary incisions as early as possible, this exploratory operation should never be neglected in doubtful cases—to anticipate rather than wait for the formation of pus being the object of every surgeon.

If this is not done, fluctuation becomes distinct in a few days, and on introducing the finger through the openings which are then made, the shaft will be found denuded to a variable extent, according to the severity of the case and the length of time that has elapsed since the pus began to burrow, before making its way through the periosteum. On moving the limb it is possible, at this stage, that indistinct crepitus may be felt between the shaft and the epiphysis. This will not be surprising after what has been said, in a preceding paragraph, on the pathology of the disease.

During all this time the temperature has been high, and the other symptoms of the febrile condition have continued unchecked, but, as soon as the pus has been evacuated, the temperature generally begins to fall and the patient improves. The temperature may again rise with a fresh collection of pus, indicating possibly the want of a counter-opening or a new area of necrosis. But before this has time to take place, or even in spite of the evacuation of pus, symptoms of pyæmia may supervene, or pneumonia, pleurisy, or pericarditis may bring the case to a fatal termination. If an epiphysis of one of the larger joints, such as the knee, has been primarily involved, and suppurative arthritis has ensued, the dangers of such a calamity have been still further increased. Should the patient avoid all these possible causes of shipwreck, he still has a long and exhausting illness before him, if the entire shaft has become necrosed. The profuse suppuration, in such a case, induces emaciation and exhaustion of the gravest kind, but, where only a portion of the shaft of a long bone has been denuded of its periosteum and has consequently died, the symptoms are proportionately less severe. The steps by which the dead bone is eventually removed are considered under Necrosis.

There are other less common varieties of this complaint than the one above described. A subacute form is occasionally seen, which is much less dangerous; and a multiple form sometimes occurs, in which several bones are simultaneously attacked. The latter is often rather more of the nature of osteomyelitis, and is especially prone to lead, very early, to a fatal result from septicæmia.

Treatment.—Early and free incisions are here imperatively needed, and can alone save the patient from necrosis of the whole shaft. The finger or probe should be passed into the incisions, to see if more dependent openings can be made than the ones first selected. At the same time—and this is the advantage that the finger has over the probe—the opportunity should be seized to estimate the amount of bone that is already stripped of its periosteum. From time to time free incisions may also be required during the subsequent treatment of the case. Absolute rest upon a good splint is oftentimes a great advantage, and is really necessary in those cases in which the epiphysis or joint is involved. Whether the strictly antiseptic method of Lister should be adopted, in such a case as this, is a matter of choice rather than necessity. Putrefaction and decomposition of the discharges should undoubtedly be prevented. But in

the Listerian treatment of acute diffuse periostitis the dressings have to be frequently changed, or they will quickly putrefy, for sources of putrefaction are already present in the pus before it is evacuated. Personally, the writer prefers, in this particular disease, a more open method of treatment, with frequent injections of an antiseptic solution. The question of amputation of the limb has sometimes to be seriously considered, in cases in which the neighbouring joint has suppurated; and the operation may also occasionally be necessary in feeble patients, who do not rally after the incisions have been freely made, but who seem gradually to get weaker and weaker, and in whom the discharge continues as profuse as before, without any sign of diminution—cases, in fact, in which one thinks there is a poor chance of recovery unless this drain be removed, and that speedily.

If the whole shaft of a long bone has become necrosed and separated from its epiphyses, subperiosteal resection may be employed quite early in the progress of the disease, before new bone has been formed by the periosteum. The patient is thus relieved of a very serious drain upon his constitution; for when this can be successfully accomplished, the amount of pus secreted is very greatly diminished, and the new bone that is formed, after the removal of the old shaft, seems as strong and as sound as when it is left within its periosteal sheath. To facilitate its removal, the dead bone may be divided by a chain saw. Each end can then be easily twisted off from its epiphysis, if it has not already become quite detached. *See* SUBPERIOSTEAL RESECTION.

The removal of sequestra at the ordinary time, when they have become loose and detached within an invaginating sheath of new bone, is discussed under NECROSIS. Little need be said about the constitutional treatment of this disease, for it is evident that everything must be done which will assist in supporting the patient through an exhausting and trying illness. Tonics and a stimulating nutritious diet must be given as far as they can be borne. Morphia may also be necessary to allay pain, and soothe the irritable condition into which many of these patients fall.

3. CHRONIC PERIOSTITIS.—Simple uncomplicated chronic periostitis is rare, except in syphilis. It is the custom, however, to call almost all cases of thickening and enlargement of bone periostitis, whereas, undoubtedly, ostitis is generally the primary condition in these cases, whilst the periosteum is only secondarily involved. Consequently, the reader must look to the article on OSTITIS for much that he might possibly expect to find here. Taking, then, the syphilitic forms first, as being by far the most important, we find that syphilitic nodes are due to a more or less chronic inflammatory infiltration of the deep layers of the periosteum. They occur both early and late in the disease. The earliest appear between the second and third month after infection, generally on the superficial bones, and yield very readily to treatment. The later variety do not often appear before the second year, and frequently not till a still more advanced period; but, in exceptionally rapid cases, they may trouble the patient somewhat earlier in the disease than even the second year. They do not yield so readily to treatment, and often lead to a development of new bone on the surface of the old. Occasionally they suppurate, and give rise to a troublesome sinus or ulcer. Dead bone is generally found at the bottom of this sinus, but may take years to separate from the living; such sinuses are therefore very slow in healing. The gumma may affect the periosteum as it does other tissues, and, if unrelieved, softens in the usual way, exposing the bone beneath. The latter is then found to be superficially affected, and often falls into a carious and necrotic condition, leading to those frightful ulcerations of bone which are now rarely seen except in our museum specimens.

There is still another form of chronic periostitis, and that is the osteoplastic variety accompanying osteosclerosis. The periosteum here slowly develops new bone, which may be arranged in layers parallel to the surface or in nodulated masses. When the latter assume a definite size and outline, they are sometimes called osteophytes. The new bone that is laid on parallel to the surface, in chronic ostitis, is at first spongy, with large vessels surrounded by round cells and running at right angles to the surface. Part of this new bone is again absorbed, but in a great measure it undergoes the same sclerotic change that occurs in condensing ostitis, and leaves the shaft so much the larger. It is doubtful whether there are other definite causes besides syphilis for the conditions above described. Localised patches of chronic periosteal thickening are seen both in hereditary syphilis and struma, but they are quite as much osteal as periosteal, like the cases of osteosclerosis above alluded to, except that they are generally rather more limited in extent.

Symptoms.—Pain of a dull aching kind, worse at night and in wet weather, is the principal and most characteristic symptom, the chief complaint which is made being the inability to get to sleep after going to bed. This pain is rarely acute. On examination, a swelling is generally felt on passing the tips of the fingers over the part complained of; this is most likely to be the shin or the superficial parts of one of the long bones, such as the tibia, ulna, or clavicle. The superficial soft tissues are found quite free from inflammation, unless a node has accidentally suppurated or the case be one of gummatous periostitis. Tenderness on pressure will vary greatly in different patients, but it is not often acute, although occasionally the slightest touch seems to cause great pain, even in men who are not otherwise very sensitive. This is, however, more generally seen in the earlier nodes, which have been before mentioned under *Simple Acute Periostitis.*

Treatment.—For the early syphilitic nodes, it is not necessary to discontinue the mercurial treatment that has already been begun. The pain and swelling generally disappear as soon as the patient is fully under the influence of the drug. If this fail, the administration of small doses (gr. v.) of iodide of potassium, for a few days, is almost certain to give immediate relief. But unless mercury is continued, as it is for the other early syphilitic manifestations, over a long period, the nodes are liable to return, whether iodide of potassium be given or not. For the later forms of syphilitic periostitis, including the gummata, even when they are fluctuating, iodide of potassium, in gradually increasing doses from gr. x. to gr. xxx. t.d.s., is generally sufficient to procure a very decided and marked improvement in all the symptoms. Occasionally, the improvement is neither very marked nor very prolonged. Mercury should then be given till the gums are slightly touched. It is not often that this is required, and scarcely ever in the gummatous form of periostitis. But when the disease does not readily yield to iodide of potassium, mercury should most certainly be tried, and most suitably in the form of blue pill gr. v. daily, or, if this be insufficient to make any impression, twice a day. Blisters sometimes give great relief, and should always be employed in conjunction with the above treatment, if there is much pain and tenderness. If, notwithstanding the treatment here prescribed, the symptoms still persist, free division of the periosteum at the most tender spot will sometimes do all that is required and bring the case to a successful termination.

If suppuration takes place, notwithstanding the above treatment by iodide of potassium and mercury, and the skin becomes thin, the abscess should be opened with the fullest antiseptic precautions, so as to avoid, if possible, the occurrence of necrosis. H. H. Clutton.

PERIPROCTITIS.—Inflammation of the tissues surrounding the rectum.—The lower part of the rectum, when at rest, is normally closed by tonic contraction of the circular muscular fibres, by which the mucous membrane is thrown into longitudinal, closely approximated folds. During defæcation the tube is more or less considerably distended. In constipated or flatulent subjects, the distension may be very great and permanent from accumulated fæces or flatus. To admit of this variation in calibre, the bowel is surrounded by lax cellular tissue, which below becomes continuous with the adipose tissue of the ischio-rectal fossæ. This cellular tissue contains a large quantity of adenoid tissue, partly diffused and partly aggregated in nodules resembling the solitary glands of the intestine.

This tissue is not infrequently inflamed, and the inflammation may be acute or chronic. It may occur spontaneously, probably from irritation of the adenoid tissue in phthisical patients, or from direct violence, as from blows or kicks, or even from exposure to cold. It may also be due to perforation of the rectum by ulceration or by foreign bodies, as enema-tubes, rectal bougies, fish-bones, &c.; or it may be secondary to inflammation of adjacent parts, as of the prostate, bladder, vagina, or from necrosis of the sacrum or coccyx. If fæcal matter escape from the bowel into this tissue, the inflammation is very severe and extensive.

In the *acute* stage, the patient complains of a sensation of heat and weight in the perineum, and of pain in defæcation. If the inflamed part be small and at some distance from the surface, there may be no external evidence; but if neglected, the inflammation will rapidly spread, and a hard brawny swelling will be found occupying one or both ischio-rectal fossæ. The chronic form is very insidious, and, if due to inflammation of adjacent parts, may fail to attract attention. If neglected, it may result in considerable denudation of the bowel.

When the patient complains of pain in defæcation, without any external sign of the cause, the rectum should be carefully ex-

plored with the finger; and if any part of the mucous membrane be discovered to be swollen, tender, and hotter than the rest, the left forefinger being retained in the bowel as a guide, a straight knife should be introduced alongside the bowel from the anal portion of the perineum, and pushed steadily onwards to a level with the tip of the guiding finger. If suppuration has already commenced, as is usually the case, the exit afforded for the pus will give relief and probably prevent perforation of the bowel. If there be no pus, the bleeding from the inflamed part will prove serviceable. Any more superficial suppuration must be incised in the usual manner, and the cavity washed out with carbolised water. The pus is usually extremely ill-smelling, even when there is no direct communication with the bowel. The wound may be dressed with iodoform and filled with cotton wool. If a rectal fistula result, it must be treated according to the condition of the part.

In *chronic* cases, any retained pus must be evacuated and the wound dressed in a similar manner. Sinuses must be either laid open or irrigated, according to their extent and direction. The exciting cause must also be treated as the requirements of the case may suggest. The patient must be kept at rest in the horizontal position, and an easy daily action of the bowels ensured by suitable diet and purgatives.

JEREMIAH MCCARTHY.

PERITONITIS, or inflammation of the serous membrane that lines the abdomen and covers the contained viscera, is, like inflammation of other tissues, brought about by various agencies, of which the effect is to lessen the vitality of the parts assailed, and to lead to more or less manifest changes in structure and function.

The *causes* of peritonitis are: (1) Bruises, and the resulting irritation; (2) wounds of the abdominal wall and organs, with infiltration of fæces, urine, or other irritating material; (3) ulceration or gangrene of the intestine, with the like infiltration of injurious material; (4) the distributed infective particles of pyæmic, tubercular, and malignant disease. The varieties of peritonitis are, accordingly—(*a*) simple, (*b*) septic, and (*c*) specific, while in extent it may be 'partial' or 'general,' and in degree 'chronic' or 'acute.'

Anatomical Changes and Mechanism.—In the event of bruise, the peritoneum may be the seat of ecchymosis in varying degrees, punctiform or diffuse, as may be seen on post-mortem examination after early death associated with fractured pelvis, ruptured viscera, &c. A slight amount of what is virtually simple peritonitis may attend the infliction of a bruise, and is present in wounds of the peritoneum which heal by a perfectly aseptic process. But, under both conditions, the recovery of the patient is so simple and speedy that the evidence of peritonitis is not conspicuous, and, in the event of death from other cause, its anatomical traces may be confined to an inconsiderable adhesion or superficial scar—provided that the parts be kept at rest. Undue intestinal movement, brought about by the use of food improper in such circumstances, may, however, aggravate the simple peritonitis to the exudation of extra lymph and its resulting adventitious adhesions. Permanent traces of previous peritonitis occur in the form of fibrous tissue variously attached to the serous surface, as smooth bluish-white opacities, streaky cicatrices, close adhesions, delicate fibrous shreds, or firm cords and bands. In extent, the above forms of simple peritonitis are 'partial.' In chronic (simple) peritonitis associated with ascites, the surface of the membrane may be slightly injected and thinly coated with granulations, lymph, or both, in the absence of pus, decomposition, and constitutional infection. In extent, chronic peritonitis is 'general.'

In the event of extensive putridity, as on the decomposition of blood or serum after operation, or on the flooding of the serous sac with the juices of the alimentary canal through sudden perforation of intestine, the result is a rapidly fatal septicæmia, chiefly characterised before death by collapse, with sometimes an entire absence of inflammatory phenomena. Petechiæ on the peritoneum and other serous membranes are not uncommonly found after death in septicæmia, and are not to be confounded with those of ecchymosis. Between these extremes are found average cases of 'acute peritonitis,' which may be 'partial' or 'general,' according to the extent to which the serous surfaces are implicated, and in which the inflammation is not infrequently partial at first, and subsequently spreads until more generalised, or until 'universal.'

Acute peritonitis is always septic, and occurs under circumstances of wound, ulceration, gangrene, and pyæmic or other metastatic infection. In perforating wound of the peritoneal cavity, decomposition may arise from without; in wound of the intestine, by issue of fæces from within; in ulceration, by leakage of fæces; in gan-

grene, by imbibition through the putrefying tissues; and in pyæmic abscess at the surface of the liver, the source of peritoneal irritation is evident. The anatomical changes denoting acute peritonitis are exudation of lymph, pus, or both, and vascular injection, which are as apparent after death as during life. The amount of lymph exuded may be no more than a stippled film, or may be enough to be stripped off with the fingers; while its colour may be yellow, drab, brown, or green. The pus exuded may have any consistence between that of milk and that of clotted cream, with any of the above colours. Either exudation may exist singly, or the two may be combined in any proportion. The vascular injection may vary from the scantiest redness to a crimson or purple velvety fulness on the parietal or visceral surface, like the condition of the eye called 'pannus.'

In the specific peritonitis of tubercle, the exudation is found, as the name implies, in dotted nodules, which vary from the size of hardly visible grains to that of mustard-seeds, green, yellow, white, or opalescent, often on a pink ground of vascular injection, at various distances apart, or forming a continuous granular membrane.

In various forms of malignant disease, the peritoneal membrane is found to be dotted in varying extent and profusion with scattered nodules of tumour-growth, averaging a size between those of mustard-seeds and peas, but in some instances forming considerable masses. Their colour is often simply white; but pink, red, or purple tints may be imparted by a varying blood-supply; while an additional or alternative yellow stain may be present through general jaundice or local bile-staining. The anatomical resemblances between tubercular and malignant infiltration of the peritoneum are sufficiently great to render their distinction in some cases difficult, without regard to other circumstances. To the latter condition the term 'malignant peritonitis' is sometimes applied.

The *symptoms* of peritonitis are local and constitutional. The local consist of pain, tenderness, and the impairment of visceral muscular functions. The constitutional are alterations in the temperature, pulse, and respiration, and also in the demeanour and facial expression. There is lastly the act of vomiting, a symptom probably indicative of local irritation and of constitutional sympathy combined.

The pain and tenderness in cases of bruise are great at first, and may be aggravated if the parts concerned be not kept at rest. In cases of perforation of the bowel and flooding of the peritoneum with fæcal fluids the pain is great, as if from the pungent irritation of the noxious matters, and ceases only in advanced collapse. In acute peritonitis, more slowly brought about by similarly septic means, the pain and tenderness are conspicuous, the area of the latter being proportioned to the 'partial' or 'general' extent of the affection. In tubercular and malignant infiltration the pain may be, and commonly is, *nil*.

The temperature in peritonitis may be raised or lowered. The painful state of mere bruising may be attended with elevation of temperature, apparently due to the pain; while the onset of the same condition may be ushered in with a lowered temperature and a certain amount of shock. In acute—that is, in septic—peritonitis the temperature is also commonly elevated a few degrees at first, followed in later stages by depression. Local changes may have something to do with this, as in the case of bruising, but the major part of the change, whether elevation or the reverse, is probably due to septic absorption, for exactly similar elevations and depressions of temperature are well known in cases of septic poisoning not arising in the abdomen. The pulse is characterised by greatly increased rapidity and hardness, which in the acute form of peritonitis is almost 'wiry' to the finger.

The respiration in peritonitis is sometimes quickened and shallow, owing to pain and tenderness affecting the respiratory muscular efforts, especially when the peritonitis is diaphragmatic. Part of this may be due to a febrile state and quickened pulse when they exist.

In peritonitis of all kinds, there is a tendency to impairment or irregularity of the intestinal muscular functions. This may be accompanied by flatulent distension, or may follow a state of contraction, both of which conditions may be found in different portions of the same bowel. In consequence of impaired intestinal functions, whether strictly localised or affecting a considerable length of the gut, constipation may result, and is commonly recognised as a frequent attendant symptom. But, also actual obstruction of intestine, subacute and even acute, may directly result from acute peritonitis, and its symptoms may be those which alone attract attention.

Vomiting occurs in cases of severe abdominal contusion and concussion, but does not commonly persist. In acute peritonitis vomiting generally occurs, and per-

sists while food or drink is administered, on the early avoidance of which it is mitigated, while it can be totally allayed by the subcutaneous administration of morphia. In tubercular and malignant peritonitis vomiting is not regularly present, and may be totally absent.

The *diagnosis* of acute traumatic peritonitis is based upon the presence of pain, tenderness, abdominal distension, and vomiting, following an injury. In that due to perforation of the intestine or vermiform appendix, with slight or gradual leakage, the same typical symptoms exist; but the suggestive circumstance of the injury is not present, and thus an important diagnostic aid is wanting. In either, the symptoms referring to peritoneal injury may be masked by those due to blood-poisoning, and attempts at diagnosis may fail, or may even reveal only those of intestinal obstruction, until post-mortem inspection clears up the obscurity of past events. Cases of perforation of the appendix, in which the leakage is not intra-peritoneal, may result in abscess, iliac or lumbar, with or without subsequent fæcal fistula; and may, in cases of still less severity, cause symptoms identical with those of typhlitis and perityphlitis. In cases of bruise the conspicuous local pains, together with the circumstance of injury, render a recognition of peritonitis not difficult, even though the symptoms are not immediately apparent; while in tubercular and malignant peritonitis there are often—in fact, usually—no symptoms by which even a clue can be gained, except in the event of ulceration, when by fæcal contact acute peritonitis may be set up, with the symptoms above related. *See* Perityphlitic Abscess.

The *treatment* of peritonitis is simple enough, whatever be its cause. The local symptoms to be combated are pain, tenderness, and the tendency to flatulent distension. The pain and tenderness can be counteracted by opiates and by alcohol; speedy relief being obtained in a state of urgency by morphia subcutaneously given. Any of its salts act well if pure, the hydrochlorate and acetate being quite satisfactory when fresh, but liable to decomposition after long keeping. The sulphate seems to retain its purity longer than any other salt of morphia, and is consequently to be preferred, in doses, for an adult, of from a quarter to half a grain in the first instance. After even frequent repetition, it is hardly likely that more than half a grain will be required, while for a first dose, urgently needed, less than a quarter of a grain can seldom be relied upon for this purpose. In the absence of urgency, the same drug may be confidently given, and found satisfactory, by the mouth, in doses varying from an eighth to a quarter of a grain, repeated every four, six, eight, twelve, or twenty-four hours. Under the same circumstances laudanum or liquor opii sedativus, in doses of ten to sixty minims, may be equally relied on. A dose of wine or spirit and water, administered by preference hot, may be given occasionally to supplement, or even in mild cases instead of, the opiate. For children, the same medication by the mouth, in doses appropriate to their age, on the scale of a drop of laudanum for each year of life, cautiously increased or repeated if relief be not speedy, will generally suffice.

The diet should at the same time be entirely liquid, and confined to small quantities of beef-tea, soups, or water-arrowroot suitably sweetened and flavoured with alcohol. Meat and fish should be rigorously avoided, except in the preparation of broth, which should be carefully strained; milk should be equally strictly interdicted until the symptoms are checked; and even bread should not be given pending improvement. At first, in fact, and during the existence of severe symptoms of any kind, it is better to avoid nourishment altogether, and to put off its administration until temporary ease is obtained, and even until craving hunger on the patient's part demands it. Warm tea, barley water, toast water, and the like, may at most times, however, be judiciously given to relieve thirst. When the pain is gone, and has shown no tendency to return, bread or toast may be broken into the tea and broth, and this kind of diet should be continued until a stool passes. In even a mild case, properly managed, much time is saved by omitting the food at first; while, in cases of more severity, a rigid attention to diet is essential, and will often result in a spontaneous easy stool in the first or second week after a previous obstinate constipation. But during recovery, moderate flatulence, without special pain or tenderness, may exist with constipation and scybala, especially if the diet have not been scrupulously attended to, and will then yield to a well-timed simple enema of hot water. It should be distinctly understood, however, that such interference is not justifiable during the existence of symptoms indicating any degree or stage of the original affection, and is only permissible during the period of actual convalescence.

The application of fomentations, poultices, or dry heat, to the abdomen is found

to be acceptable in many cases of peritonitis. The alternative abstraction of heat by laying on an ice-bag or a wet cloth (preferably in a single layer) is productive of exquisite comfort in other cases.

The above treatment may be uniformly adopted in all forms of peritonitis, and is no less successful than essential in severe remediable cases. The mildest instances are always the better for it, though no doubt susceptible sometimes of spontaneous recovery, while septic cases generally prove fatal in spite of all treatment. Even in fatal cases, however, some of the symptoms are combated by the treatment, and the sufferings of the patient minimised.

RUSHTON PARKER.

PERITYPHLITIC ABSCESS. — A localised collection of pus formed in connection with the cæcum or its appendix, situated either within or without the peritoneal cavity. By some authors the term is limited to abscesses commencing in the loose areolar tissue behind the cæcum. Taking the broader significance of the term, we must separate perityphlitic abscesses into intra- and extra-peritoneal. These forms differ from each other sufficiently to justify a separate description, though clinically it is often difficult, and sometimes impossible, to distinguish one from the other.

EXTRA-PERITONEAL PERITYPHLITIC ABSCESS.—*Anatomy.*—The loose tissue behind the cæcum is a part of the general subperitoneal areolar tissue. It is continuous above with the fat about the kidney, and internally with the loose tissue surrounding the iliac vessels and with the pelvic cellular tissue. A collection of pus, forming immediately behind the cæcum, can readily extend upwards to the kidney, inwards to the brim of the pelvis, and forward to the groin above Poupart's ligament. It is prevented from reaching the thigh by the attachment of the fascia iliaca and fascia transversalis to Poupart's ligament. Should it extend inwards to the pelvic cellular tissue, it may escape from the pelvis with the gluteal or sciatic artery through the great sciatic notch, and thus appear in the buttock, but it is shut off from the perineum by the recto-vesical fascia. It is possible for the pus to make its way to the surface along the spermatic cord or through the femoral ring, but such a course is extremely rare. In the majority of cases it comes forward, and appears above the outer part of Poupart's ligament. When the abscess is very acute it may perforate the iliac fascia, and thus come in direct contact with the ilio-psoas muscle, and it may then extend upwards towards the spine, and downwards to the thigh, taking the course of an ordinary psoas abscess. This is, however, a rare occurrence. Abscesses arising in connection with the kidney, or in the pelvic cellular tissue, can easily extend in the subperitoneal fat to the neighbourhood of the cæcum, and may thus appear to have commenced in that region.

Causes.—An extra-peritoneal perityphlitic abscess most commonly arises as a complication of disease of the cæcum, with or without perforation of the gut. When not a consequence of perforation, it probably commences in the lymphatic glands which lie behind the cæcum. The diseases which give rise to it are—simple typhlitis from fæcal accumulation; and ulceration from tubercle, typhoid fever, dysentery, or stricture of the great intestine at some point lower down. Cancer of the cæcum may lead to perforation in its later stages. Perforation of the vermiform appendix near its root may also be a cause of an extra-peritoneal abscess. In some cases, the appendix is placed completely behind the cæcum, and an abscess resulting from any disease of it would then be situated behind the gut. Perforation of the cæcum at any part covered by peritoneum very rarely causes a localised collection of pus, as it is usually speedily fatal from diffuse peritonitis. In some exceptional cases the abscess may arise without any recognisable cause.

Symptoms.—The special symptoms of a perityphlitic abscess are preceded by those of the disease to which it is secondary. It would be out of place here to describe the symptoms of typhoid, dysenteric, or tubercular ulceration of the cæcum, and those of stricture of the great intestine and of cancer of the cæcum are fully treated of under INTESTINAL OBSTRUCTION.

The symptoms of simple typhlitis are pain and tenderness in the region of the cæcum, with swelling taking the form of the distended gut. At first the pain is dull and aching, and the tenderness is not usually very acute, but by the second or third day, if the attack does not subside, the symptoms become more severe. It not uncommonly happens that the exacerbation takes place somewhat suddenly, so as almost to suggest that perforation of the gut has taken place, but the absence of collapse and of the signs of diffuse peritonitis is sufficient to show that this is not the case. The sudden increase in the severity of the symptoms is believed to be due to an extension of the inflammation to the peritoneum covering the cæcum. When this has taken place, the tenderness

is such that no accurate examination by manipulation is possible without the administration of an anæsthetic. In order to relieve tension the patient lies with his right thigh flexed. Nausea and vomiting are common symptoms at this stage. The bowels are usually confined throughout the attack, and most commonly the patient has suffered for some time from habitual constipation. It occasionally happens, however, that, even in cases of very considerable fæcal accumulation in the cæcum, a channel may exist through the mass, allowing of the passage of a daily motion. The temperature, which is normal at the beginning of the attack, usually becomes slightly elevated during the period of acute tenderness. Under proper treatment by rest, hot fomentations, and small doses of opium, the symptoms gradually subside in about a week from the commencement of the attack; some hardened fæces are passed, either naturally or by the help of enemata, and the patient recovers. In most cases he remains liable to similar attacks throughout life.

The extra-peritoneal perityphlitic abscesses must, for the description of their special symptoms, be divided into two classes—those that do not communicate with the gut, and those that do.

In the abscesses not communicating with the gut, the pain and tenderness which have attended the previous typhlitis, instead of subsiding, become more acute, and the swelling becomes more distinctly localised in the outer and lower part of the iliac fossa, in the neighbourhood of the anterior superior spinous process, and the outer end of Poupart's ligament. The temperature rises to 103° Fahr. or more, with evening exacerbations. There may possibly be a rigor, but this is not common. Accurate examination is scarcely possible without an anæsthetic, but, when the muscles are relaxed, a firm elastic swelling fixed in the iliac fossa can easily be recognised. Fluctuation may be difficult to detect, owing to the depth at which the fluid is placed. On observing the movements of the abdominal wall during respiration, it will be noticed that they cease at a point some distance above Poupart's ligament, instead of reaching to the groin as in health. At this stage of the disease, recovery may take place by the abscess discharging itself into the cæcum, but this can only occur if the tissues round the abscess are sufficiently consolidated to prevent fæcal extravasation, and if the opening is sufficiently free to drain the cavity. Under other conditions, the communication with the gut only aggravates the disease and hastens the advance of the abscess. Should the abscess continue to advance without this complication, the swelling increases, redness and œdema appear above the outer end of Poupart's ligament, and fluctuation becomes distinct. In the great majority of cases the abscess remains limited to the iliac fossa, extension upwards towards the kidney, or inwards towards the pelvis, being very rare. Perforation of the iliac fascia and extension downwards to the thigh are also extremely rare.

If the abscess from the beginning communicates with the gut, or if it continues to extend as a consequence of imperfect drainage after opening into the cæcum, the progress of the disease is usually more acute. The temperature is higher, the constitutional disturbance greater, and rigors are not uncommon. In fact, the contents of the cavity now being necessarily very foul, symptoms of septicæmia or pyæmia may appear before the pus reaches the surface. Extensive burrowing, either upwards and inwards, or downwards upon the thigh after perforation of the fasciæ, is also far more common than in the non-perforating abscess. The chief local symptom of communication with the gut is the presence of gurgling or crepitation on manipulation, and tympanitic resonance on percussion over the swelling in the iliac fossa.

Both forms of abscess, if unrelieved by treatment, usually perforate the abdominal muscles near the anterior iliac spine. They then expand over the iliac region beneath the deep layer of the superficial fascia of the abdomen. Thus, an apparently superficial abscess, on being opened, may be found to communicate by a narrow neck with a large cavity in the iliac fossa. Less frequently, the pus burrows between two of the muscles entering into the abdominal wall. Finally, the abscess will burst, discharging extremely offensive pus. If there is no communication with the gut, the offensive odour is merely due to the close contiguity of the fluid with the bowel, and soon disappears. If the gut is perforated, fæcal matter is mixed with the discharge, and, as the cavity contracts, a fæcal fistula or artificial anus may remain, according to the size of the opening.

Diagnosis.—An extra-peritoneal perityphlitic abscess has to be distinguished from—(*a*) an ordinary iliac or psoas abscess connected with disease of the bones of the pelvis or the vertebræ; (*b*) an acute abscess following a strain or other injury of the

psoas or iliacus; (*c*) a perinephritic abscess extending downwards; (*d*) an abscess following pelvic cellulitis, extending upwards and outwards into the iliac fossa. The diagnosis is often extremely difficult. If the abscess is chronic, and is accompanied by considerable signs of irritation of the psoas, and if it extends down to the thigh beneath Poupart's ligament, it is probably connected with the bones. An acute abscess, early passing under Poupart's ligament, would also have probably commenced beneath the iliac fascia. A perinephritic abscess, by the time it reaches the iliac fossa, would probably cause distinct fulness in the lumbar region, and would, in the great majority of cases, be accompanied by pus in the urine. Pelvic cellulitis occurs almost exclusively in women, and is recognised by a vaginal examination. Still, as a true perityphlitic abscess may extend upwards to the kidney and inwards to the pelvis, and may, moreover, perforate the fasciæ and extend to the thigh, it is evident that the diagnosis must be, in many cases, very difficult. Even the presence of gas in the cavity is not proof that the abscess is truly perityphlitic, as both perinephritic abscesses and those arising in pelvic cellulitis have been known to perforate the intestine. The diagnosis must, in many cases, depend very much upon the previous history, and even here it is not always easy to distinguish between attacks of typhlitis and of renal colic.

Pathology.—The post-mortem appearances present nothing peculiar. The interior of the abscess is frequently foul and the walls sloughing.

Treatment.—The prevention of suppuration in typhlitis belongs rather to the physician than the surgeon. It is sufficient to state here that rest, hot fomentations, restricted diet, and moderate doses of opium form the essential features of the treatment. Purgatives and enemata are calculated to increase the danger of suppuration. When there is reason to believe that suppuration has taken place, if the symptoms are not very acute, the same treatment may be continued for a short time in the hope that the abscess may discharge itself by the bowel. As soon as the swelling becomes superficial, and the hope of spontaneous cure is past, an opening should be made. This should not be delayed after it is evident that the abscess is advancing towards the surface. Should any doubt exist as to the presence of pus, the swelling must be explored with the aspirator, but in such cases aspiration is seldom sufficient to cure the disease. If the symptoms are not very acute, it may, however, be tried once or even twice before making an opening. If the pus is very offensive, or if it contains fæcal matter, it is better to open at once. The opening should be made by an incision close to the anterior spine, if possible. The skin and fascia and the external oblique only need be divided with the knife, the deeper parts being opened up with a pair of polypus-forceps. A large drainage-tube should then be inserted, and some form of antiseptic dressing applied. Should fæces escape with the pus, little can be done, beyond drainage and cleanliness, to avoid the formation of an artificial anus or fæcal fistula. Should these form, their treatment is most unsatisfactory. The opening in the bowel being at the posterior part of the cæcum, it is impossible to reach it, and the gut is too firmly fixed by adhesions for it to be possible to perform the operation of enterectomy, as has been done for artificial anus in other situations.

Intra-peritoneal Perityphlitic Abscess is, almost invariably, the result of perforation of the vermiform appendix. Should any disease lead to perforation of the cæcum in the part covered by peritoneum, rapid death from general peritonitis almost always results.

Perforation of the vermiform appendix is most commonly caused by the presence of a concretion or foreign body within it. According to Dr. Fenwick, who has collected and analysed 129 published cases, amongst those in which the nature of the obstructing body is recorded, 28 were concretions, 14 hardened fæces, and 5 foreign bodies. Amongst the cases in which no concretion was found, tubercular ulceration seems to have been the most common cause of perforation, and a few occurred during or after typhoid fever. Concretions are most common in males under twenty years of age.

The effects produced by perforation of the vermiform appendix will vary with the anatomical relations of the part and the situation of the ulceration. According to Mr. F. Treves, the appendix commonly lies behind the end of the ileum and its mesentery, and is directed upwards and towards the left. In the only other common position it ascends vertically behind the cæcum. It may, however, be so placed that its free end lies at the brim of the pelvis. If perforation takes place near the attached end, or if the whole tube lies behind the cæcum, the abscess would be in the same situation as that resulting from disease of the cæcum,

and would be indistinguishable from it. When the appendix occupies its more common situation, and when the perforation occurs in the free part, it is followed either by general peritonitis, usually fatal under a week, or by the formation of a collection of pus enclosed in a cavity, formed by the surrounding coils of intestine firmly united to each other by adhesions. According to Dr. S. Fenwick, in 95 cases of which accurate details could be obtained, 38 presented localised collections of pus.

Symptoms. — Premonitory symptoms may be entirely wanting, but occasionally there is a history of obscure pains in the right iliac fossa, or of periodic attacks indistinguishable from ordinary typhlitis.

When the abscess forms behind the cæcum, the symptoms are those already described of extra-peritoneal perityphlitic abscess.

In the cases in which the perforation is followed by diffuse peritonitis, there is usually a sudden invasion, often during some violent exertion. The pain commences in the right iliac fossa, but soon extends to the whole abdomen. There is constipation, distension of the abdomen, and absence of evident movement of the intestine. The abdomen is tender, but most markedly in the right iliac fossa, where some fulness may be felt. The symptoms are much less severe than those of perforation of the stomach or other parts of the intestine, as the extension of the inflammation is less rapid, owing to the absence of the abundant extravasation of the intestinal contents. For the same reason collapse is not marked. Vomiting, often of dark-coloured matter, is a marked symptom, as in all other forms of peritonitis.

The symptoms of perforation with localised peritonitis are much more obscure. The invasion is usually somewhat sudden. There are localised pain and tenderness in the right iliac fossa. The pain resembles colic in character. There is usually constipation, but it may alternate with diarrhœa. Vomiting is commonly present. After a day or two, an irregular, diffused elastic swelling may be felt in the right iliac region. It is most commonly situated rather higher up and more internal than the swelling formed by an extra-peritoneal abscess. At this time rigors are not uncommon, and the temperature may reach 103° to 104° F. If unrelieved by treatment the swelling increases, and most commonly after a time, perhaps extending into the third week, the symptoms of general peritonitis supervene and the patient dies. At no time, as a rule, can fluctuation be felt in the swelling, owing to its deep situation and the difficulty of fixing it. Should the abscess lie nearer the pelvis than usual, there may be irritability of the bladder, and sometimes a firm mass can be felt from the rectum, composed of the adherent coils of intestine round the abscess. Cases have been recorded in which recovery took place by the abscess discharging itself into the bowel, but such a fortunate issue is so rare that it cannot be taken into consideration. Almost every case, if not relieved by operation, will die.

Pathology.—At the post-mortem examination, general peritonitis with purulent fluid in the peritoneal cavity is the most marked feature. The amount of fluid varies considerably, but is often not very great. The intestines are intensely injected, and adherent to each other by soft adhesions. In the localised form, a cavity is found containing pus, the walls being formed of the surrounding intestines glued together by firm adhesions.

Diagnosis.—In the diffuse form, the diagnosis from other forms of perforative peritonitis can only be made by the comparative absence of collapse, by the commencement of the pain in the right iliac fossa, by the tenderness in that region, and by the somewhat gradual extension of the inflammation to the peritoneum generally. The localised form most closely resembles simple typhlitis, and sometimes can hardly be distinguished with certainty. As a rule, the swelling is more diffused and more acutely tender at an early period than in simple typhlitis, and the constitutional symptoms are much more marked.

Treatment.—Until recently, patients suffering from perforation of the vermiform appendix were practically left to die under the soothing influence of opium, when their end was not hastened by purgatives, enemata, and other violent measures. There is, however, no doubt that whenever perforation takes place, the only chance of life lies in opening the abdomen early, and freely draining the cavity. This is applicable to those cases in which there is general peritonitis, and still more so to those in which the mischief is localised, whenever a diagnosis can be made.

The incision should, as a rule, be made above the outer part of Poupart's ligament, and should be about three inches in length. The muscles should be carefully divided and the peritoneum freely opened. The vermiform appendix should then be sought for, and, if it be found and is evidently

diseased, it may be ligatured with catgut and cut away. If there is diffused peritonitis, with purulent fluid amongst the coils of intestine, an attempt may be made to clean the cavity by means of sponges, squeezed as dry as possible after being soaked in some antiseptic solution, such as carbolic acid (1 in 40), corrosive sublimate (1 in 500), or tincture of iodine (fʒij. to Oj.). If the pus is distinctly localised in a cavity, it is better not to attempt to clean it out, for fear of breaking down the surrounding adhesions. After the operation a large drainage-tube should be inserted, and the wound closed as far as possible by sutures. The operation should be performed with antiseptic precautions, and some antiseptic dressing be applied afterwards.

It may be necessary, in some cases, to modify the incision. Should the swelling be situated nearer the middle line, the abdomen might be opened at the outer border of the rectus, but care must then be taken not to wound the epigastric artery. The middle line can seldom be a suitable situation for the incision, as, being so far removed from the seat of the disease, the drainage would not be efficient.

This operation has been performed in a considerable number of cases with very encouraging results. MARCUS BECK.

PES GIGAS (*Synon.* Macropodia).—This affection is that form of congenital hypertrophy which is limited to part of one extremity, usually the foot, though occasionally the tissues of the leg as well are affected.

Two varieties are met with—(*a*) *symmetrical* or *true*, in which the whole foot or limb is colossal, all its parts being developed to an equally gigantic degree; (*β*) *unsymmetrical* or *false*, in which only portions of the foot are altered, either by large fatty excrescences, or by one or two gigantic toes, or by both conditions together. The tissues chiefly affected are the integumentary and the bony. Then there is great increase of the fatty subcutaneous tissue, which often takes the shape of pads or lumps; coexisting with these, capillary nævi, often of large extent, may be met with; other angeiomata are more rare. The arteries do not seem liable to change, the veins are often varicose and thickened, the lymphatic vessels dilated, whilst the glands are unaffected.

Where colossal toes are present, the phalanges and metatarsal bones are enlarged and greatly elongated, but all parts of the enlarged bones are usually in proportion. With regard to the muscles and tendons going to the enlarged toes, the former are not usually over-developed, the latter are much elongated. In some cases, a confused matting together of the muscles in the sole has been observed. The ligaments are much thickened, and secondary articular distortion is not infrequent. The affection never interferes with birth. The causes are quite unknown.

Treatment.—Pressure is always to be tried as early as possible and persisted in, by means of strapping, elastic stockings, or Martin's bandage. If pressure be made judiciously and perseveringly, steady diminution in the size of the foot or limb may confidently be expected. But it must be remembered that pressure, however used, must not be applied too tightly in young subjects, especially where a nævoid condition of the skin is present, otherwise ulceration, hæmorrhage, and a low form of erysipelas are only too probable.

Ligature of the main artery has been suggested, but, judging from the varying results which have followed upon its adoption for elephantiasis, this step is not to be recommended, save in cases where persevering pressure has failed, or where the congenital hypertrophy is accompanied by unusual pulsation in, or undoubted increase in the size of, the arteries, or by large angeiomata not yielding to other means.

In cases of symmetrical or true hypertrophy, amputation will not be required if pressure is made use of early and persevered with. Before proceeding so far, the surgeon will do well to bear in mind that 'an unnaturally heavy and cumbrous limb is after all as good as a wooden leg' (Holmes).

In cases of unsymmetrical hypertrophy, amputation of any large toes should be resorted to early. If this enlargement coexist with localised overgrowths of fat, so as to render the foot cumbrous and the wearing of boots difficult, removal of a portion or all of the foot should be resorted to.

W. H. A. JACOBSON.

PHAGEDÆNA.—This term is applied to a disease which occasionally occurs in hospitals in this country, and also in private houses, and which by some is designated as 'hospital gangrene.' It differs essentially, however, from this disease, both in the slighter ravages which it produces, and also in the fact that it may originate quite independently of any hospital contamination or influence.

Causes.—There can be no doubt that in many cases this disease is distinctly syphilitic in its origin; but there can be as little doubt that it may occur quite independently

of this cause. During the year 1863 a severe epidemic of this disease occurred in St. George's Hospital, no less a number than ninety-two cases occurring. Many of those attacked were quite young children, or individuals in whom there could not arise the slightest suspicion of syphilis, and it seems impossible to believe that the whole of these ninety-two patients could have been the subjects of that malady. It is, no doubt, possible that this disease may be generated by dirt and overcrowding, and therefore owe its origin, in some cases, to defect in hospital management, and want of proper hygienic precautions; but, nevertheless, the facts elicited in the above-mentioned outbreak prove that it cannot always be attributed to this cause. For, of the ninety-two patients suffering during this outbreak, in only nineteen did the disease break out in the wards, the remaining seventy-three occurring out of the hospital, some of them never having been near the building until they were brought suffering from the phagedæna.

Symptoms.—The disease presents itself in two forms: in the one there is the formation of black sloughs; in the other the wound spreads by a sort of ulcerative process, and without the formation of distinct sloughs. In the former case, the wound becomes dry and loses its healthy appearance, the surrounding parts become swollen and tense, and of a bright red colour, but speedily become darker, the wound being covered with a black slough. This extends, the inflamed tissue falling into a condition of gangrene. After a time, however, the progress is arrested, a line of demarcation forms, and the slough slowly separates in the form of greyish-black viscid masses.

In the other variety, there is no formation of a slough, but a rapid liquefying or melting away of the parts. The surface of the sore assumes a greyish appearance, and becomes covered with a semi-gelatinous fluid. The edges gradually melt away into this material, and there is no swelling, œdema, or redness of surrounding tissues.

Treatment.—In considering the treatment of this affection, a distinction must be made between those cases which owe their origin to a syphilitic cause and those which do not. In the former nothing but mercury appears to have any influence in checking the progress of the disease, and the best plan of administering it is by means of local calomel fumigation. The fumes of calomel (from 15 to 20 grs.), applied locally to the sore once or twice a day, rarely fail to arrest the sloughing in a surprisingly short space of time. The non-syphilitic form requires a different plan of treatment. Here, the free administration of opium, and a liberal diet, with a judicious supply of stimulants, the sore being at the same time covered with a charcoal poultice, rarely fail to arrest the disease. Some surgeons recommend the free application of fuming nitric acid to the part, but the treatment appears to be unnecessarily severe, causes very considerable pain, and does not—at all events, in every instance—succeed in arresting the sloughing. The local irrigation of the wound with a solution of carbolic acid or sulphurous acid has succeeded, in the writer's hands, in checking the gangrene when other means have failed. Mr. Hutchinson has recommended, in these cases, the treatment by a warm bath. The patient is placed in a bath at a temperature of about 96° to 98° F., and is kept there for eight consecutive hours. This is repeated daily until the gangrene is arrested. While in the bath, care is taken to maintain the water at the same temperature. Those who have tried this plan speak warmly of its success.

T. Pickering Pick.

PHANTOM TUMOURS. *See* Abdominal Tumours, Diagnosis of.

PHARYNGEAL STENOSIS. — *Definition.*—A constriction or narrowing of some portion of the pharynx, due to cicatricial contractions following ulceration.

Cause.—Generally syphilitic, occasionally strumous, and, more rarely, simple ulceration.

Pathology.—The constriction may be met with in three situations—first, between the naso- and mid-pharynx; secondly, between the mouth and pharynx; thirdly, in the lower pharynx about the level of the hyoid bone. Stenosis occurring at the junction of the pharynx with the œsophagus will be found described under *Strictures.* See Œsophagus, Injuries and Diseases of the.

I. In the first situation, the stenosis is produced by the adhesion of the soft palate to the posterior wall of the pharynx, into contact with which it has been drawn by the contraction of cicatrices following ulceration about the posterior pillars of the fauces. In this way the upper part of the pharynx may be completely cut off from the rest of that cavity, and from the mouth; but usually a small aperture is left between them about the situation of the uvula, which is itself generally destroyed by the ulceration.

II. The constriction between the mouth and the pharynx is due to the soft palate being drawn downwards towards the base of the tongue, through contractions and adhesions following ulceration about the anterior pillars of the fauces. Here the stenosis is never complete, although the aperture left for the passage of food, &c., between the soft palate and base of the tongue may be exceedingly small.

III. Stenosis in the lower pharynx is the result of an extensive ulceration of the pharyngeal walls about the level of the hyoid bone, the subsequent contraction of the cicatrices drawing in the tissues concentrically, so that the pharynx assumes in this situation an hour-glass shape. The stricture is situated above the opening of the larynx, and the aperture left has to serve for the passage of both food and air. Complete stenosis, therefore, is incompatible with life; but the writer has seen the pharynx so constricted at this spot that it would barely allow the passage of a crow-quill.

Symptoms. — When the stenosis is between the naso- and mid-pharynx, beyond some alteration in the voice but little inconvenience is usually experienced. When between the mouth and pharynx, in addition to some alteration of the voice, there will be more or less difficulty in swallowing according to the extent of the contraction. In stenosis of the lower pharynx, there is increasing difficulty in swallowing, with attacks of cough and dyspnœa on exertion. Soft food only can be swallowed, and this but slowly and in small quantities at a time, while paroxysms of suffocative dyspnœa occur if a larger morsel than usual is attempted to be taken.

Diagnosis.—In the first and second situations the stenosis is evident on inspection; and in the third it is readily made out by the laryngoscope.

Treatment. — Stenosis between the upper and mid-pharynx seems to be beyond the reach of treatment. Were the aperture enlarged it would rapidly re-contract, and, could it be kept open, would only cause the patient greater inconvenience by allowing the regurgitation of food, &c., through the nose. When swallowing is seriously impeded by a constriction between the mouth and pharynx, the tissues may be divided in an upward direction either by the knife or galvano-cautery, and re-contraction prevented by the daily passage of a bougie. But, if little inconvenience is felt, the stricture is better let alone. Stenosis of the lower pharynx, when at all extreme, calls imperatively for treatment, as life is endangered from the liability of a portion of food to block up the narrowed passage. With the aid of the laryngoscope, the cicatricial tissue should be divided in the middle line in a backward direction, by a guarded knife or the galvano-cautery. The writer has found a Ricord's urethrotome admirable for the purpose. Further dilatation may subsequently be obtained, and re-contraction prevented by the daily passage of bougies of increasing sizes. Tracheotomy as a preliminary had better be done, since the manipulation sets up very severe paroxysms of cough and dyspnœa, and, during division of the tissues, death has followed from blood escaping into the trachea.

W. J. Walsham.

PHARYNGOTOMY. *See* Œsophagotomy.

PHARYNX, Diseases of the.— Pharyngitis, or inflammation of the pharynx, although it sometimes occurs alone, is generally associated with more or less inflammation of the palate and fauces, and has a tendency to spread to the larynx and nasal passages. The inflammation is commonly of the catarrhal variety (*acute and chronic catarrhal pharyngitis*); but it may fall chiefly upon the glands of the pharynx (*granular or follicular pharyngitis*), or more rarely may spread deeply and end in diffuse suppuration (*phlegmonous or suppurative pharyngitis*). Sometimes it is attended with deficient secretion and atrophy of the mucous membrane (*pharyngitis sicca*), and occasionally it assumes an erysipelatous character (*erysipelatous pharyngitis*), and is then generally associated with erysipelas of the face.

(*a*) *Acute Catarrhal Pharyngitis*, or common sore-throat, is generally the result of exposure to cold. It is attended with more or less fever and malaise, and usually terminates spontaneously in a few days. The familiar symptoms of soreness or pain in swallowing, hoarseness, and perhaps slight deafness, and the local redness and swelling vary according to the intensity and extent of the inflammation. Confinement to the house, and an aperient followed by a simple saline mixture and an astringent gargle, are all that is generally required in the way of treatment.

(*b*) *Chronic Catarrhal Pharyngitis*, or 'relaxed sore-throat,' may follow on repeated attacks of the acute, or be induced by gastric disturbance, the abuse of alcohol,

tobacco, &c. It is characterised by a sense of dryness of the parts, especially in the morning, by a constant desire to moisten or clear the throat, and, if the uvula is elongated, by a tickling cough. The mucous membrane is slightly red and swollen, and frequently covered with tenacious mucus, and the uvula is often relaxed and elongated.

Treatment.—The exciting causes must be carefully avoided, the bowels regulated, and the health improved by tonics. Locally, an astringent gargle or lozenges may first be tried; but, if the affection be obstinate or of long standing, local remedies, to be effectual, must be applied either by the brush or in the form of sprays. Amongst the remedies that may be thus used with advantage are chloride of zinc (gr. x.–xx. to f℥j.) or tannin dissolved in ether, applied with the brush; and sprays of chloride of ammonium, bicarbonate of sodium, alum, &c. (gr. v.–xxx. to f℥j.). When the uvula is much elongated, its extremity should be removed.

(*c*) *Granular or Follicular Pharyngitis*, also known as 'clergyman's sore-throat,' is a chronic inflammation of the mucous follicles of the pharynx, and is not infrequently associated with a similar condition of the mucous follicles of the naso-pharynx, posterior nares, entrance of the larynx, and upper part of the œsophagus.

Causes.—A debilitated, and especially a strumous constitution, appears to predispose to the affection; whilst long-continued over-exertion of the voice, exposure to cold, and the breathing of air charged with irritating particles or fumes are amongst the chief exciting causes. Hence the affection, though met with in others, is most common in those engaged in public speaking, as clergymen, auctioneers, &c., and in photographers, *employés* in chemical works, &c.

Pathology. — The constant contact of cold or vitiated air renders the mucous membrane dry, and stimulates the follicles to over-secretion. The extra work thus thrown upon the follicles leads to catarrhal proliferation of their epithelium, blocking of their orifices, retention of secretion, and general hypertrophy of the tissues of which they are composed. In some cases, the hypertrophy prevails and the secretion rapidly diminishes; in others, the secretion continues excessive, and the follicles become distended and exude a viscid mucus or even a caseous material, whilst very little hypertrophy ensues. Hence, the disease has been divided into the hypertrophic and exudative varieties. In the hypertrophic form it would appear, from the observations of Stoerk, that isolated proliferations of the general epithelial covering of the pharynx also occur.

Symptoms.—A sense of dryness in the throat, hoarseness, loss of power over the voice, a continual hawking and desire to swallow for the purpose of clearing the throat, and a tickling, dry, harsh, or painful cough, are commonly complained of in the early stages of the disease. Later on, these symptoms become more pronounced, and complete loss of the voice, pain and difficulty in swallowing, impairment of hearing, and even permanent deafness and loss of the sense of smell may supervene, as the disease spreads to the surrounding parts. The pharynx presents somewhat different appearances, according as the disease assumes the hypertrophic or exudative form. In the former, the hypertrophied follicles and epithelial elevations give the posterior wall of the pharynx a characteristic granular appearance. The granules are at first scattered and isolated, of a lenticular shape, and of a deeper colour than the rest of the mucous membrane; but subsequently they coalesce, forming flattened masses or ridges. In the exudative form, the follicles appear distended with secretion, and a viscid mucus can often be seen adhering to them. The mucous membrane between the granules may be either hypertrophied or atrophied, and is generally traversed by large and tortuous veins.

Treatment.—The general health must be improved by attention to the secretions, by tonics, and change of air, all exertion of the voice being forbidden, and every known source of irritation avoided. Locally, the granulations must be severally destroyed by the galvano-cautery wire, the actual cautery, or the solid nitrate of silver fused on the end of a silver probe. Two or three of the granulations only should be destroyed at a sitting, which, as a rule, should be made not oftener than twice or three times a week. Between the application of these remedies, the parts may be painted with solutions of chloride of zinc, or sprayed with weak astringent lotions of alum, tannin, and the like. To allay the irritation sometimes caused by the destruction of the follicles, lozenges containing opium, chloride of ammonium, or bromide of potassium, or inhalations of steam may be prescribed.

(*d*) *Phlegmonous or Suppurative Pharyngitis* may occur spontaneously, or follow an injury of the pharynx. The inflammation spreads deeply and widely; the submucous tissue, and even the constrictor

muscles, become infiltrated with inflammatory products; and suppuration frequently ensues. The pus may track down the course of the pharynx and œsophagus, or make its way forward into the tissues of the neck, compressing the upper air-passages and obstructing the entrance of the larynx.

The *symptoms*, at first those of ordinary sore-throat, rapidly become alarming. Swallowing becomes difficult or impossible, respiration laboured, the pulse rapid, and the tongue furred and brown. The pharynx is intensely red and swollen, the neck often brawny and œdematous, and death usually follows, in three or four days, from sudden spasm of the glottis.

Treatment.—The strength must be supported by fluid nourishment and stimulants. Brand's extract, strong beef-tea, and the brandy-and-egg mixture, should be given in frequently repeated doses, or administered by the rectum if the patient is unable to swallow. The atmosphere should be kept moist and steam occasionally inhaled, and sulphate of quinine (gr. v.) taken every three or four hours. Preparations for instant tracheotomy should be made, and the operation performed as soon as it becomes evident that life is in danger from spasm of the glottis. Should suppuration occur in any accessible situation, an incision, to allow free exit to the pus, should be made.

(*c*) *Pharyngitis Sicca*, or atrophic pharyngitis, appears to be the result of repeated attacks of catarrh. The mucous membrane is thin, dry, and glazed, the normal secretion is completely absent, and the veins are varicose. The symptoms are those of soreness and dryness of the throat, on speaking and swallowing. The disease admits only of palliative treatment. For this purpose cubebs, given both locally and internally, inhalations of steam, tincture of benzoin, and the like, will be found useful.

Ulceration.— Ulceration, when it attacks the pharynx, is seldom limited to that cavity, but, like inflammation, more often affects at the same time the soft palate, fauces, and tonsils; whilst not infrequently the base of the tongue, the epiglottis, and sometimes the larynx and nasal cavities also become involved in the process. Ulceration of the pharynx may occur in the course of syphilis, struma, and tuberculosis, on the breaking down of epitheliomatous and other growths, on the bursting of herpetic vesicles, and in connection with ulceration of the tonsils in the affections known as simple and malignant ulcerative sore-throat.

(*a*) *Syphilitic Ulceration* may be divided into the superficial and deep. Superficial ulceration may occur both in the earlier and later stages of syphilis. In the earlier stages it is generally due to the erosion of syphilitic mucous patches, then so common about the fauces, palate, and tonsils. The ulcers are generally symmetrically arranged, quite superficial, sharply defined, covered with a grey mucopurulent discharge, and surrounded by a slight areola of redness. In the later stages, superficial ulceration often assumes a serpiginous form, and extends widely over the pillars of the fauces and palate. Deep ulceration is nearly always due to the breaking down of gummata, and only occurs in the later stages of syphilis. The ulcers are circumscribed, their edges sharp-cut, slightly overhanging, and surrounded with an areola of a characteristic coppery red colour, and their base is covered with a yellow purulent discharge, mixed with shreds and *débris* of breaking-down tissue. The ulceration is sometimes limited to the posterior wall of the pharynx, but generally attacks simultaneously the soft palate, tonsils, fauces, and base of the tongue, and frequently the larynx and nasal cavities. It often extends deeply, leading to caries or necrosis of the adjacent bones; while the subsequent cicatrisation may lead to various forms of occlusion and stricture of the pharynx. *See* Pharyngeal Stenosis.

Treatment.—For the ulcerations occurring in the earlier stages, small doses of mercury should be given internally, while the throat may be gargled with 'black-wash,' or painted with a solution of nitrate of silver, chromic acid (gr. x. to f℥j.), or boroglyceride. For the later ulcerations, large doses of iodide of potassium (gr. x., xv., or even gr. xxx. three times a day), combined with decoction of cinchona or quinine, should be given internally; whilst the parts should be cleansed with gargles of chlorate of potash, carbolic acid, or chlorinated soda, and then dusted with iodoform, or painted with a strong solution of nitrate of silver.

(*b*) *Strumous Ulceration.*— Many pathologists do not admit the existence of strumous ulceration in the pharynx, the variety here described as such being regarded by them as the result of congenital syphilis, modified by the strumous constitution of the patient. This form of ulceration is most frequently met with in badly nourished and strumous children, especially of the poorer classes. Generally

beginning in the soft palate, it gradually spreads to the fauces and back of the pharynx, and sometimes to the hard palate and nasal cavities, slowly but persistently destroying the parts and often producing great deformity; more rarely it begins in the posterior wall of the pharynx. The ulceration is generally sharply defined, though the mucous membrane around may be slightly thickened; the edges of the ulcer are raised and everted, not sharp-cut as in syphilis, nor surrounded by the coppery red zone so characteristic of the latter affection. The base is covered by a ropy, greyish, muco-purulent discharge, through which here and there granulations are seen projecting, giving it a mottled, pinkish appearance.

Treatment.— Cod-liver oil, combined with syrup of iodide of iron, or the compound syrup of phosphate of iron in drachm doses, with unstimulating diet and residence at the sea-side, are the constitutional measures attended with the best success. Locally, the parts should be well cleansed with a weak carbolic lotion, and then dusted with iodoform, or cauterised with nitrate of silver fused on the end of a probe. If there is any suspicion of a syphilitic taint, anti-syphilitic remedies should be combined with local treatment.

Tubercle.— Deposits of miliary tubercles are occasionally met with in the pharynx, as one of the local manifestations of acute general tuberculosis. In the earlier stages, the tubercles appear as scattered or confluent patches of grey granulations on the sides and posterior wall of the pharynx, often also on the palate and roof of the mouth. They differ from syphilitic mucous patches, for which they have been mistaken, in the absence of the inflammatory zone of redness, and in their more translucent appearance. Later, they break down, leaving small lenticular ulcers with slightly overhanging and hyperæmic edges and a caseous-looking base, while fresh crops of miliary tubercle are deposited around. The symptoms are those of acute pulmonary consumption, with local soreness of the throat, and the patient usually succumbs to the lung-affection in a few months.

Herpes.—An eruption of herpes, similar to that which occurs on the skin, is occasionally met with in the pharynx. The affection appears to be of neurotic origin, and is most prevalent in damp and cold climates. It usually runs an acute course of a week or ten days, and is attended with more or less smarting pain, soreness of the throat, and fever. The eruption is mostly limited to one side, and is more common on the fauces and soft palate than on the posterior wall of the pharynx, while a similar eruption is often present upon the lips and corners of the mouth at the same time. The vesicles either disappear in a few days, leaving no trace, or they break down into small superficial ulcers, which in some cases become covered with a false membrane. When several such ulcers become confluent, the membrane covering them may be mistaken for that of diphtheria; but the presence of a few scattered ulcers as yet uncovered by membrane, and of similarly shaped, isolated patches of the membrane itself, and the absence of any tendency of the disease to spread, are points which will usually serve to distinguish herpes. An aperient, followed by small doses of quinine and the use of a simple gargle, is all that is generally required by way of treatment.

W. J. Walsham.

PHARYNX, Extirpation of the.— This operation has within the last few years been performed in some instances for the removal of growths which, from their situation in the lower pharynx, have been hitherto considered beyond the reach of surgery. The following is the method devised by Langenbeck:—Tracheotomy is first performed, and the trachea plugged with Trendelenburg's tampon-canula. The head being well drawn back and the face turned to the opposite side, an incision beginning just below the lower jaw, midway between the symphysis and the angle, is carried over the greater cornu of the hyoid bone in the direction of the sterno-hyoid to just above the tracheal wound. The integuments, platysma, and omo-hyoid are divided, and the posterior belly of the digastricus and stylo-hyoid muscles detached from the hyoid bone. The superior thyroid, lingual, and facial arteries and veins, and the superior laryngeal nerve and its external branch are next divided. The pharynx is then opened, and the larynx drawn firmly to the opposite side, and rotated so that its posterior surface is well exposed. The front and side walls of the pharynx are now detached from their connections, and the posterior wall is divided transversely on a level with the lower border of the soft palate, and separated from the vertebral column. The pharynx, with the growth, is then finally removed by severing it from the œsophagus. A tube should be placed in the œsophagus

for the purpose of feeding the patient, and the tampon-canula retained in the trachea for some days, to further guard the air-passages from the entrance of food, saliva, and the secretions from the wound.

W. J. Walsham.

PHARYNX, Injuries of the.—These may be classified under—(1) Incised, lacerated, punctured, and gunshot wounds, inflicted either from within, through the mouth, or from without, through the neck; (2) burns and scalds, due to the sudden passage of flame, as in a gas explosion, swallowing boiling water or inhaling steam; and (3) charring or other chemical lesion of the mucous membrane from drinking strong acids or caustic alkalies.

(1) *Wounds* are not uncommonly inflicted from within, by the patient falling whilst holding a sharp-pointed body, as a pipe-stem or stick, in the mouth; by the forcible extraction of a sharp-angled body, as a false-tooth plate which has been impacted in the lower pharynx, by the incautious use of probangs, &c. Wounds from without are usually inflicted with a suicidal or homicidal intent. In these the pharynx is generally wounded in front, between the hyoid bone and thyroid cartilage (*see* Throat, Injuries of the). Wounds of the pharynx, particularly the punctured variety, may be attended by fatal hæmorrhage, consequent upon a large vessel being penetrated or subsequently opened by ulceration of its walls. They are not infrequently followed by acute cellulitis, due to the escape of food into the tissues of the neck, or to the instrument with which the wound was inflicted being broken off short and remaining as a foreign body. Circumscribed collections of pus may also result from like causes. *See* Retro-Pharyngeal Abscess.

(2) *Scalds* of the pharynx are most frequent in young children, from inhaling steam or drinking hot water from the spout of a tea-kettle. They should always be regarded as grave, from their liability to be followed by œdematous laryngitis.

(3) *Lesions* of the mucous membrane, caused by swallowing corrosive liquids, are generally of secondary import to the graver injuries which are usually simultaneously inflicted upon the stomach, larynx, or œsophagus. *See* Acids, Alkalies, Swallowing of.

Treatment.—For the treatment of suicidal and gunshot wounds of the pharynx, *see* Throat, Injuries of the, and Gunshot Wounds *of the Neck*. In wounds of the pharynx, attention should first be given to the arrest of hæmorrhage. Any bleeding vessel that can be seized should at once be tied. In punctured wounds about the fauces, inflicted from within the mouth, the bleeding vessel may be invisible, or if seen it may be impossible to ligature it. In such a case attempts should be made to twist it, or if this fails the forceps may be left on. If the source of the hæmorrhage cannot be discovered, and is not very severe, the patient should be given ice to suck, an ice-bag may be placed on the side of the neck, or solid perchloride of iron applied to the wound, or pressure made upon it by means of a stick wrapped round with lint. These means failing, or the hæmorrhage threatening life, the common carotid, as a last resource, must be tied. Where a foreign body, as a portion of a pipe-stem, is found in the wound, it should not be removed till the common carotid has been compressed and preparations have been made to tie it if required, as a fatal gush of hæmorrhage has been known to follow its extraction. When the wound is so situated that food is liable to escape into the tissues of the neck, the patient should be fed by the rectum for the first few days. Should suppuration occur, an early outlet for the pus must be made. *See* Retro-Pharyngeal Abscess.

In burns and scalds of the pharynx, and in injuries from swallowing corrosive liquids, &c., the patient should be carefully watched for signs of œdematous laryngitis, and everything should be in readiness for tracheotomy. Milk diet should be prescribed, or nutrient enemata if the patient is unable to swallow. *See* Scald of the Glottis.

Foreign Bodies in the Pharynx.—Fish bones, pieces of meat, false-tooth plates, and coins are the foreign bodies that have most frequently been found in the pharynx. The situation at which they are most liable to become impacted is opposite the cricoid cartilage, where the pharynx narrows to join the œsophagus; but they may also become lodged between the tongue and epiglottis, and, in the case of fish-bones or pins, in the tonsils or between the pillars of the fauces. Bodies like the latter, moreover, may be impacted lengthways across any part of the cavity.

Symptoms.—These necessarily vary according to the nature and situation of the foreign body and the length of time that it has been impacted. A small sharp-pointed body, as a fish-bone, may cause a pricking sensation in the parts and some distress or pain in deglutition, symptoms which, owing to the scratching of the mucous membrane,

may continue after the bone has been dissolved or swallowed. Large bodies, as a false-tooth plate, may cause great pain on swallowing, or render the act altogether impossible, or may produce severe paroxysms of cough and dyspnœa from reflex spasm of the glottis, or from direct pressure upon the larynx; while a large mass of food may cause fatal suffocation by blocking up the pharyngeal opening of the larynx. Though cases are on record where foreign bodies have remained in the pharynx for a long time without causing much irritation, their continued presence has usually led to ulceration, perforation and fatal hæmorrhage, peri-œsophageal abscess, or œdematous laryngitis.

Diagnosis.—A careful inspection, aided by the laryngoscope and finger, will usually detect a foreign body if lodged about the fauces, base of the tongue, or region of the cricoid cartilage. When beyond the reach of the finger, its detection may be difficult. Nothing may be felt externally, and it may be only after a long and patient examination by pharyngeal forceps, œsophageal bougies, coin-catchers, &c., with the patient under chloroform, that its presence and situation is at last discovered.

Treatment.—If a portion of meat or other substance is obstructing respiration, the finger should at once be plunged into the throat and attempts made to dislodge it. If these fail and suffocation is imminent, instant laryngotomy should be performed. A fish-bone, pin, or false-tooth plate, when within reach of the finger, may often be hooked out with the nail, or, if seen, be readily extracted with the dressing-forceps. When the foreign body is too low down to be felt by the finger, its extraction, especially in the case of a false-tooth plate, may tax the ingenuity of the surgeon. The patient had better be put under chloroform, and attempts made to grasp the plate with pharyngeal forceps having blades opening in different directions. By passing these closed, and using them as a sound, the plate may be struck and a fair estimate formed of its position. Considerable force may have to be used in its removal, as the hooks, by which the plate is attached to the teeth, often become embedded in the tissues. When the forceps fail, attempts should be made to snare the foreign body with one of the various forms of coin-catchers, or to sweep it out in front of the bristles of the expanding horsehair extractor. Whilst passing these instruments beyond the foreign body, care must be taken not to force it lower down the passage. Sometimes an emetic, or, where this could not be swallowed, one-sixth of a grain of apomorphia injected subcutaneously, has succeeded. This treatment, however, is not unattended with danger, and should only be employed under exceptional circumstances. If attempts at extraction fail, three courses are open: to remove the foreign body by the operation of Œsophagotomy; to try and push it down into the stomach; or to allow it to remain, in the hope that it may become loosened by ulceration. The first plan of treatment is, in the writer's opinion, the right one to pursue. W. J. Walsham.

PHARYNX, Tumours of the.—New-growths in the upper part of the pharynx, and at the junction of its lowest part with the œsophagus, are treated of in separate articles. *See* Naso-Pharyngeal Growths; Œsophagus, Injuries and Diseases of the. Nearly all varieties of tumour have been observed in the pharynx; all are rare in this situation, but the fibrous, the fibro-myxomatous, the fatty, the epitheliomatous, and the sarcomatous are perhaps the least so. Pharyngeal growths may be pedunculated or sessile, and may spring from the back or lateral walls of the pharynx, the soft palate, the base of the tongue, and the region of the epiglottis and arytæno-epiglottidean folds. They may have their origin in the mucous membrane or submucous tissue, in the fibrous covering of the vertebræ, or in the bodies of the vertebræ or intervertebral cartilages, and in the glands by the side of the pharynx. When arising behind the pharynx, they are sometimes spoken of as post- or retro-pharyngeal tumours.

Symptoms.—The tumours often attain a considerable size before the surgeon is consulted, the patient's attention being first called to them by difficulty in swallowing, obstructed breathing in certain attitudes, from the growth either pressing upon or partially occluding the opening into the larynx, or, when the growth is high up, by some alteration in speech. When arising behind the posterior wall, they push the mucous membrane before them, and appear as smooth, globular, uniform projections in the cavity of the pharynx. They may be hard and resistant, or soft and fluctuating, and fixed or movable, according to their origin and attachments. A rapidly growing sarcoma or other soft solid tumour may greatly resemble a retro-pharyngeal abscess, and the diagnosis can often only be made by puncture with a grooved needle. *See* Retro-Pharyngeal Abscess. A new-growth in the lateral wall may be simulated by an

aneurism of one of the carotids. Care only is required, however, to make the diagnosis.

Treatment.—Small and pedunculated growths may be readily removed either by ligature of the pedicle and excision, or by the cold wire or galvanic écraseur. Before deciding upon the removal of sessile and larger growths, a careful investigation of their attachments and connections should be made, both by the finger and laryngoscopic mirror, as these may be such—especially when the growth involves the lateral wall—as to preclude the possiblity of its extirpation with a reasonable chance of the patient surviving the operation. The retro-pharyngeal growths, when unattached to the vertebræ and of moderate size, may often be shelled out with ease by the finger, after a vertical incision has been made through the mucous membrane covering them. In attacking a growth of large size, where there is a probability of much hæmorrhage, preliminary tracheotomy should be performed, and the tracheal wound plugged with Trendelenburg's tampon-canula, to prevent the escape of blood into the air-passages. For malignant growths involving the arytæno-epiglottidean folds, the removal of the larynx will probably be necessary. This question is fully discussed under Larynx, Growths in the. Recently, Langenbeck has extirpated the whole pharynx for malignant growths beyond reach by the mouth. W. J. Walsham.

PHIMOSIS is a malformation of the prepuce which prevents its being retracted behind the glans penis. It is either congenital or acquired. In congenital cases, the prepuce is abnormally long, and sometimes so contracted at its orifice that it is impossible either to expose the glans penis or to effect retraction without much difficulty and pain. The skin is abundant, but the mucous membrane is shorter than usual, and the narrowing which prevents the retraction is always found at the junction of the skin and mucous membrane. Congenital phimosis is a fertile source of irritation and disease. Even when the prepuce is simply elongated, and not sufficiently contracted at its orifice to prevent its withdrawal from the glans, it still favours the retention of the secretions beneath it, which may result in balanitis. But, short of this, there can be no doubt that an elongated prepuce is frequently the cause of much local irritation, leading to the habit of masturbation. When, however, the orifice of the prepuce is so narrow as to prevent retraction, the results are of a much more serious nature. One of the most common symptoms is nocturnal incontinence of urine, which frequently resists all attempts at cure short of circumcision.

Occasionally the long, contracted prepuce acts as an impediment to the passage of the urine, and gives rise to symptoms resembling those of stone in the bladder. In very extreme cases of this sort, the prepuce becomes enormously distended by the retention of the urine beneath it, requiring the pressure of the hand to extrude it through the orifice. The severe straining to void the urine under these circumstances is a frequent cause of hernia in young children, and it is also stated that hydrocele and phimosis are often associated. The effect of this deformity on the nervous system has been noticed by Professor Sayre of New York, who states that paralysis of the lower extremities is often a direct result of the irritation caused by congenital phimosis. Erichsen also states that he has seen cases of chorea arising from the same cause. In after-life the evils of phimosis are not abated. There is no doubt that the immunity from chancrous affections, known to exist amongst the Jews, is due to the rite of circumcision, and it is inferred, from the statistics collected by Jonathan Hutchinson, that a long prepuce renders its possessor more liable to the infection of syphilis. At any rate, it makes the treatment of venereal disease more difficult, and in some cases impossible without recourse to an operation.

Congenital phimosis is sometimes a complete bar to sexual intercourse, or even when connexion has been effected, conception is prevented owing to the retention of the seminal fluid beneath the foreskin. It has been asserted, without much foundation, that this malformation predisposes to cancer of the penis.

Acquired phimosis is the result of inflammatory deposits in the prepuce, caused generally by balanitis, chancre, or repeated attacks of herpes preputialis. When it results from a balanitis the swelling is simply œdematous, accompanied by a profuse purulent discharge from the orifice of the prepuce. If, however, it is due to indurated chancre, a point can generally be felt beneath the prepuce more painful and indurated than the surrounding tissue. *See* Balanitis. In advanced life, the preputial orifice will be found sometimes contracted from repeated attacks of herpes, especially in gouty subjects.

The *treatment* of phimosis, whether congenital or acquired, generally requires surgical interference. In congenital phimosis,

there can be no doubt as to the propriety of circumcision in all cases of elongated prepuce with contracted orifice; and the necessity for the operation should be represented to parents even in the absence, at the moment, of painful symptoms. In simple elongation, if there is the least difficulty in exposing the glans, it is better to err on the side of operative interference.

If phimosis is associated with nocturnal incontinence of urine, it is far better at once to circumcise the child than to waste time in the constant administration of the various remedies prescribed for this condition. In cases of sexual incapacity, an elongated prepuce may frequently be shortened with good effect, and certainly, if with the elongation there is contraction of the orifice, circumcision should be recommended. Phimosis, the result of a balanitis, may of course be reduced by simple remedies, such as fomentations, hot baths, and injections; but if there is suspicion of a chancre beneath, it is better at once to expose the glans by the slitting operation. *See* CIRCUMCISION.

In cases of acquired phimosis, especially in old men, the malformation may frequently be remedied by dilating the parts either with a pair of forceps, or by a screw dilator especially constructed for the purpose. The operation may, in some cases, be facilitated by incising the orifice at two or three points with a narrow-bladed knife. PAUL SWAIN.

PHLEBITIS.—An inflammation of the veins.

Causation and Pathology.—The most purely surgical form of phlebitis is that induced by wound or contusion—traumatic phlebitis. The idiopathic form most nearly resembling this is that occurring after parturition, where the inflammation in like manner spreads directly from the open mouth of ruptured vessels, subsequently to separation of the placenta. Apart from this, acute phlebitis is almost invariably secondary either to thrombosis or inflammation of the surrounding structures, the primary changes in the former case taking place in the inner coats, in the latter in the adventitia, later becoming general. Chronic inflammatory changes may, as in the arteries, be primary, and are then due to anomalies in the force and rapidity of the venous circulation; as would be expected, however, from the less variable nature of these conditions in the veins, chronic endo-phlebitis is a much less common or serious disease than the corresponding arterial change. The inflammation may be local or adhesive, diffuse or suppurative, in character. Gouty and tubercular phlebitis are also spoken of.

Adhesive phlebitis is seen in its purest form in cases of wound. By this process the necessary obliteration is effected after wound; it is seen also in cases where thrombosis is followed by organisation. *See* HÆMORRHAGE; THROMBOSIS. Suppurative phlebitis may be secondary to suppuration of a thrombus, or to extension of inflammation from without. It is diffuse in character, and its causation resembles closely that of pyæmia. When periphlebitis occurs secondarily to cellulitis, the adventitia is principally affected; the vein is often dissected out by surrounding suppuration, and under these circumstances may slough. This is of importance, as in these cases complete thrombosis is often absent, so that hæmorrhage may result. The coats of the vein are thickened by infiltration with inflammatory new-formation, stiff, of a yellow or yellowish-grey colour, the intima opaque and more or less deeply tinged with red. This condition may extend over a large area. Besides the diffuse form of suppurative phlebitis, localised suppuration may occur in cases of adhesive phlebitis, either the clot breaking down at its centre or the change being entirely perivenous; in these cases, a well-developed clot usually exists on either side of the suppurating point, excluding the dangers of septic infection and hæmorrhage. Chronic endo-phlebitis is most common in cases of varix; usually the veins here are generally thickened, and, on examination, the intima may be more or less opaque, presenting in addition ill-defined yellowish patches, slightly raised by infiltration beneath. These patches of fatty or atheromatous degeneration are often accompanied by the presence of small calcareous spicules. In acute miliary tuberculosis, tubercles may be deposited beneath the intima, and in chronic tuberculosis of organs, the veins may become implicated by direct extension. Should a breaking-down mass in this way directly open into the general circulation, it may be the source of a general miliary tuberculosis (Weigert). No special pathology yet exists for the gouty phlebitis of Paget, who says 'the evident disposition towards being metastatic and symmetrical . . . is strongly in favour of the belief that the essential primary disease is not a coagulation of the blood, but an inflammation of portions of the venous walls.'

Symptoms.—These differ widely according to the local, or diffuse and septic character of the inflammation.

Local Phlebitis.—This is most frequently met with secondary to injury, or in cases of varix, and then in the lower extremity. The first symptoms are usually pain and swelling, accompanied by interference with the function of the limb; the other cardinal signs of inflammation, heat and redness, will be present in varying degree. Pain, increased by use of the limb, in some cases slight, in others of a severe neuralgic character, often severe in thrombosis of deep veins with subfascial œdema. Swelling, due chiefly to œdema, in part to inflammatory changes in and around a vein. The character of the swelling varies with the affection of superficial or deep veins. If the superficial veins, there is local œdema of the area from which the blood-supply is gleaned, and a hard cord or knotty tumour corresponds to the thrombosed vein. If the deep veins, there is general œdema of the limb, of a tense white character, often not pitting on pressure, and accompanied by considerable enlargement of the superficial veins. Redness, of a bright or purplish character, may extend over the thrombosed veins, if superficial; it is usually developed subsequently to the pain and swelling. The temperature of the limb may be raised generally, or locally over the patches of inflamed veins. When local suppuration occurs, the usual signs of abscess-formation will be present.

These local symptoms will be accompanied by those of a general febrile condition of varying intensity, usually not severe, the temperature rarely rising above 100° or 101° Fahr. The marked characteristics of the symptoms in gouty phlebitis are the tendency to metastasis, already referred to, and its patchy distribution.

Diffuse Suppurative Phlebitis.—In these cases we have the signs of diffuse cellulitis, accompanied by symptoms of general infection. The most frequent examples of the condition are met with in pyæmia; hence, it occurs frequently in like manner after injury to bones or veins. It may start from a wound, or may occur without any local breach of surface. The local signs again depend on the superficial or deep situation of the vein affected: if superficial, there will be œdema, diffuse, dusky redness and pain, often unaccompanied by local evidence of clot-formation, followed by rapid suppuration and extensive sloughing. If the deep veins are affected, superficial discoloration may not occur, but fluctuation and signs of deep suppuration appear early; in some cases, gangrene of the whole thickness of a limb may rapidly supervene. The general symptoms are those of septic cellulitis with constitutional infection. The temperature is continuously high, as in septicæmia (103°, 104°, 105° Fahr.), or there are frequent rigors when metastases occur. The patient is depressed, sleeps badly, is often delirious, the delirium being of a wandering character. The tongue is furred and dry, the teeth and lips become rapidly covered with sordes, diarrhœa often sets in, and the patient dies in a typhoid condition.

Prognosis.—In adhesive phlebitis the prognosis is good as to life, and, locally, permanent obstruction of the vein is uncommon except in the case of varicose veins; here such a result is to be regarded favourably, as effecting a spontaneous cure. If the vein is obstructed and sufficient collateral circulation is not set up, permanent œdema may more or less interfere with the functions of the limb. Diffuse suppurative phlebitis is, on the other hand, extremely serious, the patient as a rule dying of Septicæmia or Pyæmia.

Diagnosis.—The diagnosis of phlebitis from simple thrombosis depends on the absence of local or general inflammatory symptoms in the latter. Lymphangitis presents considerable resemblance to phlebitis. The chief distinguishing points are—(1) the primary origin—in lymphangitis in a sore, in phlebitis often in a varicose vein; (2) the early enlargement of glands in lymphangitis; (3) the bright rosy tint in lymphangitis, appearing prior to the œdema, also its tendency to spread in a spiral line, in phlebitis the tint usually being darker, the blush appearing subsequently to the œdema; (4) the extent of the œdema in phlebitis; (5) the presence of a hard cord in phlebitis.

Treatment.—The treatment consists in giving rest to the part, and affording all possible aid to the impeded circulation. The patient should be confined to bed, the limb raised, and loosely bandaged. If there be much pain, the limb may be enclosed in warm cotton-wool sprinkled with belladonna liniment, or with lint on which equal parts of belladonna extract and glycerine have been spread. The bowels should be kept acting freely, and any source of constriction or vein-pressure, if possible, removed. In the later treatment, elastic pressure, to support the limb and promote absorption of effused inflammatory products, should be employed. In the case of thrombosis, a piece of emplastrum ammoniaci c. hydrargyro, applied over the spot, often promotes absorption. In cases of diffuse suppurative phlebitis, treatment is of

little avail; stimulants must be given freely, and if the removal of the inflamed area be possible, amputation may be performed to remove the local infecting centre.

G. H. Makins.

PHLEBOLITH.—A calcareous concretion developed within a vein. Phleboliths are the result of calcareous degeneration of laminated thrombi; they are met with chiefly in the veins of the lower extremity and pelvis, most commonly lying loose in ampullæ behind the valves. They are usually rounded or oval in shape, and are constituted of phosphate of lime with twenty per cent. of protein matter and a little sulphate of lime and potash (Frankland).

G. H. Makins.

PHLEBOTOMY. *See* Venesection.

PHLYCTENULAR OPHTHALMIA. *See* Conjunctiva, Diseases of the.

PHOSPHORUS NECROSIS. *See* Jaws, Diseases of the.

PHOTOPHOBIA, a dread of light, is a common symptom of inflammation or other disease of those parts of the eyeball and its appendages which are innervated by branches of the fifth nerve. *See* Conjunctiva, Diseases of the; Cornea, Inflammation of the; Iris, Diseases of the.

PHTHIRIASIS.—The eruption produced by lice. *See* Pediculi.

PIGEON-BREAST.—A malformation of the anterior walls of the thorax, which may result from various causes. The upper half of the thorax may be quite normal, but from sudden depression of the infra-mammary regions after whooping-cough, partial collapse of the lungs, &c., the lower half of the sternum, with the contiguous rib-cartilages, become unduly prominent.

Another variety, which best deserves the name of pigeon-breast, is when the whole thorax is much narrowed from side to side, with the sternum presenting, instead of a plane surface, a convex one transversely; this is apparently of congenital origin, but becomes worse as the child grows.

A third variety is due to giving way or bulging of the sternal rib-cartilages, leaving the sternum in a hollow; sometimes there is actual hollowing out of the sternum, exactly reproducing what is known as boot-maker's chest, which is the effect of the pressure of the 'last,' against which the man presses while at work. This variety is more often unilateral than the others, as the rib-cartilages on one side may be quite normal, while those on the opposite side project an inch or more beyond the normal surface of the thorax. The anterior ends of the sternal ribs may participate in this bulging of the rib-cartilages.

A variety of pigeon-breast accompanies severe spinal caries, with much deformity of the dorsal vertebræ; here the sternum is thrust forwards, especially its lower half, with the adjoining rib-cartilages and ribs.

Pigeon-breast, not due to spinal caries, is nearly always associated with exaggerations of the antero-posterior curves of the spine (*see* Antero-Posterior Spinal Curvature), and is not infrequently found in lateral curvature.

Pathology.—In opposition to some authorities, who maintain that pigeon-breast is always due to rickets, Sir W. Jenner says that 'it very often arises from other diseases than rickets, but the two varieties are very easily distinguished. In rickets, the deformity is due to the softening of the bones, which yield at their growing ends and push forward the sternum as a rounded prominence, and the outline of the chest is a double curve. In pigeon-breast from non-rickety causes, the yielding of the ribs takes place where there is a natural maximum bend—at their angles, the sternum is pushed straight forward, and the outline of the chest is angular' (the pigeon-breast of spinal caries *par excellence*). It is, therefore, due to rickets and other affections causing softening and yielding of the bones, especially when associated with lung-trouble, as acute and chronic bronchitis, whooping cough, &c.; also with partial collapse of the lungs, caused by deficient expansion of the thoracic walls from enlarged tonsils obstructing the entrance of the air into the lungs.

This deformity is nearly always one of infancy and childhood, and is often overlooked until it gradually becomes so bad as to attract attention.

The *prognosis* as to the effect of treatment depends upon the amount of improvement immediately effected by placing the patient in the erect position, with the arms extended upwards by the side of the head. Apparently very deformed cases, especially when due to falling-in of the infra-mammary regions, can thus be almost completely restored temporarily to a normal configuration. The earlier treatment is commenced, and the more yielding the chest-walls, the more satisfactory will be the result.

Treatment.—Nothing can be done for the deformity of pigeon-breast due to spinal

caries; but considerable relief can be given to the patient's want of breath and sense of fatigue, by developing those portions of the thorax which are still movable, by means of the treatment described below. Necessarily, the spinal caries must be cured by healthy bony ankylosis before attempting anything for the chest-trouble.

In pigeon-breast due to other causes, the first thing is to correct any spinal deformity present (*see* Lateral and Antero-Posterior Spinal Curvature). The next is to enlarge the thorax anteriorly by means of the pectoral muscles, which is efficiently carried out, as follows:—The patient, lying supine, with a small longitudinal pillow between the scapulæ, fixes himself by flexing the knees over the end of the padded table on which he lies, or the pelvis is held on each side by an assistant: the arms are extended upwards by the sides of the head. The surgeon, grasping the hands, resists while the patient slowly flexes the elbows, which should touch the table the whole time, and adducts the upper arms till they are at right angles to the trunk; the patient then slowly relaxes, while resisting the surgeon's efforts to extend the arms to their original position on each side of the head. This exercise is slowly repeated twenty or thirty times, and has frequently a wonderful effect in restoring for the moment a properly shaped thorax. The same exercise can be as readily done by the surgeon sitting with the patient kneeling in front and leaning back against the surgeon's knees, kept close together, covered by a pad or cushion which fits the patient's back between the scapulæ.

Another exercise, to be recommended, is hanging by the hands with the spine and sacrum in contact with the wall, to which are fixed the two pegs the patient grasps; he has then to rotate the spine alternately to the right and left a dozen times. Great care must be taken that no article of clothing is so tight in front as to interfere with the resumption of an improved thorax. Systematic respiratory exercises are most beneficial. In some cases, the surgeon should press in with his hand any undue prominence of the sternum, cartilages, or ribs, while the depressed portion of the thorax is being elevated by any of the above described exercises. If benefit is to be obtained from treatment, a decided improvement will be effected at the end of a month.

The writer saw Dr. Monti of Vienna, some eight years ago, treating pigeon-breast by placing the child in an air-tight bath connected with an air-pump, the face only of the child being uncovered and surrounded by a broad band of india-rubber. By exhausting the air in the bath the thorax expanded, and, by repeating this daily, considerable improvement was obtained.

Bernard Roth.

PILES. *See* Hæmorrhoids.

PINGUECULA is the name given to a small yellowish elevation in the conjunctiva near the margin of the cornea, usually at its inner side, more rarely at its temporal margin, but sometimes in each place. It contains, notwithstanding its name, no fat, but is composed of connective tissue and elastic fibres. It is supposed to be due to the irritation caused by small foreign bodies. It rarely grows to a large size, and requires no treatment unless it becomes disfiguring, when it may be removed with forceps and scissors.

H. R. Swanzy.

PIROGOFF'S AMPUTATION. *See* Ankle-joint, Amputation at the.

PISTOL SPLINT.—This has the shape indicated by its name; it is used for Colles' fracture of the radius. The handle is first fixed to the hand and lower fragment, and then the portion corresponding to the barrel is raised to the line of the forearm; by this means the hand is adducted. A short anterior splint, reaching from the elbow to the lower end of the upper fragment of the broken bone, is used with the pistol splint, which should be applied to the posterior surface of the limb.

PITYRIASIS.— The name pityriasis (*P. simplex*) has ceased to convey any definite meaning to the dermatologist, and has rightly dropped out of use altogether. The older writers applied the term to any scaly condition of the skin, the nature of which they did not clearly understand. It may be stated definitely that there is no such disease as pityriasis pure and simple; all the cases so called are simply the later stages of some other disease, such as eczema, steatorrhœa, or lichen scrofulosus.

Pityriasis rubra is a name still in use for a form of exfoliative dermatitis, first described by Hebra, who drew careful distinctions between it and other forms of general exfoliative dermatitis, such as eczema squamosum, general psoriasis, and lichen ruber. The question as to whether or not Hebra was right in his conclusions is still *sub judice*. It is probable, however, that the majority of dermatologists of the present day agree with the late Dr. Baxter

in regarding pityriasis rubra as a very severe form of dermatitis, which may develop from squamous eczema, psoriasis, or lichen, the distinctive characters of these diseases being ultimately lost altogether. With this view the writer in the main agrees. If further observations prove that Dr. Baxter's conclusion is right, it will lead to the general adoption of the name 'exfoliative dermatitis' instead of 'pityriasis rubra,' so that we may ultimately get rid of the word 'pityriasis' altogether. Whatever name, however, we adopt, the disease is both serious and characteristic. In typical cases, the whole body is affected from the sole of the foot to the crown of the head, the skin itself is highly congested, but not thickened nor infiltrated; it is covered with imbricated scales of epidermis, often arranged in wavy rows like scale armour. The dead cuticle sometimes peels off in large pieces, but more commonly the scales shed are small and branny. The degree of exfoliation varies, but it is generally very great, so that a pint measure may sometimes be nearly filled with the scales which rub off in the course of twenty-four hours. The nails generally become uneven and opaque. There is always tenderness of the skin, so that contact with anything gives pain. Itching is not present in all cases. Associated with this condition of the skin, there is always considerable constitutional disturbance and greatly enfeebled vital powers. Not uncommonly there is albuminuria; it has been present in about three-fourths of the cases that have come under the observation of the writer. The *prognosis* in severe cases is unfavourable, a large percentage ending fatally.

Treatment.—This is usually very unsuccessful. Tonics, good food, and rest in bed are, of course, indicated. Simple lotions, such as the linimentum calcis, sometimes give a little local relief to the pain and tenderness of the skin. ROBERT LIVEING.

PITYRIASIS VERSICOLOR.—*Definition.*—A discoloration of the skin produced by the presence of a vegetable parasite.

Symptoms.—It differs from the other skin-diseases produced by vegetable parasites in that it is harmless, very slightly if at all contagious, and attacks adults rather than children. It occurs usually on the chest and back, in patches of variable size of a yellow or fawn colour, and more or less symmetrical though rarely covering the part uniformly. The patches are slightly raised, and covered, especially at the margins, with fine powdery scales; and on examination with a lens, the mouths of the hair-follicles will be seen to be much affected. As a rule there is no itching, but very occasionally it is severe. The disease may last for years, and, being harmless, it is only on æsthetic grounds that any treatment is called for. Sweating seems rather to encourage the growth of the parasite, which fact accounts for its prevalence among consumptive patients.

Diagnosis.—It may be mistaken for a secondary syphilide. Other symptoms of syphilis should be looked for, and, should there still be doubt, a careful microscopical examination of scales from the patch would settle the point. The presence of fungus, the scaliness of the patch and its restriction to covered parts, will serve to distinguish it from chloasma, which moreover usually occurs on the face.

Pathology. — Scales, scraped from the patch and placed in dilute liquor potassæ, show, under the microscope, a network of mycelium branching in all directions and groups of large, well-defined spores. The arrangement of the spores in groups is quite characteristic of this fungus, which is known as the *microsporon furfur*.

Treatment. — Thorough friction with soft soap, and the application of any parasiticide. A lotion composed of hyposulphite of soda, ʒj. to fʒj. of water; or sulphurous acid, 1 part to 4 of water freely applied, or linimentum iodi painted on will easily cure in a few days. If the disease reappears, it is because some particles of the fungus are still undestroyed in the hair-follicles, hence it is necessary to apply the remedies with some energy, and continue them after all apparent signs of the disease are gone. MALCOLM MORRIS.

PLANTAR ARTERIES, Wounds of. These are naturally, owing to the protected condition of the feet, much more rarely met with in this country than wounds of the palmar arches.

Treatment.—This, as in the case of the hand, will vary accordingly as the surgeon is called at the beginning or later on in the case. In the former instance, unless severe hæmorrhage is going on, the effects of careful pressure should first be tried. Thus the surgeon need not spend much time in exploring the wound, but, the main trunks being compressed above, it should be cleaned, and a graduated compress applied, the lint nearest the wound being soaked in Tr. Benzoini Co., carbolic oil, or some styptic, or dusted with iodoform. Before this com-

press is finally secured tightly *in situ*, the toes and foot beyond the wound must be carefully strapped and bandaged, to prevent the painful œdema which is otherwise certain to occur, and which will lead to removal of the compress and recurrence of the bleeding. The compress may be kept *in situ*, by means of two parallel pieces of wood, one above the foot and one below, the two ends of which project on either side, and are secured by strips of handkerchief as in Völcker's plan; and this method will be found useful where no strapping is handy, or where the patient has to be moved any distance. When the patient is in bed, the foot and leg should be kept quiet on a splint, and, if possible, slung in the raised position, with the knee bent, morphia being given subcutaneously. If the surgeon lives at any distance from his patient, it will be well to mark out the femoral artery at the apex of Scarpa's triangle, and to leave a tourniquet very lightly applied.

If hæmorrhage recurs, which is not likely if a compress has been properly applied from the first, the surgeon has to choose between ligature of the dorsalis pedis and posterior tibial arteries, on the dorsum of the foot and behind the inner ankle respectively, and ligature of the femoral at the apex of Scarpa's triangle. The former is by no means certain to prevent recurrence, as the anterior peroneal and internal calcanean, by their anastomoses with the malleolar, tarsal, and plantar arteries, will still bring in blood. Thus, ligature of the femoral will be the more certain method, but this step can only be called for under very rare circumstances.

Where the surgeon is not called to the case till some days after the accident, when recurrence of hæmorrhage is complicated by œdema, cellulitis, and suppuration, and persists in spite of relief to the tension by incisions, the elevated position, and such applications as iced lead lotion, ligature of the femoral is justified, not only for arrest of hæmorrhage, but as likely to cut short the inflammation. W. H. A. Jacobson.

PLANTAR FASCIA, Contraction of the.—Unlike the corresponding fascia in the palm, that of the foot is very rarely found contracted except in association with certain forms of talipes. Occasionally, however, it is met with either as a congenital affection, though not always marked at an early period of life, or in association with paralysis of the interossei, giving rise to the condition known as 'pes cavus.' At first the deformity is not marked, but, as the contraction increases, the relation of the bones of the tarsus becomes altered, and the weight of the body having to be sustained entirely upon the heel and the ball of the toe, pain becomes frequent after prolonged exertion or standing. The remedy is to be obtained by freely dividing the contracted fascia subcutaneously, and by the application of a Scarpa's shoe, which should be so constructed as to raise the anterior half of the sole, and to press upon the increased prominence which is given to the dorsum of the foot by the altered position of the bones. This must also be assisted by a strap and buckle passing over the dorsum, and applied to the boot which is to be worn by the patient. *See* Club-Foot.

John H. Morgan.

PLASTIC SURGERY.—The various operations of plastic surgery are designed for the restoration of functional usefulness, or for the removal of disfigurements. Of the defects in question, some are due to developmental errors—e.g. cleft palate, harelip, extroversion of the bladder, and hypospadias; some to the ravages of disease, such as the destruction of the nose by syphilis or lupus; and others to the immediate or remote effects of physical injuries, as is seen in ruptured perineum and in cicatrices from burns.

There are certain conditions essential to the success of operative procedure:—(1) The tissues concerned must be in a healthy state. It would be useless attempting to fashion a nose where lupous ulceration was still in progress. (2) When the deformity is the consequence of constitutional disease, the surgeon must take care that the general health is such as to warrant the expectation of the wound healing by first intention. Marked syphilitic cachexia contraindicates the performance of operations otherwise expedient. (3) All *tension* upon the parts must be prevented. There are different ways of carrying out this principle. The strain from muscular action is avoided in some cases by division of the muscles. Thus the tensor and levator palati are occasionally cut in the operation for cleft palate, and the sphincter ani in the treatment of fistulous openings involving the rectum and vagina. As a rule, however, it is sufficient if physiological rest is ensured—e.g. by keeping the bowels confined and a catheter in the bladder for several days after suture of a ruptured perineum. In plastic operations about the neck, the head should be fixed by a suitable mechanical appliance. It may be advisable, where the

gap to be bridged over is very wide, to put in deep sutures for the purpose of taking off the strain on the superficial ones. When the operation is for the removal of extensive contraction from burns, subcutaneous division of cicatricial bands skirting the main scar is of great service. In certain instances, lateral incisions are employed to facilitate the coaptation of the freshened edges of clefts or fissures. In the hard palate, e.g., the mucous membrane and periosteum are divided and raised from the underlying bone to allow of easy apposition to the margins of the cleft; or, instead of this, the bony plate is chiselled through, and the septal process in its entire thickness carried inwards on each side in order to secure freedom from tension.

In transplanting skin, as in the construction of a nose, or in the covering in of an extroverted bladder, the flaps should be cut considerably larger—generally about one-sixth - than the spaces they are intended to fit, since otherwise the shrinking from elasticity might entail partial or entire failure of the undertaking. Care must be taken that the bleeding has ceased before the edges are brought together, as the interposition of a blood-clot would tell against the chances of primary union, which is of paramount importance in all plastic operations. For the same reason, foreign bodies should be scrupulously excluded. The raw surfaces are to be brought into accurate apposition, and fixed *in situ* by numerous fine sutures knotted on the sound tissue. If it is deemed desirable, additional means of support can be provided.

The *after-treatment* consists chiefly in keeping the wound protected from injury, and free from the irritation of septic matter. It is a good plan, when practicable, to cover the part with oiled silk, and this with moistened boracic acid lint or iodoform wool. To retain the dressings in place, collodion is preferable to strapping, as it exercises no injurious pressure, whilst it more effectually prevents the ingress of atmospheric impurities. Where the wound, however, is of mere linear extent, it is sufficient to support it, and paint it over with flexile collodion. It may be mentioned that where healing by the first intention is not obtained throughout the entire wound, cicatrisation should be encouraged by grafting, snippings being taken from the skin for that purpose.

After union has taken place, attention should be directed to the cicatrix, which is liable to undergo stretching on the one hand and undue contraction on the other. Either of these events may frustrate the purpose the surgeon had in view.

Causes of Failure.—Neglect of one or more of the above-mentioned provisions may end in want of union, primary or secondary. Other causes of failure are erysipelas and secondary hæmorrhage, accidents to which all wounds are liable. In transplantation of skin there is always some danger of sloughing, consequently, when gliding or torsion is employed, it is necessary that the pedicle or base of vascular supply be of ample width, in order that the vitality of the flap may be ensured.

Methods of Procedure.—The primary plastic operations fall practically under five heads, three of which relate to transplantation of pieces of skin from adjacent or distant parts. (1) The Italian or—as it is named after the surgeon who introduced it—the Tagliacotian method consists in freshening the surface and margin of the area to be covered, and fixing there a flap of skin raised from another part of the body; thus, in the construction of an eyelid, the graft is taken from the hand, which is kept applied to the face until the supply of blood from the pedicle of the flap is no longer required. The pedicle is then divided. The operation is seldom practised, since it necessitates restraint of movement, which is irksome to the patient. It has one advantage—viz. the pedicle can be made as wide as desired, so that sloughing is effectively guarded against. (2) The Indian operation is generally selected in preference to the Italian. The flap is dissected from the skin immediately bounding the part to be constructed or restored, and is placed in position either by gliding or torsion. The latter plan is carried out in the operative treatment of ectopia vesicæ. Burow's operation combines excision and gliding, the object being, not only to close a gap in the skin, but also to minimise and distribute the unseemliness resulting from contraction of the cicatrix. It is admirably adapted for the removal of scars and rodent ulcers of moderate size. (3) Wolfe has shown that portions of skin can be successfully excised and grafted on to freshened surfaces. He recommends that all the subcutaneous fat and areolar tissue from the graft should be removed with scissors. The operation must be performed rapidly, and with scrupulous attention to cleanliness. (4) Fissures or clefts are closed by freely paring the edges, bringing them into accurate apposition, and fixing with sutures, harelip-pins, &c. (5) Fistulous openings are usually treated by paring the

edges, raising the skin from the subjacent tissues, and causing it to glide over the aperture to be obliterated. *See* RHINOPLASTY.

Recent experiments have shown that, in the lower animals, strips of bone with the periosteum attached can be successfully grafted on to living tissues, where they are capable of setting up osteoplastic growth. It remains to be seen how far this measure will be serviceable in the surgery of the human being. *See* GRAFTING.

AUGUSTUS J. PEPPER.

PLEUROSTHOTONOS. *See* TETANUS.

PLUGGING THE NOSTRILS. *See* EPISTAXIS.

PNEUMOCELE, or HERNIA OF THE LUNG, is the protrusion of a portion of the lung through a wound involving the pleura. It is divided into the *immediate* and *consecutive* forms.

In the *immediate* form, the lung protrudes directly from the wound, either immediately after the injury or within a very short period. It may be complicated by a wound of the lung, though this is not a necessary accompaniment. It probably arises from the patient making a powerful expiratory effort, with the glottis closed, at the time of the receipt of the injury, the thoracic wound itself being almost necessarily an incised one. The air not being able to escape from the lung, this viscus itself is forced in the direction of least resistance, which will be through the wound. When expiration takes place, the ribs descend, the intercostal spaces narrow, and the piece of lung extruded remains shut out of the cavity of the chest. As the circulation in the blood-vessels, more especially in the veins, gets impeded by the pressure, rapid swelling of the extruded mass takes place, and the hernia becomes irreducible. Under these circumstances it presents a bluish-black mass, which consists of the lung covered over by its own investment of pleura; this, as the congestion becomes greater, assumes almost a black appearance. It generally, however, retains its vitality for a lengthened period, but may, if the congestion be very intense, die and slough off at the point of constriction, leaving a granulating sore which pretty readily cicatrises. The lung remains adherent to the parietes at this spot.

Treatment.— The prognosis in these cases is favourable. If the patient be seen sufficiently early, an attempt may be made by gentle manipulation to reduce the hernia, great care being taken not to damage its delicate vesicular structure in so doing. If this be found impossible, the neck of the constriction may be cautiously divided on a director, care being taken to avoid wounding the intercostal vessels. The manipulation for reduction should then be repeated. The advisability of reducing the hernia must necessarily depend upon the state of the extruded piece. If the congestion be very intense, leading to the belief that there will be great risk of sloughing, it will be best to leave it *in situ* to separate by the natural processes. Or, if these are too long and tedious in their course, they may be expedited by surrounding the protruded mass with a ligature, or even by cutting it off. In the latter case the risk of hæmorrhage is considerable, unless the process of sloughing has already proceeded so far as to obliterate the vessels.

In the *consecutive* variety of hernia of the lung, the protrusion does not take place till some weeks after the infliction of the injury, when the wound is already cicatrised. The hernia will here be covered over by the thinned integuments, forming a doughy, pulpy mass of the normal colour of the skin. The manner of its production is probably the following. The wounded lung becomes adherent at the point of injury, which undergoes a chronic inflammatory process all around, and hence, as all inflamed tissues are weaker than healthy ones from having lost their resisting power, the whole area of the chest parietes about the wound will be weaker than usual. The lung itself, from constant coughing, as well as from the injury, becomes swollen and emphysematous, and hence tends to protrude in the direction of the least resistance, which will be towards the injured part; where its constant pressure may even cause absorption and thinning of the parietal structures, just as an aneurism does.

The *prognosis* of cases of pneumocele is favourable. The *treatment* consists simply in protecting and supporting the hernia. This may be done by some variety of truss, contrived specially to suit the nature of the case.

A special form of immediate pneumocele is occasionally seen without external wound, when the walls of the chest have been so badly crushed that the ribs have become comminuted. The intra-thoracic injury in these cases is so severe as almost always to lead to rapid death.

Congenital pneumocele is also sometimes seen. The affection is very rare, and the treatment will be the same in principle as for the consecutive variety.

H. G. HOWSE.

PNEUMONIA, Traumatic.—Inflammation of the lung, from injury to this viscus, may be due either to an external wound, to a wound produced by a broken bone, or to the harm wrought in the organ by a severe squeeze, whether producing actual rupture of the tissue or falling short of that point. The symptoms are much alike in all three cases, but the prognosis will be much more grave in the case of an external wound than in the other two, in which, as a rule, the prognosis may be regarded as favourable, if the amount of tissue involved be not very great.

The *signs* of an acute pneumonia, occurring after injury, will be much the same as in idiopathic pneumonia. But it will generally be preceded by the expectoration of frothy, light-red blood from the injured part of the lung; and this will gradually change, in from thirty hours to three days, to a rust-coloured sputum, as the pneumonia becomes established. In an ordinary acute idiopathic pneumonia, there is not the same expectoration of frothy, light red blood. There may be a small amount of white frothy sputa in such cases, but this very rapidly changes to rust-coloured expectoration. In cases of doubtful injury this may help to clear up the point, though it is not an absolute rule.

In addition to the expectoration, there will be dulness over the affected part of the lung; this may spread far beyond the actual injury. Auscultation will give in the first place a fine silky crepitation, due probably to the blood effused in the vesicular tissue of the lung,—but rapidly changing to coarse crepitant râles, as the lung becomes solid and permits the movement of the air and mucus in the large tubes to become audible. There will then be more or less bronchial breathing and bronchophony audible over the affected part, and the vocal fremitus will be increased. In the severer cases, the temperature may rise to 102° or 103° F., and the pulse in proportion. The respiration will be hurried out of proportion to the pulse, on account of the diminished breathing area available. In cases such as these, it is obvious that the disease may pass on to a fatal issue, if the injury be severe and the amount of lung implicated be considerable. More especially is this likely to be the result, if the condition of the other viscera (kidneys, liver, &c.) be not perfectly sound at the time.

The *prognosis* in these cases is generally favourable, if the amount of lung-tissue involved be not very great. The dulness becomes less marked; air is again heard entering the vesicular tissue on auscultation, the bronchophony and bronchial breathing disappear, and the expectoration loses its rusty colour and finally ceases.

The *treatment* of these cases does not require to be of an active nature. In the first stage, that of hæmorrhage from the lung, it will be necessary to give the patient as little food as possible, so as to limit the tendency to extravasation of blood. The length of the subsequent affection, and its severity, will very much depend upon the amount of blood effused, and the area of lung-tissue thus involved. The patient should be kept in bed, and at perfect rest, and the tendency to cough diminished as much as possible. In the second stage, when the hæmorrhage has ceased, this may be aided by keeping the patient in a warm moist atmosphere. The writer has found that nearly all hospital patients, in this condition, experience great relief from being placed in a tent with a steam-kettle. During both the first and second stages, benefit is derived from the administration of antimonial wine in some such form as the following:—℞ Vini antimonialis ℥x.; Tinct. camph. co. ℥xx.; Liq. morphiæ hydrochlor. ℥xx.; Liq. ammoniæ acet. f℥ss.; Aq. chlorof. ad f℥j. Ft. haustus, quartis horis sumendus.

In the last stage, that of resolution, all medicine may be suspended, and the inflamed lung allowed to take its own course. Even in this stage the diet should be very carefully regulated, for the resolution of a considerable mass of inflamed tissue is a tax upon the powers of elimination, and hence involves work for the excretory glands, which, if not in a perfectly sound condition, they may have a difficulty in performing.

Should the pneumonia be due to an external penetrating wound, the treatment would be that described under the head of Lung, Wounds of the. H. G. Howse.

PNEUMOTHORAX is the condition in which air fills the pleural cavity, the lung collapsing to a degree corresponding to the amount of air entering the pleura. In medical practice, it is most frequently caused by disease of the lung of an ulcerative character—e.g. the perforation of a tubercular cavity into the pleura, or by gangrene of the lung. In surgical practice, cases mostly arise from external injury, the air either entering from without, as in perforating wounds of the thoracic parietes; or from the lung itself, where this viscus

has been wounded. These wounds may be caused either by the pointed end of a fractured bone, most commonly a rib, or by some external penetrating agent.

Pneumothorax is more common in the adult or those past middle age than in young people. The reason of this is that, where the lung is healthy, there is less tendency in the surfaces of the pleura to fall away from each other than where atrophic or senile changes are impending. Thus, in some incised wounds of the chest, where the lung is clearly exposed, pneumothorax does not take place, the exposed lung remaining in apposition with the sides of the wounded pleura, and moving in each act of respiration. In such cases, the coaptation of the surfaces of the pleura seems to neutralise the natural tendency of the lung-tissue to contract. In paracentesis thoracis for serous effusion in young people, the tendency to pneumothorax is much less than in the same operation for empyema. The reason of this probably is, that in cases of empyema the lung itself more frequently becomes diseased, and hence loses its elastic resiliency, while the tendency to elastic contraction becomes proportionably greater.

The *signs* of a pneumothorax, whether resulting from disease or accident, are similar, and cannot well be overlooked in any careful examination of the chest. In the first place, there is drum-like resonance on percussion over the whole of the chest. The only exceptions to this rule are where a previous pleurisy has caused partial adhesions of the pleura, so that the pneumothorax does not spread over the whole of the pleural cavity. In such cases, there may be local tympanitic resonance, but elsewhere the ordinary percussion note of the lung is present. On the other hand, tympanitic resonance is very often found in the upper part of the chest-cavity anteriorly, where there is serous or purulent effusion in the pleura without any pneumothorax. This is due to the lung being pressed up towards this part by the effusion, the air confined in the vesicles giving a tympanitic note similar to that found in emphysema.

All such cases of doubt in the *diagnosis* of pneumothorax can be solved by the application of the next test—viz. auscultation. On placing the stethoscope over the chest, it is at once noted that the breath-sounds are inaudible, or extremely distant. In some cases, however, where the distension is very great, the breath-sounds from the opposite side may be heard, carried along the tight walls of the cavity. Such cases may be distinguished by another test—viz. inspection of the chest (vide *infra*). On shaking the patient or changing his position (succussion test), a noise is frequently heard like the striking of two small pieces of coin together (metallic tinkling). This is due to the falling of a drop of fluid from one part of the cavity to the other, or the bursting of a bubble of air, the sound being exaggerated by the drum-like distension of the walls. It is occasionally produced in a cavity *within* the lung-tissue, as in a large tubercular cavity, but never so distinctly as in a pneumothorax: such cases are also readily distinguished by the absence of the drum-like resonance on percussion over any considerable area.

In cases of extreme distension, inspection of the chest may afford valuable information. The walls will be found bulged, the intercostal spaces projecting, and the affected side scarcely moving at all in the act of respiration. This test is especially valuable, as indicated above, where the distension is so extreme as to cause the breath-sounds of the healthy lung to be heard over the affected side. But all degrees of distension exist, and, even in the slighter cases, there is a very marked difference in the mobility of the affected side as compared with the sound one.

Treatment. — From whatever cause arising, pneumothorax, if it does not induce symptoms of considerable distress to the patient, had best be left alone. If it be due to a temporary cause, such as wound of the lung from a fractured rib, the air will probably be absorbed, and the lung will have a good chance of again expanding. Even in some of the medical cases, where it takes place from the perforation of a tubercular cavity, the partial collapse of the lung resulting from it, if it does not have a quickly fatal issue from disturbance of the respiratory area, occasionally results in good to the patient, from checking the progress of the tubercular ulceration, by allowing the parts concerned much more complete rest after collapse than was possible before. It is only in cases where pneumothorax causes great distress to the patient, or where death is impending from pressure upon the lung, that operative measures should be adopted for its relief. These should consist in puncture of the cavity containing the air with a fine trocar and canula, allowing the air to escape freely till equilibrium is re-established. The small canula should then be withdrawn. Immediate relief will be obtained in this way, and the operation may be repeated as often as necessary. This is better than leaving the canula or a

drainage-tube in the wound, unless there is much fluid mixed up with the air, when the drainage-tube becomes desirable for the sake of allowing its escape, and partly also for the sake of washing out the cavity—especially if the contents are fetid.

The *prognosis* of every case of pneumothorax is grave. Very speedy death often takes place in the cases where it results from tubercular ulceration, but, if the patient survives two or three days, life may be prolonged for weeks or months, death finally resulting from a spread of the tubercular disease. The cases in which the prognosis is most favourable, are those in which pneumothorax is due to a fractured rib. The first shock of the injury having passed away, the air generally absorbs and the patient does well. H. G. Howse.

POISONED WOUNDS.—The expression 'poisoned wound' is here employed to denote the condition of a wound secondarily infected by a parasitic or other virus, but the term does not include such cases as insect and snake stings or bites, or the special lesions produced by various mineral poisons, though these may be alluded to. In fact, whenever a wound is followed by acute inflammatory mischief spreading from it as a centre, such mischief not being caused by one or other of the rarer animal or mineral poisons mentioned above, it would come under the present heading. It very rarely happens, however, that a patient is attacked by one variety of septic disease at a time, so that it is impossible to define the above expression more closely; and besides, the decomposition-products of one poison, being poisonous in themselves, will give rise by their own action on the system and tissues to an additional train of symptoms. On account of all this complication surrounding the causation of poisoned wounds, the diseased conditions will be simply described according to the ordinary anatomical arrangement of the tissues they attack.

Etiology and Theory of Causation.—It will be best to allude briefly to that theory of the action of the poison, in these cases, which finds most favour at the present day, before discussing the conditions which predispose a patient to suffer from a poisoned wound. Since it is found that, in every case, the wound is contaminated with some filth or other, whether it be fluids from a corpse recently dead, dirt, or any decomposing albuminous matter, it is now assumed, by most writers, that the poison is either one of the chemical products of decomposition or an actively growing pathogenic and parasitic organism. For discussion of the mode in which these poisons, chemical and living, are supposed to act, reference must be made to Sepsin; Sapræmia; Septic Diseases; in which the theories of septic poisons are given at length; but we may repeat here that of the two above-mentioned poisons, the simple chemical product of decomposition, sepsin, while giving rise to local changes about to be described, rarely produces general symptoms of 'constitutional disturbance' unless it is absorbed in quantity. *See* Sapræmia. On the other hand, a living, rapidly growing virus may easily be understood to multiply and spread through the meshes of connective tissue and along the channels of lymphatic vessels, although only a very small quantity may have lodged in the wound. The bearing of this general outline of the causation in each variety of wound-poisoning will be amplified in describing the different forms of the affection, as they are met with clinically. It only remains, therefore, to consider here the general question of predisposition in the individual which renders him open to attack.

If the above theories of local and of spreading poisons are true, then it is obvious that if a person be overworked, and his tissues anæmic and degenerate from insufficient oxidation, as is so constantly observed in town-dwellers, &c., he will form a good nidus for the development of such a virus. Travers, however, showed long ago that this simple idea of predisposition was clearly insufficient to account for the remarkable escapes of many people, who were exposed to the same mischief as others who unfortunately fell victims. The theory of personal immunity has been put forward lately to explain these facts, and is strongly supported by the powerful authority of Sir James Paget; but, beyond drawing attention here to the possibility of some instances of immunity being due to a process analogous to that of acclimatisation—since such persons are usually constantly working in a poisonous atmosphere or handling poisonous fluids—it cannot be further dwelt on here, and will be found fully discussed in the article on Septic Diseases.

A word, however, must here be said on the kind of wound which is most frequently followed by septic poisoning, and on the various ways in which the poison is inoculated. As is well known, punctured wounds are the most dangerous; the simple

reason being that the elastic skin closes the aperture of the puncture, and prevents the poison being washed out by the natural but slight flow of blood. The poison may be inoculated in one of three ways—by entry into the cell-spaces in the connective tissue, or by direct entry into wounded lymphatics, or possibly into veins. If it is free in the cavity of the wound, it may be absorbed into the lymphatics by the ordinary current into the lymph-channels, or possibly it may be conveyed by leucocytes. If there is tension in the wound, owing to plugging of the orifice with dry discharge or applications, then of course the chance of further absorption is greatly increased. In considering the question of inoculation and absorption too, it will not be forgotten that, as the surfaces of the wound glaze in a few hours, all channels of absorption—e.g. cell-spaces, lymphatics, &c.—are closed in thirty or forty hours by clotted fibrinous exudation; and, unless inflammation has been set up, they will remain impervious to the further absorption of the poison. The valuable effect of disinfectants, referred to at the end of this article, is due to their exciting this closure of the possible channels of entry.

Pathology and Pathological Anatomy. The former of these subjects has necessarily been alluded to in discussing the causation of these affections, and, as for the second, it will be best to describe the anatomical changes under each variety.

Varieties and Symptomatology.—The various kinds of septic mischief which may attack wounds, especially those received in post-mortem examinations and dissecting, are perhaps best grouped as follows :—

1. Simple local inflammation of wound.
2. Inflammation of connective tissues.
3. Pustules.
4. Warts and boils—acute and chronic.
5. Inflammation of lymphatics (superficial and deep), and glands—mild and violent.
6. Inflammation of sheaths of tendons (thecal abscess), and of fasciæ.
7. Periphlebitis.

1. *Simple Inflammation of a Wound.* A wound inflicted by a dirty instrument, as a stone, piece of coal, &c., frequently 'festers' and inflames. Instead of uniting in a few days, the edges swell, redden, become everted, and discharge a greyish yellow, sanious pus, which will be found swarming with putrefactive organisms. The inflammation of the wound here is due to the irritation set up by the decomposition of the discharge, and if this is controlled by the use of disinfectants, hot boracic fomentations, &c., the wound soon heals by granulation. *See* Wounds, Treatment of.

2. *Cellulitis around Poisoned Wound.* The connective tissues in the neighbourhood of a poisoned wound, especially in the forearms and legs, are very liable to become the seat of an acute, rapidly spreading cellulitis. Roughly speaking, this may be divided under three headings, according to the virulence of the poison on the one hand and, perhaps, the resisting powers of the patient on the other. These headings are, briefly, serous, phlegmonous, and gangrenous (*see* Cellulitis), the tissues being infiltrated in the first-named variety with a turbid serous fluid, in the second with pus, while in the third class they are sloughy and discharge a foul sanious fluid, which is purulent in the neighbourhood of the sloughs but (like the other two varieties) serous at the spreading border of the inflammation.

Serous septic cellulitis closely resembles Erysipelas in some particulars—e.g. the spreading border, &c., but the following points serve to differentiate the two diseases. Erysipelas begins as an acute specific disease—viz. with an incubation period (twenty-four hours), feeling of malaise, &c., vomiting, rigors, and high temperature. Septic cellulitis steadily (or rapidly, according to the virulence of the poison, &c.) spreads from the wound, as soon as the poison has been inoculated on it. The margin of the inflammation is well-marked in erysipelas, very diffuse in septic cellulitis, and the general constitutional disturbance in the latter (i.e. pyrexia, &c.) is in its course different from that of erysipelas.

3. *Pustules.*—(*a*) *Acute Form.*—There are apparently two conditions under which a person may be affected with pustules, as a result of inoculation with some septic poison. Thus, the pustules may be solitary or very few in number, and simply situated on the hands, or they may be multiple and scattered over the surface of the body, as well as those parts which are exposed to direct contamination. The solitary pustule is, sometimes, the result of inoculation in a small crack at the side or on the dorsum of a finger, while, at others, it clearly follows the introduction of the poison into a hair-follicle or sebaceous gland. Consequently, the dorsum of the proximal phalanx is a frequent seat of such pustulation.

The acute form of pustule runs a fairly definite course. A few hours after exposure

to the poison (such, for instance, as putting the unprotected hand into some septic serous exudation, &c.), an infected spot will be felt to itch, the itching stage lasting three or four hours; the part then begins to ache, but before pain is felt it will be found to be reddened. In twelve to twenty hours it swells, and movement of the finger becomes very painful. In thirty to forty hours the centre of the pimple suppurates and forms the typical pustule. If the pustule at this stage is incised and treated with hot antiseptic applications, it may rapidly heal. If neglected, however, there will ensue a slow spreading inflammation of its base, so that the floor of the minute abscess-cavity is formed by a mass of phlegmonously inflamed subcutaneous tissue. Under these circumstances the pustule becomes chronic.

(*b*) *Chronic Form.*—In the chronic form, the opening of the pustule is liable to scab over, and, consequently, the exudation from the inflamed base collects again in the cavity and causes pain, &c. It may remain in this state, alternately discharging and closing, for three or four weeks, and ultimately heals by absorption of the inflammatory exudation and by cicatrisation.

Treatment.—(*a*) Prophylactic. Infection, which produces the pustular form of the disease, can practically always be prevented by covering the skin thickly with carbolised vaseline, which must be well rubbed into the hair-follicles, &c. No greasy material answers so well as vaseline, others, like carbolic oil, &c., being easily rubbed off.

(*b*) Direct. As soon as the first appearance of inoculation is detected, hot antiseptic fomentations should be applied, and the pustule incised when suppuration has begun. Frequently, if the pustule becomes chronic, it may be made to heal speedily by touching the floor of the small cavity with nitrate of silver.

4. *a. Warts.*—The so-called post-mortem room wart, or—to use the term suggested by Dr. Wilks—'verruca necrogenica,' is a curious condition of the dermis, which often is a relic of a pustule as just described, but sometimes begins, more or less insidiously, from the poisoning of a crack in the skin. When it begins as a pustule, it is practically an extension of the indurated base of that lesion. The induration spreads to neighbouring parts, especially over the knuckles; the epithelium, thickening here and there, forms warty ridges, the furrows between often appearing red and sometimes exuding a little serous fluid. If the warty epithelium is picked off, the papillæ beneath often bleed a little. In the process of healing, the cracks, &c., gradually dry up and heal, the thickened epithelium scaling off. This condition, though usually attributed to the direct effect of putrid substances, may, perhaps, in some instances be started by some of the powerful metallic salts used as disinfectants, and a predisposition produced in the tissues by the free handling of freezing mixtures (e.g. ice and salt, &c.), used in the preservation of tissues, &c. It is an exceedingly obstinate affection and very often remains unchanged for several years, or alternately heals up and breaks out again.

Treatment.—(*a*) Prophylactic: see *Pustule* above. (*b*) Direct. The best immediate treatment is to keep the part constantly covered with some antiseptic but not very irritating ointment (e.g. boracic vaseline, &c.). If the epithelial thickenings are considerable, they often can only be reduced by the continuous application of wet boracic lint.

4. *b. Boils.*—Between the strictly local affections, just described, and the general infection of the lymphatic system, about to be mentioned, there is a class of partly local, partly general, inflammatory lesions, which are boils, although their mode of origin is often peculiar. Practically the condition amounts to this, that a pustule is found in the ordinary way above described, that this pustule soon becomes (by formation of a central slough or core) a boil of considerable size, and is then followed at various intervals of time (often a week or more) by others cropping out in different places on the affected limb; or they may also appear on the opposite side, probably by direct inoculation rather than generalisation of the poison. These boils customarily become fully developed in a few days (three to four), and when they are incised or spontaneously burst, there is found to be a central core or slough, bathed in pus, surrounded by the connective tissues in a state of phlegmon. If incised before they burst, although tension is thereby got rid of and pain greatly relieved, the central slough still forms as a rule. After separation of the core the cavity heals by granulation. These boils, varying in size, painfulness, &c., may continue to crop out at intervals for several weeks, or even a month or two, sometimes appearing to follow the course of the superficial lymphatics. With the formation of each boil there occur symptoms of general constitutional disturbance – e.g. headache, sickness, anorexia, pyrexia—the temperature rising to 101°–102°; these symp-

toms, however, being considerably mitigated towards the end of the attack.

Treatment. — Prophylactic, as above directed. *Direct.* The best applications to these boils are hot antiseptic fomentations, while at the same time free incision should be made into the centre of the boil and discharge encouraged. General treatment is of equal importance, and the patient should be given 15 to 30 grains of quinine a day and sent into bracing country air.

5. *Acute Lymphangitis and Lymphadenitis* arising from poisoned wounds, and especially wounds received in dissecting, &c., have been aptly described as divisible clinically into two forms—viz. mild and violent. Practically, this depends on whether the superficial or deep lymphatics respectively are involved; when the former, the affection being comparatively a slight one, but if the latter, a very grave one. In either case, the poison may be absorbed directly into the lymph-stream by means of a slight wound, or more rarely through the (apparently) unbroken skin. It is noteworthy, in considering the mode of inoculation, that this condition is almost always consequent on a very slight wound, and one therefore which, not attracting attention at the time of inoculation, is not treated until too late to prevent the spread of the poison from the point inoculated.

a. Superficial Lymphangitis and Lymphadenitis. — Symptomatology. — The point inoculated becomes reddened, swollen, and painful in a few hours after inoculation, the pain shooting up the limb from the wound. In twelve to twenty-four hours, the track of absorption of the poison along a main lymph-vessel is shown by a red line or lines, extending from the hand up the forearm to the lymph-gland just above the elbow, and from thence to the axillary glands, which rapidly swell. The pain and line of absorption appear to be as often on the radial and posterior surface of the limb as on the anterior and ulnar, and patients frequently complain of pain along the course of the musculo-spiral nerve, even after active mischief has subsided.

In consequence of the lymphangitis, the whole limb becomes swollen and œdematous. It feels heavy and tense to the patient, who is intolerant of the least pressure on it. At the same time the inflammation of the glands progresses, and by the third day they are greatly swollen and excessively tender; the least movement of the limb, dragging on the fasciæ covering them, causes great pain. General 'constitutional' disturbance, produced either by the direct absorption of the inflammatory products or indirectly through the irritation of the peripheral nerves, is evidenced by delirium, exhaustion, and rise of temperature to 103° F. or higher, loss of appetite, &c. This condition very rarely terminates fatally where active treatment has been adopted, and the symptoms just described gradually abate.

Treatment.—In the first instance, care must be taken that there is no tension in the original puncture or wound, which should be laid freely open, if necessary, and treated with hot antiseptic fomentations changed frequently (every hour or two), the limb being slung upon Volkmann's suspension splint, or supported on pillows so as to be higher than the patient's body, as he lies in bed. If the patient can bear the more or less necessarily dependent position of the limb, it may be slung in an arm-bath for half an hour or an hour once or twice a day, especially if it has been found necessary to make free incisions. The inflamed glands should be painted over thickly with extract of belladonna and glycerine, and then hot flannel fomentations frequently applied. Of course, as soon as fluctuation with extreme throbbing pain develops in any gland, it must be incised with antiseptic precautions. Relapse of the lymphadenitis is sometimes noticed in these cases, and, consequently, suppuration may be delayed to the end of the first fortnight or even later. The general symptoms are best met by giving quinine in the acute stage, and adding iron as soon as the appetite has fairly returned.

b. Deep Lymphangitis and Lymphadenitis.—The affection of the deep lymphatic structures is fortunately relatively very rare, especially at the present time, when the use of powerful disinfectant reagents is beginning to be understood.

Symptomatology.—The condition of inflammation of the deep lymphatics is very rarely accompanied by superficial lymphadenitis, so that it not infrequently happens that the first symptom complained of is pain in the axilla; and this may be diffused and described as being 'in the shoulder,' or referred at once to the lymph-glands. The wound, the seat of inoculation, is usually so small a puncture as not to have been noticed. This was the case in six out of seven cases described by Travers, taken at random. So far as can be made out, there is in these cases a distinct 'incubation period,' averaging forty-eight hours in duration but often less, during which time the patient may feel tired but not ill. Thus it happens that general symptoms begin rather suddenly, at the time when the local

mischief first attracts attention. About two days or less after inoculation the patient feels extremely ill, frequently has a shivering fit or severe rigor, this being followed by vomiting and a rapid rise in temperature. When the pain in the armpit or shoulder has made itself felt for a few hours, there will be found fulness of the axilla, often reaching up into the posterior triangle and down along the inner side of the arm to the elbow. The swollen area becomes exquisitely tender, and the whole limb tense and insupportably heavy. The inflammation of the connective tissues rapidly increases in the next few days, so that the œdematous fulness extends downwards over the latissimus dorsi, sometimes as far as the buttocks, upwards and backwards over the trapezii, and forwards over and beneath the pectoralis major. Owing, no doubt, to the confinement of the areolar planes between the pectoral muscles, it is here that the tension becomes most severe, and, consequently, pectoral abscess is so common a feature of this condition. The skin over the whole tender area soon becomes intensely congested, and, unless the deep mischief is arrested, it becomes dusky, and vesicles containing a little turbid fluid form on the surface. In fact, there is a very acute serous cellulitis starting from the neighbourhood of the infected lymph-glands, and becoming gangrenous if not interfered with.

The general symptoms, mentioned above, increase rapidly with the development of the local trouble. The most noteworthy point among them is the intense depression of the nervous system, so long as the patient is conscious; delirium is usually present towards evening, and, in fatal cases, death is preceded by coma for twenty-four hours or more. The pulse and respirations vary, of course, in number and quality according to the intensity of the general symptoms, which amount to those of acute Septicæmia. In a prolonged case pleurisy of the affected side may be present, and sometimes this becomes empyema. Pneumonia is a rarer complication.

Treatment, &c.—The parts which require frequent and careful examination are the borders of the pectoralis and trapezius muscles, as suppuration tends to burrow towards those points. If there are localised spots of very intense pain on deep pressure, incision should be made through the skin, and pus searched for with a director or aspirator needle, the abscess, when present, being freely opened antiseptically. Since free incision liberates the sero-purulent fluid of the cellulitis, as well as the pus and sloughs of the abscess, it is clear that an early incision can do no harm, if performed antiseptically. As a rule, external applications, such as leeches, fomentations, &c., give little relief, but the latter should not be omitted. Early incision is the principal line of treatment, coupled with large doses of quinine, and salicylate of soda, ten to fifteen grains every four hours, with careful supervision. The latter drug is best given by injection into the rectum in an ounce of milk. Special attention should be paid to the diet, and a proper amount of stimulation by alcohol, ammonia, ether, &c., if the pulse fails. As soon as possible the patient should be removed to country air, early change always being followed by a more favourable condition. In a case where the cellulitis is gangrenous, an attempt should be made to arrest it by hypodermic and interstitial injections, into the border, of hydrarg. perchlor. 1 in 1,000, or of carbolic acid. *See* Hypodermic Injection. Complications, such as pleurisy, &c., must be treated on general rules, early aspiration being advisable.

Prognosis.—The termination of such a case will depend, first, on the virulence of the poison, a factor which only reveals itself by the relative violence of the early symptoms. Another factor of extreme importance is the particular susceptibility, or the reverse, which the patient may show towards septic poisons, and, lastly, the state of the patient's general health. If suppuration is detected early and freely liberated, the prognosis will be improved. Any sign of duskiness or vesication, indicating that the cellulitis is likely to be gangrenous, is of course extremely unfavourable.

6. *Inflammation of the Sheaths of Tendons (Thecal Abscess) and of Fasciæ.*—A not uncommon consequence of septic puncture of the digits is inflammation of the sheaths of the flexor tendons, but as this presents no special features beyond rapidity of development according to the septicity of the poison, reference must be made to Whitlow.

Inflammation of the fasciæ and intermuscular septa is, like inflammation of the sheaths of tendons, merely another variety of cellulitis following infective lymphangitis, for the above-named structures possess a very rich network of lymphatics and cell-spaces, being, in fact, great areas for the collection of the lymph. In cases of inflammation of fasciæ, &c., the condition is simply that of cellulitis affecting all the connective-tissue structures in the limb, which consequently swells very much, and, on free incision being made, the whole of its loose

tissues are found to be infiltrated with serous pus. *See* Cellulitis.

7. *Periphlebitis.*—This is a very rare consequence of a poisoned wound, but sometimes occurs, and therefore is noted here. *See* Phlebitis.

Summary of Treatment.—The subject of 'poisoned wounds' has been so elucidated during the last few years by the labours of Koch and others, that the lines of general treatment are rendered as easy now as they were difficult when Travers wrote his celebrated treatise on the question. If a person is conscious of having wounded himself under circumstances in which he is likely to become poisoned, he should at once encourage bleeding from the part by constricting the limb or digit on the proximal side of the wound. He should then wash the wound very freely with hot water, and, if it is a punctured one, he should suck it. If the poisonous matter is from the body of a person who has died very recently of a highly infectious disorder, such as puerperal fever, pyæmia, &c., and the wound be a deep puncture, it would be wise to convert the puncture into a small incision and then apply some disinfectant as follows. After the wound is thoroughly washed as above described, it will be sufficient in most cases to irrigate it thoroughly with 1 in 20 (five per cent.) solution of carbolic acid, and then to dress it with hot boracic lint. If the poison is probably very virulent, a drop of pure carbolic acid should be placed in the wound; but free cauterisation with caustics is to be avoided, as only depressing the vitality of the tissues of the wound. The subsequent treatment of each variety has already been described, and need not be repeated here; but attention may here be directed to the fact that it is quite the exception for any variety to be uncomplicated, and that the lines of treatment, indicated above, must be greatly varied to meet the individual peculiarities of each case, care being taken—(*a*) that the poison is destroyed locally as far as possible; (*b*) that its absorption by the lymph-stream, &c., is prevented or actively treated if already in progress; and (*c*) that the patient be treated generally as if suffering from acute Septicæmia. Prophylaxis has already been referred to under the sub-heading of *Pustules.* Victor Horsley.

POLYMAZIA or SUPERNUMERARY BREASTS.—This condition is far more common than absence of the gland. Klebs divides it into three forms—1, supernumerary breasts in the pectoral region; 2, in or near the axilla; and 3, in distant parts of the body. In the pectoral form as many as five breasts have been observed. The separate glands in these cases are each provided with a nipple, and secrete milk during pregnancy. Two varieties of axillary breast have been described: one entirely distinct and provided with a nipple, and one consisting merely of a separated portion of the normal gland. The second variety is only recognised by its swelling during lactation. Possibly, such outlying portions of mammary tissue may be the true seat of origin of those cases of cancer which apparently commence between the gland and the axilla. Supernumerary breasts in distant parts of the body have been observed in the groin, on the back, on the outer side of the thigh, and elsewhere. In some cases the child has been suckled from these abnormal glands. Marcus Beck.

POLYPI.—A polypus may be described as a more or less definitely pedunculated or sessile abnormal projection from a mucous membrane. The precise position of polypi as regards classification is still a matter on which opinions differ; probably truth rests with each side, for many polypi are local hyperplasias in the restricted sense, while others may be regarded as true tumours.

Origin.—The mode of origin of certain polypi, especially those of the stomach and intestines, clearly indicates that they are local hyperplasias.

In the stomach, a mammillated or villous condition, culminating in polypoid growths, is seen as the result of long-continued chronic gastritis, which, by inducing hyperplasia of the submucous connective tissue, is presumably the primary cause of the polypi. Again, in the intestines abundant small polypi are commonly found above strictures; they are usually arranged in parallel transverse lines, and are evidently due to exaggeration of the normal transverse folds of the mucous membrane, parts of which become more prominent, and finally pedunculated. Nasal polypi are frequently associated with a general thickening of the lining membrane of the turbinated bones. On the other hand, in the glandular polypus, which reaches its most typical development in the lower part of the large intestine of children, the new formation of gland-tissue so greatly preponderates over the other constituents that such growths cannot be separated from the adenomata; and can no more be considered local hyperplasias than the glandular proliferous

growths of cystic tumours of the breast and ovary.

Structure.—Polypi are either solid or may be almost entirely composed of cysts; but many chiefly solid polypi contain gland-tissue which, by dilatation of its tubules, gives rise to cysts often only visible with the microscope; and in the mucous polypi cyst-formation results from mucoid degeneration of the connective tissue.

Compound cystic polypi are met with in the cervical canal of the uterus, where, from dilatation and projection of the mucous follicles or glandulæ Nabothi, sessile vesicular masses are formed, which may protrude through the os. Distension of the glandular follicles of the stomach and of the antrum of Highmore also gives rise to polypi composed of a single vesicle.

Minute Structure.—As regards their minute structure, polypi, for purposes of description, may be divided into mucous or myxomatous, fibrous and sarcomatous, fibro-muscular and glandular.

Mucous Polypi.—These form the largest and most widely distributed group, being found in the nose, ear, intestines, bladder, and uterus. *See* Nasal Polypus.

Mucous polypi are soft in consistence, succulent, gelatinous, and semi-transparent on section. On squeezing the cut surface small masses of mucus appear, which on removal leave small cyst-like cavities. The polypi are covered with a layer of epithelium of the same form as that of the mucous membrane from which they spring; for example, the mucous polypi of the nose are invested by a double layer of columnar ciliated epithelium. But if the polypi protrude from an external orifice, as may occur in those occupying the nose, rectum, or uterus, the epithelium covering the protruded portion is transformed into the squamous variety. A section of a mucous polypus shows, under the microscope, an interlacement of delicate fibrils, with round, elongated and stellate cells interspersed, the protoplasm of the cells being directly continuous, by means of delicate prolongations, with the fibrils of the stroma. Delicate bands of fibrous tissue traverse the section, and the capillaries are abundant and embryonic. If mucous degeneration is far advanced, the meshes of the stroma are wide, with large gaps formed apparently by solution of the connective-tissue substance. The proportion of cellular elements present in the stroma varies in different specimens and in parts of the same; the round cells may be so abundant as to obscure the fibrillar stroma.

A few gland-tubules can generally be found in the mucous polypi of the nose; in one specimen the writer observed very numerous small, irregularly-massed tortuous tubules lined with very small elongated cells, of which the appearance, together with the characters and arrangement of the tubules, left little doubt that the gland-tissue was newly formed. All mucous-like polypi are not true myxomata, some of those of the intestine being composed of loose fibrous or connective tissue; while many of the so-called polypi of the ear are composed of granulation-tissue.

Fibrous and Sarcomatous Polypi.—They occur in the posterior and upper part of the nares and in the pharynx, where they spring from the basi-sphenoid, being intimately connected with the periosteum of that bone, which they sometimes perforate. Some of them are composed simply of fibrous tissue, but, in the opinion of the writer, the majority, and especially those of the naso-pharynx, contain so large a proportion of cellular elements as to ally them with the sarcomata. Their structure is best expressed by the term fibro-sarcoma, the connective tissue being ill-formed, or even homogeneous, and containing more or less abundant round and elongated cells and nuclei, in various stages of transition towards the formation of connective tissue. Ossification may take place in them to a considerable extent. A single pedunculated polypus composed entirely of spindle cells has been observed in the nose. *See* Naso-Pharyngeal Growths.

The tendency to hæmorrhage in these polypi may be explained, probably, by the presence of numerous blood-vessels of moderate size, having no proper wall except that furnished by a layer of endothelium, and showing at intervals irregular dilatations.

Fibro-myomatous Polypi.—They commonly occur in the uterus, and, rarely, in the bladder in cases of enlargement of the prostate gland. Their minute structure need not be described here.

Adenomatous Polypi.—Among these are included polypi largely composed of gland-tissue, such as those situated on the lower part of the large intestine of children. The gland-tissue consists of straight or convoluted tubules lined with long columnar epithelial cells, many of which are distended with mucus or are 'goblet-shaped.' Some of the tubules open on the free surface of the polypus; others are dilated in various degrees. The stroma is scanty and composed of fibrillar connective tissue enclosing round cells, which are most abun-

dant around the tubules. The writer has examined polypi of the uterus containing a large proportion of gland-tissue, with a stroma of fibrous tissue or of spindle cells.

Papillary Polypi.—Ranvier describes a specimen of nasal polypus, of which the surface was covered with composite papillæ, invested with a thick layer of squamous epithelium. Frederic S. Eve.

POMPHOLYX. *See* Pemphigus.

POPLITEAL ANEURISM. — 1. *Causes.*—For the general causes see Aneurism. The following facts probably explain the great relative frequency of aneurism in connection with the popliteal artery:—*a.* Arteries are particularly prone to become the seat of atheroma where they lie in contact with bone, and hence the popliteal artery is very frequently atheromatous, and liable to become aneurismal. *b.* The popliteal trunk is the only part of the main artery of the lower limb that is not well supported by the surrounding tissues. The entire length of the femoral artery is supported by muscles or firm fascia, while in the middle of the ham the vessel is surrounded on the back and sides by soft compressible cellular tissue and fat. *c.* During the free and rapid movements of the knee, the constant changes in the length and calibre of the vessels may predispose to the formation of aneurismal pouchings. *d.* Immediately below the ham the artery breaks up into smaller vessels, lying deeply under muscles by which they are supported or compressed; this may occasion such resistance to the passage of blood into the leg as to favour the yielding of the popliteal vessel just above.

The share which embolism takes in the production of aneurism is not fully determined, but it is obvious that an embolon, entering the main artery of the lower limb, is particularly liable to be arrested at the bifurcation of the popliteal artery, and this mode of origin may account for some cases of aneurism in this situation.

2. *Pathology.*—All varieties of aneurism, except the 'dissecting,' may be met with in the ham; but the various forms of 'traumatic aneurism' are very rare. Fusiform aneurism may be found as a globular dilatation of the whole circumference of the artery, or as a spindle-shaped dilatation of some length of the vessel. A sacculated aneurism may spring from the anterior or the posterior aspect of the artery, and upon this difference depend, in no small degree, the subsequent progress and complications of the cases. Aneurisms springing from the front of the artery are usually of small size, and are liable to cause caries of the femur or tibia, with destruction of the posterior ligament of the knee-joint, and they may rupture into the joint. Aneurisms springing from the back of the artery grow fast, and reach a large size, owing to the slight resistance offered to their enlargement by the yielding tissues of the ham; they often interfere seriously with the return of blood through the popliteal vein—compressing or even destroying that vessel—and cause severe pain from pressure upon the internal popliteal nerve; they are very prone to become diffused, bursting either subcutaneously or beneath the popliteal fascia. When subcutaneous rupture occurs, the blood rapidly infiltrates the superficial cellular tissue, and the deeper planes as well; when the rupture is subfascial, the infiltration of the blood may be more gradual, or quite sudden, spreading up the back of the thigh and down beneath the calf of the leg; if extensive, it quickly impedes the venous circulation, and leads to moist gangrene of the foot and leg. Double popliteal aneurism has been frequently observed, and there are many recorded cases in which the cure of one aneurism has been quickly followed by the development of another in the opposite ham. For the general pathology of popliteal aneurism, *see* Aneurism.

3. *Symptoms and Diagnosis.*—The earliest symptom of popliteal aneurism is usually pain in the knee, with a certain amount of stiffness of the joint, which is kept flexed, and hence the patient is very apt to regard his affection as 'rheumatic.' These symptoms may increase, the pain becoming constant and severe, and the movements of the joint more limited. To them may be added pain down the calf of the leg and in the sole of the foot, from pressure upon the internal popliteal nerve; and lividity and œdema of the leg and foot, from pressure upon the internal popliteal vein; while the patient may be conscious of a 'sensation of beating' in the ham. Occasionally the patient can fix precisely the time of origin of the aneurism, on account of the sudden occurrence of pain and stiffness; in other cases the symptoms come on more insidiously. On examining the ham, the surgeon will detect a tumour over, and fixed to, the artery, with an expansile pulsation in every part, and possibly also a thrill accompanying every upheaval of the tumour. On compressing the femoral artery in the groin, not only is the pulsation arrested, but the swelling collapses or yields

under compression to a greater or lesser extent, and then, when the finger is removed from the artery, the pulsation immediately returns with full force in the tumour, which assumes its former size in two or three bounding beats. Auscultation over the tumour reveals a blowing, systolic murmur, which at times may be replaced by a musical or a rasping bruit, and there may be, in addition, a diastolic sound. On comparing the pulse in the tibial arteries of the two sides, that on the side of the tumour will be found delayed behind the other, smaller and weaker. There may be considerable œdema and venous congestion below the ham; frequently there is a certain amount of fluid in the knee-joint, filling out the synovial pouches, and causing 'floating of the patella.' There may or may not be evidence of atheroma in the brachial, temporal, and other superficial arteries, and of hypertrophy of the left ventricle of the heart.

An aneurism being recognised by these signs, the surgeon should proceed further with his investigations, for the purpose of determining its relation to the popliteal artery, the condition of the sac and its contents, and the degree to which the surrounding structures are involved in the tumour. If the tumour be large, of rapid growth, and threatening to become 'diffused,' venous obstruction and pain along the branches of the internal popliteal nerve having been early and marked symptoms, the aneurism is connected with the back of the artery. If, however, the tumour be of small size and slower growth, but attended with constant and severe pain in the knee, while the signs of pressure upon the popliteal vein or nerve are slight or altogether absent; and especially if the pulsation be markedly thrilling, or a distinct line of pulsation, corresponding to the artery, can be felt over the tumour, it is an aneurism springing from the front of the artery. It is this variety of aneurism that is frequently accompanied with synovitis of the knee-joint. If the tumour be clearly defined, firm, with deep pulsation, and but very slightly compressible when the flow through the artery is arrested, it shows that the sac is filled to a large extent with clot; while if the tumour be ill-defined, soft, perhaps fluctuating, with very superficial pulsation, and the tumour can be completely emptied by gentle pressure, when the arterial flow is arrested, it indicates that the contents of the sac are all fluid blood. All intermediate grades between these two extremes are met with.

When an aneurism is noticed to enlarge rapidly, but at the same time its outline becomes less well-defined, the pulsation indistinct, and the bruit altered in character, the signs point to a giving way of the sac, and a slow leaking of the blood into the surrounding tissues; this may occur beneath the strong popliteal fascia, and, from the pressure of the effused blood upon the vein and nerves, there will be considerable œdema of the leg and foot, and severe pain and numbness. When a patient with an aneurism experiences a sudden sharp pain in the ham, as if he had been struck, followed by a hot trickling sensation in the leg, and general pallor and faintness, while the surgeon finds a sudden and great increase of the swelling, with entire loss of its outline, loss of pulsation and thrill, and great diminution in the intensity of bruit; and if with this there be ecchymosis of the skin, intense œdema, coldness, lividity, and numbness in the leg below, while there is no pulse in either of the tibial arteries, it will readily be recognised that the aneurism has burst subcutaneously, with free extravasation of the blood and complete arrest of the circulation in the limb below.

An aneurism growing from the front of the artery may burst into the knee-joint. This event would be recognised by the sudden distension of the cavity of the joint and the formation of a tense pulsating swelling, which may yield under the hand when the femoral artery is compressed. The introduction of a fine trocar or a grooved needle would, in a case of doubt, show the nature of the fluid. The comparative fulness of the pulse in the tibial arteries shows the extent to which the aneurism interferes with the arterial circulation; the amount of venous distension and œdema in the leg and foot is a measure of the obstruction to the venous return. Even aneurisms of small size may seriously compress the popliteal vein, and ultimately lead to its obliteration. This is a very important point to determine, as, where there is great obstruction to the venous return, any treatment of the aneurism, if attended with occlusion of the artery—and from this possibility no form of treatment is exempt—is very liable to be followed by gangrene. The extent to which the popliteal nerve is compressed by, or involved in the sac of, the aneurism, can be determined by the severity of the pain referred to the leg and foot, by numbness and paralysis. Destruction of the ligament of Winslow and caries of the bones of the knee are recognised by the ordinary signs of these affections, particularly by the severe local pain and the limitation of movement of the joint.

Should the parts about an aneurism become swollen, œdematous, hot, painful, tender, and reddened—the swelling obscuring the outline of the aneurism, and lessening the distinctness of the pulsation—while the limb below retains its former appearance, and the tibial pulse is not lost, the surgeon must diagnose inflammation around the sac of the aneurism. General fever will aid this diagnosis. Should abscess form, fluctuation will be detected, and if an incision be made, masses of blood-clot or fibrin will be discharged with the pus, and sudden profuse hæmorrhage from the aneurism will probably occur in a few hours or days. One other change in an aneurism requires to be carefully recognised, and that is its cure. If spontaneously, or as the result of treatment, an aneurism becomes firmer, and loses its expansile pulsation, its thrill, and its peculiar bruit, it may be held to be solid, and if this condition persist it is cured. If the artery be not at the same time obliterated, there will still be a heaving pulsation in the swelling, and on gently compressing the swelling against the artery, a thud-like murmur may be heard in it. A cured aneurism gradually shrinks, and if this lessening in size be not observed, it affords ground for serious suspicion that there is still some blood entering the sac from the artery.

4. *Treatment*—Except in the conditions named below, when very prompt action on the part of the surgeon is demanded, he will do well to place his patient in bed on a dry and somewhat restricted diet, and keep him under observation for some few days before deciding upon the course of treatment to be adopted. In addition, a thorough examination of the heart, great vessels, lungs, and other viscera should be made. Where the aneurism is of small or moderate size, and its sac contains a fair amount of laminated fibrin, and the patient is placid and submits patiently to the necessary restraint, some form of *compression* should be employed. If the pulsation in the aneurism be readily stopped by flexing the knee, *flexion* should be tried. For this, the limb should be evenly bandaged with domett from the toes to the ham, and a lithotomy anklet placed on the foot. With the patient lying on the affected side, the knee should be bent to a degree just sufficient to arrest all pulsation in the sac, and it should be fixed in that position by a bandage from the anklet to a band round the waist, and supported by heavy sand-bags laid along the thigh and leg. If the patient complain of the restraint of this position, a subcutaneous injection of morphia, gr. $\frac{1}{4}$, should be given. Every few hours the surgeon should examine the aneurism, to feel whether the sac is solid. This should be done without altering the position of the limb. If the patient bear the treatment well, the position may be maintained for four days after the sac is felt to be solid, and then the limb gradually extended, a careful watch being kept upon the aneurism for any return of pulsation. If the restraint be unbearable, the knee may be partially straightened out as soon as the aneurism is felt to be solid, and compression applied to the femoral artery by a Carte's compressor, a bag of shot fastened on the groin, or by digital compression. If the limb be extended and no compression applied to the artery, the clot formed is very liable to disintegrate and the pulsation to return as before. Should no change occur in the aneurism after a fair trial of flexion for forty-eight hours, it may be abandoned. This treatment is not suited to aneurisms of large size, or to those with thin sacs and rapidly enlarging.

For aneurisms of small or moderate size, in patients who are free from internal aneurism, fatty degeneration of the heart, and very advanced arterial disease, *Esmarch's bandage* may be tried with good hope of success. The patient should be prepared by rest in bed, and a dry albuminous diet for a week or ten days. The bandage should be applied from the root of the toes up to just below the aneurism, while the patient is recumbent; or it may be wound firmly round the upper part of the leg only, and then, while the patient stands up, it should be continued obliquely across the front of the knee, and around the lower half of the thigh above the aneurism. The bandage should be kept in place for an hour and a half, pain being subdued by hypodermic injections of morphia or the administration of chloroform. When the bandage is removed, compression of the femoral artery at the groin must be kept up—if the aneurism be not solidified, for twelve hours; if it be solidified, for forty-eight hours, being gradually lessened after the first eighteen hours.

If these methods have failed, or the case be not deemed suitable for them, *simple compression* of the femoral artery should be employed. This is best done by digital compression at the groin, by relays of assistants, who should work in pairs, one having his hand on the aneurism to notice any pulsation in it, and the other compressing the artery with his thumb

with force just sufficient to obliterate pulsation in the tumour; a conical weight or bag of shot pressing on the thumb will greatly facilitate this procedure. Where assistants cannot be procured, Carte's compressors should be used, one being placed at the groin, and one about the middle of the thigh, and used alternately for half an hour, the second being screwed down on the artery before the pressure of the first is relaxed. The skin of the thigh should be washed with spirit lotion two or three times a day, and then carefully dried and powdered, and the pressure employed should not be more than sufficient to abolish all pulsation in the sac below. So soon as the aneurism is found to be solid, the pressure may be relaxed. Continuous compression cannot be prolonged for more than forty-eight hours, but some surgeons prefer to apply it for eight or ten hours a day, merely having a bag of shot bandaged on to the groin in the interval; unless distinct benefit be obtained in a week, this treatment should be discontinued. Should the aneurism continue to enlarge in spite of compression of the femoral artery, or the patient become very restless and irritable, the treatment must be discontinued.

When these measures fail or cannot be carried out, the femoral artery should be *ligatured* at the apex of Scarpa's triangle. Where the patient is of an irritable disposition, and resents confinement and restriction, or where there is reason to suppose that the sac has ruptured, but without free extravasation of blood, this should be resorted to at once; and now that the operation is so much less dangerous than formerly, a patient should not be harassed and worn out with long and repeated applications of compression before resorting to it. If the ligature be followed by dry gangrene, the dead part should be wrapped in iodoform cotton-wool, and allowed to separate spontaneously, the surgeon merely dividing the bone, or trimming up the stump left. If, however, moist gangrene occur, the surgeon must not wait, but *at once* proceed to amputate the limb just above the condyles of the femur.

When the ligature fails to cure the aneurism, and a pulsating tumour is still left in the ham, the surgeon must first of all determine whether the artery be obliterated at the seat of ligature, and if he find it still pervious there, from premature softening of the ligature, he should reapply the ligature close to the same spot. If, however, the artery be obliterated, digital compression of the femoral artery at the groin should be employed, aided by direct compression of the tumour itself, or Esmarch's bandage may be tried. Should these measures entirely fail, and the patient be young or middle-aged, and with a healthy heart and arteries, the external iliac artery should be tied; if the patient be old, or with a weak or diseased heart, or advanced arterial disease, it would be better to amputate through the lower third of the thigh. Where an aneurism has ruptured externally, or subcutaneously with free extravasation of blood, amputation should be at once performed close above the tumour. Where the aneurism has caused extensive caries of the knee-joint, amputation is also indicated. Should there be evidence of commencing inflammation around the aneurism, ligature of the artery should be performed at once, and the usual means taken to allay the inflammation; if abscess form, an early incision should be made into it, and if hæmorrhage occur from the aneurism, or the aneurism burst into an abscess, the limb should be amputated just above the knee. If the aneurism rupture into the knee-joint, the femoral artery should be tied; should this fail to cure the aneurism, or the joint remain useless, amputation through the thigh is indicated.

A. Pearce Gould.

POPLITEAL ARTERY, The, extends from the opening in the adductor magnus, down the back of the knee to the lower border of the popliteus muscle. It reaches from five inches above, to two inches below the knee, bifurcating at the level of the tubercle of the tibia.

Coverings.— 1. Skin thin, but pretty firmly fixed. 2. Superficial fascia with but little fat; in this fascia are the small sciatic nerve and the external saphenous vein. 3. The deep fascia, called popliteal, is dense and firm; the external saphenous vein perforates it. Beneath the fascia are the popliteal space and its contents. This is a diamond-shaped space, bounded above by the diverging hamstrings, below by the converging heads of the gastrocnemius. Most superficially is the internal popliteal nerve; the vein lies on the artery; the artery lies the deepest. The popliteal vein lies slightly to the outer side of the artery; whilst the internal popliteal nerve—which is first one inch external, and then on the artery—finally tends to the inner side. The artery rests on the femur, the posterior ligament of the knee-joint, and the popliteus fascia covering the popliteus muscle.

Ligation of the Artery in the Middle Third.—Lay the patient on the face or in

the three-quarter prone position. Make a perpendicular incision in the line of the vessel, having its central point opposite the knee. The incision should be three inches long at least. Cut through the skin and superficial fascia, avoiding the external saphenous vein; divide the popliteal fascia; clear away the fat with the director; pull outwards the internal popliteal nerve; open the vessel-sheath on its inner side, separate the vein, and pass the needle from without inwards.

Ligation of the Artery in the Upper Third is best done from the inner side of the thigh. Lay the patient on the back; place the limb as for ligature of the femoral; the surgeon is to assume also the same position relative to the limb. Make an incision three inches long just behind a line drawn upwards from the adductor tubercle; the lower end of the incision being on a level with the tubercle. Cut through skin and superficial fascia; avoid the internal saphenous vein and nerve, pulling them backwards; recognise the sartorius, and cut through the fascia along its anterior edge, to find the round tendon of the adductor magnus; clear the part, tying or twisting some branches of the anastomotica magna; pull back the sartorius, the gracilis, the semi-tendinosus and semi-membranosus, and, passing the director behind the adductor tendon, search amongst the fat, when the artery will be easily found. Pass the needle from before backwards, and apply the ligature as far as possible from any of its larger branches.

The popliteal artery can only require to be tied for wounds or rupture, involving possibly the knee-joint, and, under these circumstances, the operation must be more or less of a tentative nature, and be performed under the disadvantages of the popliteal space being filled with blood-clot, and the pulsation of the artery arrested.

James Cantlie.

POPLITEAL ARTERY, Wounds of the.—1. *Causes.*—Stabs and other wounds inflicted from without; ulceration of the artery by the pressure of a sequestrum of the femur, or by laceration during its extraction. The artery may be ruptured subcutaneously by severe blows, strains, or wrenches.

2. *Signs and Diagnosis.*—If there be an external wound or sinus there is profuse arterial hæmorrhage, the limb below becomes blanched and cold, and the pulse in the tibial arteries is greatly weakened or lost. Loss of tibial pulse indicates a very free or complete division of the artery; if the tibial pulse be not affected, it shows that the hæmorrhage is from some branch and not from the main trunk. The signs of a subcutaneous rupture resemble those of a ruptured aneurism; there is a rapidly formed tense swelling in the ham, extending up the thigh and down the leg; coldness, pallor, and loss of pulsation in the arteries of the leg, which quickly becomes gangrenous. There may be a bruit in the swelling; signs of inflammation are wanting.

Treatment.—If all hæmorrhage has ceased when the surgeon sees the case, he should content himself with dressing the wound antiseptically, and with keeping the leg and foot slightly raised and at perfect rest, either fixed on a splint or resting between firm pillows. Where hæmorrhage is continuing, a tourniquet should be applied at once, and both ends of the artery sought and tied. For this it may be necessary to enlarge the wound, the incision being made parallel with the vessel, and great care taken not to injure the external saphenous vein and the popliteal vein and nerve; the artery lies very deeply, and the operation may prove exceptionally difficult. If the popliteal nerve is found severed, its ends should be united with fine catgut. If the vein be also wounded, it is a grave question whether amputation should not be at once performed; and if the wound be extensive, with contusion and laceration of the soft parts, or injury to the bone or joint, or the patient be old with a weak heart and diseased vessels, this would certainly be the better course. Should the patient be young and otherwise healthy, and the wound a clean incision and limited in extent, the vein should be ligatured as well as the artery; but if moist gangrene ensue, secondary amputation at the level of the wound will be necessary. In cases of necrosis of the femur, an attempt to tie the artery should be made, but if this be found impossible, amputation of the thigh should be at once performed. Should secondary hæmorrhage occur, an attempt to re-ligature the vessel should be made; failing this, amputation is indicated. In cases of rupture of the artery, an incision should be made along the outer edge of the semi-membranosus muscle, and search made for the ends of the vessel, which should be tied. The effused blood should, as far as possible, be allowed to escape, and the condition of the limb below be carefully watched. If signs of 'moist' gangrene appear in the foot and leg, amputation

through the lower third of the femur should be at once performed; where the gangrene is 'dry,' the separation of the sphacelus may be left to nature.

A. Pearce Gould.

POPLITEAL SPACE, Diagnosis of Affections of the.—The affections of the ham, requiring to be carefully distinguished from one another, may be grouped under the headings of *sinus* and *swellings*.

A *sinus* in the ham may be the sequel to a simple or a lymphatic abscess, or may be connected with necrosis of the lower end of the femur, or with disease of the knee-joint. To determine the question, the general outline of the joint and bones, the degree of mobility of the joint, and the history of the case must be made out, and the sinus should be carefully probed. Where there is no enlargement of the bones or joint, and the movement of the joint is painless and free from grating, and the probe fails to detect any bare bone, it may be regarded as a *simple sinus*. With a sinus present, the joint may be held flexed and complete extension be impossible, owing to contraction of the ham-strings and the matting together of the parts around the sinus. Unless the sinus be very carefully probed, a small surface of bare bone may be overlooked. If, however, the probe strike bare bone, the diagnosis of *necrosis* will be arrived at. Necrosis of the flat popliteal surface of the femur is very common, and when it occurs, no involucrum of new bone is formed around the sequestrum. Where, with a sinus, there are the usual signs of disease of the knee—swelling, rigidity, pain, grating in the joint—the dependence of the sinus upon the *arthritis* will be evident.

Swellings.—It is most important to determine whether any given swelling is connected with the popliteal artery or not, and no pains must be spared in this investigation. The chief sign of such connection is pulsation in the tumour. Pulsation may be due to one of three causes—(1) Contact of a tumour with the main artery; (2) extreme vascularity of a solid tumour; (3) communication with the artery—aneurism. (1) When the pulsation is communicated, it is heaving in character, and the tumour is not expanded with a wave; compression of the main vessel does not cause the tumour to shrink, and, except in the case of reducible bursal cysts, the tumour does not yield under compression. In the latter case, the tumour is reducible when the artery above is not compressed. In many of these cases the pulsation is limited to or most intense in one part of the swelling, and can be increased by gentle pressure; it is often possible to draw the tumour away from the artery, and cause the pulsation to disappear. Such tumours have no thrill, and, if a bruit be heard, it is a dull thud rather than a prolonged blowing sound; the pulse in the artery beyond is not modified.

(2) When pulsation is due to the vascularity of a tumour, it is somewhat expansile in character; but, on controlling the artery above, the tumour is quite unaltered in size and consistence, and is incompressible; on removing the pressure above, the pulsation at once returns as before. Often other special signs characterise these tumours—thus the pulsation may occur at a distance from the main artery, or there may be 'egg-shell crackling' at some part of the tumour.

(3) When the pulsation is due to aneurism, it is always expansile in character, and is felt as a wave distending the tumour, and generally it is uniform in intensity throughout the tumour. On compressing the femoral artery, the tumour contracts somewhat, and by gentle compression it can be made to yield still more; then, when the pressure above is removed, the tumour is filled out again in two or three bounding beats. Such tumours generally are the seat of a prolonged blowing bruit, and often of a thrill. The pulse in the arteries below is delayed in time, and lessened in force and size as compared with that in the opposite leg. From pressure on the vein or nerve there are often cyanosis and œdema of the leg, and neuralgic pains in the foot and ankle. *See* Popliteal Aneurism.

A. *Sudden Swellings.*—Where in a previously healthy man a deep tense swelling suddenly develops as a result of a blow, strain, or other injury, and the leg below is found pulseless, cold, swollen, and livid, with numbness gradually becoming complete, the diagnosis of *rupture of the popliteal artery* may be made. Should there have been some amount of swelling in the ham before, or the patient have been conscious of a beating in the part, or subject to neuralgic pains in the leg and foot; and especially if the patient be at or past middle life, and have atheromatous arteries and hypertrophy of the heart, it may be regarded as a *ruptured aneurism*.

B. *Acute Swellings.*—Should the swelling be deep in the ham, painful, tender, the touch firm, and without superficial œdema, and with only communicated pulsation, if any at all, it is a *bubo* or en-

larged popliteal gland. The detection on the heel or ankle of some source of infection would support this diagnosis. If the swelling be less well-defined, boggy or fluctuating, painful, tender, and the superficial tissues be œdematous and reddened, an *abscess* may be diagnosed. In this condition the joint will be semi-flexed, and any attempt to straighten it out will be painful, and resisted by the patient. There will be pyrexia, and perhaps a rigor or rigors, to confirm the diagnosis. An abscess may be combined with aneurism, or may open into the artery. The surgeon should therefore carefully examine for pulsation, thrill, bruit, and especially for compressibility of the tumour when the artery above is controlled, and for alterations in the tibial pulse. Only when he has ascertained the absence of *all* these phenomena, must he diagnose abscess pure and simple.

C. *Chronic Swellings.*—A soft, rounded, compressible swelling, immediately beneath the skin, which is continuous with the saphena vein in the leg, is a *varix.*

If the tumour be subcutaneous and loosely adherent to the skin, movable over the deep fascia, with a lobulated surface, and a defined, rounded smooth edge, it is a *lipoma.* A soft, ill-defined, lobulated swelling at the back of the knee, adherent to the skin, and immovable in the subcutaneous fascia, is of no pathological importance.

A tense, more or less globular fluctuating tumour, painless and not tender, without any signs of connection with the blood-vessels, unless it be transmitted pulsation, is a *bursa.* This form of tumour is often reducible into the joint, and is most tense and prominent when the joint is extended. A firm, solid tumour deep in the ham, movable over the artery, with doubtful transmitted pulsation, is an enlarged *lymphatic gland.*

A very hard tumour, growing slowly from the bone in a young person, is an *exostosis.* These tumours may be multiple; they may cause severe pain by pressure on a nerve. Occasionally an exostosis is broken off by violence.

A firm, steadily increasing tumour, fixed to the bone, or expanding the bone over it, perhaps varying in consistence in different parts, is a *sarcoma.* Such a tumour may exhibit pulsation from its great vascularity; it may attain a great size, and involve more of the femur or tibia than its popliteal surface.

A tumour over, and irremovable from, the artery, with expansile pulsation, blowing bruit, and thrill, yielding to pressure when the artery above is compressed, and subsequently filling out with two or three bounding beats, is a Popliteal Aneurism.

A. Pearce Gould.

PORRO'S OPERATION.—This is the Cæsarean section together with supra-vaginal amputation of the uterus and removal of the ovaries and tubes. It is indicated in the same cases in which the Cæsarean Section, Laparo-Elytrotomy, or Symphysiotomy (Sigault's operation) may be performed; and, besides avoiding certain special dangers pertaining to each of these procedures, has the further recommendation that the patient cannot again become pregnant and be exposed to the same risks a second time. Another great advantage, which it possesses over any of these alternative operations, is that it can be performed at a fixed time selected by the surgeon, without waiting for the actual commencement of labour.

The possibility of performing this operation, and thus lessening the danger of the Cæsarean section had at various times suggested itself to Cavallini, Michaëlis, and our countryman Blundell, who was so far in advance of his time in many of his thoughts and writings on abdominal surgery. Storer, of Boston, U.S., in 1869, was the first operator who actually performed the operation on a living woman, having been forced to remove the uterus to check the hæmorrhage during Cæsarean section; the presence of a large uterine fibro-cyst being the cause of the hæmorrhage. The patient survived sixty-eight hours.

To Porro, of Pavia, the credit belongs of having first performed Cæsarean section, with the intention of also amputating the uterus and its appendages. His operation was performed on May 21, 1876, and both mother and child survived.

In the *British Medical Journal*, January 26, 1884, Dr. Godson records a successful case in which the writer assisted him; and he gives very complete tables of all the cases which he could collect. A study of these tables shows that, though the maternal mortality of the operation has been very heavy, it compares favourably with that of the ordinary Cæsarean section.

Operation.—The bowel having been cleared by enema, and the bladder emptied by the catheter, the patient is laid on her back, with the arrangements which will be found described in detail in the article on Ovariotomy. An incision five inches long

is made through the linea alba, bleeding points are secured by pressure-forceps, and the peritoneum is carefully opened to the same extent as the skin-incision. The possible escape of any of the contents of the uterus into the peritoneum is guarded against by placing carbolised sponges in the peritoneum, between its parietal surface and the uterus, all round the space selected for incision. A small incision is then made in the uterine wall, and rapidly enlarged by tearing with the two index fingers (a modification suggested by the writer during Dr. Godson's operation); the child is then seized and extracted, and handed to an assistant, who ties and cuts the umbilical cord. As the operator removes the child, the chief assistant grasps the uterus and closes the uterine incision, covering it by a sponge; he at the same time slips one hand past the uterus into the pelvis, and grasps it firmly just above the vagina, including in his hand the broad ligaments on each side; all risk of any serious hæmorrhage is thus prevented. The upper margin of the bladder, at its reflection from the uterus, should now be defined by a catheter or a steel sound, introduced before commencing the operation, and the wire of Kœberlé's serre-nœud passed round so as to include the uterus just above the internal os, and both broad ligaments, with the contained appendages. The wire is first pulled as tight as possible with the special forceps, and its free end is passed twice round the catch on the serre-nœud central screw, and then twice round the whole stem of the instrument, which is then screwed up; a strong capped pin, like that described for hysterectomy, is passed through the right broad ligament, the uterus just above the wire, and the left broad ligament, and the cap is screwed on. The uterus, with the placenta left *in situ*, is then cut away. *See* Uterus, Extirpation of the.

The sponges are then removed from the peritoneum, the anterior and posterior *cul-de-sacs* are sponged out, a flat sponge is placed over the intestines, and the pressure-forceps are removed from the edges of the incision. The sponges and forceps are carefully counted by the nurse or assistant. The serre-nœud is tightened if necessary, and the stump is fixed in the lower angle of the wound by a strong suture passed through the whole thickness of the abdominal wall and the edges of the peritoneum, so as to close the latter firmly round the stump without constriction. The remaining sutures are introduced, and the flat sponge removed. After the sutures are tied, and the upper part of the wound dressed and strapped, dry carbolic gauze is carefully packed round the stump, and under the stem of the serre-nœud and the supporting pin. The wire is then again tightened if necessary, and the stump trimmed; a silk thread is run in and out round the cut edge of the broad ligament and uterine stump, and firmly tied. The stump is then lightly and carefully smeared with solid perchloride of iron, and covered with the usual dry carbolic gauze dressing and straps.

The after-treatment is exactly the same as after hysterectomy. Various modifications of the operation have been proposed, but they have nothing to recommend them. One, that of Müller, requires a brief notice.

He makes a longer incision, turns the uterus out entire, and surrounds its neck with an elastic ligature before opening it and removing the child, the object being to save risk of hæmorrhage and of fouling the peritoneum with the uterine contents. The great objection to this is that the child is often asphyxiated by the elastic ligature stopping the uterine circulation, and the fear of this must always hurry the operator while applying the ligature, incising the uterus, and extracting the child. Such hurry is always to be avoided; and the risks above referred to (hæmorrhage and fouling of the peritoneum) may be equally well obviated by the careful arrangement of sponges, by the tearing of the main part of the uterine opening, and by grasping the uterus in the pelvis as described above.

The long incision necessitated by the Müller modification, apart from the danger to the child, increases the shock, adds to the exposure of intestines, to the length of the operation, from the number of sutures required, and exposes the patient to increased risk of hernia from the long scar.

One of the great advantages of the Porro operation is that all proper arrangements as to skilled assistance, &c., can be made beforehand, and thus no difficulty should arise in carrying out each detail with precision and care.

Drainage should never be necessary after an operation carefully performed, when necessitated by contraction or deformity of the bony pelvis; but may in rare cases be required when a large adherent tumour has been removed along with the uterus. In such cases the operation may have to be modified in many ways, and it may even be necessary to adopt Schröder's intra-peritoneal method of amputating the uterus; but a detailed discussion of all such eventualities would occupy too much space in the

present article, and they only require the application of the rules laid down in the articles on Ovariotomy, and Uterus, Extirpation of the.

J. Knowsley Thornton.

POSITION interests the surgeon in diagnosis and treatment. Position in bed is frequently suggestive of the constitutional state. A patient sleeping on the back, with hands clasped behind the head, or resting on the side, with open hand under the face or temple, is generally doing well. After injuries and operations in the abdomen, the position on the back with down-stretched legs is of good omen; so is lying on the side with sufferers from chest-lesions. In advanced cases of tetanus, the backward arched position of the body is pathognomonic; but, even in early trismus, the patient's complaint of slight stiffness about the jaws acquires special importance, if the chin project and the head be thrown a little backward. In serious cases generally, the patient's high or low position in bed indicates power or feebleness; and, in determining the nature of many injuries, the position of parts may be one of the most obvious signs—e.g. in dislocations of the lower jaw, of the shoulder, elbow, and hip; so also in fractures of the lower end of the radius, and just above the ankle. In diagnosing the presence of tumours or collections of fluid in the chest or abdomen, much valuable information is gained from the influence of varying positions of the body on palpation and percussion.

The diagnosis of many tumours and ulcers is largely determined by position. The scalp is the favourite seat of cystic, the trunk of fatty, tumours. The majority of herniæ are on the front of the abdomen, of aneurisms at the bends of joints. The almost invariable domain of varix is the lower half of the body; the upper half is the favourite one of scrofula. Ulcers are rare in the upper limbs, and their position on the lower is in a large measure diagnostic. They are usually varicose below, and syphilitic above, the middle of the leg.

The operating surgeon has to consider position in making incisions, so as to prevent deformity, pain, and tension, and favour drainage by natural declivity. In operating on the face and neck, it is best to follow the natural lines; on the hand and foot, to elect the dorsal aspect, whenever practicable, so as to avoid cicatrices on the surface exposed to pressure. A similar consideration should influence the surgeon in planning his incisions for amputations. Position is of the first importance in exploring and operating in the natural passages, in the administration of anæsthetics, and in treating aneurism, dropsy, hæmorrhage, hernia, and spinal and uterine affections and displacements; also in restoring persons whose lives are endangered by asphyxia or faintness.

In the treatment of wounds and fractures, and generally of surgical conditions, position is a potent factor, regulating nervous, vascular, and muscular action, preventing congestion, facilitating coaptation, and, in direct measure, favouring repair, with a minimum of constitutional and local disturbance.

'An elevated position, of any part of the body which admits of being raised above the rest, has effects far beyond what are generally known on the circulation of the elevated part, and consequently on the heat, pain, and tumefaction which may have previously existed. If the hand be held up for a little time above the head, the pulse immediately becomes soft. The hand is soon after found to be pulseless and reduced in size. There is a feeling of lightness and coldness, which continues for some time after the hand has been taken down.' This very simple experiment, related by James Macartney in his *Treatise on Inflammation* (1838), is full of instruction and suggestiveness, as to the value of position in surgical therapeutics. A purple and swollen leg has been proved to decrease one inch in circumference, at the expiration of sixty seconds from the time that an assistant held the foot vertically above the pelvis, the skin at the same time becoming pale and the previously tense tissues flabby. As a contributory to rest, position is potent for good, all the more so if circumstances permit the application of equable pressure. As a general rule, that position is therapeutically the best which is most conducive to the patient's comfort. *See* Pressure; Rest; Suspension; Wounds, Treatment of.

Sampson Gamgee.

POSTHITIS — Inflammation of the Prepuce. *See* Balanitis.

POST-MORTEM WOUNDS. *See* Poisoned Wounds.

POST PHARYNGEAL ABSCESS. *See* Retro-Pharyngeal Abscess.

POTT'S DISEASE. *See* Caries of the Spine.

POTT'S FRACTURE. *See* Leg, Fractures of the.

POULTICES are hot, moist, local applications, which may be employed solely on account of the heat and moisture which they possess, or less commonly as vehicles for some special therapeutic agent. The poultices recognised by the pharmacopœia may be classified as *emollient*, *sedative*, *stimulant*, and *disinfectant*.

Emollient poultices are made of linseed-meal, bread, or starch. Their therapeutic effects depend entirely upon the heat and moisture which they contain, and, so long as the skin to which they are applied is unbroken, they form very efficient applications. They relax the tissues, and so relieve the tensive pain of inflamed parts; they also, by virtue of their heat, stimulate the vital processes of those tissues which are not too much injured to respond, and thus either aid the resolution of inflammatory products or hasten their approach to the surface. These properties they share in common with fomentations, and with the above reservation—viz. that the surface to which they are applied be unbroken—they are equally efficacious. Poultices retain their heat longer than fomentations, unless special care be taken to prevent the cooling of the latter by surrounding them with cotton-wool. This property is a great recommendation in cases where the frequent renewal of a fomentation disturbs the patient a good deal, or where the regular attendance of a nurse cannot be obtained. If the skin be ulcerated or the seat of any open wound, a poultice is an objectionable application, as it very quickly becomes sour and favours putrefaction of the discharges from the wound. When a poultice is changed, small fragments are very commonly left in the folds of the skin, between the clefts of the fingers, and under the nails for days together, and these, together with the discharges with which they are mixed, become centres of decomposition. Linseed poultices often irritate a tender skin, and frequently cause an eruption of irritable papules, which are liable to develop into boils.

A linseed poultice is best made as follows: The basin used should be well scalded and about half-filled with boiling water; linseed-meal from which the oil has been expressed should be dredged into the water, whilst the mixture is vigorously stirred with a spatula until a soft and tenacious pulp is produced. The linseed should then be quickly and evenly spread on a piece of linen, so as to make a poultice about one-third of an inch thick; the edges of the linseed should be trimmed off, and the borders of the linen should be turned up on to the face of the poultice; the surface of the poultice should be smeared with a little olive-oil, so as to prevent it sticking to the skin. The poultice should be quickly applied, and covered over with a layer of oil-silk, so as to prevent the evaporation of its moisture.

A linseed poultice is very close-textured and heavy, so it is important that it should not be made any thicker than is necessary to obtain its heat-retaining properties.

A bread poultice is more porous and consequently lighter than a linseed poultice, but it retains more moisture than the latter, and soddens the skin much more. To make a bread poultice, the crumb of a loaf two or three days old should be well powdered and dredged into a basin of boiling water, and well stirred up until a pulpy mass is produced; all superfluous moisture should be drained away, and the bread quickly spread on linen, and covered with a piece of muslin so as to prevent its falling to pieces.

Starch poultices are not much used. They retain their heat a long time, but they yield very little moisture. The starch should be first mixed up with a little cold water, and then boiling water should be well stirred in until the starch acquires a gelatinous consistence; the further steps in the preparation of a starch poultice resemble those described for the preparation of a linseed poultice.

Sedative poultices contain some substance which acts locally as a sedative. The only officinal poultice of this kind is made of conium. Two ounces of the extract of conium should be mixed with a pint of boiling water, and then sufficient linseed be added, in the way described above, until a poultice of the proper consistence is made. Other anodynes, such as the tinctures of opium or belladonna, may be added to poultices.

Stimulant poultices are made of powdered mustard, when a strong stimulant or counter-irritant effect is desired; but both yeast and carrot poultices are credited with slightly stimulant properties, and have been used as local applications to sluggish or sloughing wounds. The efficacy of yeast poultices is thought to depend on the carbonic acid which is slowly evolved during the process of fermentation. Mustard poultices are strong counter-irritants, and they cause much pain when applied to a tender skin; they are also liable to produce troublesome vesication if they are

kept on too long; as a rule they cannot be borne for more than twenty minutes.

Mustard poultices are employed to influence deep-seated inflammations, such as pneumonia or bronchitis; to stimulate a failing heart, or as a general stimulant in low fevers when stupor or delirium are present, or to rouse a patient from the stupor resulting from narcotic poisons. To make a mustard poultice, the powdered mustard should be well mixed with cold water, which should be added gradually until a thick paste is produced; hot water should on no account be used, as it causes the active principle of the mustard to evaporate. Vinegar, which has been recommended for making mustard poultices, is still more objectionable, as it destroys the active principle. The mustard paste should be spread on a piece of brown paper and warmed by a short exposure to a fire before it is applied, as the chill of a cold application might be objectionable.

When a mustard poultice is employed to modify a deep-seated inflammation, the poultice should be diluted with bread or linseed, and applied for five or six hours as a jacket-poultice to the entire chest.

The *disinfectant poultices* authorised in the pharmacopœia, are made of either charcoal or a solution of chlorate of soda mixed with linseed and water, but the oakum poultice is far better than either of these. Charcoal in a dry state is well known to absorb gases, but it is questionable whether it retains this power when its pores are filled with moisture, as must be the case in a poultice; it is also questionable whether it possesses any true disinfecting power at all. At the best, a charcoal poultice is an unsightly application, and is very inferior in its action to many modern antiseptics; it is far preferable to sprinkle the wound with crystals of iodoform, and to apply a fomentation over all, than to make use of a charcoal poultice.

To make a charcoal poultice, equal parts of animal charcoal and linseed-meal should be thoroughly mixed and dredged into a basin of boiling water, just as in making a simple linseed poultice.

The chlorate of soda poultice is composed of two ounces of the solution of chlorate of soda, four ounces of linseed meal, and eight ounces of water. It would, however, be far preferable to wash a foul ulcer frequently with the disinfectant than to apply it as a poultice.

The oakum poultice or fomentation is a very good antiseptic application; it is made of loosely picked oakum and prepared, like a fomentation, by wringing it out of boiling water; it is well to wrap up the oakum in a piece of muslin before applying it to a wound, as its fibres are very liable to stick to the surface.

BILTON POLLARD.

PRESBYOPIA.—This name is given to the optical defect of the eye which is caused by natural senile changes in the crystalline lens, in consequence of which changes the nearest point of distinct vision recedes from the eye. These changes consist chiefly of gradual hardening of the lens. This hardening process really goes on throughout life, with the result of causing a progressive diminution in the amplitude of accommodation, as the nearest point of vision recedes. The far point of distinct vision remains stationary until the age of fifty and then it also recedes, but more slowly than the near point, so that at the age of seventy-five the near and far points coincide—i.e. the amplitude of accommodation equals 0. When the near point has receded beyond 22 centimètres (about 9 inches) from the eye, which would correspond in a case of emmetropia to a remaining amplitude of accommodation equal to 4·50 dioptres, a difficulty is experienced in seeing small objects, such as small print, fine stitches, &c. This difficulty is first noticeable when the illumination is not good, e.g. during the evening, when artificial light is employed. It becomes necessary, under these circumstances, to supplement the existing amount of accommodation by means of a lens whose focal power, when added to one the focal distance of which equals the distance of the near point from the eye, is of sufficient strength to make that combination equivalent to a lens of 4·50 dioptres. In other words, we must place in front of the eye a lens which is sufficiently strong to bring the near point to 22 centimètres from the eye. Thus, for instance, if the near point be at 50 centimètres from the eye—i.e. equals the focal distance of a lens of 2·0 dioptres—it must be brought to 22 centimètres from the eye, which again equals the focal distance of a lens of 4·50 dioptres. The lens which will effect this has a refracting power equal to the difference between 4·50 and 2·0—i.e. equal to a lens of 2·50 dioptres.

Recourse will have to be taken to such aid sooner or later, and the actual glass required will have to be stronger or weaker according to the age at which the near point has receded beyond 22 centimètres from the eye. In hypermetropia this will

take place at an earlier age than in emmetropia, and earlier according to the degree of hypermetropia; in myopia, on the other hand, it will take place later than in emmetropia and later according to the degree of myopia. The condition of presbyopia is generally said to exist when such a glass is required as an aid to near vision, although more correctly it has begun when the same optical correction is not sufficient for both distant and near vision. The following table gives the number of the lens (in dioptres) generally required at different ages:—

Age		Age	
45	1·00	65	4·75
50	2·00	70	5·50
55	3·00	75	6·50
60	4·00	80	7·00

If the individual be ametropic and x represent the number in dioptres of the lens correcting his ametropia, x must be added to the lens given in the table for any particular age in the case of hypermetropia, and subtracted from that number in the case of myopia.

There are some special points which should be attended to in testing and prescribing glasses for presbyopia, viz.:—

1. The proper test to use, when the vision is good, is very small print (e.g. No. 1 Jaeger), as in order to read this there must be accurate fixation.

2. Care must be taken not to prescribe too strong glasses, as they are frequently resented, the reason probably being that the individual has always been accustomed to converge towards and accommodate for the same distance simultaneously; and as the defect in accommodative power is due to want of elasticity of the lens and not to weakness of the ciliary muscle, the correcting glass should not be stronger than the difference in the amount of accommodation which the contracted muscle actually effects, and that which it would bring about, did a sufficient elasticity in the lens exist. Any unwonted dissociation of the relation existing between accommodation and convergence gives rise in the long run to discomfort, which is the more felt the older the individual by whom the change has to be made.

3. Great care must also be taken that the two eyes are corrected for the same distance: this will generally be the case by the use of the same glasses, as the refraction is generally the same in both eyes, but it is a good precaution to test either eye separately. It is still a disputed point whether, in the interest of binocular vision, each eye is capable of an independent amount of accommodation or not; in any case, it is pretty certain that, if such independence exist, it is only brought into play by more or less effort. If we do not bring the near point of both eyes to the same distance, we must have either defective or strained binocular vision. As long as there is a certain amplitude of accommodation left, there will also be a greater or less range through which the individual has distinct vision while using his glasses, as, although the eye provided with a convex glass has a smaller amplitude of accommodation than without, yet the diminution in the amplitude is but slight. Convex glasses magnify for two reasons—first, and principally, because they allow the individual to approach the object closer to the eye, but also because they cause the second nodal point of the eye to advance, and thereby increase the visual acuity; and this to a much greater extent than is done by the change in the crystalline lens, sufficient to give rise to an accommodation for the same distance.

G. A. Berry.

PRESSURE.—As a cause of pathological states, a means of diagnosis, and a therapeutic power, pressure merits the closest attention of the surgical student and practitioner. It has been usual to divide the subject under 'compression' and 'pressure;' but these are essentially synonymous terms, only admitting of artificial distinction in science and practice. Pressure is the least ambiguous term, and its preference may, it is hoped, result in clearness of statement and economy of space.

As a cause of pain and functional disturbance in many constitutional states, and as the prime mover or concomitant in structural changes after injury, pressure operates variously, according to its intensity and duration and to the parts or tissues acted upon. In abscesses, cysts, and dropsies; in aneurisms and varix; after lesions of the nervous centres and of the thoracic and abdominal viscera; in atrophy and hypertrophy; contusions, dislocations, and fractures; in hernia and prolapsus; ulceration and gangrene—in fact, in the great majority of surgical states, pressure is an etiological factor deserving close investigation.

In the endeavour to determine if, and to what extent, pressure be the cause of pathological phenomena, accurate comparison of analogous parts of the body is very instructive. So, too, are measurement and palpation, auscultation and percussion

in different positions, and examination of the organs of special sense and of the visceral cavities by instrumental aid. Light and deep tapping and grasping, dilating and concentric pressure, have distinctive diagnostic values; and the surgical student cannot be too assiduous in training his fingers to the exercise of intelligent pressure. The touch is scarcely more important to the pianist than to the surgeon: a proposition very forcibly demonstrated in the study of the therapeutic uses of pressure.

The coaptation of divided parts, the crushing and dispersion of a ganglion on the wrist, truss retention of a hernia, dilatation of strictures by bougies, injection of air or oil per rectum in cases of intussusception, are some of the most striking and varied illustrations of the mechanical action of pressure. Its other therapeutic uses, in combination with immobility and position, antiseptics and styptics, are *hæmostatic*, *antispasmodic*, and *antiphlogistic*.

In all methods for arresting hæmorrhage, by bandage, pad and tourniquet, forceps, ligature and needle, pressure is the chief agency, to which physiological position and immobility are powerful contributories. The swelling which takes place immediately after a bruise or sprain is due to subcutaneous hæmorrhage, which is most efficiently controlled by uniform pressure and immobility. Nothing is more soothing to an injured joint, nothing more powerfully conducive to the balance of innervation and circulation, to the prevention of extravasation, and to its removal when it has taken place, than gentle, equable, elastic pressure. Much depends upon how, and with what materials, pressure is applied. If a limb be firmly bandaged with a strong calico roller, without padding, or over ordinary pads or dense common wadding, against wooden or iron splints, the risk is unquestionable; but perfect ease and safety may be ensured by applying pressure with light absorbent bandage, and absorbent gauze and cotton tissue, over well-fitting moulds. Pressure so applied is hæmostatic, anti-spasmodic, and antiphlogistic. Pressure is, by common admission, one of the most powerful therapeutic agencies in counteracting the effects of chronic inflammation; but its efficacy in preventing and treating acute inflammation, though equally demonstrable, is not so generally known. No other triple combination in surgical therapeutics rivals in beneficent power rest, position, and pressure. As to the degree of pressure to be applied, the patient's comfort must be the measure in each case. Nothing in surgery is more noteworthy than the considerable amount of well-applied, equable, elastic pressure which may be borne, with the most perfect comfort, by a part just previously so sensitive that the slightest touch was intolerable.

When pressure causes pain, that is a proof of excess, and it should be at once lightened. It is misleading, and often dangerous, to wait for the relief of numbness which may succeed the patient endurance of painful pressure. Such numbness may only indicate impaired vitality, and be the immediate precursor of structural disorganisation.

Well-adjusted elastic pressure is of great value in the treatment of such diverse conditions as simple flesh-wounds and complicated fractures, ingrowing toe-nail and burns, bubo, and carbuncle. Digital compression of arterial trunks is a powerful antiphlogistic, and gives relief, though often only auxiliary to other remedial measures, in whitlow and phlegmonous erysipelas, in arthritis and compound fracture. From the combination of equable elastic pressure of the surface, digital compression of the main artery, immobilisation of the joints and elevation of a limb, the most beneficial results may be anticipated in removing pathological products and restoring the physiological state.

Pressure may be applied in a great variety of ways. The most generally useful are bandaging with efficient padding or with india-rubber; strapping, adjustment of air-and-water cushions, or of bags filled with ice, sand, or shot. The pressure exercised by successive layers of freshly-applied collodion is considerable. Its antiphlogistic action is very beneficially demonstrated in the treatment of acutely swollen testicle, and it makes the best retentive and immobilising shield for fractures of the nose. *See* Position; Rest; Wounds, Treatment of.

Sampson Gamgee.

PROBANGS are instruments used to dislodge or extract foreign bodies from the œsophagus. The sponge probang consists of a long flexible piece of whalebone with a small sphere of sponge attached to one end; it is used to dislodge soft bodies, such as pieces of meat, which have become impacted in the lower part of the œsophagus, and to push them into the stomach. The horsehair probang is an ingeniously contrived instrument for extracting pins or fishbones from the gullet. The point of the instrument is protected by a small piece of sponge, and about an inch away

from it there is a wisp of horsehair, which can be made to open out something like an umbrella. After the instrument has been insinuated past the foreign body, the umbrella is made to spread out, and then the instrument is withdrawn, in the hope that the foreign body may become entangled in the meshes of the horsehair and so be removed.

An instrument known as a coin-catcher is usually combined with the sponge probang; it consists of a flat flexible piece of whalebone, at the extremity of which there is a metal ring, fixed at an acute angle with the whalebone. The best instrument is provided with two rings, which make an angle of about sixty degrees with one another, and are fixed by a hinge to the extremity of the probang; the hinge allows of one of the rings falling flat against the whalebone, if it meets with any obstruction as it is passed down the œsophagus. When the instrument is withdrawn, it is hoped that the coin may be caught by one of the rings and so be removed.

BILTON POLLARD.

PROCTITIS (Inflammation of the Rectum).—It is a symptom of many affections of the rectum, such as hæmorrhoids, polypus, prolapse, stricture, ulceration, &c., but may also occur independently of these, from local or general causes. It may be due to the introduction of foreign bodies into the rectum, or to the irritation caused by oxyurides, or to gonorrhœal infection. It may also be caused by large and repeated doses of drastic purgatives, or in some persons by errors of diet; or may be associated with diphtheria, gout, or constitutional syphilis. Gouty and diphtheritic proctitis come under the notice of physicians rather than surgeons. Constitutional syphilis sometimes appears to produce this condition. A young married lady who had lived for some years abroad, lately consulted the writer for a painful condition of the rectum, accompanied with a profuse purulent discharge which had persisted for six months. The sphincter muscles were firmly contracted, and the mucous membrane was hot and swollen. No breach of surface, piles, or other exciting cause could be discovered. As ordinary treatment for inflammation had previously failed, and as the history of the patient suggested the probability of some syphilitic taint, the writer prescribed five-grain doses of iodide of potassium thrice daily and a suppository of iodoform ointment to be inserted at bed-time. The painful sensations ceased almost immediately, and the discharge gradually diminished, and finally disappeared in about three weeks.

Gonorrhœal inflammation may be caused directly by unnatural intercourse, or accidentally from a vaginal or urethral discharge. It is more frequently met with in females, as a vaginal discharge would, when the patient was in the supine position, gravitate towards the anus. The chances of rectal infection would be greatly increased by the existence of prolapse or piles. In males, the infecting material might be carried by the fingers of the patient to the anus. It is characterised by a profuse purulent discharge, and by burning and smarting sensations. The existence of a vaginal or urethral discharge, or a recent history of such, would indicate the cause.

Proctitis may be acute or chronic. In the *acute* form the patient experiences a sensation of weight and heat in the perineum, and pain in defæcation. The sphincter muscles are usually firmly contracted, and the mucous membrane is hot, dry, and congested. A few small flakes of brownish mucus usually adhere to the finger of the surgeon, when withdrawn after digital examination of the bowel. This stage is usually succeeded after a few days by the *chronic* form. The sphincters are not firmly contracted, and may sometimes have lost some of their contractile power. The mucous membrane is œdematous, and there is a discharge of either gelatinous lumps of mucus, or of a mucopurulent or purulent fluid. This may escape either during defæcation, or, if the orifice be patulous, constantly, and so excite irritation and excoriation of the adjacent cutaneous surfaces.

Treatment.—In the acute stage, leeches to the perineum and warm baths will give relief. When the spasmodic contraction of the sphincter has subsided, lukewarm injections with, in adults, some laudanum, will be of service. In the more chronic stage, the discharge can be arrested by injections of alum or of weak solution of nitrate of silver. The diet must be simple and such as will not leave a bulky residue, and alcoholic stimulants must be prohibited. If the inflammation has been excited by worms or some constitutional taint, appropriate remedies must be employed as well as local treatment. JEREMIAH MCCARTHY.

PROLAPSUS ANI et RECTI.—Eversion of the mucous membrane of the anus or of all the constituent structures of the rectum through the anal orifice.

The mucous membrane of the anus and rectum is attached to the other structures of the bowel by very lax connective tissue, so as to admit of its adaptation to the varying calibre of the tube. It is normally slightly everted during defæcation, and withdrawn again at the conclusion of that process by fibres of the tunica mucosæ muscularis, which are considerably developed at this part of the alimentary canal.

In feeble, unhealthy children, from the irritation of diarrhœa, or of oxyurides in the rectum, or of a calculus in the bladder, the mucous membrane may be more largely everted, and require adventitious aid for its replacement. This may also occur in adults from the like causes, or from the straining resulting from constipation, rectal or urethral stricture, or prostatic enlargement. Prolapsed piles and rectal stricture also tend to produce this eversion. This condition is termed *prolapsus ani*, to distinguish it from eversion of all the structures of the rectum, which is known as *prolapsus recti*. This latter condition may result from congenital or acquired want of tone in the sphincter, levatores ani, and recto-coccygei muscles. It sometimes occurs in young persons from some congenital defect in these muscles. In adults it may result from some acquired want of muscular tone, especially in women who have borne many children. A large rectal polypus would also tend to produce it. The everted bowel necessarily draws with it, in the male, the recto-vesical and, in the female, the recto-vaginal fold of peritoneum. If the protrusion be considerable, this fold may be drawn through the anal orifice and so form a hernial sac, into which a loop of intestine or some of the pelvic viscera might fall. If, from inflammation of the surrounding structures, or from contraction of the sphincter ani muscles, the neck of this sac should become constricted, strangulation of the contents of the sac might result, and form a serious complication. The prolapsed bowel forms a spherical or cylindrical mass, projecting in extreme cases many inches from the anus.

The *symptoms* vary with the degree and condition of the protrusion. There is always a disagreeable sensation as of some foreign body at the fundament, and there may be mucous, purulent, or sanguineous discharge. If the protruded part become inflamed and ulcerated, there is local pain and general feverishness. This is naturally greater in prolapsus recti, from the greater amount of protruded mucous surface and vascular structures. If the protrusion be neglected, the submucous tissue will become loaded with leucocytes and inflammatory exudation, so that the replacement will be either difficult or impossible, and the continued exposure will tend to produce ulceration and increased inflammation; sometimes sloughing of the protrusion results. If it be complicated with a strangulated rectal hernia, the usual symptoms of this condition will be superadded, and the protrusion can be felt in the anterior wall of the prolapsed rectum.

The *diagnosis* does not present any difficulty. In ordinary prolapsus ani, the mucous membrane forms an annular uniform projection with central aperture. If it be caused by piles, the protrusion may not be uniform, and so the orifice may be eccentric. The condition is, however, very evident, and as the treatment will practically be the same as for the concomitant piles, the distinction is not of importance. Prolapsus recti may be confounded with protrusion of intussuscepted bowel through the anus. But in prolapsus recti the cutaneous surface will be either directly continuous with the upper part of the exposed mucous surface, or separated from it by a groove, of which the upper limit can readily be reached by the finger introduced along the projection through the anal orifice. In intussusception no such limit could be ascertained.

The *treatment* will vary with the condition of the part, and with the cause. The prolapsus ani should always be, if possible, reduced. In recent cases this is readily effected by pressure with a sponge. But if the protrusion be very congested, compression, with the interposition of some oiled lint, may be necessary, so as by squeezing out part of the blood and lymph to render the replacement possible. In young children, fright and pain may induce much resistance, which may be easily overcome by inverting the patient, and, if there be much spasm of the sphincter muscles, an anæsthetic should be administered. When reduction has been effected, the nates should be pressed together, and kept in that position by adhesive strapping. If the prolapse has been caused by some general irritation of the alimentary canal, a powder of rhubarb grs. iij. and carbonate of soda gr. j. will be useful. If there be oxyurides, the rectum should be washed out with an injection of salt and water, but as the rectal worms are only emigrants from the cæcum, some vermifuge should be also administered. A vesical calculus must be removed by lithotomy. Tonics and atten-

tion to diet will also be requisite. In children with a tendency to prolapsus ani, defæcation should always be performed in the supine position, and the child should not be allowed to sit during the process.

In adults, similar treatment must be employed, the prolapsus being reduced, and the exciting cause, so far as possible, removed. If the protrusion become inflamed and irreducible, rest in the recumbent posture, with the application of ice or warmth to the part, and opium either by the mouth or rectum, unless otherwise contra-indicated, will be necessary. When the acute symptoms have subsided, the protrusion, if it be still irreducible, must be removed by ligature or cautery in the manner described for internal hæmorrhoids. *See* Hæmorrhoids. When the exciting cause has been suitably treated, astringent injections may be of service, as well by checking the mucous catarrh, which usually exists, as by constricting the vessels of the part. The injections may be of oak-bark decoction or weak solutions of alum or tannic acid. They should not exceed three or four ounces, and should be administered at bed-time, so that they may be retained as long as possible. Sometimes, linear cauterisation of the anal mucous membrane is very beneficial. The actual cautery or nitric acid may be employed, and the number of lines of cauterisation must be regulated by the amount of the prolapse. The resulting cicatrisation will contract the part so as to prevent any future prolapse. In more severe cases, portions of the mucous membrane may be excised in order to produce a similar result.

In prolapse of the rectum, all the symptoms of anal prolapse exist in an exaggerated degree. The bowel must be at once replaced if possible, and the patient should wear some artificial support for the part. Many contrivances have been devised for this purpose. Anal obturators only increase the evil which they are intended to remedy, and an elastic pad of suitable size, retained in position by a T-bandage, will probably be found to be the most effectual. The radical cure of this condition has been attempted in many ways. The simplest consists in excision of portions of the mucous membrane. For this purpose, the patient should be placed in the lithotomy position and anæsthetised. The operator should then take up a broad fold of mucous membrane at the side of the bowel with four-pronged forceps, and excise it with scissors curved on the flat. When all bleeding has been arrested, the lateral margins of the divided mucous membrane should be united by interrupted sutures, and the operation repeated on the opposite side of the bowel, and, if necessary, also posteriorly. A morphia suppository should be then inserted into the rectum, and the patient kept in the horizontal posture until the wounds have healed. The patient should be carefully watched for several hours after the operation, as hæmorrhage may occur in the rectum to an alarming extent without any external evidence. If the patient become pale or faint, the rectum must be examined and, if there be hæmorrhage, the clot must be removed, and the bleeding vessel, if possible, ligatured. If this be impossible, solution of perchloride of iron should be applied, and the rectum plugged with pledgets of cotton-wool. This procedure is sometimes completely successful, but sometimes causes only partial relief. The general health must also be attended to, and the different preparations of strychnia may be given with benefit.

In neglected cases, the protrusion may be irreducible from chronic inflammation. Being exposed to injury or irritation, it may ulcerate or, if strangulated by contraction of the sphincter muscles, slough. If the removal of the projection by operation be considered advisable, the operator must remember that the weight of the mass draws down the bowel, which might, unless suitable precautions were employed, slip up out of reach when relieved of the weight. Well-waxed ligatures should therefore be passed through the projection a little above the line of excision, which can afterwards be used as sutures to unite the mucous and cutaneous surfaces. Drainage-tubes should be introduced between the sutures, to prevent the retention of any discharge, and the patient must be kept at rest until union has taken place. The possibility of a peritoneal sac must also be remembered, and careful digital examination made to ensure that it is empty. Prolapse of the rectum is, however, comparatively infrequent, and the hernial complication is very rare.

Jeremiah McCarthy.

PROSTATE, Diseases of the.—General View.—The prostate is a compound organ, being partly glandular, but chiefly muscular. The glandular portion secretes a fluid which lubricates the urethra prior to the venereal orgasm, and which also forms a part of the discharge emitted during the sexual act. The muscular portion assists in the expulsion of semen from

the urethra. The double function of the prostate being, therefore, sexual, its chief diseases are not met with before puberty. In the infant and child the prostate is very small; it is sometimes, although rarely, the seat of tumour or of the deposition of tubercle. After puberty, and up to fifty years of age, it is chiefly liable to inflammation and functional disturbance. It is not until after fifty that its liability to disease becomes of great importance, owing to its tendency to hypertrophy, and hence to cause difficulty in micturition. The prostate is seldom malformed; in extroversion of the bladder its anterior portion or roof is wanting, and if there is great lack of sexual and urinary development, the gland may be entirely absent. It is rarely wounded, except by the surgeon's knife in lithotomy, or by the improper use of catheters introduced through the urethra. It is very tolerant of injury, and little harm usually follows if the prostatic capsule remains intact. The average normal weight of the prostate is 4¾ drachms.

Inflammation.—Acute inflammation is usually the result of gonorrhœa, and is most likely to occur if the patient has neglected himself, or has freely partaken of stimulants, or has used too strong urethral injections; but prostatitis may come on when every care has been taken in the treatment of the gonorrhœa, from its commencement. Other causes of prostatitis are, the application of caustic and other irritating solutions to the deep urethra, and the introduction of urethral instruments, particularly when very large or when roughly used. Severe stricture of the urethra, stone in the bladder, and prostatic calculi, are not infrequent causes. Sitting on a cold damp seat, especially when heated after exercise, excessive venereal excitement, and hard riding have all been known to cause this affection. Other causes, such as hæmorrhoids, ascarides, drastic purgatives, turpentine, cantharides and other medicines are often mentioned, but the evidence is unsatisfactory. A form of prostatitis, without very apparent cause, is not unusually met with in middle-aged men who are habitually free livers; they may perhaps recently have been exposed to cold or damp, indulged in excessive venery, or been longer than usual in the saddle; but generally the attack cannot be definitely attributed to these causes. This condition has been called by some, not inappropriately, gouty prostatitis.

Symptoms.—The most evident is an urgent, frequent, and painful desire to pass water. The pain is not relieved by micturition, but rather aggravated by it. With the first flow of urine some muco-purulent matter passes, and with the last few drops a little blood may appear. There is usually considerable constitutional disturbance, and occasionally the demand for relief from pain is very urgent. Complete retention of urine sometimes occurs.

Prognosis.—The inflammation usually disappears, if actively treated. In some cases matter forms; this formation is often preceded by a definite rigor, and abscess is produced. In other cases the inflammation becomes chronic, with chronic pain and chronic urethral discharge.

Treatment.—Absolute rest must be enjoined, preferably in bed, but at least upon a couch. A hot sitz-bath should be taken twice or thrice daily, the bowels be freely opened, and doses of liq. potassæ (♏xx.–xxx.) in water administered every three or four hours, washed down by good barley water. The diet must be light, stimulants be forbidden, and, if gonorrhœa is present, urethral injections be abandoned. If the symptoms are severe, half-a-dozen leeches should be applied to the perineum, previously shaved and washed. As they fall off, bleeding should be encouraged by fomentations. If pain continues, an anodyne draught or suppository may be administered. Small doses of tartar emetic or of antimonial wine are often useful.

Chronic Inflammation.—Acute inflammation may become chronic, which is characterised by painful and frequent micturition, sometimes by constant pain, and by the presence of a few muco-purulent shreds in the first flow of urine. Per rectum the prostate is found larger and harder than it should be, either symmetrically or on one side. Frequently, this condition is accompanied by sexual hypochondriasis, and the general health becomes seriously impaired. Sexual intercourse is often painful when the orgasm occurs.

Treatment.—A blister should be applied to the perineum, and kept open by a savin ointment dressing. A few cases are benefited by the careful introduction of a steel sound not larger than No. 11. Injections are useless. The general health must be maintained by cod-liver oil, iron, simple but nutritious food, and perhaps some sound red wine; a little blue pill, and an occasional dose of aperient salts, being given to those of full habit. Finally, as no organ can be healthy unless its function is regularly performed, the best and also most certain cure is a happy marriage.

Abscess.—Acute prostatitis may run into abscess in from five to seven days. Pus may form in the follicles or in the parenchyma, or around the gland; or it may result from the breaking down of tubercular deposit, or from malignant growth or calculus in the prostate. Practically, suppuration in or about the prostate may be divided into acute and chronic abscess.

Symptoms.—In *acute* abscess all the symptoms of prostatitis are aggravated. There is always fever, and frequently a rigor. The difficulty in making water may increase until there is complete retention of urine. *Chronic* abscess generally comes on insidiously; it usually occurs in cases of prostatic hypertrophy, where catheterism is regularly practised. The patient has pain about the perineum, and is ill and complaining for some time before matter is detected. Prostatic abscess may spontaneously open into the urethra, rectum, bladder, or peritoneal cavity, or by the side of the anus, or forwards into the perineum. The writer has known prostatic abscess to fill one or both iliac fossæ, and to require opening in the groin like a bubo.

Diagnosis.—Fluctuation, in or about the prostate, is determined by a rectal examination with the finger. The operation is a painful one, and must be gently done, with the patient lying on his back and the finger well greased (*not* oiled). The swollen prostate will readily be defined. In chronic abscess, the prostate may appear only hypertrophied, and fluctuation may be difficult to make out.

Prognosis.— Acute abscess generally soon heals. Chronic abscess is much more serious, and not infrequently fatally exhausts the sufferer.

Treatment.—The soothing treatment of acute prostatitis must be vigorously carried out. Hot baths, poultices smeared with laudanum and belladonna, leeches, or wet cupping, a hot water enema and anodyne suppositories, may all be employed. Retention of urine must be relieved by catheter—if possible, by a soft one. Catheterism will often cause the abscess to burst into the prostatic urethra. No incision should be made until fluctuation is distinctly felt, unless the pain is so great that it seems desirable to relieve tension, for considerable thickening may undergo satisfactory resolution. Directly fluctuation is detected the abscess must be opened. If the matter is close to the rectum, it may be aspirated through the bowel or opened into the bowel with a small incision. If pointing towards the perineum or deeply seated, the surgeon should pass his finger into the rectum and enter a sharp-pointed narrow bistoury into the perineum just in front of the anus; the knife will often have to pass in an inch or more before matter is reached. Tubercular, calculous, and ordinary chronic abscesses may sometimes require to be freely opened from the perineum and thoroughly cleared out and drained; in these cases a grooved staff should be introduced, and the patient held as for lithotomy.

Urinary Fistula following Prostatic Abscess.—After a prostatic abscess has been opened by the surgeon's knife, or has discharged spontaneously into the rectum, ischio-rectal fossa, or perineum, the case is not always at an end; for frequently, if it is not further treated, troublesome urinary fistula results, and great care will often be necessary to prevent this unfortunate consequence. The external opening of the abscess-cavity must be watched, in order to observe if any urine issues during the act of micturition. The patient's account must be verified by the surgeon's own inspection while water is being passed. If urine issues, the urethra must be examined for stricture, and if any is found, it must be treated immediately by internal urethrotomy or interrupted dilatation; for as long as stricture exists, so long will the fistula remain unhealed. If the urethra is found to be of normal calibre throughout, the case may be left to itself for a week or two and merely watched, in the hope that healing will take place naturally, the patient meanwhile keeping himself quiet. If, after this interval, the fistula has not closed, the patient must be taught to pass the simplest and softest catheter applicable to his particular urethra, and instructed to draw off all his water by catheter; not a drop of urine must be allowed to pass naturally, and, before going to stool, the bladder should invariably be emptied by the instrument. By these means the majority of cases will heal up soundly.

Atrophy of the Prostate.—Exhausting disease like phthisis, the wasting of old age, the effects of pressure—notably in old-standing, unrelieved stricture—and disease such as abscess in the prostate itself, will produce atrophy of that organ. There are no symptoms, and the affection is without clinical importance. A prostate is atrophied if it weighs between two and three drachms.

Hypertrophy of the Prostate.—After middle age the prostate is liable to undergo simple enlargement. This hypertrophy is singular because it is not the result of increased function, as it is in other organs,

such as the heart of the pregnant woman or the arm of the blacksmith; and it is important because of the great influence it frequently has upon the vital function of micturition. *See* PROSTATIC HYPERTROPHY.

PROSTATIC ULCERATION.—In old-standing urethral stricture, prostatic ulceration doubtless precedes extravasation of urine and prostatic fistulæ. It is not an independent disease, and does not require special treatment.

PROSTATIC 'STRICTURE.'—In the strict pathological sense of the term, prostatic stricture does not exist. Cases are met with occasionally, however, where the hypertrophy has so invaded the urethra that its dilatability is very slight, and the catheter goes so tightly that there is some excuse for speaking of 'stricture at the neck of the bladder.' A dilating olivary bougie or even metal dilator may be passed with caution, and the consequences watched before the operation is repeated; if irritation does not follow, some good may result; but, generally, the safest plan will be to select a catheter sufficiently small to pass with ease.

PROSTATORRHŒA consists of a thin mucopurulent discharge from the urethra, which is not easily distinguished from an ordinary gleet. It frequently supervenes upon a gleet, and occurs amongst those who are morbidly anxious about their sexual organs and who are in bad health. Sometimes the loss of fluid at stool is considerable. The patient always exaggerates the importance and severity of his symptoms.

Treatment.—Fresh air, exercise, tonics, sea-bathing, and liberal diet are chiefly indicated. The surgeon must assure the patient that the complaint is not a serious one, and insist upon his leading a healthy sexual life, which consists in the natural performance of the sexual function, never to be attained outside the pale of matrimony. The passage of a cold steel sound every three or four days may prove beneficial, but the best local application is a solution of nitrate of silver (5 to 10 grs. to f℥j.) applied by means of a prostatic injector. A flying blister may often advantageously be kept up in the perineum for an indefinite period. When there is much loss of fluid at stool, it will be diminished if the patient is taught to use a small enema of water before retiring; the process of defæcation is then accomplished with little muscular exertion.

PROSTATIC NEURALGIA.—Men are sometimes met with who, having had many attacks of gonorrhœa or much urethral instrumentation, or being simply highly neurotic, complain of constant aching at the neck of the bladder and along the urethra. They are free from all apparent disease of the prostate, the stream of urine from first to last is clear of inflammatory product, and there is no calculus or urethral stricture.

Treatment.—All the urinary and sexual functions must be regularly and naturally performed. The general health is to be attended to, and the hepatic system cleared by a few doses of blue-pill. Iron, nux vomica, bromide of ammonium and, occasionally, belladonna will be found useful. As a rule, no instruments should be passed, but, occasionally, distinct improvement will follow the gentle use of a steel-sound. Perineal blisters may be tried.

TUBERCLE OF THE PROSTATE.—Tubercle rarely invades the prostate; and when it does, some other portion of the genito-urinary apparatus, generally the kidney or testicle, is always similarly affected. The deposit consists of grey miliary bodies in the glandular or stromal tissues; these coalesce, increase, and ultimately form bodies as large as a pea, or even a walnut; sometimes the whole gland becomes invaded. These tuberculous masses may at any time break down into abscess, which will usually burst into the urethra; but may open into the rectum, ischio-rectal fossa, or peritoneal cavity.

Symptoms.—Generally, the patient has frequency of passing water, and pain in the act. The finger introduced into the bowel may or may not detect the deposit, either as one or more isolated masses in the prostate, or as a general enlargement of that organ; for it is only after abscess has occurred, followed by destruction of tissue, cicatrisation, and contraction, that the prostate can be said to become smaller when affected by this disease. The urine contains more or less pus, and occasionally a little blood. The patient slowly becomes weaker and thinner. The diagnosis is difficult, and can seldom be made except after considerable careful observation of the patient.

Treatment.—Urethral instruments must be avoided as far as possible. Stress is laid upon this, as these cases are often needlessly sounded for stone over and over again, with much injury. Abscess must be watched for and promptly treated, the patient's general health cared for by attention to diet, exercise, clothing, and climate, with the administration of such tonics as the individual case demands.

PROSTATIC CYSTS.—The prostatic gland follicles may become dilated and form

little cysts. These cavities are frequently found in the hypertrophied prostate. They may contain semi-fluid material or solid calculous matter. Hydatid cysts have not been found in the prostate, but they are not uncommon between the rectum and the bladder, and have been known to occasion complete retention.

Prostatic Calculi.—Calculi may form in the prostate as in other glands, and must not be confounded with renal or vesical calculi, which may have become fixed in the prostatic urethra. They begin as inspissated prostatic secretion, with degenerated epithelium cells from the tubes and acini; irritation is caused, and phosphates are deposited. Several hundreds have been found in a single prostate. They vary in size from a pin's head to a pea; occasionally they grow as large as a chestnut, and a mass, consisting of coalesced calculi, has been removed weighing 3½ ounces. When numerous, they may break through their partitions and collect in a kind of cyst; they then become facetted from constant friction. They consist of phosphate of lime, a trace of carbonate of lime, and animal matter (84·5 p.c.). They are frequently associated with other diseases of the urinary organs—namely, stone in the bladder, hypertrophy of the prostate, and stricture of the urethra.

Symptoms.—Prostatic calculi are often first detected when the patient is treated for stricture or for stone in the bladder. Here, the sound or the bougie conveys a grating sensation as it traverses the prostatic urethra, and, if the finger is introduced into the rectum, the stone may be felt through the prostate. In other cases the concretions may themselves cause local irritation, pain in sitting and moving about, possibly obstruction to the flow of urine, and sometimes even abscess.

Treatment.—The general treatment consists in attention to the health. The bowels and liver should be gently stimulated, and the mineral acids administered in an infusion of alchemilla arvensis, buchu, or uva ursi. The radical treatment consists in their removal by surgical operation. The formation may often be attacked per urethram with a short-beaked lithotrite, or a pair of urethral forceps or a curette; in using the latter two instruments, the calculus should be steadied by the left forefinger in the rectum. If the stone is large, an attempt may be made to seize it with the lithotrite, and push it backwards and upwards into the bladder, where it may be dealt with by lithotrity. In other cases a perineal incision must be made. The patient is anæsthetised, and placed in the ordinary lithotomy position. The formation is localised, and its size estimated by the finger in the rectum; a grooved staff is introduced and held in position. Generally a median incision will suffice, beginning about an inch and a half above the anus, and continued downwards for an inch and a quarter. The stone is cut down upon and removed with short forceps. Care must be taken that *all* the stone is removed. The bladder need not be interfered with by this operation, and it is usually a safe and simple one. After the operation, a soft catheter should be passed through the penis into the bladder, tied in, and worn for four or five days. If the stone is considered to be very large, the perineal incision may be made into the urethra upon a grooved staff, as in lateral lithotomy.

Cancer of the Prostate.—The nomenclature of tumours is in a transition state; according to the most recent classification, tumours of the prostate are divided into four groups: (1) Myoma, or new growth consisting entirely of muscular fibre, a very rare form of tumour; (2) adenoma, or simple hypertrophy, including the encapsuled tumours, *see* Prostatic Hypertrophy; and the two malignant groups, (3) sarcoma (encephaloid of the older nomenclature), the varieties of which are—(*a*) round-celled, (*b*) spindle-celled, (*c*) lympho-sarcoma; (4) carcinoma (scirrhus), the varieties of which are —(*a*) acinous, (*b*) tubular, (*c*) colloid. No case of epithelioma of the prostate is on record.

Under the head of cancer of the prostate we here include sarcoma and carcinoma. The former is much the more common. The prostate may be primarily or secondarily affected by cancer. Fortunately this distressing complaint is rare; it seldom attacks men in the prime of life, but is almost entirely confined to youth and old age.

Symptoms of Cancer.—A diagnosis of cancer must only be made after close watching of the case and careful consideration; for in ordinary hypertrophy there may be much pain, and great size and hardness felt by the rectum, so much so as readily to deceive the inexperienced. Moreover, chronic prostatic abscess, a much more common affection, may, in its earlier stages, and before it has declared itself by fluctuation or discharge of matter, present symptoms remarkably like those of cancer. The chief symptom is pain, more or less constant, described as about the neck of the

bladder, or at the end of the penis, or in the thigh or leg. At first there is frequency and difficulty in making water; generally the patient is more or less dependent upon the catheter. The urine contains, sooner or later, pus and blood. It may be noted here that the urine, in malignant diseases of the bladder, often possesses a peculiarly disagreeable smell, almost but not entirely characteristic to the practised observer. Washing out the bladder constantly, and with powerful disinfectants, may altogether fail to remove the odour. There are usually attacks of hæmorrhage. The patient becomes weaker and thinner, and latterly may have deposits in the glands of the groin, or in those along the course of the iliac vessels. In doubtful cases, the urine should be thoroughly searched by means of the microscope for cancer cells; it must, however, be remembered that the sources of error in such examinations are very numerous.

Treatment. — The patient's powers should be sustained by suitable food, stimulants and medicines; the bladder, if necessary, relieved of retained water by catheter exactly as in the retention from hypertrophy of the prostate, and washed out from time to time with disinfectants. Great care must be taken to ensure an easy daily opening of the bowels by suitable laxatives, such as senna electuary, aloetic preparations, castor-oil, or compound liquorice powder. The diet may be made to aid in this by the daily ingestion of whole-wheat meal bread, oatmeal, raw or cooked apples and other fruits (not too sweet), and green vegetables. The use of the enema, every day or every other day, will often prove of the greatest service. Above all, the patient must be relieved of pain: in many cases the hypodermic injection of morphia, combined with a little atropine, will be best. In others, anodyne suppositories are useful, although the action of suppositories is always more or less uncertain. A suppository should always be applied after the bowels have acted, because a constant source of uncertainty of action is, doubtless, the pushing of the suppository into a mass of fæces. In other cases, relief must be obtained by opiates administered by the mouth; they must be selected carefully, and those chosen which are best borne by the individual patient. Many will take laudanum, Battley's solution, or the liq. morphiæ hydrochloratis well; others will do well with the solution of the bimeconate of morphia, and others with the old-fashioned black-drop. Extirpation of cancer of the prostate is only mentioned here that it may be condemned. It has been attempted two or three times, and has in each case been followed by the speedy death of the patient. In one instance the peritoneal cavity was found, after death, to have been opened.

G. Buckston Browne.

PROSTATIC HYPERTROPHY consists in an increase of the normal elements of the organ. The normal elements are: (1) *stromal*, consisting of involuntary muscular fibre, connective tissue, and elastic tissue; (2) *glandular*, consisting of racemose glands, formed of basement membrane lined with columnar epithelium, and containing secreted matters. The hypertrophy may consist of an equal increase of stromal and glandular structure. This is rare; more usually the stromal are increased far more than the glandular elements. In very rare instances the glandular portion is in excess of the stromal. In addition, there is an interesting and surgically important form of hypertrophy—namely, a growth of both structures, but chiefly of the stromal, in the form of distinct tumours. These tumours are embedded in the body of the gland, or may form nearly separate outgrowths into the bladder. They are rarely found except when general enlargement of the prostate exists. They are the peculiar bodies which occasionally come away entire in the surgeon's forceps, during the performance of perineal lithotomy.

Hypertrophy of the prostate is never found in men under the age of fifty. It usually declares itself between fifty-five and sixty-five. Actual hypertrophy of the prostate exists in about thirty-four per cent. of men at and above sixty years of age, and there are manifest symptoms in about fifteen or sixteen per cent. (Thompson). If a prostate weighs more than seven drachms, it may be said to be hypertrophied. An hypertrophied prostate has been known to weigh ten ounces.

For surgical purposes the prostate may be divided into three parts, two lateral lobes and a posterior middle lobe; these three portions may undergo equal hypertrophy, or any one of them may become more developed than the remaining two. The enlargement of the middle lobe is perhaps the most important, because it interferes more with the performance of micturition than does lateral enlargement. A patient may have marked prostatic enlargement and yet have little or no difficulty in passing water; on the other hand,

he may have great difficulty, and indeed may be unable to make any water except by catheter, and the surgeon may be unable to detect any enlargement per rectum. In such a case the middle lobe is the only part enlarged. Care must always be taken not to confound hypertrophy of the prostate with inflammatory depositions in that organ. Men under fifty are often carelessly spoken of as having enlarged prostates, when really they are suffering from prostatitis, or in rare cases have special pathological formations in the organ.

Causes.—The consequences of the enlarged prostate are so serious that, naturally, all who have studied the subject, from the earliest times, have anxiously inquired why a certain number of elderly men are so afflicted. We are still, however, in the dark, and the truest answer is that we do not know the cause of hypertrophy of the prostate. It may, however, be definitely stated that the disease affects all sorts and conditions of men, and that those of full or gouty habit, especially if they are obliged to lead sedentary lives, are more prone to the complaint than others. It has, indeed, been called 'the judge's disease;' and certainly judges, magistrates, members of parliament, bankers, clerks, shoemakers, weavers, tailors, and coachmen form a large proportion of those afflicted.

Symptoms.—The enlargement of the prostate necessarily interferes with the mechanism of micturition, and the bladder finds difficulty in dealing with any undue accumulation of urine, as after sleep or after the taking of stimulating fluids. This is the explanation of what is usually the first symptom of hypertrophy—namely, that the patient finds, on rising in the morning, that he can only empty his bladder by repeated efforts, and that he is therefore called upon to make water frequently during dressing. Others find that they are disturbed twice or thrice in the night to pass water. Often, there are obscure aches and pains about the neck of the bladder. There may be a little undue straining at stool, with ill-defined but general uneasiness. In rarer cases there may be marked pressure-symptoms, such as pain down one or other great sciatic nerve. The patient may be troubled with erections of the penis; he may also notice that his stream of urine is poor, that it does not commence well, and that when once begun he has to make continued effort to keep it up. If the patient obtains no relief from art, his symptoms gradually increase in severity. Very commonly, he may suddenly be seized with complete retention of urine; but if this is not the case he gradually fails to empty his bladder, the quantity of habitually retained urine slowly increases, and the calls to pass water become more and more frequent, especially at night; he begins to experience pain when the desire to micturate comes on, which is relieved by passing water, and is therefore unlike the pain of stone. Throughout the progress of the disease the urine may remain clear and acid, but without the intervention of urethral instruments cystitis may come on, and the urine become decomposed and loaded with mucus and the products of decomposition.

Sooner or later the patient begins unconsciously to wet his bed at night. This incontinence is rarely true 'incontinence of urine,' which term means that the bladder cannot hold any water at all. Prostatic enlargement, in very exceptional cases, may so open the neck of the bladder that the organ can only retain a very small quantity of urine; but the surgeon must always suspect a man, over fifty years of age, who complains that he cannot hold his water and that it is always coming from him, of having a bladder full of urine, the apparent incontinence being in reality the overflow from an habitually full or engorged bladder. Too much stress cannot be laid upon this, and surgeons may accept as an axiom that *an involuntary flow of urine indicates retention, not incontinence.* Remembrance of this will save many a patient from death, and many a practitioner from disgrace. At any time hæmorrhage may occur; the bleeding is rarely severe, and often relieves the bladder and prostate considerably. If from ignorance on the part of the patient, or from a mistaken dread of the catheter on the part of either patient or surgeon, a case of prostatic disease, causing the bladder to fail to empty itself, is left untreated by instruments, the progress of the case will be as given below; death being sometimes more speedily brought about by the intervention of a chill, or retention of urine or other disorder, making surgical interference with the urinary organs absolutely imperative at a time when they may prove themselves unable to bear the shock of operation, in consequence of long-standing urinary embarrassment.

At first the bladder undergoes some hypertrophy, and then becomes either simply dilated or sacculated, owing to the great pressure which has to be exerted in order to void urine. By hydrostatic law, this pressure is equally transmitted in all directions, and brought to bear upon every

portion of the bladder-wall. Sacculation of the bladder results from the mucous membrane being gradually forced outwards between the muscular trabeculæ. Sacculi are almost invariably multiform; their walls consist merely of mucous membrane, and, where the bladder is covered by serous membrane, of peritoneum also. In advanced disease, an attack of retention of urine or the application of violence may cause rupture of a sacculus either extra- or intraperitoneally, with fatal result, especially in the latter instance. Clinically, sacculi of the bladder are interesting, as phosphatic calculi are apt to form in them. Urine never regurgitates from the bladder into the ureters, but, as urine is constantly passing from the kidneys into the ureters, and as they cannot readily convey their contents into the engorged and constantly contracting bladder, they gradually become dilated; the pelvis of the kidney shares in this dilatation, and the renal structure itself becomes diseased from the obstruction met with to the outflow of urine. Interstitial nephritis ensues, followed by abscess (surgical kidney), uræmia, coma, and death.

In all cases of suspected hypertrophy of the prostate, a rectal examination should be made. The patient lies on his back, and the surgeon gently introduces his forefinger. The finger should be familiar with the dimensions of the normal prostate, which is not larger than a chestnut, and can easily be defined above and on each side. Usually, the enlarged prostate will feel as large as a Tangerine orange, sometimes much larger. As before stated, occasionally no enlargement may be felt by rectum, although there is sufficient hypertrophy of the middle lobe to cause complete retention. In certain cases it is proper to ascertain the amount of prostatic growth into the bladder; but this can only be done by the introduction of a short beaked metal sound, and, as instrumentation should always, at the commencement of treatment, be reduced to a minimum, the prudent surgeon will rarely deem it necessary to sound unless symptoms of calculus are also present. When the prostate is examined by a sound, the length of sound introduced before the cavity of the bladder is reached must be noted, and, when the beak has fairly entered, an attempt should be made, by depressing and rotating the handle, to turn the beak to one or other side. If at the same time the finger is passed into the rectum, a very good idea can be formed of the extent of the hypertrophy. It has been asserted that the enlarged prostate grooves the fæces as they pass. This is not the case. Sometimes, owing to great hypertrophy of the prostate, the bladder becomes entirely an abdominal organ, and, when only containing five or six ounces of urine, suprapubic dulness on percussion will be found as high as the navel.

Treatment.—The importance of the treatment of enlarged prostate cannot be overestimated. If properly treated, life may often be indefinitely prolonged instead of suddenly cut short, and the latter part of it rendered tolerable and useful instead of miserably painful. Moreover, there are few cases more likely to bring the surgeon into sometimes deserved, but far oftener into entirely undeserved, discredit. Thus, a surgeon overlooks a distended bladder, another practitioner passes a catheter and removes a pint or more of urine, to the great advantage of the patient, who naturally draws his own inference; or, on the other hand, from causes explained further on, a case may perish in spite of the most skilful attention after the passage of a catheter.

In the first place, it must be definitely stated that all attempts to diminish the bulk of the enlarged prostate by means of medicines applied locally or by the mouth; or to excise portions of the gland by perineal incisions, or by instruments introduced through the urethra, or to destroy portions by the electric or other cautery, are worse than useless. So also is the injection of iodine into the body of the gland, or the use of bellied sounds to dilate the prostatic urethra. Grave injury may be inflicted by all these attempts to make a radical cure, and although the subject is a very interesting one and has engaged the attention of many good surgeons, there is at present no sound evidence before the profession that any of these plans of treatment are of the smallest use; the practitioner may, therefore, safely dismiss them from his mind, and confine himself to the palliative treatment of the affection.

Catheterism.—When a patient, over fifty years of age, without any history of stricture, and unaccustomed to urethral instruments, consults his surgeon about frequency in passing water, and perhaps other painful urinary symptoms, it will be of the first importance to ascertain if he is emptying his bladder. This can only be done by passing a catheter, and, as will be immediately described, catheterism may be followed by important consequences. These consequences will be much less severe, and in many cases may be effectually warded off, if the following precautions are taken.

They should always be taken wherever easily practicable, and invariably if the patient has had urinary symptoms for some time, and if he is elderly, worn-out, and really ill. Other cases may be treated with a little less ceremony, and sometimes necessarily so, since nervous patients may be seriously excited and alarmed if they see that much preparation is required, and they may therefore be tempted to forego the operation and lose the chance that surgery offers them of maintenance of health. In such cases, the surgeon may pass the catheter in his consulting-room, but he will do well to advise his patient to go home immediately afterwards, and, if not very robust, to go to bed and stay there, warm and quiet, for the next twelve or eighteen hours. But if convenient, and certainly if the case appears to be a grave one, an appointment should be made with the patient to meet him in his bedroom at home; the room must be warm, and he should be in his dressing-gown, ready to go to bed if so advised, after the catheter has been introduced.

Before passing a catheter, the patient is desired to make all the water he can by his natural efforts; he must be at his ease, and on no account be hurried. He is then placed with his back to the wall, and the surgeon seats himself in front and passes a perfectly clean, small, soft catheter. A No. 7 E vulcanised india-rubber catheter is less painful to the patient than any other, but sometimes it will not pass readily, and then a soft *coudée* catheter of the same size should be used. (See *Prostatic Retention* under Retention of Urine.) All urine drawn off will be water which the patient could not pass, or 'residual urine.' The patient should keep his room for the rest of the day and take a hot sitz-bath; if the quantity drawn off exceeds three or four ounces, he should go to bed. If the bladder is found empty, and if all is well on the following day, he may be allowed to go about as usual. But if he is found to retain only one or two ounces, the experiment above detailed should be repeated next day, in order to avoid error. A frequent source of error is that the patient, when desired to pass water, fails from nervousness to make his bladder act as fully as it is really capable of doing. If, however, several ounces are found retained, or if the habitual retention of two or three ounces is confirmed by a second inquiry, the patient will have to commence the regular use of the catheter, and will at first need close attention. Should the quantity of retained urine be considerable, say ten to twenty ounces, he must not be allowed to leave his bed, and will require special treatment, which will be detailed after the fever which may follow catheterism has been described.

Fever following Catheterism (Urinary Fever).—Some men take to the habitual use of the catheter without any constitutional disturbance; but, usually, catheterism is followed by a more or less well-marked febrile attack. This fever comes on independently of abrasion of urethral surface or of any septic contagion; it is frequently confounded with septicæmia, but is quite a distinct fever. It must not be forgotten, however, that septicæmia may follow injury to the urethra, just as it may follow a wound in any other part of the body. The fever now under consideration has unquestionably a neurotic cause, being due to reflex irritation communicated from the urethra to the excretory apparatus of the kidney; it may follow the most skilful and delicate passage of a urethral instrument with every antiseptic precaution, or any kind of surgical or other interference (passage of a renal calculus) with the urinary organs. The kidneys are in a state of shock more or less complete, and more or less temporary. The shock may be so profound that, for a time, there is complete suppression of urine. Practical surgeons have long been satisfied that the fever has a renal origin; the term *urinary fever* is, therefore, more correct than the terms catheter or urethral fever which are sometimes used.

The time that may elapse between catheterism and the onset of urinary fever is very uncertain; fever may come on within a few hours or any time during the first week. It is generally but not always marked at its outset by a rigor, followed by heat and profuse sweating: the temperature varies from 100° to 105° F. The attack may be very transient, or it may be recurrent; but it is usually a continuous fever. The patient feels very low and prostrate, the tongue becomes dry, there is no appetite, but great thirst. This condition may last a week or ten days and pass gradually away, or the patient's state may become rapidly alarming. If the temperature keeps high (103°) and the pulse for some days is over 100, and if the tongue is hard, dry, and furred, the prognosis is unfavourable. Usually, the temperature rapidly comes down, the pulse keeps about 90, and the patient ultimately makes a good recovery and remains thoroughly accustomed to his catheter. In the present state of our knowledge, there is reason to believe that these cases do not end fatally if the kidneys are healthy at the

outset, and if all the precautions about to be described are taken. But if, from long-standing urinary obstruction, the kidneys are diseased, they may not be able to recover themselves, and the patient dies uræmic and comatose.

Unfortunately, the use of the catheter appears to the patient and his friends to be the starting-point of the illness, and surgery, or in other words the catheter, is unjustly blamed; whereas the fatal result is really due to want of the catheter at the proper time. For, if that instrument had been used when the obstructive disease first manifested itself, the renal mischief which actually causes death would have been prevented. We have no means of ascertaining beforehand whether the kidneys are in a state to bear catheterism or not; although, undoubtedly, urine of a low specific gravity is an unfavourable sign. But we need not let this inability impede our practice, for if a catheter is necessary, on account of partial or complete retention, *it must be used*, otherwise the patient's fate is sealed; and if, through long-continued, although perhaps unobserved, disease, he succumb from urinary fever, it is very certain that had he not used the catheter he would have died also, and with much suffering. *See* Urethral Fever.

Treatment at commencement of Habitual Catheterism.—If from the patient's symptoms, and the large area of hypogastric dulness on percussion, there is little doubt that the bladder contains a large quantity of urine (a pint or more), the fever, which is almost absolutely certain, in such a case, to follow catheterism, may be considerably controlled if a small dose of opium, laudanum, or morphia, is administered half an hour before the catheter is first used. In all cases, if there is much constitutional irritability, advantage will follow the administration, two or three times a day, of small doses of morphia. Should rigors occur, spirits must not be administered, but the patient should be wrapped up warmly in bed, hot bottles be put to his feet, and hot tea or other simple drink given to encourage perspiration. From a consideration of the pathology of urinary fever, it follows that, at the commencement of habitual catheterism, all the organs which are complementary in their action to that of the kidney—the lungs, liver, intestines, and notably the skin—should be kept active and in order. This can only be done by confining the patient for at least a fortnight to a warm room, and, if there is fever, to his bed. The diet should consist of bread, vegetables, soup, fish, game, and chicken, with little if any butcher's meat, and no milk or cheese; spirits must, as a rule, be avoided, and as little wine given as the patient's previous habits will allow. The bowels and liver must be kept gently acting by some laxative medicine, combined with small doses of blue bill. Irritation and soreness of the parts must be met by hot baths.

Above all, the patient must be able to obtain relief by the catheter whenever necessary. As the secretion of urine varies in quantity from time to time during the twenty-four hours, he should not be dependent upon the periodical visits of his surgeon for relief by the catheter, but should learn to pass it himself or have a skilful attendant always at hand. If the quantity retained is about three ounces, the catheter must be passed morning and evening. If the quantity is more than three and less than six ounces, the instrument must be used three times in twenty-four hours; if the amount is much over six ounces, it will be required four times a day. Should no water be made naturally, the catheter must be used whenever the desire to micturate comes on. Patients often try to postpone the use of the catheter as long as possible, and look upon the instrument as a source of irritation. This is not the case, and it is better for them to pass the catheter even oftener than is really necessary than too seldom.

Special Care after Complete Retention. For the instrumental relief of retention from enlarged prostate, *see* Retention of Urine.

All the details above enumerated as necessary when catheterism is commenced, are here more than ordinarily called for. If the patient prove to be one of the very few who, after such an attack, do not require to commence regular catheterism, because he recovers with complete control over his bladder, he should keep his bed for twenty-four hours, and his house for two or three days, and take a little calomel or blue-pill with some colocynth or rhubarb. If, on the other hand, as is almost sure to be the case, the regular use of the catheter is required, the patient should be kept in bed until the fever, which is to be expected within the first five or six days, has passed away. A catheter should not be tied in unless, owing to irregularity of the canal or false passages, constant catheterism is very difficult. A silver catheter should never be retained. If the amount of retention has been great, say 30 to 40 ounces, the bladder should not be emptied at the

first catheterism, but about 20 ounces be drawn off. Death from syncope has been known to follow the sudden emptying of a bladder under these circumstances, and, in all cases, such a proceeding increases the shock to the system, causes pain, and may provoke dangerous cystitis. Generally, it is wise to let four or five days pass before the bladder is entirely emptied. Early in the progress of such a case there may be a good deal of hæmorrhage into the bladder.

After complete prostatic retention, it is improbable, although not impossible, that the patient will recover the power of emptying his bladder. He may be fortunate enough to regain his power completely; but this is very rare, and if he regains power at all, it is more likely to be partial only. In any case, he should learn to pass a catheter without delay, either in order to use it habitually, or when seized with retention, which is very likely to recur. Patients are often most anxious to be treated for want of bladder power, but reliance must not be placed on drugs, although a little strychnia may be given. The general health and nutrition must be carefully attended to, and the bladder allowed all the relief from the catheter it requires. The catheter is a good friend to an atonied bladder, and its use allows the bladder any chance it has of recovering its tonicity, although the very reverse of this is often considered to be the case.

General Treatment of the Enlarged Prostate.—Cases of prostatic hypertrophy are not infrequently met with, where there is no habitual complete or incomplete retention of urine, but where the patient is subject to sudden attacks of what he calls 'stoppage of his water.' These are brought about in three ways: first, by the influence of strong emotion or excitement, as great or prolonged mental effort, anger, fear, or grief, which appear to withdraw nervous energy from an organ already in need of all it can possess, and bring about entire inability on its part for a time to expel its contents. Secondly, by mechanical closure of the prostatic urethra and neck of the bladder due to congestion, which may be caused by exposure to cold, constipation, venereal excitement, and prolonged sittings (railway journeys in the sitting posture, particularly if occupying many hours, and if the weather is cold, are very likely to bring on retention in these cases). Thirdly, by any cause which fills the bladder with more urine than it is able to cope with, diuretic medicines, excess of alcoholic or other stimulating drinks, or failure on the part of the patient to give his bladder an opportunity of relief when it first demands it. The advice to be given to these patients is obvious: they must avoid mental excitement, exposure to cold, much stimulant, long railway journeys, and so on. Above all, they must be taught to use a simple catheter, so that, whenever and wherever seized with retention, they may be able at once easily and safely to relieve themselves.

The majority of sufferers from enlarged prostate, however, sooner or later require regular catheterism, and should be invariably taught to perform it for themselves. The best instrument for habitual use, undoubtedly, is the soft French *coudée* catheter (No. 7, E.); the end is permanently turned up, and in consequence avoids the irregularities of the floor of the prostatic urethra and passes easily into the bladder. Some patients prefer the vulcanised india-rubber catheter; but its interior is small and its walls are thick, and contact with oil causes it to swell and destroys its polished surface. The olivary catheter is rarely desirable when the prostate is enlarged, but the English gum catheter is not infrequently superior to all others. As a rule, silver catheters should not be used. Sometimes the most careful manipulation of the catheter will fail to empty the bladder. When this is the case, there is probably some sacculation of the bladder, or dilatation of the ureters, or large interuretal ridge. The patient is to be advised not to keep pushing his catheter in and out, in search of a little more urine, beyond a minute or so, but to trust to washing out the bladder at stated times to keep it free from decomposing urine. Much manipulation of the catheter is very likely to cause orchitis.

Catheters must be kept scrupulously clean; they should be syringed through every now and then with a solution of carbolic acid (1 in 500). The best lubricant is fresh olive oil; if desired, a little carbolic acid may be added (1 in 40). Some prefer castor oil and others vaseline. It will add much to the patient's comfort if he is directed to draw back the foreskin once or twice a day and wash with soap and water, to dry the part thoroughly, and apply a little simple dusting powder with a puff before readjustment. Neglect of this precaution may result in inflammation, soreness and itching, from the constant manipulation and contact with urine and oil.

The *diet* should be light and unstimulating; food should be selected which tends to keep the bowels easily opened, such as vegetables, apples, and brown bread. The less stimulants are used the better. *Exercise* should be taken regularly. When once the catheter has been mastered, there is no reason why the patient should not resume his usual activity, and ride or even hunt. He should also return to his usual pursuits and the ordinary duties of society; examples are numerous of men, occupying active and responsible positions, who have practised catheterism fifteen, twenty, and even thirty years, and finally have died of complaints in no way connected with their urinary organs.

The whole of the *medicinal treatment* of the enlarged prostate consists in keeping the bowels gently opened. Patients instinctively discover that they are never so comfortable as when the bowels act easily. The enema is useful, and mild laxatives, such as senna electuary, castor oil, aloetic pill, or compound liquorice powder, may, if necessary, be taken habitually.

The *skin* should be kept in constant action by means of hot water and soap applied once or twice a week, and daily rubbing with a stout flesh-brush. There is no real need for patients to seek a warm climate during the winter months, if they are careful to be warmly clothed from neck to heel in flannel underclothing. Exposure to cold need not be avoided if extra clothes are worn. Great risk is often run by wearing evening dress; if this cannot be avoided, the deficiency of external clothing must be made up by additional underclothes.

Washing out the Bladder.—In prostatic disease it is often necessary to wash the bladder out. The mucous membrane may require astringent applications, or the interior may be sacculated, and the catheter alone be insufficient to entirely evacuate the urine, which, if left behind habitually, decomposes and deposits the triple phosphate of ammonia, lime, and magnesia; in such cases irrigation with disinfectant washes is called for.

The best apparatus to use is an india-rubber four-ounce injecting bottle, with nozzle and stopcock, or a Higginson's enema apparatus fitted with a two-way tap specially arranged by the writer, and known as his bladder-irrigator. In these instruments, the hand regulates the quantity of fluid and the force with which it is injected. Many forms of apparatus have been devised, chiefly on the principle of the syphon, which, among other reasons, are objectionable because the force with which the injection is made cannot be nicely regulated. No air must be allowed to enter the bladder, and not more than two or three ounces of warm fluid (100° F.) injected at a time, although that quantity may be thrown in over and over again if deemed necessary. For cleansing the bladder, a solution of carbolic acid (gr. ½ to f℥j.) is useful, or boracic acid (f℥j. of the saturated solution to f℥j.) may be used. Other disinfectants which may be tried are perchloride of mercury (gr. ½ to f℥j.), liquor pot. permanganatis (♏xij. to f℥j.), Barff's boro-glyceride (♏xij. to f℥j.), and also thymol and sanitas. A good soothing wash is composed of f℥ss. of glycerine and gr. xv. of borax to each ounce of injection. Nitrate of silver (gr. ¼ or ½ or ¾ to f℥j.) often acts remarkably well on the inflamed vesical mucous membrane. The mildest solution just named should always be used at first; if well borne by the patient, the injection may gradually be made a little stronger. Acetate of lead (gr. j. to f℥j.) makes a good injection, especially when there is cystitis with a tendency to deposition of phosphatic crystals. The glycerine of tannin (♏iv. to f℥j.) or tincture of steel (♏v. to f℥j.) make good astringent washes, and quinine (gr. j. to f℥j.) has been much used as a germicide. Dilute nitric acid (♏j.–ij. to f℥j.) and dilute phosphoric acid (♏iij.–iv. to f℥j.) are recommended when there is a tendency to alkaline deposits.

Phosphatic deposits can here be barely alluded to. When small, they may be washed out through large catheters; when larger, they come within the province of the lithotritist. If a patient has pain after he has used his catheter, blood and mucus in his water, and pain when driving, a stone behind his enlarged prostate should always be suspected.

Treatment of Advanced Prostatic Disease when Life is in Danger from exhaustingly frequent Catheterism.—Cases of habitual catheterism are exceptionally met with where, as age advances, the bladder becomes intolerant of urine, and the patient is gradually driven to pass his catheter more frequently, until at last he lives only to do so, hourly or even oftener. This continual exertion, night and day, rapidly exhausts an elderly man, and, unless relieved, he dies miserably. The circumstances of the case make the presence of a stone in the bladder not unlikely, and the patient should first of all be carefully sounded. If no stone is found, and the case permit of a little delay, opiates may be

tried, with rest and hot bathing. A soft catheter may be tied in, but it rarely does any good, and often adds to the patient's sufferings. If, on the other hand, the necessity for relief is urgent, and if morphia in its various forms is not tolerated or fails to give substantial relief, the bladder must be opened and drained, and not allowed to act as a reservoir for a time, but only as a channel. Suprapubic incision into the bladder has been tried and found wanting, and there are grave objections to rectal tapping and subsequent drainage, to perineal cystotomy, and to tapping the bladder with trocar and canula through the perineum without incision—an old method recently revived.

The safest and best means of drainage is obtained by the old operation, called by the French 'la boutonnière périnéale.' The patient is anæsthetised, a grooved staff is passed into the bladder, and he is tied up in the lithotomy position. An incision, an inch long, is made through the skin in the median line of the perineum, ending within three quarters of an inch of the anus. The operator's left forefinger in the rectum distinguishes the apex of the prostate and the groove in the staff. A narrow, straight, sharp-pointed bistoury is introduced at the lower part of the wound, back downwards, and carried in front of the rectum to the membranous urethra, which is opened upon the staff, care being taken not to wound the bulb. A narrow blunt gorget is passed along the staff into the bladder, the staff is withdrawn, and the right forefinger (the left is reserved for the rectum) passes along the gorget into the bladder and explores its cavity; if nothing abnormal, except an enlarged prostate, is found, an india-rubber tube is passed through the wound into the bladder, by means of which drainage is effected for ten to fourteen days. The tube may then be permanently removed. The wound soon heals, the patient returns to the use of his catheter, and finds that the intervals between the catheterisations are considerable, and that life is again tolerable.

Hæmorrhage from the Hypertrophied Prostate.—During the first two or three weeks of entire dependence upon the catheter, the urine may suddenly be found to contain much blood. The bleeding is probably from the walls of the bladder, and is due to the withdrawal from them of the pressure of retained urine. Patients, also, who are accustomed to the catheter may occasionally pass much blood; they have had difficulty in passing the instrument, or familiarity has somewhat bred contempt, and they have been rough or careless; the hæmorrhage here is from the prostate. In advanced prostatic hypertrophy the veins about the prostate become enlarged, and bleed freely when injured. 'Vesical hæmorrhoids' are sometimes spoken of; but a condition deserving such an appellation is extremely rare. Whether the blood is from the prostate or bladder, the appearance of the urine is the same: it is intimately mixed with blood, and, when it issues from the urethra, the beginning of the stream is as bloody as the end. The blood is of a peculiar rich purple colour, and, looked at in bulk, is almost black. The patient and his friends are seriously alarmed, but with careful management he usually recovers.

It may be well to mention here that, in hæmorrhage from a tumour of the bladder, the stream of urine as it issues from the penis is usually more bloody at the beginning, or at the finish, than it is in the middle of its flow; it is generally most bloody at the finish. There is also pain with a tumour of the bladder, specially at the end of making water; this is not so in the cases now under consideration. The urine may be very full of blood in cases of stone in the bladder, but only after the patient has taken an unaccustomed amount of exercise.

Treatment.—Absolute rest in the lying posture in bed must be ordered and enforced. The urine must be drawn by a soft, easy-going catheter, passed with care and skill. Metal catheters should not be used. If, from injury to the urethra, the catheter can only be introduced with difficulty, it may be tied in and plugged; when the patient wishes to relieve his bladder, he does not rise from his bed, but simply turns over on his side and withdraws the plug. The bladder should not be washed out. Clots of blood in the bladder may safely be left to the disintegrating action of the urine; they gradually break up and come away. Should clot, however, get into the eye of the catheter and interfere with its action, a little cold water may be injected through the instrument and the clot washed back into the bladder. If, as sometimes happens, clots cause much difficulty, the catheter may be fitted with an English gum bougie just large enough to fill the interior; when introduced into the bladder, the bougie is withdrawn, and usually urine flows freely. In one case of the writer's, he and the patient were worn out by incessant trouble from difficult catheterism and the constant

blocking up of the catheter by clot. Morphia was administered freely, and under its influence the bladder was allowed to fill with blood and urine. In twelve hours the catheter was used cautiously. The patient was still kept under the influence of morphia, and the catheter used every six hours. At the end of forty-eight hours the urine came away almost clear, with quantities of broken-down blood-clot, and the patient made a good recovery.

Ice may be applied above the pubes or placed in the rectum, but it is of questionable service. An iced infusion of matico has been injected into the bladder, and in certain cases is worthy of trial. Styptics may be administered by the mouth: gallic acid, tannic acid, alum, iron alum, sulphate of iron, tincture of steel, red gum, hamamelis, Ruspini's styptic and ergot are those generally used, but the writer has no confidence in these remedies. He considers opium, or some preparation of opium, the only medicine likely to be of service by the mouth. The system must be supported by light, nutritious foods; hot drinks should not be taken, and alcoholic stimulants are to be avoided unless the patient is much exhausted. G. Buckston Browne.

PRURIGO is a chronic inflammatory disease of the skin, characterised by the formation of pale, discrete papules, accompanied by intense itching.

Cause.—Numerous theories have been invented to account for the presence of prurigo, but none are satisfactory. Although it may be accompanied by diathetic conditions—scrofula, rachitis, &c., or by albuminuria, yet no one of these has been proved to be its cause. It is at present rather regarded as a disease of the skin itself. Prurigo, though a rare disease, is comparatively common in Austria, where it was first described, but less common in other countries; it is found most frequently amongst the poor, ill-cared-for classes. Though not congenital, it makes its appearance very early in life (during infancy), at which period it is evidenced rather by the formation of wheals than of the peculiar papules about to be described. The disease is worse in winter than in summer, and generally persists during a lifetime.

Pathology.—There are two theories as to the pathology of prurigo. (1) That it is a neurosis, giving rise to a tetanic contraction of the arrectores pilorum, thus causing a papulation analogous to cutis anserina. (2) That it is inflammatory in origin. A considerable number of observations have been made upon the prurigo papule, and there is pretty general agreement that the microscopic appearances are not peculiar, but such as may be encountered in any cutaneous inflammation—that is to say, there is cell-infiltration, especially in the papillary body, together with later changes in the epidermis, notably the exudation of fluid in the form of an abortive vesicle. It is this late formation of fluid which is said to give rise to the itching by irritation of the nerve-endings, the itching being always secondary to the papulation. What originates the inflammatory papules is not known. All other objective symptoms of prurigo are due to the mechanical irritation of the skin by scratching.

Symptoms.—The papules which are peculiar to the disease are often recognised with difficulty, as they are but slightly raised, and may be only perceptible to touch. In colour they may be pale red, but more often they take the hue of the surrounding skin; they are mostly of the size of hempseeds, and are not closely placed, but disseminated. The intense itching and consequent scratching which they give rise to soon modifies their appearance; their summits become abraded by the finger-nails, and ultimately topped with a minute blood or serum crust. Again, the scratching gives rise to the formation of other secondary blood-crusted papules, such as are common to all itching skin-affections. A picture made up of these disseminated blood-crusted papules, affecting especially the outsides and extensor surfaces of the limbs, the trunk to a less extent, and possibly the cheeks and lower jaw, together with a dusky, harsh, ill-nourished skin, is the one which is most often encountered in this country as the representative of prurigo (prurigo mitis).

In severer types of the disease (Hebra's prurigo, prurigo ferox), in consequence of the chronic inflammation the skin becomes deeply pigmented, the natural furrows deepened and exaggerated, especially in the neighbourhood of joints; finally, thickened and resisting to the touch, so that a fold is pinched up with difficulty. On passing the hand over the affected skin, say of the leg, it feels wooden and rough, like a coarse nutmeg-grater; this roughness is conferred by the broken wiry hairs which cover the part. The limbs are always the parts most affected, and of these the extensor surfaces. The flexures and scalp are very rarely attacked; the palms and soles, penis and scrotum, never. Prurigo of any grade, but especially the severer type, is liable to be complicated by linear excoriations, ecthymatous lesions,

and local impetiginous eczemas of varying extent and degree.

Diagnosis — from Scabies.— The long chronic history, the absence of burrows or lesions on the palms, soles, or penis; the absence of the eruption from the axillæ and insides of thighs, the presence of the eruption on the face, are the most important points. *From Phthiriasis or Pediculosis.* — The presence of the eruption about the hands; its characteristic localisation on the extensor surfaces rather than in the positions where the clothing fits tightly—e.g. the shoulders and waistband, as in phthiriasis; the absence of pediculi or nits about the clothing, which are rarely absent in old-standing phthiriasis. *From Eczema.* — Chronic eczema tends to affect the flexures; the scalp, penis, and scrotum are also liable to be the seat of the disease. Anatomically, eczema is characterised by closely set papules turning into vesicles. Many cases of prurigo are, however, complicated with eczema, only revealing their nature on the latter affection being cured. Prurigo must not be confounded with pruritus.

Treatment. — Tonics may be given if required—iron, arsenic, cod-liver oil. But only external remedies will give relief for any time; of these, soft-soap, sulphur, and tar are the best.

The uppermost layers of the cuticle should be removed by soft-soap baths, their use being alternated by the inunction of some bland oil (olive or almond). Then, after the irritation produced by the soft-soap has subsided, the patient should have the affected parts painted with juniper tar (ol. cadinum or *huile de cade*), and immediately afterwards he is to remain in a warm bath from three to six hours. Such treatment will mitigate the disease, and may be undertaken from time to time; but permanent benefit is not to be expected. Any complicating eczema should be controlled before the above treatment is undertaken.

A. Sangster.

PRURITUS. *See* Prurigo.

PRURITUS ANI. — A sensation of itching on the cutaneous surface surrounding the anus. It is frequently most distressing, and local examination should always be made, as it sometimes depends on easily removable causes. The effects of scratching, which the itching induces, must not be mistaken for the cause. It is sometimes due to pediculi pubis which have, unknown to the patient, settled there. External piles and inattention to cleanliness will also induce it. In fat subjects, chafing of the nates and retention of the secretion of the anal glands may cause it. Oxyurides in the rectum, or a chronic mucous or purulent discharge from the rectum, due to catarrh or piles, prolapse, polypus, or stricture, may be the exciting cause. Venous congestion of the part, from obstruction of the portal or systemic circulation or chronic constipation, may lead to malnutrition of the tissues, which may be expressed by local irritation similar to that experienced by patients with varicose veins of the lower extremities. This variety may be exacerbated by indulgence in alcoholic stimulants or by highly seasoned food. It is sometimes a symptom of gout. Occasionally, no cause can be discovered.

The *treatment* consists in the removal or alleviation of the exciting cause if it can be discovered. For pediculi, a lotion of corrosive sublimate four grains, rectified spirit two drachms, and water to an ounce will suffice. Oxyurides may be removed by injections of salt and water, with scammony and calomel pills. External piles should be cut off. Attention to diet and purgation will relieve local congestion. Perfect cleanliness is essential. Eczema will usually yield to some mild stimulating ointment, such as nitrate of mercury ointment, diluted with two parts of vaseline. When the itching has continued for some length of time, the skin will be found to be seamed with cicatrices produced by scratching, and the subcutaneous tissue will be converted into an unyielding mass by infiltration with leucocytes and chronic inflammatory exudation. In this condition, painting the surface with acetic acid—so that the acid shall not touch the margin of the anus—and the subsequent application of petroleum ointment, will be found very beneficial. This affection is especially intractable when the exciting cause cannot be ascertained. It is then probably due to some disordered condition of the constituents of the central nervous system. Internal administration of bromide and iodide of potassium may be advantageously combined with local applications. When the irritation is the result of catarrhal discharge, the exciting cause must be suitably treated. Jeremiah McCarthy.

PSAMMOMA. *See* Sarcoma.

PSEUDO-HYPERTROPHIC MUSCULAR PARALYSIS.—Pseudo-hypertrophic paralysis is a progressive disease, characterised by weakness of many muscles, some of which are usually at first enlarged

and others wasted. The change in the muscles consists in an interstitial growth of fibrous and fatty tissue. Ultimately contractures occur, causing deformities. The affection usually commences in childhood, develops with growth, and after the symptoms have existed for ten or fifteen years, death occurs in consequence of secondary results of the weakness of the respiratory muscles.

The chief features of the malady were described in 1861 by Duchenne, who gave it the name by which it is now known, based on the muscular enlargement, which is, however, a variable and inconstant feature. A well-marked group of cases had been studied and described by Meryon in 1852, and isolated examples had been before published, the first by Sir Charles Bell in 1830.

Etiology.—Males are more prone to suffer than females, in the proportion of 6 to 1. The disease is often hereditary, and cases may occur through several generations. It is almost always inherited through the mother, who does not herself suffer from it. A woman's sons by different husbands may be affected. In other instances, several brothers and sisters may suffer, although no antecedent cases can be traced. Eight brothers have been known to suffer without any ancestral cases. The disease must, then, be due to a congenital tendency, although it is not actually inherited. In other cases, which constitute about half the total number, the disease is isolated, no other instance being traceable in the family. No hereditary relation to other diseases can be traced. The affection always commences during the period of development, and usually when muscular development is most active—in early childhood. In a few instances, symptoms have not been noticed until early adult life; but the disease always long precedes its symptoms, and in such cases there is often a history of large muscles since childhood, although there was no obtrusive weakness during youth. No immediate causes can be traced. Some morbid influences, such as acute diseases, have preceded the first symptoms, but have merely served, by their depressing action, to bring out the indications of the pre-existing malady.

Pathological Anatomy.—The affected muscles, whether large or small, are firmer than normal, unless the enlargement is considerable, and then they may be soft. On section they are yellowish in colour, and those much enlarged may resemble perfectly a fatty tumour, no red tint being perceptible. The microscope shows that the resemblance is more than one of appearance. The chief part of the bulk of the enlarged muscle consists of fat-holding cells, with fibrous tissue between them, identical in structure with ordinary adipose tissue. Here and there among the fat are bundles of muscular fibres, most of which are unduly narrow, although otherwise normal in aspect. Some, however, present signs of degeneration, and there are many empty sarcolemma sheaths, showing where fibres have perished. In the muscles that are small there is little fat; the fibrous tissue is increased, and the muscular fibres are narrow and in process of destruction. No other organ constantly presents changes. The spinal cord may be perfectly healthy; in some cases slight alterations have been found in it, but these have varied much in seat and character, and are certainly of secondary origin.

Symptoms.—These are of two kinds—the weakness of certain muscles, and the change in their size—both being the result of the morbid process just described. The increase in size, in rare cases, affects almost all the muscles of the trunk and limbs; usually it affects only a few muscles. Those almost constantly enlarged are the calf muscles and the infraspinati; next in frequency are the extensors of the thigh, glutei, erectors of the spine, deltoid, and triceps; much less frequently the biceps and the forearm muscles; very rarely the masseters are enlarged. The muscles almost always wasted are those that depress the raised arm—the latissimus dorsi and the lower part of the pectoralis major; they may even seem absent. The upper arm muscles may also be small instead of large. The extensors of the knee are frequently lessened in size. Sometimes, the rectus is small and the vasti abnormally large. Before definite muscular weakness is observed, often soon after a child learns to walk, a certain clumsiness of movement attracts attention; he readily falls, and runs with difficulty, and with a waddling gait.

The definite loss of power, which slowly comes on, affects, first and chiefly, the extensors and flexors of the hip and the extensors of the knee, and causes a characteristic defect of movement. There is a difficulty in going upstairs and in rising from the floor. If the child cannot take hold of furniture to help him up, he puts his hands on his knees, and so helps their extension by transferring part of the weight of the trunk from the upper to the lower end of the femur, close to the fulcrum of the lever which this bone then constitutes, and the part of the body in front of the

centre of gravity serves to aid instead of opposing the extension of the knee. If the extension of the hip is feeble, this movement is aided by grasping the thighs and moving the hands alternately higher and higher, and so, as it were, pushing the trunk up by 'climbing up the thighs.' Sometimes the extension of the knees is effected by getting on 'all fours,' and, when the child is resting on the toes and hands, the latter are transferred to the knees, first one and then the other, and the erection completed as above described. Lordosis is very constant, the lumbar spine being curved (convexity forwards) so as to cause a considerable hollow in the back, and the shoulders are carried backwards to compensate and maintain equilibrium. The lordosis is not the result of any weakness of the trunk muscles, but of that of the extensors of the hips, which causes the pelvis to be tilted forwards. When the patient sits, and the pelvis becomes horizontal, the lordosis disappears at once. Sensation, cutaneous reflex action, and the sphincters are all normal. The knee-jerk, however, is lessened, and ultimately lost. Slight contracture comes on in the muscles of the calf, so that the foot cannot be flexed beyond a right angle. There is, for a long time, little impairment of power in the arms. The mind is unaffected as a rule, although the disease has occurred in association with idiocy.

The loss of power slowly increases, until the patient becomes unable to mount a single step or to rise from the floor without help. He can still walk on level ground, swaying the body so as to throw its weight on to the leg that is on the ground. The contraction in the calf muscles increases until definite talipes equinus results, and at last prevents walking. When this occurs, the deformity rapidly develops, the foot becomes inverted, and the equino-varus extremely marked. The hamstrings also undergo contraction, and, in the sitting posture, the unequal weakness of the spinal muscles leads to lateral curvature. The arms gradually lose power, chiefly in the muscles of the shoulder and elbow; the hands remaining useful to the last. As the disease progresses the muscles waste, the fat becomes absorbed, the muscular fibres perish, and the fibrous tissue contracts. There is at first no change in their electric irritability; but, as the disease progresses, this irritability lessens slightly to both currents. Death results in most cases from chronic broncho-pneumonia, the result of the weakness of the respiratory muscles, or from some pulmonary or laryngeal inflammation which that weakness renders serious. The course of the disease varies much in rapidity, and, as a rule, is shorter the earlier the symptoms begin. If it commences in early childhood, power of rising from the floor is lost at about eight, that of standing at ten or twelve, and death occurs between fourteen and eighteen. If the first symptoms are delayed till six or eight, the power of walking may not be lost till fourteen or fifteen, and life may be prolonged until twenty or twenty-two. In rare cases, failure of power does not occur until the end of the second decade, although enlargement of muscles has existed since childhood. In these cases the progress of the disease is slow, and may even cease.

The enlargement of the muscles, although a common and obtrusive characteristic, is not an essential feature of the disease. It depends on the growth of fat in the interstitial fibrous tissue: the latter may form alone, and all the muscles may be lessened in size, although firmer than normal.

Pathology.—The balance of evidence is strongly opposed to the idea that the disease is primarily one of the nervous system. Its origin, course, and character all suggest that it is a developmental disease of the muscles, the expression and result of a morbid tendency of growth, a vice of the germinal material, by which there occurs an undue development of the interstitial tissue, before which the muscular fibres waste. The weakness is due to the interference with the latter, and is thus a secondary effect of the overgrowth. The muscular fibres, moreover, seem to suffer less when there is a deposit of fat in the interstitial tissue than when this consists only in a fibrous overgrowth. The only symptom that might suggest a doubt as to the purely muscular nature of the disease is the loss of the knee-jerk; but that difficulty disappears if we regard this phenomenon—as the writer believes we must regard it—as the expression of a muscle-reflex irritability which may well be impaired by a muscular disease.

Diagnosis.—The diagnosis rests on the peculiar impairment of motor power, coupled with the enlargement of some, and the wasting of other, muscles. The enlargement of the calf muscles, with a contracture that cannot be overcome, the enlargement of the infraspinati, and the wasting of the depressors of the arm, the swaying walk and waddling run, the mode of rising from the floor, the lordosis, and the diminished knee-jerk, make up a characteristic group of symptoms. The chief diagnostic difficulty is the distinction from

cases of slight congenital spastic paraplegia, in which the muscles of the legs are large and firm, there is contracture of the calves, and the gait may resemble that of pseudo-hypertrophic paralysis. But attention to the following characteristics of these cases will always prevent error: The knee-jerk is excessive; there is a tendency to rigidity in the legs; the contracture of the calf muscles is active, and can be overcome by steady pressure applied to the soles; there is no wasting of the depressors of the arm; there is often slight inco-ordination of the hands; and the tendency of the disease is to lessen instead of to increase.

Prognosis.—Of a disease that consists in a morbid tendency to tissue-development, growing with the growth of the sufferer, and as little open to influence as is increase in stature, the prognosis is of necessity most grave. All that can be said is that, the later the disease commences, the slower its advance is likely to be; and when growth is over and adult life is reached, its progress may almost or even altogether cease.

Treatment.—No treatment has a distinct influence on the morbid process that underlies the symptoms. In no instance has its course been arrested. Arsenic seems, in some cases, to hinder for a time the increasing weakness, but frequently it has not even an apparent influence. The same may be said of cod-liver oil. The tendency to the accumulation of fat in the muscles does not contra-indicate cod-liver oil, since the muscular fibres seem to suffer less when there is fat than when there is simple fibrous tissue. Faradisation may be employed to aid the nutrition of the muscular fibres, but its influence is small compared with that of the normal physiological stimulus to muscular nutrition—muscular exercise. Systematic movements, so arranged as to call into action the muscles that are weak, are of great importance. They should not be carried to the point of fatigue, but should be frequently repeated. Walking should be persevered in, and a low step arranged, a few inches high, on which the patient may step first with one leg and then the other, and the height of the step may be gradually increased. Systematic rubbing of the muscles is also desirable, and passive movements may be employed to prevent or lessen the contractures, when these are threatened. It is of great importance to hinder the contraction of the calf muscles, and keep the patient as long as possible on his feet. If considerable contraction has occurred, tenotomy is necessary. The writer has known the operation to restore for several years the lost power of walking. It is important that the tenotomy should be performed promptly when the necessity for it has arisen, before the muscles suffer further from disuse. In the later stages of the malady, the danger of pulmonary disease must be remembered, and its exciting causes as far as possible avoided.

W. R. Gowers.

PSOAS ABSCESS.—An abscess occupying the sheath of the psoas or of the psoas and iliacus muscles, eventually and generally spreading beyond these limits.

Cause.—When the abscess is chronic, the usual cause is caries of the vertebræ from which the psoas muscle arises, or, more frequently, disease of the dorsal vertebræ; also sacro-iliac disease. Occasionally there is no cause assignable: the superficial erosion of the vertebræ found in these cases at the autopsy, and regarded as a consequence of the suppuration, the writer believes to be the cause. Acute psoas abscess in adults is rare, but has been seen following rupture of the muscular fibres from strain; one proved fatal in two weeks from pyæmia (Marshall). Acute idiopathic psoas abscess is seen occasionally in children.

Pathology and Course.—Caries of the lumbar vertebræ gives rise to suppuration beneath the origin of the psoas, and, following the line of least resistance and of gravity, the pus passes down the whole length of the muscle, destroying its fibres, and, when spreading (in ilio-psoas abscess) into the iliac fossa, converts the iliacus also into a sac of matter. When due to caries of the dorsal vertebræ, the pus enters the sheath of the psoas beneath the *ligamentum arcuatum internum* of the diaphragm. The abscess is more or less multilocular, especially in the psoas portion: it may be single or double. At first it is of the shape of the psoas, then it expands considerably, either from the iliacus becoming involved, or from the pus extending beyond the limits of the muscle-sheath.

When following an anatomical course, the matter leaves the abdomen under Poupart's ligament behind the vessels, and passes inwards to the adductor region. If the iliac portion passes out separately or distinctly, it forms a swelling external to the artery. Where the amount of matter is large, its relationship to the artery varies: sometimes it quite conceals it, and sometimes pushes it against the skin so that it beats subcutaneously. Once in Scarpa's triangle, the abscess forms its own sac,

and then varies very much in character. Generally it is globular, and presents in the adductor region; but, in addition or independently, it may turn outwards under the tensor vaginæ femoris and open over the great trochanter. When large, it may appear double from an oblique depression on it caused by the sartorius; when small, it may simulate a femoral hernia as a small tumour at the ring, having an impulse on the patient coughing, or as a sausage-shaped swelling parallel to Poupart's ligament. It has been known to simulate inguinal hernia by travelling down the canal (Shaw).

Psoas abscess may protrude from the abdomen in other places: thus, posteriorly above the iliac crest, forming a lumbar abscess, or, turning downwards, become gluteal. It may pass through the sciatic foramen and descend the back of the thigh and even reach the leg, or following the curve of the sacrum it may present in the perineum. The extra-abdominal part may be of any size up to that of a sac holding pints; at times it causes great œdema of the leg from pressure. From the proximity of the sacro-iliac joint to the psoas muscle, and of the hip to the conjoined psoas and iliacus, secondary suppurative disorganisation of these joints may at times be seen—that of the hip being always a fatal complication.

Psoas abscess points usually in the upper adductor region; occasionally just above Poupart's ligament or over the trochanter. It may open in various parts of the back of the thigh: into a viscus (bowel or bladder) or into large arteries, aorta (Savory), iliac artery (Ashurst). It may never point, gradually receding and vanishing by caseation and absorption, and that when of large size. When double, one abscess only usually reaches the thigh. When it bursts of its own accord, it does so through a minute opening: a gush of serous flows, and the opening soon gets blocked with flocculi; after a time these are displaced and more fluid escapes. Owing to the gradual evacuation and the protection against admission of air, the discharge is frequently quite unattended with constitutional disturbance. When quickly evacuated, inflammation of the sac follows, and pyrexia or septicæmia is usual.

Symptoms.—There may be none; old unsuspected psoas abscess being often found at the autopsy (Bryant). Early symptoms depend upon irritation of the lumbar nerve-roots — namely, sciatica, cruralgia, or neuralgia of the anterior crural. Aching across the hip and back and the base of the sacrum; cramp, and at times paralysis. Inability to extend the thigh; bent position when standing; rotation inwards of the thigh. Children merely complain of a pain down the thigh, and always carry it flexed. Deep pressure in the abdomen, along the semilunar line, reveals a vertical, sausage-shaped, tender, fluctuating, elastic tumour (mistaken for loaded bowel, but which does not roll from under the fingers). It may or may not reach Poupart's ligament, and may be accompanied by a tumour of similar character in the iliac fossa.

The abscess may run its course without any subjective symptoms; the extra-abdominal tumour first attracting attention. When extra-abdominal, the usual physical signs show it to be abscess: and the impulse on coughing that it has intra-abdominal connection; combined pressure above Poupart's ligament and over the tumour in, e.g., the thigh, reveals fluctuation. Psoas abscess is most likely to be overlooked when symptoms of spinal or sacro-iliac disease are not co-existent.

Diagnosis.—For its most successful form of treatment, the abscess should be diagnosed whilst intra-abdominal. As stated above, chronic psoas abscess must not be mistaken for loaded bowel. When in the groin, the history, the imperfect reducibility, the absence of gurgling, and the presence of an intra-abdominal portion will differentiate it from hernia; while the presence of impulse will distinguish it from bubo. Acute psoas abscess must not be confounded with typhlitic abscess; this latter is generally more external, often emphysematous, and has a special history of its own.

Treatment.—(*a*) *Non-operative.*—Treat the cause, if discoverable, the abscess being left to itself; if the cause does not necessitate rest, the abscess, unless painful or producing œdema, will not do so. The chances of its absorbing cannot be calculated upon; and as most abscesses eventually discharge, moving about hastens this end. A very large abscess, which spontaneously disappeared under the writer's observation, did not confine the patient to bed for even a day.

When inflamed and pointing, rest and fomentations are necessary; when it has discharged, a dressing of carbolic tow with iodoform (ten per cent.), is best. After the first day or two, the upright position aids discharge. A sinus usually results, which can be dressed with boracic acid ointment. Tonics, according to circumstances, must be given.

(*b*) *Operative. Aspiration, Tapping.*—This is of use to relieve tension for a time,

but is employed only when more radical measures cannot be adopted. Repeated tappings at one point will often determine the final pointing of the abscess. Complete evacuation should not be attempted at one time.

Free Incision.—This ought only to be undertaken when the fullest antiseptic precautions are adopted, both at the operation and subsequently. Whilst *intra-abdominal*, there are two places for opening a psoas abscess—one in the loin, the other just above Poupart's ligament; both wounds can be kept aseptic, but the former more certainly so; besides, it is the better one for drainage in the recumbent position.

Operation above Poupart's Ligament.—The incision is that for ligature of the external iliac artery. After division of the external oblique the knife is discarded; the rest of the tissues are turned up with the forefinger; and, when the fluctuating tumour is exposed, it is opened with dressing-forceps. A large drainage-tube is inserted, and a Listerian dressing, with the elastic spica bandage, applied. However opened, the abscess, if kept aseptic, should not be syringed out.

Operation in the Loin.—The patient being in the colotomy position, a vertical incision, four inches long, is made at the edge of the erector spinæ, its centre being, in the adult, two inches above and in the same line as the posterior superior iliac spine. Everything is divided till the quadratus lumborum is reached; this is then incised to the extent of two inches in the same direction. On reaching the anterior surface of this muscle, the subperitoneal fat is seen—a sure guide. The finger, now thrust into the wound in the direction of the base of the sacrum, feels a fluctuating tumour, especially if an assistant makes counter-pressure on the abscess in front. Where fluctuation is most distinct the abscess is now incised. Counter-pressure and rolling the patient backward will evacuate the contents, and the finger then explores for sequestra.

A perforated drainage-tube, at least three-eighths of an inch in calibre, and long enough to reach the iliac fossa, is then inserted, and its mouth stitched with two sutures to the skin wound, flush with the surface. The rest of the wound is now closed with deep and superficial sutures. Where full Listerian dressings (with spray) are used, the abscess need not be syringed out. Daily dressings are required for ten days; then the drainage-tube is shortened to three inches, and at the end of three weeks removed. In successful cases there may be no discharge of matter after the operation, the wound closing round the tube by primary union, and uniting completely on its removal. Two such cases have occurred to the writer. The patient must remain supine, with the thighs bent, and a pad firmly bandaged over Scarpa's triangle and along the line of the abscess in the abdominal walls.

When *extra-abdominal*, the abscess can be opened at its most prominent point; but the adductor region of the thigh should, if possible, be avoided, since it is impossible to ensure asepticism in that position. The writer has reached such an abscess through an incision outside the rectus femoris below the iliac spine, and thus ensured its evacuation away from the neighbourhood of impurities. When the abscess is opened in the inguinal region or thigh, the supine position is the worst for drainage, and the writer prefers getting such cases out of bed at the earliest opportunity.

Where psoas abscess is the result of sacro-iliac disease, and where matter is also presenting behind, over the joint, this posterior abscess should be opened and the joint explored. The psoas abscess may be finally evacuated by the same incision. The writer once trephined the joint and thus reached the abscess; the patient made a good recovery. C. Hilton Golding-Bird.

PSORIASIS. (*Synon.* Lepra, Alphos.) *Definition.* — Psoriasis is a non-contagious chronic disease of the skin, attended with the formation of roundish, slightly raised red patches, thickly covered with pearly-white scales.

Symptoms and Pathology.—Psoriasis, though an inflammatory disease, is one in which the inflammation is often so slight as to escape notice. At other times, it is well marked and attended with the usual signs of redness, itching, and other subjective sensations. The eruption consists at first of small slightly raised red patches, which spread at the margin and quickly become covered with silvery-white scales; these form rapidly, and as the disease increases are shed in great quantities. In some few instances the scales are not shed, but become heaped up into conical masses. In psoriasis there is no moist exudation on the surface of the skin, but it is not difficult to produce, artificially, an exudation of this kind by over-stimulating the patches, especially when they are present on the flexor surfaces of the body. Under these circumstances the disease may be easily mistaken

for eczema. The white scales are a characteristic feature of the disease; they consist of imperfectly formed, dry, epidermic structures, the silvery-white appearance being due to the presence of air in this epidermic accumulation. Psoriasis spots have a strong tendency to spread at the circumference and heal in the centre, and thus ringed or gyrated patches are produced. As the spots disappear they often leave behind considerable pigmentation of the skin.

The disease may attack exceptionally any part of the body, but is not common on the penis, scrotum, and face below the forehead, and very rare on the soles and palms. There is, however, a common form of dry eczema of the palm, which is often miscalled Psoriasis palmaris. The parts of the body most liable to the disease are the extensor surfaces of the limbs, especially the point of the elbow and the skin just below the patella; when, however, the disease is scattered in small spots over the trunk (Psoriasis guttata) the elbows and knees often escape. The disease is generally developed symmetrically on both sides of the body. It is probable that psoriasis does not attack the mucous membranes; there is, however, one form of leukoplakia buccalis which has a superficial resemblance to psoriasis, but it does not occur especially in those subject to that disease, and is probably not in any way related to it nor to ichthyosis, by which name it is sometimes erroneously called.

Etiology. — Psoriasis never occurs in infants at the breast, and hardly ever before the age of four or five; in this respect it presents a strong contrast to eczema. It is equally common in males and females. There are two varieties of psoriasis commonly met with. One appears for the first time in early life, usually before the age of twenty; it is attended with little or no itching and much scaliness; it almost invariably recurs after longer or shorter intervals; those subject to it generally have a fresh pink-and-white complexion. The other variety appears later in life, is attended with more marked inflammatory symptoms and especially with itching; the scales do not accumulate to any considerable extent. This variety is rather common in gouty families. The exciting causes of psoriasis are quite unknown.

Diagnosis.—A typical case of psoriasis cannot be mistaken for any other disease. In an irregularly developed form the disease may be confounded with dry eczema, lichen planus, tinea tonsurans of the trunk, and scaly syphilitic eruptions. Psoriasis may be distinguished from dry eczema (1) by the fact that it generally attacks the extensor surfaces of the limbs; (2) that the patches are more raised and scaly, especially at their margins, which are always more defined than in eczema; (3) they heal first in the centre; (4) the history of the case. It is difficult to distinguish confluent patches of lichen planus from psoriasis. For the differential diagnosis, see *Lichen Planus* under Planus. Tinea tonsurans of the trunk sometimes assumes the appearance of healing psoriasis, but a few scales scraped from the surface, treated with liquor potassæ and examined under the microscope, will often aid the diagnosis. Psoriasis is perhaps more likely to be confounded with a squamous syphilide than with any other eruption. This is especially liable to occur when the psoriasis is in the form of crescentic patches or rings, and confined to the scalp and forehead. The absence of any syphilitic symptoms and the general appearance of the patient, together with a history of former attacks of the disease on the elbows and knees, will be valuable aids to diagnosis. The appearance of the eruption in psoriasis is of a more silvery-white colour and the pigmentation less than in squamous dermatosyphilis.

Treatment may be considered under two heads:—(1) General; (2) Local. To the former belong medicines and diet, and to the latter baths, ointments, and lotions. Of medicines used for the treatment of psoriasis, arsenic occupies the first place and should always be tried, unless some special circumstances contra-indicate its use. It may be combined either with acids or alkalies, according to circumstances, and should always be given either just before or after a meal. It must be admitted, however, that arsenic fails in a considerable number of cases, especially when the disease is associated with a gouty constitution. Under these circumstances, colchicum and small doses of iodide of potassium are sometimes very useful. The internal administration of turpentine or copaiba is occasionally beneficial, but they are remedies which are not usually so well borne as arsenic. Rules of diet, though not of the first importance in the treatment of psoriasis, should not be entirely neglected. In the psoriasis of the young, fat, and especially cod-liver oil, should form an article of daily food during the winter; in the psoriasis of middle life, especially if there be any gouty tendency, an abstinence from sugar, coffee, and beer is indicated.

(2) Of local remedies, baths are, on the whole, the most satisfactory and effective. The removal of psoriasis by baths is more lasting than by other local means, probably because the remedy is not simply local. An ordinary warm alkaline bath, in which the patient can soak for half an hour every evening before going to bed, is both an effective and pleasant remedy. The temperature of the bath may be regulated to suit the taste of the patient, and the addition of from two to three ounces of carbonate of potash will be sufficient for a full-sized bath. The best mineral waters for the treatment of psoriasis are those of La Bourboule in the Lower Auvergne; the local effect of these waters is also excellent. When psoriasis covers a very large area, it is not easy to apply local remedies except in the form of baths; but when the patches are confined to the limbs or scalp, tar lotions, especially the liquor carbonis detergens, are often very useful. The latter remedy may be used either pure or diluted with spirit, and painted on the spots with a large camel's-hair brush; thus applied it dries quickly, and is one of the best as well as one of the least disagreeable remedies. Goa powder (chrysophanic acid) has long been a favourite remedy in India for ringworm, psoriasis, and other scaly diseases. There are, however, several objections to its use. (1) Chrysophanic acid stains both the skin and clothes; (2) it is apt to set up too much inflammation, and thus cause considerable annoyance to the patient; in a few instances the writer has seen grave symptoms produced when chrysophanic acid ointment has been used over a large area. (3) The most serious objection to its use, however, is that psoriasis returns more quickly when removed by this means than when removed by any other method. Pyrogallic acid ointment (ten to twenty grains of the acid to the ounce) is a useful local remedy, and not quite so disagreeable as chrysophanic acid ointment.

ROBERT LIVEING.

PSORIASIS BUCCALIS. — LEUCOPLAKIA.—This disease, which has long been known to surgeons, has in recent years attracted a large amount of attention in consequence of its relations to epithelioma. It has been more particularly described in connection with the TONGUE, where its tendencies appear to be most serious, but all parts of the buccal mucous membrane are liable to the complaint.

Etiology.—Habitual irritation of the affected parts, especially in connection with smoking, seems to be the chief causative agent; but the disease sometimes appears, without obvious exciting cause, in patients subject to psoriasis and other dry chronic forms of cutaneous eruption. Its relation to syphilis is somewhat doubtful, for although a history of hard chancre, with the usual sequences, may often be obtained in the great majority of cases, its origin is independent of ascertainable constitutional infection; and it appears probable that the *rôle* of syphilis is that of a common and not of a specific source of irritation, mucous tubercles, gummata, &c., acting merely by establishing an instability of the tissues in the parts attacked and a consequent susceptibility to malignant influence. In accordance with this theory of origin the disease is far more common in men, the consumers of tobacco, than in women, 101 cases out of 110 collected by Mr. A. E. Barker belonging to the former sex.

Symptoms.—The lesion as it appears upon the mucous surface of the lips, cheeks, palate, or tongue, is at first seen in the form of hyperæmic patches, which become developed into dull, whitish, roughened plaques of hypertrophied epithelium; and at a later stage may be associated with shallow fissures in the situation of the normal folds of the mucous membrane. On examination of the affected tissues, the epithelium is found to be more or less thickened and opaque, the papillæ at first enlarged, afterwards atrophied, and the submucous tissue infiltrated with white corpuscles, which extend chiefly along the course of the vessels. The anatomical changes in the parts entail no symptoms beyond the occurrence of a little salivation in the later stages, but the remarkable tendency to merge into epithelioma is a most important point for consideration. Mr. Barker has traced this sequel in no fewer than 43 instances out of 110 cases of buccal psoriasis.

The condition must be distinguished from the irregularly distributed scars and deep fissures left by the healing of gummatous lesions in tertiary syphilis.

Treatment.—All sources of local irritation, causative or otherwise, must be removed, the diet carefully regulated, and the mouth kept clean. The patients should be warned as to the possibility of remote trouble, and be kept under observation.

WILLIAM ANDERSON.

PTERYGIUM.—*Cause.*—The starting-point of a pterygium is generally an ulcer at the margin of the cornea, which, in

healing, catches a morsel of the limbus conjunctivæ and draws it towards the cicatrix, throwing the mucous membrane into a triangular fold. The ulcer then forms anew in the cornea immediately inside the cicatrix, and the point of conjunctiva is drawn into it again, and is carried a little further into the cornea, and so on.

The hollow lying between a PINGUECULA and the margin of the cornea is apt to lodge small foreign bodies, which cause shallow marginal ulcers, and these, in healing, draw the pinguecula over on the cornea.

In this country pterygium is a rare affection, but it is not uncommon in countries or localities where the air is filled with fine sand or other minute particles.

Symptoms.—Pterygium consists in a vascularised thickening of the conjunctiva, triangular in shape, situated most usually to the inside of the cornea, sometimes to its outer side, and rarely either above or below it. There is frequently, but not always, a tendency of the growth to advance into the cornea, as above mentioned; but it seldom reaches the centre, and still more rarely extends quite across the cornea. Vision is not affected, unless the growth advance over the centre of the cornea. There is no pain, and the disfigurement alone is what the patient complains of.

Treatment.—Unless the pterygium be very thick and have invaded the cornea to some extent, or be progressing over the cornea, it is well to let it alone; the more so as, by removing it, a perfectly normal appearance is not given to the eye, for a mark is necessarily left, both on the cornea and on the conjunctiva.

If the growth be progressive, or very disfiguring, it should be removed, other proposed methods of dealing with it being futile. This may be effected either by ligature or excision.

In the method by ligature, a strong silk suture is passed through two needles. The pterygium being raised with a forceps close to the cornea, one needle is passed under it here, and the other needle in the same way close to its base, and the ligature is drawn about half-way through. The thread is cut close behind each needle, thus forming three ligatures, which are respectively tied tight. In four or five days the pterygium comes away.

In excision, the apex is seized with a forceps and dissected up, either with a scissors or small scalpel, care being taken not to injure the true cornea. The dissection is continued towards the base of the pterygium, where it is completed by two convergent incisions meeting at the base. The mucous membrane in the neighbourhood of the base is separated up somewhat from the sclerotic, and the margins of the conjunctival wound brought together with sutures.

H. R. SWANZY.

PTOSIS—Drooping of the Upper Eyelid. See *Third-Nerve Paralysis* under OCULAR MUSCLES, Affections of the.

PUDENDAL HERNIA.—This rupture appears in the posterior inferior part of the labium. The neck of the sac lies between the ramus of the ischium and the vagina. The sac on making its way to the labium must pass through the anterior fibres of the levator ani. This form of rupture is most common in women past middle life, who have borne several children. The protrusion is usually small and contains small intestine. It has been mistaken for a labial cyst. It is usually readily reduced, and gives but little trouble. It has been strangulated, and has—when in that condition—been successfully reduced by taxis. It would appear that in no reported case has herniotomy been required. FREDERICK TREVES.

PULMONARY ARTERY, Wound of the.—This is a rare accident, but it occasionally takes place in stabs or shot-wounds. In the former it may be the only vessel wounded, from its anterior and comparatively superficial position in the chest. If the vessel be wounded before its bifurcation, the accident must necessarily be of an exceedingly fatal character. On account of the way in which the serous pericardium wraps round both this vessel and the aorta, the wound must perforate the upper part of the pericardium, and extravasation of blood from the vessel must take place directly into the pericardial sac, and thus cause very speedy death, as in incised wounds of the heart, by filling up this sac with blood and impeding the action of this viscus. Such a wound may perforate through into the ascending part of the arch of the aorta, and thus form a communication between these two vessels.

In those cases in which the artery is wounded beyond its bifurcation, the blood extravasates into the root of the lung, and hence into the posterior mediastinum. Such wounds, which are generally of a very complicated character, are sometimes the cause of immense extravasations of blood into the posterior part of the chest. The prognosis in all such cases is exceedingly grave.

The diagnosis is generally obscure, the symptoms much resembling those of HÆMOTHORAX, the treatment also being the same.

H. G. HOWSE.

PULPY DEGENERATION OF SYNOVIAL MEMBRANE. *See* JOINTS, Diseases of.

PULSE.—The pulse affords valuable indications for the surgeon, and a careful study of it is essential for diagnosis, prognosis, and treatment. It is one of those indications of the condition of a patient which is very readily obtained, and obtained also without the intervention of instruments; and for this reason it is deserving of very special attention. The *tactus eruditus* applied to the radial artery at the wrist may give the first warning to the operator that the patient has cardiac trouble, and is therefore a bad subject for anæsthetics or the knife; or that he has a granular contracted kidney, and is, therefore, not well fitted for operative interference. It tells him more, probably, than any other source of information, concerning his patient's 'strength' (i.e. the strength of the muscles of organic life), and of his progress towards recovery or death; and, above all, the administration or withholding of stimulants can only be properly regulated by one who is able to value properly the indications afforded by the pulse.

The pulse is usually 'taken' by placing the tips of the right index, middle, and ring fingers upon the radial artery of the patient, as it lies upon the bone just above the left wrist. With each stroke of the heart the artery is felt to dilate. This constitutes the 'pulse,' of which we have to note the rapidity and the other characters which form the subject of this article. The radial artery is usually selected because of its accessibility and convenience. Occasionally, the radial artery (owing to abnormal distribution or other cause) is not available, and then we may have recourse to the temporal, brachial, or any other superficial artery of the body.

By feeling the pulse we estimate mainly two things—(*a*) the rate at which the heart is working; (*b*) the pressure of blood in the artery. The rate is always stated in terms of pulsations per minute. The pressure is estimated by noting the force needed to stop the pulse with the fingers. In the healthy person it may be stated, as a rule, that pressure is inversely as the speed. A heart that hurries is often to some extent inefficient, and fails to maintain the pressure in the vessels. Again, the pressure in the vessels is far more dependent on the state of the arterioles and capillaries than on the force of the heart's action, and raising the pressure has the effect of raising the tone of the vagus centre in the medulla, and consequently of slowing the heart. The converse also holds good.

THE PULSE-RATE varies with *age*, as shown by the following table:—

In the fœtus . . .	140 to 150
Newly born infant . .	130 „ 140
During 1st year . .	115 „ 130
„ 2nd „ . .	100 „ 115
„ 3rd „ . .	95 „ 105
From 7 to 14 . . .	80 „ 90
„ 14 „ 21 . . .	75 „ 85
„ 21 „ 60 . . .	70 „ 75
Old age	75 „ 80

The influence of *sex* is considerable, and Dr. Guy has determined that the pulse of the adult female is quicker, by from 10 to 14 beats, than the pulse of the adult male.

The effect of *muscular exercise* is to quicken the pulse, the increase in pulse-rate being proportioned to the effort made. Thus, the pulse is quicker when standing than when sitting, and quicker when sitting than when the body is at complete rest in the recumbent position.

The effect of *position* apart from muscular effort is shown to be considerable. It is stated by Graves that the erect posture, as compared with the horizontal, increases the pulse-rate in a healthy person from 6 to 15 beats. This difference increases with the frequency of the pulse at the time of the experiment; thus, if it has been raised to 90 or 100 by moderate exercise, it is not unusual to find the difference 20 or 30. Dr. Graves found that this variation of pulse-rate with posture did not depend entirely upon the muscular effort involved in maintaining the posture, and that, when the position was changed by means of an apparatus which excluded the factor of muscular effort, the variations of pulse were nearly as great as when posture was changed by means of the patient's own exertions.

The pulse, according to Graves, is also 'evidently stronger in the horizontal than in the erect posture; consequently its *maximum of strength and minimum of frequency* are attained together.' This constitutes one of the reasons for placing persons horizontal for the relief of syncope.

A somewhat extended study of the effect of posture on the pulse-rate enabled Graves to conclude—

1. That the greatest difference occurs in patients labouring under fever, or in a

debilitated state in consequence of fever or any other cause. It may amount to 30, 40, or even 50, between the horizontal and erect postures.

2. That this difference decreases after the first quarter of an hour (i.e. after the subsidence of the variation due to exertion of muscular effort), but always remains considerable as long as the same position is observed.

3. That in persons not much debilitated the difference is much less, and often does not amount to more than 10.

4. Generally, the pulse-rate in the sitting posture may be taken as the mean.

5. In persons convalescent from fever or acute diseases, it is extremely useful to the physician to ascertain the comparative frequency of the pulse in the horizontal and in the erect posture. The greater the difference, the greater is the debility of the patient, and, consequently, the more guarded must his medical attendant be in allowing him to sit up for any length of time, particularly if the pulse, on his lying down, does not resume its usual degree of frequency.

Dr. Graves also asserted that, in cases of considerable hypertrophy and dilatation of the heart, the variation of pulse-rate with variation of position is often not observable, and he concludes 'that in a debilitated person, when a sudden change of position makes no difference in the frequency of the pulse, we may conclude that the heart, or at least its left ventricle, is increased in size and strength.'

The pulse-rate is influenced by *temperature*; and it has been shown that when animals are exposed to high temperatures it rises, and when exposed to low temperatures it falls. In fever there is, speaking generally, a correspondence in direct ratio between the body-temperature and the pulse-rate—i.e. they both rise and fall together, or, to be more accurate, the variations in pulse-rate usually follow by a little the variations in temperature. When the temperature is high, it is found that influences which disturb the pulse-rate (such as mental emotion, muscular effort, and posture) act with undue force, and thus it often happens that the pulse-rate runs ahead of the temperature.

The pulse-rate in fever, like the temperature, is subject to daily fluctuations, having a morning minimum and an evening maximum. In mild cases of fever a pulse of 100 is common. In more severe cases it runs up to 120 or 130; but if a rate above this (say 140) is maintained for any time it makes the prognosis grave. Towards the end of fevers which terminate fatally, we may have a falling temperature and a rising pulse—a condition which is always grave. In heart-disease, we may have a rapid pulse with a sub-normal temperature. In tubercular meningitis or in other fevers complicated by mischief at the base of the brain, we may have a high temperature with a sub-normal pulse. In short, there is a rough correspondence between pulse-rate and temperature, and, when we find such correspondence wanting, we should always search for the cause.

We may have a very rapid pulse without rise of temperature. This is notably the case in Graves's disease or exophthalmic goître, in which the pulse-rate may reach 160 in a minute. In poisoning by atropine, a rapid pulse occurs, due, as is supposed, to a paralysis of the inhibitory apparatus in the heart. Similarly, Guttman records a case of very rapid pulse (160), unaccompanied by rise of temperature, and due to compression of the vagus nerve by swollen lymphatic glands.

Mental and emotional excitement has been known to quicken the pulse. *Diminution of atmospheric pressure* does the same thing, and Mr. Glaisher records that in rising in a balloon from the ground to a height of 20,000 feet, the pulse-rate rose gradually from 76 to 110. It would be impossible entirely to eliminate the effect of mental excitement in this experiment.

In valvular disease of the heart the pulse is usually quickened, and especially, also, during an acute inflammatory condition such as peri-, endo-, or myo-carditis. A fatty heart often causes a slow pulse; sometimes remarkably slow, falling below 30.

The pulse may be *irregular in force and rhythm*. This may depend upon organic disease (valvular) of the heart; upon disturbed innervation, which may be central (as in tubercular meningitis), reflex (as in dyspeptic conditions), or toxic (as from digitalis and the excessive use of tobacco). Irregularity is common in old people, and seems generally (in the absence of cardiac disease) to cause no trouble, and probably does not influence the expectation of life.

Sometimes, the irregularities are very regular in their intervals of occurrence, sufficiently so to have a pseudo-mystic title, and accordingly we find in books the words *bigeminus*, *trigeminus*, and *alternans* applied to irregular pulses. The last form occurs when the left ventricle is so weakened that only every other contraction makes

itself felt at the wrist. Intermission of the pulse at irregular intervals may be due to similar causes. It may accompany heart-disease or may occur in persons otherwise healthy.

In considering the pulse, it must be borne in mind that the capacity of the blood-vessels is far more than is sufficient for the blood which they hold. When the vessels are relaxed, the blood does not nearly half fill them. In a 'full-blooded' man who has died suddenly, we find *post mortem* the arteries empty, and the veins by no means distended. During life, the vessels contract on their contents, but, their potential capacity being so great, it is evident that unequal contraction in different areas of the body leads to unequal distribution of blood. In health, the blood-distribution is always proportioned to the need of the part, the need to the work being done. When there is a 'determination' of blood to any part, there must be a compensating emptiness of some other part. When the surgeon stands his patient against a wall, and, passing a catheter, draws off perhaps a gallon of urine from an over-distended bladder, the sudden removal of pressure from the belly causes a sudden flow of blood into the vessels of that part, with the result that the brain and medulla are suddenly starved of blood, and the patient falls down senseless and faint.

The Volume of the Pulse varies in individuals. It may be of different volume at the two wrists, and this may depend upon irregularity in the distribution of the radial artery, or it may depend upon some pressure or obstruction in the main trunks either inside or outside the thorax.

The pulse may be of small volume (*a*) from loss of blood; (*b*) from failure of the heart to supply the required amount to the arteries, as in mitral or aortic obstruction and cardiac failure; (*c*) from pressure upon the aorta; (*d*) from diversion of the blood-stream, producing relative emptiness of the radial artery. This occurs in peritonitis and collapse, in which there is dilatation of the abdominal vessels. It is at the commencement of peritonitis, when there is determination of blood to the abdominal vessels, and before the muscular tone of the arteries or the muscular power of the heart has begun to fail, that we get the so-called 'thready pulse' (small and hard), which is almost diagnostic of abdominal inflammation.

When the heart is hypertrophied from aortic disease, the volume of the pulse is large. In advanced atheroma of the arteries, there is often a seeming increase of volume from the increased thickness and tortuosity of the vessel.

The *hardness* or *softness* of the pulse, the ease with which the pulse can be arrested by pressure of the finger, is most important from a diagnostic point of view. If the volume of blood be normal, if the left ventricle be hypertrophied and the aortic valves efficient, if the arterial wall be thickened from muscular or fibroid increase, and if the emptying of the arteries be hindered by contraction or thickening of the arterioles and capillaries, then the compression of the pulse is necessarily difficult, and we get the high-tension pulse which is so common with gouty kidneys, arterio-capillary fibrosis, and hypertrophied heart.

The causes above mentioned which, when they concur, produce a high-tension pulse in its most marked form, may not all be present simultaneously, or some of the causes of high tension may be counteracted by others which tend to produce low tension, such as deficiency of blood, mitral obstruction, cardiac weakness, or loss of tone in the blood-vessels from anæmia or acute febrile diseases. A soft compressible pulse, occurring in febrile diseases, indicates weakness and a failure of the muscles of the heart and vessels.

When the left ventricle is greatly hypertrophied and the aortic valves are inefficient, we have a very marked and forcible distension of the artery with sudden collapse, owing to the failure of the valves to maintain the pressure in the vessel. This is the *quick-bounding* pulse of some writers, otherwise known as the *water-hammer* pulse or Corrigan's pulse. Owing to the great distension of the vessels, the pulse is often *visible* in the arteries throughout the body, and visibility of pulse is to be reckoned amongst the surest indications of aortic incompetency. Visibility and hardness of the pulse also occur in advanced atheromatous disease of the vessels in persons advanced in life. It may occur also in healthy individuals in a state of nervous excitement.

A very important form of pulse is the so-called *dicrotous* pulse, in which for each contraction of the ventricle there are two pulsations in the artery.

It must be remembered that dicrotism is a physiological phenomenon which, by the use of the sphygmograph, can be seen to be always present in the pulse. It is only, however, when dicrotism reaches a high degree, that it can be detected by merely

placing the finger on the artery. Dicrotism is a sign of weakness, and appears to be due to a want of tone or failure in power of the muscular coat of the artery.

When the ventricle contracts, the tidal wave of blood distends the elastic artery; this distension ceases with the cessation of the ventricular contraction. The artery then recoils, and the force of the contracting artery closes the aortic valves and, at the same time, gives an impulse to the blood in the vessel, which travels to the periphery. This 'dicrotic' wave, though always present, only becomes manifest when it is excessive. The elasticity of the arteries depends upon (*a*) yellow elastic tissue, the action of which is mainly, if not entirely, mechanical and independent of central control, and (*b*) muscular element, in which the elasticity is 'vital,' and subject to great variations. The amount of elastic and muscular elements present in an artery bear an inverse proportion to each other, the latter increasing as the former decrease. The muscular elements in the radial artery at the wrist are present in relatively large proportions, and one of the effects of their activity is to check the oscillations of the vessel and render the dicrotic wave impalpable. When the artery loses its tone and the muscular coat is paralysed, as happens in acute and severe febrile conditions, then the dicrotic wave is easily felt, and its presence is made the more striking in consequence of the smallness of the tidal wave, caused by the failing power of the ventricle.

A dicrotic pulse is usually the accompaniment of high fever, and indicates that the powers of the patient are failing. It is sometimes the precursor of hæmorrhage (according to Graves), and is often observed as an immediate sequel of extensive hæmorrhage. In fever, says Graves, a dicrotous pulse, which is at the same time hard, is a *very bad* symptom if it lasts more than twenty-four hours; when succeeded by epistaxis, and when it disappears after moderate epistaxis, it is not bad; when it lasts for many days without any tendency to hæmorrhage, the case, nine times out of ten, ends fatally.

'In hæmoptysis, epistaxis, and internal inflammation, a very hard dicrotous pulse sometimes occurs, which resists all treatment and portends a fatal issue; no matter how much the other symptoms may improve, so long as the pulse continues of this character, the patient is in imminent danger.'

The Pulse-respiration Ratio is a point which always demands attention. As a rule there are, on an average, four beats of the pulse to each respiratory act, and the healthy individual has eighteen respirations and seventy-two pulse-beats per minute. Any persistent disturbance of this ratio should excite suspicion. If the pulse-respiration ratio changes from 4:1 to 3:1 or 2:1, the lungs should be carefully examined, and in the majority of cases they will be found the seat of disease. The quickening of the respiration is usually proportioned to the amount of lung-damage. Thus, in double pneumonia, where the amount of lung available for respiration is reduced to a minimum, the breathing is often enormously quickened, and, notwithstanding great rapidity of the pulse, the pulse-respiration ratio may be 2:1.

In pleurisy and bronchitis the ratio is usually less disturbed than in pneumonia. Sometimes, while the pulse is quickened the respirations are slowed. This is observed in a very marked degree in opium-poisoning, in which the respirations get gradually slower, while the rapidity of the pulse is above normal. In some cases of delirium tremens the same phenomenon is observed. In hydrophobia also, towards the end of the case, the respirations may become very slow and very unequal in rhythm, while the pulse remains rapid.

Speaking of the importance of the pulse-respiration ratio, Graves says: 'A quickening of the breathing in fever, without any particular lesion of the thoracic viscera, is always a proof that the muscular powers of organic life have been injured; that the diaphragm and respiratory muscles are impeded in their functions, and that the case is of a dangerous character.'

The pulse affords valuable *indications for treatment*, especially in acute conditions, whether medical or surgical, in which the administration of stimulants is necessary to enable a patient to tide over a crisis. To use stimulants with intelligence is of the greatest importance, and the surgeon must always bear in mind the difference between stimulants and food, a difference of the same kind as that which exists between the spur and a feed of corn in relation to a horse. The analogy is only partly correct, however, for there can be no doubt that alcohol may serve as a food, and especially would this seem to be the case in fevers with high temperature.

If the pulse tells us that the muscles of the heart or arteries are failing, if want of force is being compensated by undue rapidity, if the pulse be soft, compressible, or especially if it be dicrotous, then stimulants

are advisable, and, judiciously given, will enable a patient to recover from a condition which might otherwise be fatal.

Alcoholic stimulants act quickly, and the surgeon should always ascertain, within a quarter of an hour or so after their administration, if the indications for which the stimulants are given have diminished. If stimulants are being useful to a patient, this should always be the case. The rapid pulse should be slower, the soft pulse harder, and the dicrotous pulse less dicrotous. Or, if stimulants be administered to quicken the action of a slowly acting heart, the end ought to be fulfilled and the pulse ought to be more rapid within a short time of administering the stimulants.

It is a golden rule never to give a drachm of alcohol which is not necessary, but to keep it in reserve in case of need. Stimulants, in acute conditions, should be given in small doses and at frequent intervals. Directly the indications for which the alcohol has been administered have been met, it should be discontinued, or the dose lessened. It is especially in acute cases of high fever, in which it is impossible to give food, that alcohol is of use. In cases of failing heart from hæmorrhage, alcohol is generally contra-indicated, and liquid food, which is easily digested, is likely to be of more service to the patient.

G. Vivian Poore.

PURPURA.—*Definition.*—Purpura is, in the modern acceptation of the term, synonymous with non-traumatic hæmorrhage into the skin and mucous membranes, and occurs in both sexes and at all ages.

Etiology.—The causes of cutaneous hæmorrhages are very numerous, and may be classified under five heads:—

1. Blood-alterations caused by—(*a*) specific fevers, especially typhus, variola hæmorrhagica and epidemic cerebro-spinal meningitis; less often by typhoid, measles, scarlatina, acute septicæmia, pyæmia, and syphilis; (*b*) snake-poison; (*c*) some drugs, where there is an individual idiosyncrasy, as iodine, iodide and bromide of potassium, quinine, salicylic acid, copaiba, belladonna, ergot of rye, chloral, &c.; (*d*) certain general diseases, as scurvy, hæmophilia, leucocythæmia, pernicious and other anæmias, rickets (scurvy rickets); (*e*) cachexiæ, as in tuberculosis and cancer.

2. Many diseases of the viscera, including some of those of the spleen, liver (especially cirrhosis and chronic jaundice), intestines, kidney (especially chronic Bright's disease), lung and cardio-vascular system, acting probably and mainly through the sympathetic.

3. Want of support to the vessels, due to—(*a*) Relaxation of the tissues, as in old age (P. senilis), getting up after long illnesses, parturition, &c.; or (*b*) the existence of other eruptions, especially bullæ or wheals.

4. Sudden changes in the circulation, as in purpura in the new-born (P. neonatorum).

5. Diseases of the nervous system—(*a*) Functional, in connection with shock, grief, epilepsy, angina pectoris, and other neuralgias; (*b*) organic, as in tubercular meningitis, plugging of cerebral sinuses and some other serious lesions, also in posterior myelitis, injuries to nerves, &c.

Pathology.—Blood may escape from the vessels by rupture, diapedesis, or by transudation of blood colouring matter only; the last two play an unimportant part, and there is no doubt that, in the majority of cases, rupture of the vessel takes place. This may occur from—increase of blood-pressure behind the point of rupture, especially if suddenly produced, and the commonest cause of this is some obstruction in the vessel, which may be due to stasis from inflammation or some external pressure, thrombosis or embolism. Extreme contraction of the vessels on the one hand, or dilatation on the other, may also lead to rupture of the vessel. In another class of cases the rupture may be due to changes in the vascular walls, from inflammation or degeneration. A third class are due to changes in the nervous system, which may produce variations in the calibre of the vessels or alterations in the nutrition of their walls.

Blood may be extravasated into the tissues either between the layers of the epidermis or into the papillæ and corium; or more rarely into the sweat-glands, hair-follicles, and subcutaneous tissues. The changes that take place in the absorption of blood-clots are as follows:—The serum is first absorbed with the broken-down corpuscles, later the fibrin shrinks, liquefies, and is also absorbed. The variety of colours seen during life is mainly due to hæmatin changes. The hæmatin escapes from the corpuscles and stains the fibrin and serum; after they are absorbed it remains as yellow or reddish-brown granules, either scattered or aggregated. In some cases the hæmatin remains in the corpuscles, and then these shrink into a granular mass, and the hæmatoidin finally separates into yellowish or

ruby red rhombic columns or tables. Small hæmorrhages leave no trace behind, but the larger or deeper ones leave a more or less permanent pigmentation due to hæmatoidin.

When hæmorrhages take place into mucous membranes, erosion of the membrane frequently results, and hence it is common to find ulcers of this kind, often of a considerable size, in the stomach, intestines, &c.

Symptoms.—The most common are petechiæ or spots beneath the epidermis, from an eighth to half an inch in size, of a bright red to a claret or deep purple colour at first, but changing, as absorption takes place, into the bluish, greenish, yellowish, and brownish tints of a fading bruise; round or irregular in shape, sharply defined, but with finely ragged edges. They are seldom raised, are unaltered by pressure, come anywhere, but mostly in dependent positions, are never transitory, never increase in size except by fresh hæmorrhages, and remain visible after death; they are unattended by itching or any other alteration of sensation.

Besides the numerous cases in which the cause is known, there is a large remanet occurring in apparently healthy individuals, presenting some varieties which necessitate a separate description; but it must always be borne in mind that the differences between them are mainly in degree, or in the accompanying symptoms.

Varieties.—These are three in number.

1. Purpura simplex. This may be considered as the type of the affections to which the name of purpura was formerly restricted. In this form, apparently spontaneous hæmorrhages make their appearance suddenly, often in the night, and generally without previous symptoms. In adults the hæmorrhages come first, most frequently upon the lower extremities, especially the flexor aspect of the thighs and calves, and in children upon the neck and upper part of the arms, but almost any part may be attacked. The lesions are mostly petechial, of any size, roundish or oval, but may be irregular. They come in crops, are usually symmetrical but occasionally unilateral, and give rise to no inconvenience. Fresh crops of petechiæ continue to appear for a period varying from a few days to a few weeks.

Sometimes the outbreak of hæmorrhages is preceded by lassitude, aching in the limbs, especially the calves, anorexia, and general malaise, but these symptoms are more common, though not invariably present in 2. Purpura hæmorrhagica, which may be regarded as an exaggerated P. simplex, and is often preceded, in addition to the above symptoms, by headache, great debility, and even convulsions. The lesions present every variety of aspect; beginning upon the legs and lower part of the trunk, they rapidly involve by successive crops the whole of the body-surface. Sooner or later the hæmorrhages take place internally, especially from the mucous membranes, into the parenchyma of organs and various serous cavities, and epistaxis, hæmoptysis, hæmetemesis, or hæmaturia may ensue so profusely as to rapidly undermine the strength of the patient and lead to speedy death by exhaustion; or the fatal event may be produced by the position of the hæmorrhage—e.g. the meninges or brain-substance. Or, again, the bleeding may be more moderate and continue for a few weeks, or may cease altogether in about a fortnight, either abruptly or gradually, the general health being affected in proportion to the amount of the hæmorrhages.

3. Peliosis, or purpura rheumatica, is generally described as a variety of purpura; there can be, however, little doubt that it is an exudative erythema, with superadded cutaneous hæmorrhages, which in rare instances have amounted to P. hæmorrhagica. The affection is uncommon; in it the patient complains of malaise, lassitude, and pains of moderate intensity in the limbs, especially the joints, which are often slightly swollen and tender; after lasting a few hours up to a day or two, during the evening or night an eruption appears, and the pains then often abate, but sometimes the eruption precedes the pain. The eruption is generally most abundant in the neighbourhood of the joints in which the pain has been greatest, and upon the calves; the knees and ankles are always, the elbows and wrists frequently, and the trunk rarely, involved. The eruption is petechial upon the calves and may be so round the joints, but more frequently the lesions there consist of slightly raised papules or patches, bright red at first, like an erythema papulatum, but unaltered by pressure and soon becoming purplish. The temperature may be raised three or four degrees, but this elevation has no apparent relation to a fresh attack, the joint-affection, or the eruption; and the temperature is often normal when all the other phenomena are as severe as in those in which there is marked fever; the pains subside in a few days, but the hæmorrhages take the usual time for absorption. Even without the recognisable presence of rheumatic fever, valvular heart-disease has

occasionally ensued. Albuminuria and hæmaturia have been seen, but in rare instances.

Diagnosis.—Purpura simplex has to be distinguished sometimes from erythema papulatum and flea-bites. The fact that the purpura spot is unaltered by pressure distinguishes it at once from erythema, which it only resembles when the petechiæ are of a brighter colour than usual. The later stage of flea-bites is exactly like the petechiæ of disease, but they do not come suddenly in crops, have a ring of congestion round them at the commencement, and a central punctum is discernible for the first few days. P. hæmorrhagica has only to be distinguished from certain other symptomatic hæmorrhages. Scurvy most closely resembles it, but this disease is invariably due to the deficiency of vegetables in the dietary, while P. hæmorrhagica has no relation to diet; moreover, the distinctive premonitory symptoms—great prostration, frequent faintings, and later, swelling of the gums, loose teeth, and the characteristic brawny swelling of the limbs—always accompany a well-marked case of scurvy.

The history of hæmophilia, and the general symptoms of leukæmia and pernicious anæmia, will always distinguish these diseases from P. hæmorrhagica.

The diagnosis of P. rheumatica is easy; joint-pains, and purpura without symptoms of other disease, are generally sufficient to establish it. The rare cases of embolic purpura, due to ulcerative endocarditis in the course of rheumatic fever, would be distinguished by the high temperature and serious general condition.

Prognosis.—The majority of cases terminate favourably, but the duration is very variable; and as we have nothing to guide us as to the course the case will pursue, even the simplest cases sometimes passing without assignable cause into severe forms, it is well to be guarded in prophesying the termination. In purpura rheumatica the patients nearly all get well, but often take a long time, and the disease is very liable to recur.

Treatment.—Cases of moderate severity often require no treatment, or only that appropriate to the general condition, in which the purpura is intercurrent; but rest in the horizontal position is one of the most important precautions, and should be rigorously insisted upon in all cases except the slightest. In purpura hæmorrhagica, every effort should be made to support the strength from the first by nourishment in an easily assimilable form; but diet has no influence upon the hæmorrhage, except when it is dependent upon general disease like scurvy. When the hæmorrhage is sufficiently severe to be treated, or is the only symptom present, the drugs upon which most reliance can be placed are the liquid extract of ergot and ergotin injected subcutaneously. Turpentine internally and by inhalation, ice internally and externally, are often useful, and local astringents may sometimes be tried in severe cases: in one apparently desperate case, faradisation of the whole surface seemed effectual. Perchloride of iron, quinine, and general astringents have their advocates, but, from what is already known of the pathology of purpura, it is not surprising that in some cases all remedies should fail.

Purpura that is intercurrent in general conditions rarely requires separate treatment, except in diseases like scurvy and hæmophilia, where it is very profuse. The treatment of peliosis rheumatica is scarcely more satisfactory; rest is essential, and a liberal dietary should be prescribed. Salicylate of soda often gives relief to the pains, though it does not seem to exercise much influence over the general course of the disease; quinine and iron separately or in combination are beneficial in some cases, but many run their course uninfluenced by treatment. People who have had one attack should take the same precautions as those who have had rheumatic fever, and carefully guard against exposure to rapid alterations of temperature.

H. Radcliffe Crocker.

PURPURA URTICANS. *See* Urticaria.

PUS. *See* Suppuration.

PUSTULAR OPHTHALMIA. *See* Conjunctiva, Diseases of the.

PUSTULE, MALIGNANT. *See* Malignant Pustule.

PYÆMIA is the name given to a group of morbid processes, which are characterised generally either by peculiar local and constitutional symptoms, or by the presence in the blood of a specific infective organism. Two fairly well-marked forms may thus be distinguished; one, in which the prominent symptom is fever, caused by the entrance into the blood of an organism having the power of multiplying itself indefinitely, accompanied or not by local lesions such as venous thrombosis, embolic abscesses in the viscera, acute suppurations of the serous or synovial spaces, multiple abscesses in the

connective tissues, and eruptions on the skin; the other, in which local troubles of the same nature are present, but in which the constitutional symptoms do not attain such prominence, and the infection by a specific pathogenic organism is uncertain.

In spite of the views held by Koch, Davaine, and others, as to the relationship between pyæmia and septicæmia, it does not seem advisable to regard the presence of metastatic abscesses as the criterion by which to distinguish one from the other. They are not of necessity present in all cases of pyæmia; the infective process may prove fatal before there is time for them to develop; and some, at least, may be present under other conditions without there ever having been true infection at all.

Burdon Sanderson, in his lectures on the 'Infective Processes of Disease' (*Brit. Med. Journ.*, Dec. 29, 1877), says: 'What I mean by septicæmia is a constitutional disorder of limited duration, produced by the entrance into the blood-stream of a certain quantity of septic material. It must, therefore, be regarded, not so much as a disease, but as a complication, differing from pyæmia, not only in the fact that it has no necessary connection with any local process either primary or secondary, but also in the important particular that it has no development. Pyæmia is a malignant process which goes on and on to its fatal end; but in the case of septicæmia, inasmuch as the poison which produces it has no tendency to multiply in the organism, there is no reason why the morbid process should not come to an end of itself, unless either the original dose is fatal or a second infection takes place from the same or another source.' The one is septic intoxication due to the absorption of chemical products of decomposition, exceptionally attended by local mischief; the other embraces a group of diseases, of which one at least is due to the multiplication in the system of a pathogenic organism, and in all of which metastatic inflammations so frequently occur that their presence is held to stamp the disorder as pyæmic, even when no evidence of a germ can be found. From the evidence collected by the committee of the Pathological Society it seems probable that among the cases returned as pyæmic were some (1) in which the constitutional symptoms were so severe as to prove fatal before any local manifestations could have made their appearance; others (2) in which these were present as complications often causing death from their affecting vital organs; and (3) a third class, in which local thrombosis gave rise to local abscesses (often confined to the lungs) and death, without evidence of any pre-existing systemic infection.

There may be distinguished in the majority of cases of pyæmia two series of morbid processes: first, the general constitutional disturbance due to the systemic poisoning; and, secondly, local metastatic inflammations consequent on this, but sometimes present independently. The former of these, it is admitted, is caused by the circulation of some animal poison in the blood; but beyond this fact nothing is certainly known. Pyæmia derived its name 'purulent infection,' from the idea that the material introduced was pus, which was carried round by the blood and deposited in the various parts affected. It was pointed out, in proof of this, that the disorder was commonest after injuries involving structures full of venous channels, particularly if the veins when cut were in any way prevented from collapsing; that it very rarely occurred in wounds which healed by the first intention; and that it was especially frequent when the pus spread from the seat of injury along the planes of cellular tissue, surrounding and bathing the exterior of veins whose swollen and thickened walls enclosed a broken-down semi-fluid clot. It was this pus-like fluid, supposed to be the secretion of the inflamed *intima*, and in general prevented from entering the circulation by the protecting coagulum, that sometimes was carried off to form metastatic deposits.

Further observation, however, soon made it clear that the metastases were not merely deposits of pus in the viscera, but true inflammatory foci, abscesses set up by some irritant conveyed to them by the blood; and, further, that this irritant could not be healthy pus, for, when this was injected into the blood-stream, it only set up a slight and transient pyrexia, and if it blocked the blood-vessels anywhere, caused, not an abscess, but a purely passive mechanical infarction. If, however, the pus had been allowed to remain exposed to the air and become putrid, the most violent reaction followed, all the symptoms, local and constitutional, of pyæmia setting in with extreme severity. Evidently some change had been produced during the process of decomposition (by which was understood ordinary putrefaction, attended by the presence of minute organisms), and it was at once concluded that pyæmia was due to the entrance into the circulation of these septic germs. The unorganised poison that

could be extracted from putrefying pus caused septic intoxication, in which the severity of the symptoms, other things being equal, was directly proportionate to the quantity injected, and there was no reproduction of the poison in the animal's body, so that a drop of its blood taken immediately after death contained only a minute proportion of the original amount, and caused scarcely any disturbance. If, on the other hand, the organisms found their way in too, though the general symptoms might be the same, they did not set in at once, and the poison while in the blood increased in quantity, and perhaps in virulence, to such an extent that the most minute trace was sufficient to cause the most unlimited effect. It was a living poison, associated with the presence of living organisms, and from the analogy of such diseases as that caused by the bacillus of anthrax, they must be the cause of the symptoms; like living organic ferments, which, while growing, can evolve at the expense of the material they absorb some substance capable of producing rapid and extensive chemical changes. This was septic infection.

Putrefaction (σῆψις), in the ordinary acceptation of the term decomposition with the evolution of stinking and offensive gases, is not, however, absolutely essential. Though they must be very closely allied, and usually do occur together, the organism that is the cause of pyæmia cannot be the ordinary bacterium termo, or the equally common form of bacillus. In certain cases putrefaction is not present at all; the exceedingly virulent poison in the bodies of those who have died of puerperal peritonitis diminishes in activity as decomposition advances; and Dowdeswell (*Proc. Roy. Soc.*) has shown, by experimenting on animals after the fashion of Davaine, that the action of putrid bullock's blood, so far as its specific infectivity is concerned, is always uncertain. In summer, kept from five to ten days, it was usually most active; after a longer time its power diminished; and in winter (and this was not due to the temperature at which it was kept) it never became infective at all, the experiments failing uniformly. Whenever it was active, and then only, an organism was present, peculiar in its microscopic appearance and in its dimensions, so that this form at least of so-called septicæmia must be regarded as the result of infection by a specific germ. This germ may or may not be the cause of pyæmia in man; very likely there are many possessing this property, different species or different forms of the same, and it may be that at some future time we shall be able to isolate them, and distinguish them from each other as easily as we now can the bacillus of anthrax. All that may be inferred at present is, that in decomposing animal matter there are sometimes present organisms, closely allied to the common forms but not identical with them, capable of acting as the most powerful infective poisons.

It is easy to conjecture from this how surely pyæmia follows on the neglect of any of the ordinary hygienic principles: impure air, defective drainage, unhealthy occupations, overcrowding (particularly if there are at the same time many open suppurating wounds), careless dressings, the use of ward sponges. Everything, in fact, that tends to the accumulation or decomposition of organic matter directly conduces to it. For the same reason it attacks some persons more readily than others, those especially being liable in whom, either from privation or disease of important excretory organs, it may be imagined that the blood is loaded with effete nitrogenous material; and in this way may be explained the well-known predisposing action of the puerperal state, intemperance, fatigue, loss of sleep, mental anxiety, and acute fevers. Children, in spite of the large relative amount of waste material, owing to the activity of their excretory organs, absence of mental disturbance, and ready power of repair, are more exempt than adults, except—and this is very significant—from that form which follows acute suppurative periostitis.

It is even probable, as showing the influence of these predisposing causes, that the tissues of the human body, so long as they are healthy, possess the power of resisting the action of these germs, perhaps even of destroying them. Burdon Sanderson has shown, with regard to the bacteria producing the poison of septic intoxication, that even if they do enter they have no effect on a healthy organism; and this principle may have a much wider range of application, serving, for example, to explain the susceptibility to scarlatina of patients suffering from traumatic fever.

Pyæmia most frequently attacks large foul and sloughing wounds, particularly if there are imperfectly drained cavities, the contents of which are under high tension. The poison germ gains access to the system all the more easily if the protecting barrier of granulations is often disturbed, or if there are large open venous channels such as those of bone, the walls of which cannot collapse; but it may enter through

the smallest puncture, and, under certain conditions, even this is not required. There are at least two disorders, acute suppurative periostitis and ulcerative endocarditis, in which pyæmia, with organisms present in the blood and numerous secondary deposits, frequently develops and proves fatal within a few days, without there ever having been at any time the smallest breach of surface. How the poison enters is not known; it may be through the respiratory or the alimentary tract. But in the light of Burdon Sanderson's observation, it is difficult to avoid the conclusion that somehow or other it does find its way in, and that either the tissues while in a state of health possess the power of preventing its action, or else that it can only develop its energy under certain conditions, of which the effusion of lymph in connection with bone, and the presence of vegetations on the cardiac valves, may be especially favourable. Just as some patients are able to outlive the exceedingly infective germ of malignant pustule, so, unless there is present some condition favourable to its growth, they may be able to live down the scarcely less virulent one of pyæmia; or the germ may not be able to grow unless the soil is ready for it.

The morbid appearances due to the direct action of the poison differ only in degree from those present in septicæmia, the changes being less marked owing to the comparatively slow development of the poison. All the viscera are congested and œdematous, with here and there small extravasations, especially under their serous coverings; the cut surface is not clearly defined, its structure appearing blurred and confused; the interior of the vessels is deeply stained by the hæmoglobin from the broken-down and disintegrated blood corpuscles, and often there are long, partly decolorised heart-clots. But, except for the presence of microscopic organisms in the blood and tissues, there is nothing special in any of these changes—they are common to all cases of blood-poisoning from whatever source.

Nor does the wound, when there is one, present any characteristic appearance; it may, indeed, show no sign of anything wrong, may seem to be healing in a thoroughly satisfactory manner without a trace of suppuration. But more often suppuration sets in, preceding any evidence of systemic poisoning spreading along cellular tissue and tendon-sheaths, and foul and offensive sloughs make their appearance far away from the seat of injury, with diffuse patches of redness on the skin, or long red lines leading up to swollen and tender lymphatic glands; while, if the bone is exposed, the periosteum can be seen drawing away from it, and the coats of the vessels, especially the veins, are thickened and sodden, with coagula, sometimes of great extent, in their interior. These clots, which by breaking up and being carried off into the circulation give rise to some of the most characteristic metastatic deposits of pyæmia, if of recent formation, are simply loose, dark-coloured masses extending, probably, as high as the opening of the next large branch; but gradually, as they become older, the outer layers become firmer and adherent to the walls of the vessels, while the interior slowly breaks down into a puriform fluid, the result of slow caseous degeneration and disintegration. Only exceptionally, when there is some intense irritant retained in the cavity of the vessels, do the leucocytes collect in sufficient number to form a fluid that may really be compared with pus.

When these clots break down, the débris are carried off by the blood-stream until, meeting with arteries too small to allow them to pass, they become impacted. The immediate effect of this differs according to the arrangement of the blood-vessels. If the branch is a terminal one—that is, its area of distribution having no other arterial supply—local anæmia at once sets in, and passes on either to rapid necrosis with suppuration, or else to slow degenerative changes. If, on the other hand, an influx of arterial blood can take place from collateral sources, one of two things will result—either the circulation will be restored and nothing else happen than thrombosis of the small arterial trunk as far back as its last big branch; or else, the supply not being sufficient for this, and only brought by minute arterioles, the blood from all sides will pour into this small territory without strength of current enough to force its way. From this will follow great congestion, and then, owing to the impaired nutrition of the walls of the vessels, diapedesis, until the whole area becomes a firm, solid mass, dark-red in colour and granular in section—a hæmorrhagic infarction. In pyæmia the source of the embolus is infective, so that suppurative inflammation, sometimes even gangrene, at once sets in, whether there has been infarction or not. Only the appearance differs; in the one case, the surrounding purple zone of congestion being much better marked and the suppuration incomplete, consisting rather in the rapid breaking down

of the tissues than in the formation of a large number of pus-cells. Both varieties are met with in the lungs, but previous infarction never takes place in the liver or the subcutaneous tissues.

As a general rule, when the systemic veins are involved, the metastatic deposits are met with in the lungs, and similarly in the liver when the source of the disease is in the range of the portal circulation. But it rarely happens that the abscesses are confined to these viscera, and not seldom it would seem as if the embolus had traversed the first set of capillaries in the order of the circulation without causing any disturbance, and had then set up secondary inflammations in other organs beyond; and it is no real explanation of this, that Weber has found that purulent fluid can be injected into the veins so fine that it will pass through the lungs and be arrested in the systemic circulation, for the distribution of the abscesses in these viscera is not such as can be explained on merely mechanical grounds. Moreover, there are other circumstances that lead one inevitably to the conclusion that thrombosis, and its consequent embolism, can be only one of the agencies which give rise to metastatic deposits in pyæmia. The secondary affections may be rigidly confined to the same class of tissues as that first attacked; the bones alone may suffer, as in some cases of multiple suppurative periostitis, where, following acute necrosis of the shaft of one bone, others become involved later on and with less severity; or the subcutaneous tissues, or the joints, as in chronic pyæmia, and that which follows scarlatina and other acute specific fevers. It may be that, like rheumatism and syphilis, pyæmia has a certain predilection for certain tissues, or that homologous structures are so intimately associated together by their nutritive changes that it is impossible for one to be affected without the others suffering; but it is quite certain that many of the morbid appearances, in the bodies of those who have died of pyæmia, cannot be explained either on the hypothesis of general systemic infection or of impacted emboli.

Thrombosis, with its attendant embolism, originating at a distance from the seat of injury, will account for some of the morbid conditions. Owing to the alteration in the character of the blood and the serious impairment in nutrition of the walls of the vessels and the surrounding tissue-elements, coagulation readily takes place in some of the smaller capillaries, and spreads backwards and forwards for long distances, especially in those parts of the body in which extensive hypostatic congestion is found *post mortem*. Slight injuries, perhaps never noticed, will account for many more; the vitality of the tissues being lowered to such a degree that a touch, which would not suffice in the healthy body to cause an abrasion, or a puncture with a hypodermic needle, will often cause an abscess. Even a little over-use of a part will set up extensive suppuration; and perhaps this is the reason why the sterno-clavicular articulation, the knee-joint, and the tendon-sheaths around the ankle, are so often involved. So with tissues that have been injured long before and seemingly have recovered completely: fresh mischief lights up again in them as in the residual abscesses round an old diseased joint, or pneumonia in a lung that has once been inflamed. But even when full allowance has been made for all of these, there yet remain many for which no explanation is as yet forthcoming.

Space is too limited to admit of a detailed account of the various lesions found in pyæmia. The reddened patches on the skin, often fugitive during life, of course disappear after death, only a livid staining, with, exceptionally, pustules and superficial abscesses, being left. In the subcutaneous tissue, and extending thence between the muscles, dissecting them from each other, may be extensive collections of pus without limiting walls, and here and there, especially if there has been bruising or undue pressure, extravasations of blood just breaking down, evidently the result of widespread capillary thrombosis. Pleura, pericardium, and peritoneum may all be full of intensely infective fluid, sometimes consequent on embolic abscesses in the walls of neighbouring viscera, sometimes of independent origin. Every organ in the body, but especially the liver, lungs, spleen, and kidneys, may be intensely congested and riddled with abscesses of all sizes, some the result of embolism, and these conical in shape, with their bases towards the surface and perhaps in the centre of an infarction, sometimes more diffuse and irregular in shape and size. Even the brain and the eye do not always escape. Nowhere around these abscesses is there any evidence of repair—there is nothing but destruction, most advanced in the centre and spreading rapidly all round. The great congestion of the alimentary canal, so common in the pyæmia of animals, is not often met with in man. Frequently, the joints or the tendon-sheaths are distended with thin oily pus, greenish from the pressure of broken-down

blood; sometimes only one is affected, more often several, even when it has not been suspected during life. When very recent, the synovial sac and the cartilages show no great change, but soon they become eroded and detached from the bone underneath, while the pus bursts through the softened and yielding capsule, leaving the joint utterly disorganised. Occasionally, in those forms of pyæmia following gonorrhœa, scarlatina, and the puerperal state, the joint is less acutely affected, and if the patient survive, recovers a surprising amount of its usefulness.

Symptoms.—Pyæmia may set in with a sudden and severe rigor, or its commencement may be insidious, with nothing to mark it but an indefinable sense of anxiety and uneasiness on the part of the patient. The wound may show no change, but this, it must be acknowledged, is the exception; more often the stump or the limb, as the case may be, becomes swollen, red, and exceedingly tender, while the surface of the wound is dry, the discharge thin and offensive, and the granulations ashy-grey. Rigors are rarely absent altogether; there may be only one, and then it is usually of extreme severity, or they may occur throughout at intervals of such regularity as to simulate an attack of intermittent fever; sometimes two or three will occur within a few hours, and then there will be a cessation for days. There is no relation between them and the occurrence of metastatic deposits; often the patient is conscious of when they are coming on; the temperature rises rapidly to 106°, or even higher; the skin on the body becomes hot and pungent, while the extremities are livid and cold; there is an expression on the face of the most intense distress, and the sensation of cold is so extreme that the teeth chatter. Then, after an interval of from a few minutes to half an hour, the temperature begins to fall, the blood makes its way to the surface again, and profuse sweating sets in with a feeling of great exhaustion. Even when rigors are not present, the diagnosis of pyæmia can be made from the great irregularity of the temperature, especially if at the same time there are occasional and profuse sweats.

The aspect of the patient soon changes for the worse; at first he may not feel particularly ill, but soon there is visible on his face an expression of peculiar anxiety and apprehension; emaciation is rapid and extreme, particularly when there is much sweating, the features becoming shrunk and withered, and the complexion assuming a sallow, often icteric tint, and this independently of any secondary mischief in the liver. The eyes are sunken and surrounded by dusky rings; one cheek may have a bright flush on it, particularly if there is any pneumonia; herpetic vesicles, breaking and leaving painful sores, appear on and round the lips, after the rigors; the tongue becomes dry and brown, the teeth and gums covered with sordes, and the breath, and sometimes the patient's whole body, exhales a peculiar sickening, mawkish odour. The pulse is small, irritable, and too frequent; the respiration hurried and shallow; there may be cough, with rusty expectoration, but this is often absent, even when there is extensive pneumonia; more frequently there is great dyspnœa from intrathoracic effusion; vomiting is not usual, except just at the first, nor is there, as a rule, the profuse diarrhœa met with in the case of animals. The poisoned condition of the blood very early shows its effect on the nervous system; wandering delirium, from which the patient can be roused at first, sets in very soon, and becomes continuous; the skin becomes exceedingly sensitive, the slightest touch giving rise to the most excruciating agony, especially over those places where a slight amount of swelling or induration points to the commencement of some deep-seated inflammation; a typhoid state rapidly follows, and ends in unconsciousness and death. Reddened patches make their appearance here and there on the skin, and change their position from day to day; sloughs and bedsores form with the most extraordinary rapidity, extensive areas of skin becoming gangrenous in twenty-four hours. Swellings make their appearance over joints or muscles; at first white and doughy, they rapidly become soft and livid, until either the skin breaks or they are opened; it seems as if whole sheets of connective tissue melted away into pus. If the joint is left unopened, the capsule gives way, and the abscess may first point a long way off.

If the patient should, happily, survive the first infection, and the secondary complications be limited to the extremities, recovery may take place after a long and exhausting illness, with the limbs more or less crippled. When the viscera are involved, the prognosis is even more serious. Death may take place as early as the fourth day, before rigors or secondary deposits have had time to make their appearance; more commonly the patient dies with some visceral complication about the second week, or from exhaustion from prolonged fever and

suppuration later on. In some exceptional cases the disease is even more protracted, rigors, with sweating and other characteristic phenomena, making their appearance after long intervals of comparative good health. Under these conditions, as Paget has pointed out, there is, in general, less severe disturbance of health and less risk to life, especially in the later stages; moreover, the secondary affections are generally limited to one single structure, such as the subcutaneous tissue of the limbs.

Pyæmia most frequently sets in about the second week after operation or injury; but it may commence at any period, and, as has been mentioned already, may occur without there ever having been an injury at all, the germ entering the system in some other way, and finding an appropriate nidus for its development.

There is rarely any difficulty about the *diagnosis* of pyæmia; in its acute forms the constitutional disturbance is so severe, and the onset of typhoid symptoms so rapid, that there can be no question as to the existence of intense blood-poisoning. It is harder in the case of the joint-affections which occur as complications following gonorrhœa, scarlatina, and some other diseases. That they are due to blood-poisoning in the wider sense of the term there is no question, but it is not easy to say, at present, whether they would come within the stricter definition of pyæmia. Acute periostitis, affecting the lower end of the femur and causing effusion into the knee-joint, is not infrequently mistaken for rheumatic fever until pyæmic symptoms definitely make their appearance; and acute ulcerative endocarditis occasionally presents a somewhat similar difficulty.

From the foregoing it is evident that the *treatment* of pyæmia must be mainly preventive; when it has once set in, we have but slight influence over its course, though, if the patient survive, much may be done by surgery in the treatment of the local affections. It is so much more prevalent in some years than others, independently of any cause known at present, and is so liable to occur as a complication of diseases of the urinary tract and other parts in which it is almost impossible to prevent decomposition taking place, that it is more than doubtful whether it can ever be stamped out; but a great deal may be done to prevent its occurrence. Pure air, especially absence of overcrowding; rigid cleanliness on the part of everyone concerned; avoidance of anything like tension in a wound, by means of drainage or suitable incisions (probably early incision is the only way to prevent pyæmia in acute periostitis); perfect rest, so that the granulations of a wound are bruised as little as possible; and careful attention to the activity of the chief excreting organs (which are often seriously interfered with when a patient is suddenly confined to bed) are absolutely essential.

When it has once set in, there is little that can be done; if it occur after amputation, consequent on acute osteomyelitis of the stump, disarticulation has been recommended, and might succeed if it could be done sufficiently early, but much more often the osteomyelitis is itself pyæmic. Division of a vein on the cardiac side has also been advised, and may be successful when the mischief is clearly originating there, but such conditions must be altogether exceptional. Quinine in large doses often has a distinct effect on the temperature, and on the severity of the rigors; but the great indication is to husband the patient's strength in every conceivable way, in the hope that he may be able to live down the activity of the germ, and may avoid visceral complications. Local abscesses should be opened early; no good can arise from leaving them, and often when they are opened they are found to be already much more extensive than they appeared to be. Joints that are affected should be treated in the same way, especially if the skin over them shows a fugitive erythema: in the case of the knee in particular, if a free incision is made on either side sufficiently early under antiseptic precautions and drainage-tubes are inserted, the patient will often regain almost perfect movement, especially in the form of pyæmia following parturition. The same treatment has been adopted in the case of the pericardium, but as the inflammation is nearly always consequent on an embolic abscess in the walls of the heart, a favourable result is much less to be expected.

C. Mansell Moullin.

PYELITIS, or inflammation of the pelvis of the kidney, is not common as a primary disease, but is very often met with as secondary to other renal affections. Amongst its exciting causes may be mentioned the use of turpentine, cantharides, or other stimulating diuretics, the presence of calculi or gravel; again, it is not infrequent in the acute specific fevers, such as scarlatina, measles, &c., and is also due in some cases to tubercle deposited on the surface of the pelvis; finally, it may be produced by cold and chill, or may be due to extension of inflammation upwards from the bladder, such as is met with in gonor-

rhœa. It is met with in both the acute and chronic forms.

The *symptoms* of pyelitis are often masked by those of the condition on which it depends as a secondary affection; but if we confine our attention to those of the local disease in its simplest forms, we shall find them tolerably distinctive. In the acute forms, there is usually pain of a dull aching character in the renal region of the side affected; this is increased on pressure; sometimes it is paroxysmal when obstruction takes place. There is fever in proportion to the severity of the affection, and the rise of temperature is greatest at night, and often very regular as to the time of its appearance. The disease may commence with a rigor. The condition of the urine, however, gives the most important evidence of all. At first there is great frequency of micturition, and the fluid voided is blood-stained, containing mucus and cells (oval, tailed, angular, or rounded) from the renal pelvis, and actual pus-cells besides. Presently, the pus becomes more abundant and regular in its discharge, unless the ureter becomes blocked; in some cases it is intermittent with tolerable regularity. The urine is acid throughout, unless decomposition extend up to the kidney from the bladder. There is often diarrhœa, except when the bowels are pressed upon by an enlargement of the kidney, which is not uncommon where more or less obstruction of the ureter exists. The most characteristic symptoms of all are the presence of abundance of pus and epithelial débris in the urine, with acidity of the latter; tenderness and pain in the loins, and evening fever with no evidence of disease of bladder, prostate, or urethra.

The *prognosis* of pyelitis, if unilateral and simple, is not unfavourable, but if bilateral the condition must always be considered grave. In simple cases which terminate favourably, the congestion gradually diminishes and the pus with it, the subjective symptoms subsiding at the same time. Too often, however, the inflammation in the pelvis is associated with other graver disease, such as interstitial suppurative nephritis, the course of which determines the result; or pyonephrosis supervenes with all its complications. *See* Pyonephrosis.

The *treatment* of pyelitis is essentially the same as that for Nephritis.

Arthur E. Barker.

PYELONEPHRITIS, or inflammation of the pelvis and substance of the kidney, has been so frequently met with associated with serious surgical conditions of the lower urinary passages, for which operations have been required, as to have been often called 'surgical kidney.' This is an unfortunate misnomer, tending as it does, on the one hand, to suggest that the disease is not met with except as the result of surgical operations, and on the other that, when renal disease supervenes in the course of some condition lower down, it is always necessarily pyelonephritis. Neither of these propositions is true: the disease is often met with independently of surgical operations; and when the latter, or the conditions requiring them, are followed by renal mischief, it is often of a kind quite distinct from pyelonephritis.

If we take a typical case of the affection, its course will be about as follows. Usually, owing to some obstruction to the flow of urine from the bladder, whether it be from stricture, enlarged prostate, villous growth, or other cause, the bladder is kept in a state of chronic distension, and becomes hypertrophied. If the obstruction persist long enough, dilatation of the ureters and pelvis of the kidney is very likely to take place, owing to the pressure of the secretion endeavouring to reach the bladder against the resistance of the hypertrophied organ. And this effort, again, on the part of the kidney is probably a source of some irritation to the parenchyma of the organ, predisposing to, if not actually initiating, inflammatory changes in it. The bladder, further, is predisposed to catarrhal affections by the chronic retention of urine in it. If, now, any acute cystitis is set up, as the result of the introduction of some ferment into the retained fluid (either on a foul instrument or by the spread of decomposition up the traces of urine and mucus remaining in the urethra during the 'overflow' of bad retention, or by other causes), we have almost inevitably a spread of the septic process sooner or later into the dilated ureter and pelvis, and from this into the straight tubes of the gland, already predisposed to inflammation by the prolonged irritation. As a consequence of this, free suppuration and even ulceration is set up in the calyces and pyramids until, in many cases, the latter are almost completely destroyed, and the whole organ is converted into a foul abscess.

The disease is, however, produced in other ways. Thus, the presence of a calculus or calculi may cause ulceration in the calyces, and suppurative inflammation in the substance of the gland. But this cause alone rarely produces the worst forms of the

disease. It may be the result of breaking down of tubercular deposits in the kidney or its pelvis. It may also follow gonorrhœal inflammation of the urethra and bladder without retention; but in this case, too, destructive inflammation is not often met with.

The appearance of a kidney affected with a considerable amount of acute pyelonephritis is remarkable. The organ may or may not be enlarged; it will in recent cases strip readily out of its capsule, except at certain points at which more or less firm adhesion has taken place. At these spots the colour of the cortex will be altered, and may range from purple to ash-grey or the colour of pus. In the latter case, the consistence of the affected spot will be diminished, or it may even be diffluent. In addition to this, the softer areas are usually somewhat bulged outwards, giving to the whole outline of the organ a peculiar irregularity. On section of the kidney from its great curve to the hilus, each bulged discoloured portion will be found to correspond to a suppurating tract, reaching from the apex of a pyramid to the surface. In many cases the affected pyramids are almost completely destroyed, and the whole organ and its pelvis are converted into a foul, grey, sloughing cavity, more or less crusted with phosphatic deposits.

The *symptoms* are usually severe pain in the loins, aggravated by pressure over the kidney through the abdominal wall. Then there is high fever, especially at night, often ushered in and accompanied by rigors; there are also thirst and anorexia. Objectively, we have a hot flushed skin and an expression of much anxiety, and great frequency of micturition. There may be slight fulness in the renal region, to be felt with the hand. The urine passed is not so abundant as usual, and is loaded with pus, but is still acid in ordinary cases, if taken fresh from the kidney. Often, however, during its sojourn in the bladder, it decomposes, and is passed alkaline. If, however, the bladder be washed out, and then a little of the secretion be collected fresh, it is acid, and may possibly be inoffensive to the sense of smell.

The *treatment* of this condition is by no means satisfactory: still, something can be done. In the first place, all sources of irritation in the lower urinary tract must be removed as far as possible. Obstruction should be relieved as completely, but with as little violence to the parts as may be. The bladder should be washed out carefully with an antiseptic fluid, such as a two-grain solution of sulphate of quinine or weak Condy's fluid. The loin or loins may be cupped and fomented, if there be much tenderness and check to the secretion of urine. The diet should be very light, consisting chiefly of milk. Quinine should be prescribed internally, and tr. ferri perchlor. Stimulants must be given in very asthenic cases, but should be used cautiously. Complete rest of body and mind should be secured as far as possible, and the surface of the body be kept warm, and protected against alternations of temperature. In certain cases of tubercular disease, or where renal calculi or gonorrhœa are at the root of the condition, it may be proper to perform nephrotomy if the patient's general health be fairly good.

The *prognosis* in cases of double pyelonephritis is extremely bad. In such cases, we usually find the other conditions lower down so severe as to be themselves very dangerous to life, and the additional disease of the kidneys renders them almost necessarily fatal. When one organ alone is suppurating freely there is a better prospect, provided the other conditions are not too far advanced. One kidney may be thus more or less completely destroyed, and, on the inflammation subsiding, nothing but a small mass of cicatricial tissue be left in its place, the opposite kidney taking over the double task, and hypertrophying accordingly. ARTHUR E. BARKER.

PYLORUS, Operations on the.—In considering this subject it is to be noticed, first, that hitherto these operations have been undertaken chiefly for the removal of neoplasms of the pylorus, usually varieties of carcinoma—i.e. scirrhus, colloid and medullary cancer. They have also been employed in a few cases for other conditions, such as simple ulcer, or stenosis from various causes, or for the establishment of a permanent opening of the duodenum, for the purpose of introducing food in desperate cases of gastric cancer. But, should they be limited to selected cases of malignant disease of the pylorus alone, there is still a large field of usefulness open. Cancer of this part is a comparatively common affection, and as it is a common, so is it a hopeless condition, unless the diseased mass is early removed; and not only so, but the suffering entailed on the patient is most distressing. In the matter of pain there is certainly some variation, little being complained of in certain cases, though in others it is most severe. But, apart from this, there is the distress of

hunger not to be appeased, of distension of the stomach, and, often, of persistent vomiting. At the best we can only look forward to slow, inevitable starvation for our patients, until extreme weakness and perhaps anæmia, due to repeated bleedings from the new growth, put an end to a miserable existence.

It would be foreign to the scope of this article, to enter into the details of diagnosis of disease of the pylorus and the resources of medicine in its palliative treatment. It must be assumed that these points are understood, and that the cases are taken up by the surgeon when the physician admits his powerlessness to do more. This leads us first to the consideration of the operation for removal of the pylorus.

This was first performed on April 9, 1879, by Péan of Paris, whose description of the procedure is too imperfect for the reader to estimate safely the probable cause of its want of success. It was next performed by Rydygier of Culm on clearly defined principles, but the patient succumbed from shock twelve hours after the operation. Billroth followed next with a success in the case of a woman of forty-three, who was alive and well some months after. The next two operations were also performed by Billroth, but both patients died from their effects. Then comes a most successful case by Woelfler, whose patient was alive and well four years afterwards. Since then, the operation has been done many times, with varying results, by several Continental surgeons. In this country but little has been attempted in this direction, the only three cases recorded having proved fatal, and we are obliged to turn to the German surgeons for statistics of the procedure so far. Thus, Billroth and his assistants have removed the pylorus eighteen times with ten deaths, Gussenbauer five times with four deaths, Rydygier five times with two deaths, Czerny four times with two deaths. On the whole, up to August 1885, the pylorus has been resected at least 82 times, according to Kramer. Of these 72 suffered from carcinoma, the rest from stenosis—the result of ulcer of the pylorus. Of the first 72, 55 died, 17 recovered; and among the remaining 10 we find 4 recoveries and 6 deaths. These statistics teach but little, except so far as the results in the hands of individual operators can be compared. They are introduced here as indicating the extent to which this branch of surgery has already developed, and as generally suggestive of the gravity of the procedure.

But though a most formidable operation, both on account of the difficulty of its performance and the high rate of mortality which has hitherto attended it, it has been justified on the following grounds:—First, the inevitably fatal character of the disease for which it is undertaken, and the suffering entailed thereby. Secondly, the disease, if cancerous, remains for a long time localised to the immediate neighbourhood of the pylorus. Thus, out of 542 cases dying of cancer of this part, 223 had no secondary deposits anywhere. Thirdly, it is slow to contract adhesions to adjacent parts. Finally, it has been shown, by post-mortem examination of a large number of cases dying of malignant disease here, that it does not commonly extend to the duodenum or neighbouring glands before it has produced fatal stenosis.

Admitting, then, that for certain patients, and in the hands of skilled surgeons, this operation is justifiable as holding out a sufficiently good prospect of temporary and perhaps permanent relief, we have briefly to consider the selection of cases and the preliminary preparations necessary before operation.

In the first place, the patient's age is a matter of more importance here than elsewhere, in view of the length of the operation and the vital region in which it is performed. The same may be said of the general health. Old and weakly individuals, therefore, should not be subjected to the risk, and, with younger people, their general state should be good to justify the operation; which is as much as to say that, if anything is to be done for them, they should not be allowed to run down to the last stage of weakness before the surgeon is asked to interfere. The subjective and objective symptoms should be distinct, and especially the tumour, which, moreover, should be freely movable in all directions—i.e. without adhesions to surrounding parts. Slight adhesion to the abdominal wall may not, perhaps, quite contra-indicate the operation in cases otherwise favourable, inasmuch as the adherent portion of the parietes may be excised with the growth. Cases, again, in which there is great chronic dilatation of the stomach, appear unsuitable for operation, unless the condition can be overcome by preliminary treatment. A dilated stomach, after such an operation, almost inevitably assumes a position in which its walls act like a valve to the new opening, and prevent all passage of food through it, as in Billroth's second case.

All these points should be closely examined into with the help of careful palpation of the abdomen under chloroform; and in cases in which there may be doubt on one point or another, but which appear generally suited for operation, an exploratory incision through the abdominal wall is quite justifiable, in order to examine the relations and condition of the growth with perfect accuracy. If these things appear on closer inspection to contra-indicate interference, this opening may be closed without further action.

When it is decided in any given case to proceed to excision of the pylorus, certain preliminary measures have been shown by experience to contribute to a favourable result. Among these, the careful washing out of the stomach with tepid water stands first in importance. This is effected by means of an ordinary soft rubber tube passed into the stomach, and attached to a funnel at the other end. Through this about a quart of tepid water is passed into the organ, and then allowed to syphon out again with the funnel held at a lower level. This is repeated over and over again, until the water returns clear. This treatment should be begun several days before operation, and should be done two or three times each day, and finally, about an hour before the operation is begun, the organ should be washed out with a solution of salicylic acid in water (1 in 1,000). It is an extremely unpleasant procedure for the patient at first, but is better tolerated with practice. In view of the gravity of the operation, neither it nor any other detail necessary for the absolute cleanliness of the field of action should be omitted. The bowels should also be carefully unloaded by means of high-reaching enemata, repeated for days beforehand.

As to the operation itself, it is first necessary to remark that the position of a cancerous pylorus may vary greatly. It has been found to the right or left of the umbilicus, and even as low down as Poupart's ligament or the symphysis pubis. The position of the ventral incision will therefore vary accordingly, but it usually lies between the navel and the margin of the ribs, and parallel to the latter on either side. Some operators however prefer the linea alba above the umbilicus. The direction, in the first case, will be modified more or less by the exact situation of the diseased mass, which is the real determining consideration. The incision in the abdominal wall is made layer by layer, until the serous lining is reached, but the latter is not divided until all bleeding is completely arrested. In severing the attachments of the diseased mass, both the greater and lesser omenta are divided, but always to as small an extent laterally as possible. One of the greatest dangers after operation is sloughing, either of the gastric or duodenal margins of the united wound, or of the walls of the colon, due to disturbance of nutrition or innervation as the result of damage to the greater or lesser omenta, and this has to be guarded against by every means possible. Every effort should also be made to spare the pyloric, gastro-duodenal and gastro-epiploica dextra arteries and their branches, consistently with the thorough removal of the growth, and any glands in the neighbourhood which may excite suspicion. In dividing the stomach and duodenum, bold strokes should be made with a very sharp scissors, to ensure even-cut edges suitable for accurate apposition. Various clamps have been suggested, from time to time, to fix the borders of the viscera during the stage of stitching; but if Woelfler's suggestion (see below) be adopted—i.e. to divide each viscus only partially, and unite the portions thus divided before proceeding to complete the excision—nothing of the kind will be required.

Operation.—In an ordinary case, in which the pylorus maintains very nearly its normal position, an oblique incision is made parallel with the right costal margin, and between this and the navel. This incision should be about 11 centimètres long, = 4½ inches, about one-third of it being to the left of the linea alba. If the tumour be to the left of the middle line, a corresponding incision is made parallel with the left costal border. Either of these gives much freer access to the affected region than the incision in the linea alba, practised in several cases. At first the knife is only carried as far as the peritoneal lining, without dividing it, and before the membrane is opened, every bleeding point is controlled until the wound is dry. Then the serous lining is divided, the cavity of the abdomen opened, and a most careful examination of the condition of the pylorus is made. For the present, at all events, it is well to adopt the rule that extension of the growth either to the colon, the pancreas, or the duodenum, contra-indicates completion of the operation; and if such complications exist, further exploration should cease and the abdominal cavity be closed, unless digital dilatation of the pylorus be considered justifiable (*vide infra*).

But where the growth is limited to the immediate neighbourhood of the pylorus and lesser curvature of the stomach, we proceed by drawing it, with a broad many-toothed vulsellum-forceps, as far as possible out of the parietal wound, and commencing its isolation. First, the omentum is separated for a certain limited distance along the greater curvature of the stomach, having been tied in small portions and divided between the ligatures. Then the lesser omentum is similarly severed, but also to as limited an extent as possible. All this time the exposed viscus is covered with thoroughly aseptic napkins, wrung out of warm carbolic or salicylic acid solution. When fully isolated above and below, a napkin or flat sponge is slipped under the diseased portion, and this protects the abdominal cavity from the entrance of blood or fluids from stomach or duodenum, when divided. The removal of the growth and subsequent union of the cut edges is, consequently, practically an extra-peritoneal operation. One of the most difficult problems presented by the whole procedure now offers itself—namely, how to divide the sound tissues on either side of the growth, so that the very much larger lumen of the stomachal opening may be best adapted to the smaller duodenal one, and how best to unite them. This is done in various ways, according to the shape of the growth. The mode now described is that followed by Billroth in his later cases, and embodies slight modifications of the method pursued in his first successful one. These modifications had shown themselves to be of great value first in the hands of Woelfler, from whom they emanated.

In the smaller end of the stomach an incision is first made with one or two bold, steady strokes of a scissors downwards and obliquely from left to right, dividing both sides of the organ at once, but only for about two-thirds of its depth. This incision will lie about three-quarters of an inch from the limits of the growth, and in sound tissue. The stomach is now freely opened above, but is still attached to the pylorus below. The edges of the stomachal wound are now brought carefully together with a double row of stitches, according to Czerny's method. This consists in introducing first one row of fine carbolised silk threads, dipping through the serous and muscular coats of the organ at about a quarter of an inch from either edge of the wound in its walls, and coming out on the cut surfaces without including the mucous coat. When drawn tight, the edges are brought together by their serous surfaces alone. These threads are set at about a tenth or an eighth of an inch apart from one another, and when tied are cut short at once. They are then succeeded by a second row a little farther off from the edge of the wound, each stitch lying opposite an interval between those of the first row, and entering and leaving the serous and muscular coat without including the mucosa. These are not cut short at present, as they serve to hold the stomach steady after its complete division. This is now done with the scissors as before, and the resulting opening ought now to correspond in size with the lumen of the duodenum. The latter is now half cut through from above with the scissors, by one bold stroke passing obliquely from left to right, as in the case of the stomach, and clearing the border of the growth by about three-quarters of an inch.

Steadying the duodenum by the still attached mass held in a vulsellum-forceps, and the stomach by the ends of the 'occlusion sutures' not yet cut short, the operator now stitches the upper divided portion of the duodenum to the upper part of the reduced orifice in the stomach. The stitches here may be introduced as in the case of the stomach, or may be begun on the inner aspect of the bowel for its posterior third, by thrusting the needle between the mucous and muscular coat, then through the latter and the serous, then through the serous and muscular coats of the opposite border, and so out on the edge of the second cut surface again, where the thread is tied. The knot in this case lies within the bowel instead of between the serous surfaces, but the effect is the same as far as the apposition of the latter is concerned. This mode of suturing the ends is only applicable to about the posterior third of the circumference of the bowel. When this has been accurately united to the border of the stomach, the remaining half of the duodenum is severed and the growth is now completely removed. The rest of the stitching is now finished with the Czerny suture, as above described, introduced from the serous aspect. The two cut ends of the bowel are now accurately united on their serous aspect, and should be quite water-tight if sufficient care has been taken to place the stitches at equal distances and to tie them evenly. The partial division of the viscera, just described, may be done either from above or below, according to the shape of the growth, but the former method has been found to give the best

result as to the future shape of the stomach. In either case, the reduction in size of the stomachal opening by stitching (Occlusionsnaht) precedes the further steps of the operation. It is almost needless to remark that, throughout the whole procedure, the field of operation must be constantly cleansed from blood and the visceral secretions with soft carbolised sponges, besides being protected from every chill; all bleeding, too, must be at once arrested with clip-forceps.

The subsequent steps of the procedure are simple. After a final cleansing of the whole field of operation, the united ends of the viscera are carefully replaced in the abdomen, and adjusted so as to favour the directness of the opening of the stomach into the duodenum; then, the abdominal cavity is closed in the usual manner, so as to bring the serous surfaces of the parietes into contact with one another.

The *after-treatment* of the patient is often a matter of much difficulty. A careful study of the articles of diet best borne by the stomach before operation is of the greatest importance. At first some easily digested fluid is given, iced and in very small quantities, while peptonised and alcoholic enemata are administered at regular intervals. Then, by degrees, there is a cautious return to the ordinary articles of diet. Opium may be required, but should not be given unless urgently called for, as it may produce nausea or even vomiting, which would be most injurious. In some of the successful cases it is remarkable how little interruption there was to complete and rapid recovery; in one (Woelfler's), the patient was able to eat meat from the tenth day onwards, and in Billroth's first case, a beef-steak was eaten on the twenty-first day with no ill effect.

Several variations in the method of suturing the bowel might be mentioned here, but the writer has thought it wiser to describe what may be taken as the typical method only, lest any confusion should arise. In addition to the last-mentioned operation of pylorectomy, another has to be mentioned here which will probably take its place in the future, in many cases of disease of this part.

Digital Dilatation of the Pylorus is an operation designed and practised first by Prof. Loreta of Bologna, in September, 1882. Hitherto it has been employed only in cases of non-malignant stenosis, and here it appears to have done good service. The operation consists in cutting down upon the pyloric end of the stomach, with all the preliminary precautions mentioned as necessary for pylorectomy, drawing a portion of the viscus into the parietal wound, and incising it sufficiently to admit the forefinger. The latter is then thrust with a rotatory motion through the narrowed pylorus, dilating as it goes; then, the left forefinger is similarly insinuated along the first, and both are separated until a dilatation of three inches has been effected. The stomach wound now is sutured in the usual way, and then (with due care as to cleansing the parts around) the abdomen is closed.

So far, this operation has been performed six times. Three of the patients recovered and were much benefited, in a fourth the result is doubtful, while two died as the result of the operation. The time consumed in the whole procedure compares very favourably with the records of other operations in this region. In Loreta's four cases the average duration was under thirty-three minutes, the longest fifty minutes.

Gastro-enterostomy is an operation which was first performed by Woelfler in September, 1881, as an alternative to pylorectomy in certain cases. Indeed, it appears not improbable that it may supplant the latter measure to a large extent, in view of the great tendency to recurrence after excision of the pylorus and its great risks, the newer operation giving much relief and being easier of performance and far less dangerous, although of course only palliative. Without entering further into this question here, the operation may now be briefly described.

In the first place its object is to establish an opening between the stomach and small intestine, as high up in the latter as possible, in order that the contents of the former may find their way through the digestive tract, hitherto blocked by the disease of the pylorus. If this opening is once established, the food leaving the stomach becomes mixed with the secretions of both liver and pancreas in the bowel, and the processes of digestion and assimilation are performed as usual, the patient being much relieved until generalisation of the disease, if malignant, terminates life. If, on the other hand, the operation is performed on account of chronic ulcer of the pylorus, with or without stenosis, the rest given to the part, and the improvement in general nutrition, may lead to repair and cure of the condition.

The preparations for the operation are identical with those for pylorectomy, described above. The same may be said of the incisions until the stomach is reached.

From this point the procedure is very simple. First, the stomach-wall is drawn out of the wound and so held. Then, a loop of small intestine is caught as near to the duodenum as possible and also made to protrude from the abdominal opening. Here, it is emptied of its contents by being passed through the fingers, and is kept so by two ligatures passed through its mesentery on either side of the emptied portion and tied lightly. It is then incised along its free border for an inch and a half, and this wound is carefully cleansed. A corresponding opening is made towards the pyloric end of the stomach at some small distance above its great curvature, so as to avoid the larger vessels. When all bleeding has been controlled and the parts cleansed perfectly, the two openings are united on their serous surfaces by Czerny's suture in the usual way, the posterior edges being stitched first. To avoid a possible 'kink' in the intestine at the point united to the stomach, it is well to stitch the bowel to the latter for about an inch or so beyond either end of the orifice, in the same way. Nothing now remains but to cleanse the whole field of operation, and to close and dress the abdominal wound in the usual manner.

Duodenostomy, or the formation of a permanent artificial opening into the duodenum through the abdominal wall, is another alternative to pylorectomy, which need only be briefly mentioned to be condemned. It has been performed three times in desperate cases of cancer of the pylorus, but has proved fatal in each. It is hard to see any grounds for its justification, especially since in gastro-enterostomy we possess an operation as easy of performance, not more dangerous, and which re-establishes the communication between the stomach and small intestine so that the patient may be fed in the usual manner by the mouth.

The operation consists in cutting down upon the pylorus in the way mentioned above, then drawing the anterior wall of the duodenum into the wound and stitching it there by its serous and muscular coats alone, as in gastrostomy. When adhesion has taken place all around after a day or two, the bowel is opened and the patient is fed through the orifice.

In Jejunostomy, which has lately been brought under notice, we have another alternative to pylorectomy. It has the advantage over duodenostomy that it is easier to perform in every way. But, beyond this, it is difficult to see how it is likely to come much into use so long as we have gastro-enterostomy to replace it. In the report of an interesting case brought before the Clinical Society by Mr. Golding-Bird, in November, 1885, the method of procedure was detailed, as well as some recommendations for the after-treatment of the patient; and, in the debate which followed the reading of this case, the whole question was fully discussed. But though the patient did not die as the result of the operation, but in consequence of a regrettable accident, the impression left upon the mind of the writer is that the operation has little to recommend it, so long as gastro-enterostomy gives such promising results as hitherto in the very distressing class of cases in which it is employed. The mode of operating for jejunostomy is essentially the same as that for duodenostomy just described, except that a coil of the jejunum is opened instead of the duodenum.

Arthur E. Barker.

PYONEPHROSIS, or the distension of the pelvis and body of the kidney with pus, is a common affection. Like hydronephrosis, it is usually unilateral. In the mechanism of its production, too, it resembles the latter condition in many ways, with the element of inflammation superadded. This inflammation presents itself in one or other of the many forms of Pyelitis. Again, a hydronephrosis may be converted into a purulent collection by injury, such as a strain or blow upon the sac, or after puncture for its evacuation. Further, a penetrating or contused wound of the kidney may lead to the formation of pyonephrosis.

The *objective symptoms* are almost identical with those of Hydronephrosis, and need not be separately described. It has been noted, however, that though the latter may enlarge until it has transgressed the middle line of the body, such is never the case with the purulent collection. An examination, too, of the urine will often furnish extra evidence. Thus, we are, in many cases, able in this disease to demonstrate pus in it, when there is no evidence of any morbid condition in bladder or urethra. Such pus is met with in acid urine, and is not usually constant in amount. Indeed, on some occasions it is entirely absent, often to re-appear suddenly in abundance, with perhaps some relief to the general symptoms of distension, but with increased frequency of micturition.

The *subjective symptoms* here are those again of hydronephrosis, with, in addition, some rise of temperature in many cases.

This is usually regular in its appearance every evening, the morning temperature being normal as a rule. In some cases, too, where renal colic accompanies the onset of the condition, there may be a rigor with general febrile disturbance. But the diagnosis between hydro- and pyonephrosis is always made quite easy by puncture and aspiration with a fine needle, a procedure easily carried out and destitute of risk, if performed on the lines already laid down under HYDRONEPHROSIS.

The *treatment* of pyonephrosis is not always the same. Aspiration, often repeated, may be at last successful in relieving the patient, but is very rarely so. It is just possible, too, that it may give rise to further complications if not employed with great care. Thus, septic matter may be introduced into the sac, with the consequent risks, or again, the sac, being frequently perforated by the needle, may yield at one thin spot and the pus escape into the perinephral tissues, so forming a lumbar perinephral or a psoas abcess.

The best treatment for ordinary cases is no doubt, in the first place, free antiseptic drainage at the point of election behind. *See* NEPHROTOMY. If this does not result in the final shrinking and closure of the sac, and the patient suffer much from the prolonged discharge with its attendant discomfort and risks, which are often great, NEPHRECTOMY should be resorted to. It should not be forgotten, too, that prolonged suppuration here may lead to amyloid change in the internal viscera; and that any change of that kind affecting the opposite kidney would, in this case, be more than usually grave, in view of the damaged condition or perhaps complete destruction of its fellow. But besides this, the opposite kidney may, in some cases, be damaged by chronic reflex irritation due to the passage of pus from the diseased side through the bladder, when the drainage through the loin has released the obstruction to the ureter, as it sometimes does. As this pus, in spite of every precaution, often becomes foul in the sac, during the months throughout which the renal fistula discharges while the patient is up and about, we need not be surprised to find that it produces cystitis in some cases, and the secondary changes just alluded to in the opposite kidney, which has hitherto been quite sound. This is a strong argument against allowing a pyonephrosis to drain too long through the loin. If there is evidence that the other kidney can do the work of the economy, and the patient's general condition do not contra-indicate it, nephrectomy will be the proper treatment in many cases.

In the *prognosis* of pyonephrosis we have to consider the immediate prospects of the patient, and the remote. The first vary much with the cause of the purulent accumulation. If it have formed slowly—e.g. from the gradual closure of the ureter due to inflammation of the pelvis—the immediate outlook is not grave. The collection may only give rise to distress from its bulk, and, until this becomes extreme, little is complained of, and the febrile disturbance may be but moderate. But when the condition is caused by the sudden blocking of the ureter of a kidney actually suppurating, there is rapid distension, with far greater disturbance of the parts around, and this, with the usually greater fever, is a distinct source of danger calling for speedy treatment. Eventually, the remote dangers in both instances are the same. First among these is rupture of the sac, with outpouring of its pus. If this take place into the peritoneal cavity, the result is a necessarily fatal peritonitis. Fatal empyema is also occasionally produced by bursting of the sac into the thorax, or abscess of the lung, but recovery has been seen even after these complications. Less dangerous, but still formidable, is rupture of the sac into the adherent colon or small intestine, with the thorough evacuation of the pus, but most probably with acute inflammation of the bowel sooner or later. If the collection burst into the perinephral tissues the pus may rapidly form a large extra-renal collection, which again may rupture in various directions. *See* PERINEPHRITIC ABSCESS. The most favourable termination of all is very rarely seen—namely, the giving way of the obstruction and permanent drainage of the pus into the bladder, or the ulceration of the sac into the ureter itself at a point low down, where it is expanded and flattened out, being pressed upon by the tumour; in either of these ways a spontaneous cure may be brought about, but the chance of such an event is exceedingly remote.

But, without rupture in any of these directions, a pyonephrosis may become dangerous from its gradual enlargement, with pressure upon important parts, and interference with their functions. This, together with the consequent fever, often gradually leads to a state of marasmus, which eventually terminates the patient's life.

ARTHUR E. BARKER.

PYO-SALPINX—Pus in the Fallopian Tube. *See* FALLOPIAN TUBES, Diseases of the.

Q

QUILLED SUTURE. *See* Sutures.

QUININE, Eruptions from. *See* Medicinal Eruptions.

QUINSY. *See* Tonsils, Diseases of the; Pharynx, Diseases of the.

R

RABIES. *See* Hydrophobia.

RADIAL ARTERY, The.—I. *In the Forearm*: from opposite the neck of the radius to the styloid process of the radius. The artery runs down superficially for most of its course, but overlapped above by the supinator longus muscle.

In front are the cutaneous structures only, but the supinator longus overlaps it above. *Behind*, it rests on the tendon of the biceps, the supinator brevis, the pronator radii teres, the flexor sublimis, the flexor longus pollicis, the pronator quadratus, and the radius. The radial nerve approaches it on the outer side in the middle third of its course. Venæ comites accompany it.

Ligation.—1. In the upper third: Support the limb in the position of abduction, with the forearm supinated. Make an incision in the line of the artery, two inches long, avoiding the cutaneous veins. Cut through the cutaneous structures, and find beneath the deep fascia the inner free edge of the supinator longus; flex the forearm slightly, draw the relaxed supinator longus outwards, expose the artery, and, after separating the venæ comites, pass the needle from without inwards.

2. In the lower third: Place the arm and forearm as before. Make an incision in the guiding line of the artery, or on the radial side of the flexor carpi radialis, for a distance of two inches, ending not lower than one inch above the wrist. Cut through the cutaneous structures, raise the deep fascia on a director and incise it, find the artery and, after separating the venæ comites, pass the needle from without inwards.

3. In the middle third: The radial nerve is found on the radial side of the artery; hence care must be taken to avoid it.

II. *At the Wrist.*—The radial artery lies in the front of the forearm, and passing downwards below the level of the styloid process of the radius, it winds backwards beneath the three extensor tendons of the thumb, to reach the palm of the hand between the first and second metacarpal bones. In this course it can be felt, and could be tied, between the extensor primi and extensor secundi internodii pollicis tendons. James Cantlie.

RADIUS, Dislocation of the.—The head of the radius may be displaced in three directions—viz. *forwards*, *backwards*, or *outwards*.

Dislocation Forwards is the most frequent, and it may be partial or complete. Usually, it is caused by a fall on the palm, occasionally by a direct blow or fall on the outer and back part of the elbow, and in children by dragging them by the arm. The writer saw, in 1880, a partial dislocation forwards, caused by a nursemaid angrily dragging a crying child upstairs to bed, when the parents were out. The *symptoms* are semi-pronation and inability to flex the arm beyond a right angle, owing to the head impinging against the front of the humerus. During extension the head comes forward, and can be felt and often seen beneath the skin, whilst, behind and below the external condyle, a depression may be felt in the situation from which the bone has been displaced. Much difficulty has occasionally occurred in reducing this dislocation, owing perhaps to a portion of the orbicular ligament intervening, but more often the bone may be reduced with ease, and then has a tendency to reluxation. Reduction is to be effected by extension at the wrist, whilst the thumb is pressed on the head, followed by flexion. Afterwards, the limb should be put up in a rectangular anterior splint, and, if there is a tendency to reluxation, this position should be maintained for a month or six weeks, and then passive motion be gradually commenced. In cases where the dislocation has remained unreduced, a new

joint is formed in front of the humerus, the head of the radius becomes partially absorbed, and the power of flexion gradually increases.

An injury produced by dragging young children by the arm, causing pain, pronation and semiflexion, has attracted the attention of several surgeons, and doubt has been expressed whether the injury was at the elbow or wrist, Goyrand having suggested that it was due to displacement of the triangular cartilage in front of the carpal extremity of the ulna. J. H. Hutchinson, in experiments recently undertaken upon the bodies of infants, has found that, by strong traction during supination, the head of the radius slips below the orbicular ligament, and that semiflexion and pronation will cause the ligament to assume its natural position, with a click. This displacement of the orbicular ligament, he believes to be the lesion usually present in these sprains.

Dislocation Backwards comes next in point of frequency. It may be caused by falls on the palm when the forearm is strongly pronated, by direct injury to the front of the arm, or by twisting the forearm into a state of over-pronation. The forearm is semiflexed and pronated; supination and flexion are painful; the head of the bone may be seen and felt behind the external condyle; and a depression can be felt below the external condyle, whence it has escaped. Fracture of the external condyle is sometimes a complication. Reduction should be effected by extension and pressure, after which a rectangular anterior splint should be applied, and a pad strapped over the back of the head of the radius. During extension the head is liable to be reluxated. W. Allen has recorded a case where, as a result of backward dislocation in early life, the head of the radius released from pressure grew three-quarters of an inch, and the external condyle half an inch.

Dislocation Outwards is very uncommon, and, according to Hamilton, is secondary to dislocation forwards. The head projects beyond the external condyle, and may be felt to rotate during pronation and supination. It should be pressed into place during extension, and a rectangular splint be afterwards used, with a pad to keep the bone from again slipping out.

R. Clement Lucas.

RADIUS, Fracture of the.—Fractures of this bone, unassociated with fracture of the ulna, are, if we exclude Colles's fracture, rare. They may, however, occur through the neck, shaft, or lower end.

Fracture of the *neck* is much more rare than some have believed; yet there are now many instances on record in which it has been proved by dissection. The writer has recorded an instance in which, during an operation for the removal of the upper end of the radius in what seemed to be a case of old unreduced dislocation of the head forward, locking the joint, he found the real condition to be that of comminuted fracture of the head and neck of the bone, with large heaping up of callus between it and the ulna. In a second case, that of a little girl aged ten, the daughter of a surgeon, there was, after she had fallen upon the hand, very plainly marked crepitus, apparently close beneath the skin, and at the junction of the neck with the shaft of the radius; and no movement of the head of the bone occurred when the shaft was freely rotated. There was no displacement. All the symptoms disappeared at the end of a month, during which the arm had been kept in a rectangular splint. There was no loss of movement.

The *symptoms* of fracture of the neck of the radius are non-movement of the head when the shaft is rotated; preternatural mobility of the upper fragment when grasped between the finger and thumb; crepitus and pain on attempted supination. In the first of the two cases related above, the injury presented all the appearances of dislocation of the head of the radius. The only *treatment* required is the use of a rectangular splint for the arm and forearm, to maintain rest. Passive movement should be commenced at the end of three weeks, to be, of course very gently, used till union is firm, and steadily employed while stiffness remains.

When fracture occurs at any point between the insertions of the biceps and the pronator teres, the upper fragment, as Mr. Lonsdale has pointed out, will tend, under the action of the biceps (and, it may be added, of the supinator brevis), to be strongly supinated, while the lower will be left entirely to the pronators. Should union in this position be allowed to occur, even though the fragments are placed end to end, the rotation of the one or the other will entail complete loss of the movement of supination. To avoid such a result, the limb, in this particular fracture, must be placed in a position of supination on a rectangular splint, applied to the posterior or dorsal aspect of the arm and forearm. Passive movement of pronation and supina-

tion should be commenced in about a month, and the splints may at the same time be discontinued, the arm, however, being kept in a sling.

Fracture of the radius and ulna together is of frequent occurrence at all ages, but especially in children, in whom it results from falls on the limb. In adults, it is generally the result of direct violence, as by the passage of a wheel, or by a heavy blow. Malgaigne records a case in which it was caused by muscular action (while the patient was digging). The fracture is most often seen at the junction of the middle with the lower third of the bones, or above this point. The bones are usually broken transversely, and at the same level; but the radius may give away a little higher up than the ulna. In children, in whom the fracture is often incomplete (greenstick), displacement is very slight, or may present itself as a mere bend, not easily observed in the fat limbs of infants. Thus, care must be taken that this injury is not overlooked. In adults, considerable riding of the ends may occur when the fracture is oblique. The nature of the injury is generally indicated by deformity, mobility, and crepitus.

It is difficult to secure a good result after this fracture, on account of the strong tendency that exists to displacement by the supinators and pronators of the forearm, as described above. To prevent this, the limb should be fixed in a position of supination on a rectangular splint, applied to the posterior aspect of the arm and forearm; and, for an extra precaution, a short anterior splint should be applied to the forearm, with a narrow pad placed over the interosseous space to maintain, as far as possible, the proper interval between the bones. The limb must be supported in a firm sling. In adults, movements of supination and pronation should be gently employed every other day or according to circumstances, at the end of a month; but the dorsal splint should be continued, so as to maintain supination, for at least five weeks. In children the period of treatment may generally be reduced to three weeks.

Fracture of the radius and ulna, at their *inferior extremities*, is occasionally seen. The nature of the injury is usually clearly indicated by mobility and crepitus, and the tendency for the deformity to return when extension is discontinued; but when the fracture is within an inch of the articular surfaces, the aspect of the limb may very closely resemble that of dislocation of the carpus backwards. The latter accident, however, is extremely rare. In fracture, moreover, it will be found that the styloid processes of the radius and ulna are displaced with the hand, while in dislocation they occupy their normal relation to the shaft of their respective bones.

Treatment consists, after careful adjustment, in the use of straight dorsal and palmar splints, as recommended for Colles's fracture.

Fracture of the *lower extremity* of the radius—*Colles's fracture.* The lower end of the radius is more often broken than any other part of the skeleton, except the clavicle. Though expanded to articulate with the carpus and carry the hand, this part of the bone is of no great strength, for it is formed, except for a compact layer on the surface, entirely of cancellous tissue; and this in the old, in whom the fracture is very common, acquires a very open texture in consequence of the partial absorption of its trabeculæ. Though occasionally, either alone or in conjunction with fracture of the ulna, the result of direct violence, this injury is in the great majority of cases produced by falls on the hand.

The fracture is generally transverse, but occasionally it is oblique from side to side. It is usually situated at some point within an inch of the articular surface; but the size of the lower fragment is subject to much variety. It may be a mere plate, while sometimes, though rarely, it measures an inch and a half from above downwards; and between these extremes all gradations are met with. In some instances displacement is very slight, but most commonly the lower fragment is carried backwards with the carpus, and rotated on its transverse axis, so that its articular surface acquires a certain amount of inclination upwards, instead of looking, as it should, directly forwards; it is also displaced more or less laterally, so that the projection of the styloid process towards the radial side is increased. This complicated displacement produces a very characteristic deformity, best seen when the forearm is raised in the horizontal position to the level of the eye and looked at in profile.

The lower fragment, carpus, and neighbouring part of the hand form a considerable prominence on the dorsal aspect, sloping downwards towards the metacarpus, while immediately above is a well-marked hollow; on the palmar surface, just above the wrist, is a projection formed by the end of the upper fragment, while at the level of the wrist itself is a depression corresponding with the dorsal prominence.

Thus the shape of the limb is somewhat like that of an inverted spoon. In many cases the hand is inclined towards the radial side, and appears to have dropped away from the styloid process of the ulna, which becomes very prominent. The deformity, as R. W. Smith maintains, depends no doubt in some cases on muscular action, the effect of which is clearly seen in the reproduction of the displacement, when, after adjustment, the parts are again left free from restraint. But very often—that is, probably in more than half the cases—it is due to the fact that the force applied to the bone has been sufficient not only to fracture it, but to drive the posterior part of the upper fragment into the cancellous tissue of the lower, so that the fracture is impacted.

Other symptoms of the injury are severe pain, and inability on the part of the patient to move the wrist. In some instances, there is mobility of the fragments on each other with crepitus. The opportunity, if it occurs, of making a complete examination before swelling has supervened to obscure the features of the case, should on no account be neglected. Plain as its existence often is, this fracture is sometimes so little marked, that it may be, and in fact not rarely is, overlooked. It should be added that fracture of the lower end of the radius is said by R. W. Smith to occur in falls on the back of the hand, the lower fragment being in that case displaced forwards; but the present writer knows of no specimen which illustrates this condition. In young subjects (under the age of twenty) separation of the epiphysis not rarely takes the place of fracture. In many cases the lower fragment is extensively comminuted, the fracture entering the wrist-joint.

Treatment.—Readjustment is often difficult: sometimes because the fracture is firmly impacted, in other instances because the lower fragment is small and cannot easily be grasped, or is broken into several displaced pieces; in others, again, from the tense condition of the tendons. The method most likely to succeed in effecting reduction consists of extension while the hand is supinated and adducted, combined with direct manipulation of the fragments; but the direction in which extension is made may be varied according to the case. Though considerable force may be used, this should not be carried to the point of violence, for, after all, extension of the hand does not act very directly on the lower fragment, as no very strong connections exist between these parts, while such as should be present have been more or less lacerated by the injury. Moderate extension, combined with pressure on the fragments in a direction the reverse of that in which they are locked together, will generally secure the best attainable result. Should reduction not be accomplished on the first trial, the attempt should be repeated a week later, when the fragments may have become somewhat loosened on each other, and when, swelling having subsided, manipulation can be more accurately directed.

Numerous different splints have been recommended for Colles's fracture. Many surgeons prefer the pistol-shaped splint, placed on the dorsal aspect of the forearm and hand, so that the latter is carried towards the ulnar side, and the lower fragment is drawn in the direction opposite to that of its displacement. Often, a short splint is at the same time applied to the palmar surface of the forearm, and is padded so as to take effect on the radius a little above the fracture, and press the upper fragment backwards. Others use the pistol splint on the palmar, and the short splint on the dorsal aspect. Carr's (American) is a palmar, trough-like splint, curved to the shape of the limb, and appended to this a hand-block, over which the palm rests in an easy position. Gordon's splint is in extensive use. The present writer, like many other surgeons, prefers simple straight splints, of the width of the limb, and placed one on the palmar and one on the dorsal aspect of the limb. When adjustment has been secured, and while extension is still kept up, the palmar splint is fixed to the limb by wide pieces of strapping, three for the forearm and one for the metacarpal part of the hand. The splint reaches only to the heads of the metacarpal bones, so that from the first the fingers are left entirely free. The dorsal splint is then applied with wide pieces of plaster, and the two together are surrounded by a bandage. This method efficiently controls muscular action, and, as the dorsal splint can be removed without disturbing the palmar, the fracture can be easily inspected.

Before the splints—whatever form is chosen—are applied to this fracture, great care in modelling the fragments to a perfect adjustment must be used. The deformity which remains after repair is often due, not to recurrence of displacement, but to the fact that it had never been removed. In every case the fracture should be examined, to see that good position is main-

tained, twice or three times in the first fortnight. At the end of a month or five weeks in adults and the old, of three weeks in children, the splints may be discontinued. The forearm should, however, be kept in a sling for a week or ten days longer. In order to prevent stiffness, the fingers should be regularly exercised, and, as soon as the splints are left off, passive movement of the wrist and hand should be employed. The treatment ought not to be regarded as complete till motion has been, as far as possible, restored. HOWARD MARSH.

RAILWAY INJURIES.—It is a common opinion that railway injuries present peculiar features of general nervous shock, and symptoms of spinal injury distinct from the sequelæ of ordinary accidents.

It is said that the greater severity of such symptoms is accounted for by the suddenness of the accident and the alarming character of the surroundings. It is open to question, however, whether the well-known symptoms that so commonly follow can always be accounted for in this way, for, as a matter of fact, injuries on the platform, and contusions in the street from collisions with railway vans, are nearly always followed by the same symptoms. Again, it is within the writer's knowledge, from experience in the treatment of a large body of men liable to injury from assaults, personal encounters, and street accidents, that symptoms precisely similar to those following railway accidents commonly occur.

As, in railway accidents, it happens that the most trivial injuries are followed by the most formidable array of nerve-symptoms, so it is with the men before mentioned, if injured on duty. The slightest cut or blow on the head, or a kick, is likely to be followed by loss of memory, defective sight, pain in the back, sleeplessness, and all the usual symptoms of nerve-shock. There is a condition common to both classes of injury, which must not be lost sight of by the practitioner. A person hurt on the railway knows that in nearly every case he is entitled to compensation, and the official, injured on duty, knows that he is entitled to a pension for life, if it is proved that he is incapacitated from the further performance of his duty thereby. On the other hand, the ordinary accidents of every-day life, such as falls downstairs, carriage accidents, and falls in the hunting-field, are not usually followed by such an array of nervous symptoms.

This assertion brings one face to face with very delicate questions—viz. how far are those symptoms dependent on the injury, and how far are they dependent on the probability of obtaining pecuniary compensation for the injury? Then there is the further question. How far are the symptoms compatible with the reasonable anxiety and worry which are imposed by the prospect of litigation, and, on the other hand, how far are such symptoms purposely exaggerated or assumed? These are questions which must always exercise the mind of the practitioner who is called upon to attend such cases.

Railway injuries may be divided roughly into four classes, viz.: 1. Contusions and shocks, the result of slight collisions. 2. Fractures, dislocations, and concussions, caused by severe collisions and wrecks of trains. 3. Accidents on the line, including crushes by buffer accidents and limbs cut off by passing trains. 4. Platform accidents, caused by falls while getting in and out of trains.

Accidents belonging to the first class enormously preponderate, and as they are followed by every variety and degree of nervous shock, including the so-called railway spine, they demand the special attention of the surgeon.

Accidents of the second class present no special features distinguishing them from other injuries, and it is worthy of note that, after severe fractures and dislocations, the nervous sypmtoms are commonly less severe and less prolonged than after apparently trivial injuries.

Accidents of the third class generally occur to railway servants, and are often fatal. In shunting accidents, the abdominal or pelvic viscera are the seats of injury, and death may be occasioned by internal hæmorrhage, or by shock alone. In these cases, it often happens that the most extensive and severe internal lacerations may be present, without any external lesion or even a bruise. The injuries inflicted on limbs by carriage wheels are necessarily very severe, often resulting in immediate division of the part, or if not, so crushing the bones and soft parts as to require, in nearly every case, primary amputation. The distinctive character of these cases is that they are commonly fatal, in spite of the fact that the injured person is immediately carried to the nearest hospital, or surgical aid is obtained as quickly as possible. The usual explanation of the fatal issue is that it is caused by shock; but why a cleanly divided leg or forearm should cause fatal shock is at first sight difficult to understand. The explanation is that hæmorrhage in such cases is

very severe. The sharp edge of the wheels and of the rail act like scissors, and often divide a limb, or even the trunk, as if cut by a knife.

It is only quite recently that railway companies have seen the importance of providing immediate surgical aid, and the fatality of such accidents in the past has no doubt been due chiefly to hæmorrhage, and not, as was usually supposed, to shock. This fact is now so well recognised, that two of the largest railway companies in England have provided Esmarch elastic bandages, to be kept at every station, accompanied by printed directions for their use; and have also made arrangements for periodical instruction to be given to the officials and porters. (The instructions will be referred to under the head of *treatment*.) Again, ambulance classes are being held at most of the large railway termini, and it is to be hoped that a more general knowledge of how to give first aid to the injured will materially lessen the fatality of such accidents.

The fourth class, or platform accidents, may be sub-divided into two sections—1. Those caused by falling between the train and the platform, which are nearly always fatal, from the body being dragged down between the footboard of the carriage and the edge of the platform, thereby tearing off limbs, fracturing the pelvis, and causing terrible injuries. 2. Falls on the platforms, which are very common and entail much litigation. These injuries are seldom serious, but there is the disturbing element of litigation nearly always present, and there is generally a question as to the liability of the company. Moreover, it is a curious fact that some of the most aggravated cases of nervous disturbance and heavy claims for damages have arisen from trivial injuries of this class.

Nervous Shock.—This condition may be described as a functional disturbance of the sympathetic nervous system, directly affecting the vital functions, and also indirectly disturbing the functions governed by the cerebro-spinal nervous system. It is the peculiarity of railway accidents that nervous shock follows every conceivable variety of injury. It has hardly ever been the experience of the writer to see a crushed finger, a cut head, or a broken nose, or any other trivial accident occurring on a railway, which has not been followed by more or less nervous shock.

In considering the symptoms, it will be convenient to classify them as affecting the different functions of the body and the organs of special sense.

Circulation. — The heart is primarily affected; the action is weakened and the beats are quickened and irregular. The pulse is rapid and weak in unison, and the surface of the body pallid and cold. The temperature often sinks one or two degrees below normal, and the body is bathed in a cold sweat. This condition may pass off in a few hours, or it may continue in a modified form for weeks or months.

Digestion. — The stomach is immediately affected by the nervous disturbance, as indicated by vomiting, foul tongue, indigestion and all its concomitant symptoms, loss of appetite, constipation, flatulence, and palpitation of the heart. Then follow loss of flesh, hepatic disturbance, mal-assimilation of food and gouty disorders, and even albumen in the urine may occur.

Sleeplessness.—This condition is always associated with nervous shock. Sleep, of course, is not totally absent, but it occurs in short snatches and is disturbed by dreams and visions, and there is no sense of refreshment or rest on awakening.

Sight.—This is usually impaired; dimness of vision and specks floating before the eyes are complained of. The pupils of the eyes appear abnormally dilated, and it not infrequently happens that the power of continuing the effort of reading is found to be notably diminished. This may be, and often is, the result of impairment of the function of accommodation by which the eyes are adjusted for near objects, or it may be a sort of inco-ordination arising from the nervous shock, and likely to pass away as the shock is recovered from. *See* Vision, Disorders of, from injuries of the head and spine.

Memory.—It is difficult to estimate how far the memory may be impaired. Patients usually complain that their memory is entirely gone, but at the same time they will relate, in minute detail, every incident connected with the accident, and give a long history of their symptoms. The truth is, the memory is not impaired, but the mind is alienated from the usual course of thought, and centred on the incidents of the accident. Thus, there is a difficulty in conversing on ordinary subjects, and a slowness in finding words to express the thoughts.

Moral Sense.—Nothing appears more demoralising than a railway accident. It is a common statement for a patient to make, that there has been no sleep for a month, or that not a morsel of food has been taken, and it is often painful to see the open at-

tempts at imposition. This happens constantly in persons who have been really injured, and is different from the deliberate and well-planned attempts to deceive which are characteristic of the malingerer.

Sensation and Motion.—These functions are frequently impaired. Anæsthesia is often found in men as well as in women, without any other symptom of hysteria. It frequently attacks the whole of one side of the body, and may occur with or without loss of motor power. The pulse on the affected side is small, the temperature is subnormal, and the skin pale. An arm, a leg, or even the course of a single nerve may be affected. Paralysis, again, is a very common result. It may take the form of paraplegia or hemiplegia, and is generally associated with anæsthesia. In these cases, the electric contractility of the muscles is usually unimpaired, but the sensibility of the muscles is more or less lost. Grave errors are of constant occurrence in the diagnosis of these affections, and after railway injuries there is a general tendency to attribute all such symptoms to spinal lesions, whereas, as a matter of fact, it is a very rare thing to find any spinal lesion following directly on railway injuries. The symptoms of hyperæsthesia and anæsthesia and paralysis, which so often follow such injuries, are in most cases purely functional, and correspond, in all their phenomena, to the symptoms which occur in ordinary hysteria. Other symptoms indicating some loss of the inhibitory power of the cerebrum are generally found—viz. the tremulous motion of the tongue and the shaking of the hands, as well as the tendency to cry when spoken to. Exaggeration of the reflexes is common, and sometimes even ankle-clonus is found.

Hearing.— Deafness is sometimes found, but it is not common. Persons often complain of noises in the head and inability to bear the slightest noise without starting.

Taste and *smell* are rarely affected, except in cases of hysteria.

Nervous shock may be the result of fright or of a very slight injury, and it is often a question whether it is not more the result of the events following than of the accident itself. Often, the sequence of events after a railway accident is as follows. The frightened or injured person is immediately dosed with brandy. He is naturally nervous and excited, and on arriving at his destination the doctor is sent for, who does not always reassure his patient. Then follows a sleepless night, with dreams and visions, and thoughts of paralysis and spinal injury. Rest, narcotics, and stimulants are prescribed, with the usual results of dyspepsia and headaches. The patient becomes really ill and nervous, as well as apprehensive. At this period, a plucky resolve to throw physic away and stick to work would soon re-establish the usual health, but unfortunately there is, generally, passive resignation, and no effort of any sort is made to resume work. Should there be an attempt it is not persevered in, and the patient, without actively intending to impose upon himself and others, will soon work himself up into a state of nervous apprehension, which rapidly develops all the symptoms of severe nervous shock. It must also be remembered that a person may actively encourage emotional disturbance, by which a similar result may be produced. This condition may be justly said to be a borderland which approaches malingering as nearly as can be.

On the other hand, no doubt many cases occur where a severe shake or concussion does produce general nervous shock, the effects of which it is very difficult to shake off, and which renders the patient absolutely unable to follow his usual avocations. Again, severe shock may accompany traumatic lesions of the limbs or organic injuries to the viscera or nerve-centres; but, in the majority of cases where nervous shock follows a railway accident, it is a moral disease and is not directly due to any physical injury.

In ordinary cases, shock to the nervous system is completely recovered from after a variable period, but elderly persons are sometimes permanently affected. The early symptoms may not be severe; in fact, the emotional condition may be absent, and there may be no special symptom beyond a general sore feeling in the back or legs. Soon the usual cheerfulness is lost, the gait becomes feeble, the circulation weak, and the person gets thin and pallid. There may be no headache, nor loss of sleep, nor any particular pain, yet complaint is made of feeling ten years older, and friends and acquaintances corroborate the statement, judging from appearances. In such cases, there is nothing of the nature of spinal disease to be apprehended in the future; but it may be taken as a general rule that the person will never be as well as before the accident.

Concussion of the Spine.—This is a term difficult to define, for, as the phrase is usually employed, it includes several distinct conditions:—1. A jar or shake to the spinal cord, causing pain and disturbed innervation without any symptom of special lesion.

2. A condition depending on pressure, either of extravasated blood or by exudation of serum. 3. Alterations in the structure of the cord itself, the result of chronic inflammatory changes either in the substance or in the coverings of the cord. The term 'railway spine' is often applied indiscriminately to any of these conditions. These may be the result either of direct or indirect violence. The primary symptoms will, of course, vary according to the severity and position of the injury. In the upper cervical region, grave danger may occur to life from implication of the large nerve-trunks, which take their origin from the medulla oblongata. If the vagus nerve be affected, the symptoms of dyspnœa will be urgent; if the phrenic, a feeling of constriction of the chest, caused by paralysis of the diaphragm will be felt. A blow on the lower part of the cervical spine has been known to induce paralysis of both arms, without any paralysis of the trunk or legs; sometimes there is loss of sensation, in other cases there is hyperæsthesia, but in this respect there is every variety and combination of nerve-disturbance.

A blow on the dorsal or lumbar region may cause complete loss of voluntary power in the lower limbs, with or without loss of sensation. One leg is usually more affected than the other. The patellar reflex also is generally much increased. There is often complete loss of power over the bladder, accompanied by incontinence; less frequently there will be retention. The usual symptoms of nervous shock will be present, the most prominent being pain in the head, furred tongue, constipation, pain in the back, and intense neuralgic pain in the affected limbs. A pricking sensation is also often complained of, and there is great skin sensibility over the lumbar and sacral regions. There is pain on pressure—generally referred to the lumbar region in the middle line, and radiating to the sides. There is difficulty in turning over in bed. If walking be possible it appears difficult; the legs are spread open as if to make a wider base for support, and the position of the body is fixed and constrained; there is no power to stoop to pick up anything; the appearance is as if the sacro-iliac joint were injured.

A marked peculiarity in cases of concussion is the frequent coincidence of nervous disturbance, affecting the part supplied by the spinal nerves which emerge opposite to the part struck. On the hypothesis of concussion of the substance of the cord this is difficult to understand. One would expect the nervous disturbance to be wider in its radius; and when it is considered how thoroughly the spinal cord is protected from external injury, both by its solid case and elastic surroundings, also how completely it is protected from jar through being suspended in a double tube—viz. the spinal canal on the outside, and the fibrous sheath (with an interspace of fluid) on the inside—it seems reasonable to suppose that the nerves which emerge from the injured spot are alone affected. The cord being somewhat movable, it is easy to understand how a sudden blow may cause a stretching or strain of the nerves as they pass through the intervertebral foramina, or the nerves may be pressed upon by an effusion of serum or blood outside the sheath of the cord. No doubt this often happens; and, even when symptoms of injury to the cord may co-exist, it is more than probable that they may be caused by irritation reflected from the injured nerves.

For a description of injuries to the muscles and ligaments of the back, *see* Back and Spine, Injuries of the.

Remote Injuries.—It is a commonly stated opinion that railway shock is peculiarly liable to be followed by organic disease of the spinal cord. The experience of the writer, however, does not support this view, for during the last six years, out of more than 500 cases examined, where claims have been made for personal injury, in half-a-dozen cases only were undoubted symptoms of organic disease found. Two of these were cases of tabes dorsalis, and a third a case of cerebral hemiplegia. In another, paralysis from disease of the spinal cord was present, but in this case the symptoms had commenced before the accident. No doubt, after spinal concussion, slow inflammatory changes occasionally occur in the cord or in its membranes, and may result in degeneration of nerve-tissue. Two forms of degeneration have been described: the one chronic meningitis with myelitis, the characteristic signs of which are a localised pain in the spine, greatly increased by movement, rigidity of the body or of the limbs, with spasmodic contraction of muscles and great muscular rigidity. The patient resents the slightest displacement of the body. These symptoms are generally accompanied, more or less, by cerebral symptoms—viz. headache, loss of memory, intolerance of light, suffusion of the eyes, noises in the head, &c. There is no paralysis of the sphincters, but often some loss of motor power affecting one or more of the limbs. There is exaggeration

of reflexes, also skin hyperæsthesia extending along the course of the nerves, and sensations of pins and needles in the limbs. There is a peculiar, unsteady, rolling gait; the legs are placed far apart, the heels drag, and the body is kept rigid either in the erect or bent posture. The other form of degeneration is sclerosis. This condition may no doubt follow traumatic injuries of the cord, but is more likely to be the result of mental shock or prolonged hysteria. There are no definite symptoms except a gradually increasing paresis of the lower limbs, extending ultimately to the upper limbs. There is no loss of ordinary sensibility; the muscles shake and quiver when called into action, ankle-clonus is distinct, and the reflexes are often exaggerated; there is no wasting of the muscles, nor any loss of electrical excitability.

Tabes dorsalis may, possibly, be a rare result of railway injury. In these cases sclerosis of the posterior columns is found, but it is more probably the result of indirect causes than of actual injury to the cord. Of the two cases which occurred in the writer's experience, in one there was a history of symptoms before the accident, and in the other the man was of an intensely neurotic temperament, and, besides the railway shock, had recently been subject to domestic bereavement, and had great business worry. There is another condition described which is known as 'spinal anæmia,' but it is questionable whether this is a pathological condition. It is generally accompanied by hysteria. The symptoms are as follows:—There is intense hyperæsthesia, greatly increased by pressure and by the application of a hot sponge; the tenderness is usually diffused more or less over the back: it has no tendency to follow the course of the nerves. In the more severe cases, there is often loss of motion in the lower extremities: the legs and feet are cold, and the reflexes are absent. In this case, again, it will be found that the sphincters are not paralysed, and that the general health is often good.

Hysteria is a common sequence of nerve-shock, especially with women. The patient becomes emotional; she bursts into tears, or is quick-tempered and violent; she dwells on her symptoms, exaggerates all her injuries, is untruthful, and her moral nature appears perverted. She may simulate disease consciously or unconsciously, and practise all sorts of tricks in order to deceive the persons around her. Hysterical paralysis is very common after railway injuries. It usually takes the form of paraplegia. Tonic spasm of the limbs is also frequent. Hyperæsthesia, anæsthesia, convulsions, and mania are all common in these cases of hysteria.

Method of Examination.—A practitioner, who is called on to report on a railway accident, cannot be too careful in keeping an accurate record of the case. The notes should be taken as follows:—State the date and place of examination; name, sex, age, occupation; married or unmarried; in the case of women, number of children; date and place of accident, and also the patient's description of the accident and events immediately following; when seen by a doctor, and by whom; patient's history of symptoms to date; patient's description of present condition. In examining the patient, avoid putting leading questions as far as possible. Make a note of each organ examined, and describe any local injuries found.

Where injury to the spine is supposed to exist, examine by percussion; examine surface sensibility by hot sponge, by touch with the finger, or with a feather.

Where paralysis is alleged, measure the limbs most carefully and compare them with each other; note the strength of the muscles by the grasp of the hand or power of locomotion; examine the patellar reflex, and also the power of contraction of the muscles generally, and whether ankle-clonus is present. The electrical irritability of the muscles may be tested, but there is a great deal of confusion existing regarding the utility of the electrical phenomena. This is due, not so much to the difficulty of interpreting facts, as to the general absence of technical knowledge necessary to elicit them with accuracy and precision.

The eyes should always be examined, and the condition of the pupils noted. An ophthalmoscopic examination is also desirable, and in some cases essential, as the existence of lesions of the retina may be confirmatory of cerebral or spinal symptoms.

The urine should always be examined for albumen and sugar, and the specific gravity should be taken, as well as the reaction with litmus paper. If possible, the medical history of the case should be taken down as related by the patient's medical attendant, and the treatment, past and present, noted. It is also desirable that a consultation should be held apart from the patient, in which the medical men in attendance on the patient should be invited to take part. This procedure is not always followed, and sometimes may not

be considered necessary or expedient. The diagnosis of the injury should be agreed upon as far as possible, and a note should be made whether opinions coincide as to the diagnosis and prognosis; especial note should be made of the period that will be probably required for partial or complete recovery. The amount of compensation should not be discussed; it is, however, quite within the province of the medical men to agree upon a time, during which the patient is likely to be incapacitated, as a basis whereon the railway company may estimate the amount of compensation that should be awarded.

All original notes of the examination should be carefully preserved, and they should be made at the time of, or soon after, the examination.

Compensation.—Occasionally, both the claimant and the railway company agree to have the amount fixed by the medical men. It is not a task that should be lightly undertaken by them, and it should never be considered a part of their duty. In dealing with this subject there are three points to be considered:—1. How long has the claimant been incapacitated from business? What has been his loss thereby, and how much expense has he legitimately incurred? 2. How long is he likely to be incapacitated and what loss and expense is he likely to incur in the future as the direct consequence of his injuries? 3. What is a fair sum to fix as a solatium? in other words, how much should be paid for the pain and suffering he has had to endure?

Considerable diversity of opinion may naturally be expected on this latter point, and, at first sight, it would seem only fair that the position in life of the claimant should make no difference in assessing the solatium. Thus, if a labouring man with a broken leg should be paid £100 for his pain and suffering, a professional man earning £1,000 a year should only be entitled to a similar amount. Juries, however, do not usually take this view, and the heavier the pecuniary loss, so much the more do they give as solatium. After all, this is not unreasonable, for £100 to a labouring man would appear a good sum, whereas to the professional man it would be a very poor recompense for the suffering he had undergone. It is the practice to take into consideration the comparative value of money to the injured persons. This, however, should be done only within narrow limits. It would be impracticable as applied to a peer with £50,000 a year, and would be most unjust to the railway companies, though no doubt £5,000 would not appear of greater money value to him than £500 to the professional man, or £100 to the workman.

Arrangements as to compensation, made between the company's medical man and a plaintiff, are scarcely ever proper, and never prudent. To say nothing of the fact that the bargain for terms of settlement is not the business of a medical man, the parties are not upon equal terms, their means of knowledge are essentially different. The more delicately and kindly the medical man has discharged his duty in watching the case on behalf of the company, the more will a kind of confidence on the part of a sufferer have sprung up, which tends to place him at an additional disadvantage. So strong is the feeling against such arrangements, that they can rarely be maintained. There is no legal difficulty in their way; the doctor is not the doctor of the patient, and there is no such 'confidential relation' as renders them theoretically incapable of enforcement. But they are open to so much of well-grounded suspicion that juries will rarely believe they are honest, and judges are prone to take the same view, so that they have a very slender chance of success; whilst the mere fact of having attempted to make them is felt to be discreditable, and to lower the position and reputation of the medical man to whom it is brought home. As before mentioned, cases may sometimes occur, in which the medical man employed by the company and the medical man employed by the plaintiff may fairly and properly come to arrangements for settlement of claims for personal injury. But, even here, there is frequently room for suspicion and unfavourable comment. When, as has sometimes happened, it has been part of such an arrangement that the company should pay the bill of the medical man who has acted for the patient, the bargain, however honest, is likely to be treated by juries as fraudulent, if afterwards assailed by the patient, and no prudent or experienced practitioner ought to place himself in a position from which he can scarcely escape without discredit.

Privileged Communications. — Communications between solicitor and client are privileged from discovery, so also are all documents prepared for the *bonâ-fide* purpose of being laid before the solicitor of the patient in order that he may advise his client thereupon, whether prepared at his instance or not. Reports therefore made

really, and not merely colourably, for the purpose of being laid before the solicitor of a company to assist him in giving his advice to the company or its directors or officers, are privileged from production to a plaintiff. Not so, however, if prepared for the use primarily of the directors, so that, as a general rule, reports or letters addressed to the directors, secretary, manager, or other officer of a company may be inspected under a judge's order.

Notes of verbal reports fall under the same rule. If intended for the use of the solicitor to enable him to advise his clients, they are protected. If for the use of some officer of the company or the directors, they are liable to inspection.

Professional Ethics.—In arranging examinations and consultations, there are many points to be observed. A medical man, acting on behalf of a railway company, has no right to examine an injured person except with the consent of the patient, his doctor, or his solicitor. If such consent be not given, and if an action is pending, there is no power of compelling a medical examination of a plaintiff except in the manner provided for by 31 & 32 Vict. c. 119, sec. 26, which is, that the judge may order an examination, for the benefit of the tribunal, by a medical man named by him who is not a witness. This is rarely acted upon, consequently, an examination being a matter of arrangement merely, the plaintiff can impose any conditions he chooses, and the other side must submit; thus, the solicitor for the plaintiff may insist on being present. In such case, of course, the solicitor for the other side has a right to be present also.

In consultations between the medical officer of the railway and the plaintiff's doctor, the former usually fixes the appointment, for the reason that he often has a long distance to travel, and is generally a consultant; but, of course, the plaintiff and his doctor and solicitor have a right to fix the time and place for the examination. If several consultants be engaged, it is usual for the consulting officer of the company and the ordinary medical attendant of the patient to arrange the appointments. Sometimes the fixing is left to the solicitors, but it is not a good plan, as they do not know how best to study the convenience of the consultants.

A railway surgeon should never consent to examine a plaintiff in the presence of his solicitor alone. If the plaintiff's doctor cannot be present, then the railway company's solicitor should attend as well, but it is never desirable that solicitors should be present at a purely medical or surgical examination. Again, a railway surgeon should never visit a plaintiff alone, if it can be avoided. In the case of Casson *v.* Great Western Railway Company, tried at Birmingham, the plaintiff swore to a conversation between himself and the doctor, not a word of which had ever taken place. Luckily, an inspector was present, who was able to prove that the conversation, which was narrated, had taken place between himself and the plaintiff on a previous visit. Leading questions should not be put, nor is it wise to make any remarks bearing on the case, in the presence of the plaintiff. It is no part of the duty of a railway surgeon to interfere with the treatment, though, as a matter of fact, suggestions are often asked for and adopted by the plaintiff's doctor. Sometimes, an injury is discovered by the railway surgeon which had not previously been diagnosed. Opinions may vary as to his duty in such a case. The writer has no hesitation in saying that it would be incompatible with a high standard of duty and professional honesty to conceal such a discovery. Although he is surrounded by pitfalls on every side, and sees tricks and deceit constantly practised, absolute professional honesty and candour should be his guide in every case. It must be remembered that medical men attending cases of railway injury have no right to increase their fees. The scale should be such as would be charged to persons in the same rank of life, suffering from ordinary illness. With regard to attendance in court and journeys on behalf of railway companies, special arrangements should be made beforehand.

Medical Evidence.—With regard to medical evidence in cases of railway injury, there is much that is unsatisfactory. There are, unfortunately, medical men who encourage fraudulent claims, by acting in concert with speculative solicitors. In case of the claim being lost they agree to waive payment, but, if compensation is obtained, they get a good share of the plunder. Again, some men ignorantly encourage fraud by recklessly asserting that every slight case of injury is likely to be followed by disease of the spinal cord. It is also very common for medical men to allow their sympathy for an injured person to influence their judgment, beyond all bounds of fairness and common sense. On the other hand, it is alleged that railway surgeons commonly ignore all injuries, and it is a usual custom in courts of law to attempt

to discredit their honesty. Whether this imputation be deserved or not, it has led to a most unfortunate custom—that the very suggestion of possible fraud, even in the most flagrant case, is sure to bring down on the surgeon a vigorous attack from the plaintiff's counsel, and a cross-examination intended to suggest want of honesty and indifference to anything except the interest of the railway company. The eloquence on this point is usually so effective with the jury, that the counsel for the defence is unwilling to allow any imputation of fraud to be made, even if there is clear evidence of it.

It must be conceded that it is the duty of the railway surgeon to keep an unbiassed mind. He sees so many cases of attempted and successful fraud, that there certainly is a risk of his mind being soured and his judgment perverted. In every case, he should be able to give his reasons for statements and opinions, and he must take care not to allow any amount of exaggeration or fraud to turn his mind from the recognition of injuries that do exist. There should be no suppression of opinion that might be unfavourable to the company. It has sometimes happened that opinions expressed by the medical witnesses for the plaintiff have appeared to the counsel for the defence less prejudicial to his case than the opinions held by his own professional witnesses, and in defending the action he has wished to adopt the theory of the other side; but the zeal of the advocate should never extend to the medical witness. It would be a gross impropriety for him to suppress or modify his opinions at command of counsel; the only alternative, for a counsel who wishes to adopt the opinions of the other side, should be not to call his medical witnesses.

The witness should remember that technical terms are to be avoided as far as possible, and that his opinions should be expressed in such language as to be intelligible to the judge and jury.

Again, the medical witness should know that all original reports and notes are liable to be called for, and, if so, must be produced. The witness should never lose his temper, and all questions should be answered respectfully and to the point. Where it is impossible to answer a question without an explanation, it is better to appeal to the judge for permission to make it. Counsel are very apt to insist on 'yes' or 'no' for an answer in cross-examination, but, of course, are bound to allow an explanation if the judge permit it.

Diagnosis.—The difficulties of diagnosis in railway injuries are well known, and are being continually illustrated in the law courts. This is not to be wondered at, as we may have, mixed up in one subject, the symptoms of fright, nervous shock, injuries to muscles and ligaments, hysteria, spinal and brain concussion, organic injury to brain or spine, and, added to these, symptoms either imagined or invented. The first point, of course, in diagnosis, is to differentiate symptoms of real disease or injury from those imagined or invented. That malingering is common cannot be denied, but the medical man is never justified in concluding that symptoms are assumed (however inconsequential they may appear), until he has satisfied himself by the most careful tests that they cannot be produced by nervousness or hysteria. The variety of cases in which such tests require to be applied, precludes the possibility of giving any general rule for testing the genuineness of symptoms. The surgeon must rely on his own judgment and sagacity in each individual case. Mr. Erichsen writes: 'When symptoms are invented or wilfully exaggerated in order to mislead, the fraud may usually be detected, by a surgeon accustomed to these investigations, by finding that the symptoms do not bear a due proportion to one another, that one is brought into greater prominence than the rest, and that the patient contrives to direct attention to and lay emphatic stress on it. There is, in fact, an absence of that harmony of symptoms which characterises all true and real diseases.'

Notwithstanding the extreme difficulty in diagnosing the effects of railway accidents, opinions are given and sworn to in these cases, with a recklessness which would be deemed most culpable in ordinary illness. One reason is that the directors of the railway companies require from their surgeons a definite opinion on the case at an early period—first, as to the nature and extent of the injury, and whether it is likely to be permanent; secondly, how long the effects will last or incapacitate the person from his usual employment. These opinions have to be formed, generally, after a single visit. On the other hand, the practitioner in attendance is equally pressed by the injured man's friends or solicitor for his opinion, in order to make a statement of claim for compensation; and thus it is that, on the one side, insufficient opportunity for observation, and, on the other side, inexperience or undue bias in the interpretation of the symptoms which so commonly follow

railway accidents, lead to such divergences of opinion, and such pitiable exhibitions in the witness-box, as to be a byword of reproach to the medical profession. In injuries where there are objective symptoms, the same rules of diagnosis will apply as to ordinary accidents; but often, when the railway surgeon examines a case, all objective symptoms will have disappeared, and yet allegations may be made of grave injury remaining.

It cannot be doubted that the diagnosis between malingering and hysteria is most difficult. It has happened, again and again, that symptoms which have been pronounced hysterical by the most competent physicians have disappeared directly after the trial; and in one case lately tried, where large compensation was obtained, and where the doctors on both sides agreed that the case was one of aggravated hysteria, the woman took a public-house directly after the accident, and boasted to her customers how she had 'done' the doctors.

After falls on the platform, a claim is often made for permanent injury to the hip-joint. No doubt, a fall on the hip may either bruise the joint, or may cause some inflammatory exudation around the sciatic nerve. Lameness and pain are complained of, and large claims for compensation are made. The difficulties in the diagnosis are as follows:—First, whether the patient is really suffering; secondly, whether, if suffering be present, it is due to the injury or to ordinary sciatica or rheumatism of the joint.

Ruptures are often discovered after railway accidents, and no doubt a sudden jerk may produce a hernia; but if coming down for the first time through violence, great pain would immediately be felt, whereas, in the great majority of the cases complained of, it will be found that the rupture was discovered only some weeks or months after the accident, and usually after a claim for compensation had been made. It is a very common method of making a fraudulent claim. In some cases, no doubt, fraud is not intended. The plaintiff is thoroughly overhauled for the purpose of making a statement of claim, and the rupture is discovered for the first time. It is necessary in such cases to make close inquiry into the history of the swelling, whether a truss has ever been worn, and whether the patient has been ever examined for a club or for life assurance. It is sometimes impossible to say how long a hernia has existed. The abdominal rings may have been weak and bulging for years, and the slightest exertion may bring on the hernia, without causing pain or inflammation; but a hernia, coming down through a strong abdominal ring on account of violence, would be accompanied by sudden pain, and probably sickness and shock.

It is possible that a hydrocele may be caused by a blow on the testicle. In a recent case, such an injury was alleged to have been caused by a railway accident. A month after the accident one testicle was enlarged, and very hard and irregular. There was a good deal of fluid in the tunica vaginalis, but the tissues were much thickened by chronic induration, and not thin and distended as in a recent case of inflammatory exudation. Again, the surgeon who examined the plaintiff directly after the accident found the testicle in exactly the same condition as at the later examination. This was reported as a fraudulent claim, and compensation was refused.

Where injury to the nervous centres is suspected, the following points in diagnosis must be made out:—1. Whether the symptoms are real. 2. Whether the symptoms are due to a general shock to the nervous system. 3. Whether to concussion of the brain or spinal cord. 4. Whether to organic injury or disease affecting the brain or spinal cord or nerve-trunks. 5. Whether to injury to the muscles or ligamentous tissues of the back. 6. Whether to rheumatism. 7. Whether to hysteria.

Now, considering that the symptoms may be purely subjective, and that nearly all the above conditions may co-exist, it will be understood how difficult the question of diagnosis must be in certain cases. The history of each particular case must be minutely investigated, and a careful comparison of the subjective with the objective symptoms must be made. Again, where malingering is suspected, the relative compatibility of the symptoms must be examined. It must also be remembered that there are different degrees of malingering:—1. There may be the actual assumption of symptoms which have no existence. 2. The reference of old diseases or symptoms to a recent accident. 3. The wilful exaggeration of injuries which really exist.

In general shock to the system, the diagnostic symptoms are mostly subjective—viz. sleeplessness, headache, loss of memory, defective eyesight, constipation, pain in back; the objective symptoms being disturbance of the circulation, weak or intermittent pulse, foul tongue, and exaggeration of the reflexes.

When there has been concussion of the spinal cord, there is pain in the back, generally most severe in the lumbar region; pain on pressure over the spines of the vertebræ, varying in extent; hyperæsthesia of skin; irritability of the bladder; diarrhœa or constipation; great pain in turning over in bed, or, if able to get up, inability to stand upright or straighten the back; a stiff and constrained position in walking, with the legs spread open as if unable to balance the body; radiating pains of a neuralgic character down the legs, and feelings of pins and needles.

In brain-concussion there is the history of a blow on the head, loss of consciousness at time of accident, subsequent pain in head and confusion of ideas, suffusion of eyes, intolerance of light, feeble pulse, accompanied more or less by symptoms of general shock.

Where paralysis is present it may be functional (including hysterical paralysis), or it may depend on organic injury to the brain or spinal cord or peripheral nerves. In functional paralysis the muscles retain their nutrition, or, if there be wasting, this is of the character of general emaciation from simple disuse, and is not an atrophy of particular groups of muscles. As a general rule the electrical reactions are normal, but after very long disuse there may be sometimes, at first, a slight loss of irritability to induced currents. After a very few applications, however, this passes off. It is to be noticed that the lowered irritability obtains equally as regards not only the induced, but the galvanic, current also.

In paralysis from lesions of the brain, there is ordinarily nothing abnormal to be noted in the electrical reactions of the muscles of the affected limb, and this applies also to a lesion limited to the lateral or posterior columns of the spinal cord. But, if the anterior horns of grey matter in the cord be affected, there are—1. Loss of power in certain muscles of the limb supplied by nerves issuing from the affected part of the anterior horns. 2. The tendon reflex in the affected muscles is absent. 3. The paralysed muscles tend to atrophy. 4. Examined electrically, it is found that the reaction to induced currents is materially lessened or entirely absent, and this whether the rheophore be applied either to the muscles or the nerves supplying them. If, however, the rheophore conveying a galvanic (constant) current be applied to the muscle, and the current slowly made and broken, there will be contraction—strongest when the positive pole is applied. If the galvanic current be applied to the nerve only, there is no reaction.

Similar phenomena result when, instead of disease in the anterior horn of grey matter, the lesion is situated in the trunk of a motor nerve. They are absolutely indicative of organic lesion of a certain part of the spinal cord or of the trunk of a nerve. A destructive lesion of the spinal cord, high up (say in mid-dorsal region), will cause complete paralysis of the lower extremities and viscera, and yet the electrical reaction of the paralysed limbs will be normal, because the anterior horns of grey matter, at the point of origin of the motor roots of nerves going to the limbs, are unaffected. The paralysis here depends not upon lesion of the anterior horn of grey matter, or of the trunk of nerve, but upon the interruption to the descent of voluntary impulses from the intracranial centres along the antero-lateral columns of the cord. The tendon reflexes in this condition are exaggerated. They are also in excess as a result of secondary degeneration from disease of the motor area of the cerebral cortex. They are usually also heightened in functional paralysis. It may be said, generally, that the conditions of the muscles in functional paralysis, as regards electrical reaction, nutrition, and tendon reflex, resemble those of limbs paralysed as a result of cerebral and not spinal lesion. The diagnosis between functional paralysis and paralysis from an intracranial lesion requires the consideration of a large number of possibly attendant circumstances, the discussion of which is impracticable in an article of this scope. Reference must be made to special works upon disease of the nervous system.

The use of electricity, as a diagnostic agent in investigating injuries after railway accident, may be summed up shortly as follows. If, in a given case of asserted paralysis, the electrical reactions are found to be universally normal, it may be concluded that the injury is not due to any organic disease of the muscles, the nerves, or the anterior cornua of the cord. It does not, however, exclude lesions of other portions of the cord, such as lateral sclerosis, locomotor ataxy, affections of the brain, such as cerebral hemiplegia, or functional disorders such as hysteria. In these the electrical reactions are practically normal, and the diagnosis must be determined by other concomitant symptoms. If, on the other hand, positive evidence of abnormal electrical reactions can be obtained, it is a

certain proof of organic tissue-change in either nerve or muscle. These abnormal changes may be in nerve alone, in muscle alone, or in both together. They may be distributed in a variety of ways, a knowledge of which, combined with the other circumstances of the case, generally enables the inquirer to diagnose the seat of lesion —that is, whether it originates in the nerve, the muscle, or the cord.

As a matter of fact, organic disease of the nervous centres is of very rare occurrence after simple collision, and even after direct traumatic injury to the spine it is not common.

Where injury to sight is alleged, it will of course be a question for diagnosis whether the eye has been directly injured. Such cases would not be likely to differ from wounds or contusions arising in any other manner, but claims for remote or indirect injury are frequently made, and no doubt are, in a certain proportion of cases, well founded. A person, who is confined to bed or to a sofa by the effects of a railway collision, would often be desirous to while away the tedium of such confinement by reading, and it is often found that the power of continuing the reading effort is diminished. So long as the distant vision remains of normal acuteness, or can be brought up to normal acuteness by a lens, the mere failure of reading power need occasion little or no anxiety. It is a symptom of nervous shock which will disappear with restoration of the general health, or which, at most, will require an earlier employment of spectacles than might otherwise have been necessary. Sometimes, however, the acuteness of distant vision suffers, and then, even if the diminution should at first be but trifling, the case assumes a serious aspect. Injuries to the nervous centres may affect the optic nerve and retina in two ways: by the production of neuritis, probably leading to eventual atrophy and blindness, or by an atrophy without antecedent neuritis, a so-called 'simple' or 'sclerosal' atrophy, which, although producing great impairment of sight, sometimes stops short of complete blindness, and which may probably be attributed to injury of the nerve-centres which govern the nutrition of the optic nerve.

In every case in which impairment of vision, as distinguished from diminution of endurance, is complained of, the eye should be subjected to early and complete examination with the ophthalmoscope, by which, in the earlier stages of neuritis, some blurring of the disc and some vascularity of the nerve-tissue will be detected; while, in the instances of simple atrophy, the nature of the change must before long be apparent. At the same time, the actual state of the visual function, as regards acuteness, extent of field, colour sense, and accommodation, should be investigated as carefully as circumstances will permit, and with reference not only to prognosis but also to treatment. The surgeon will frequently have to deal with cases in which the truth is more or less obscured by nervous excitement or by actual simulation; but these conditions before long cease to be deceptive. It is necessary to be provided with a sufficient variety of lenses, test-objects, and methods of examination; and any attempt at malingering would certainly soon be exposed by the contradictions and inconsistencies to which it would lead. But it must be remembered that a superficial knowledge of diseases of the eye is insufficient in dealing with such cases; the aid of an experienced oculist should be obtained before forming a definite opinion. *See* VISION, Disorders of, from injuries of the head and spine.

Treatment.—In severe injuries prompt treatment on the spot is of the first importance; arrest of hæmorrhage, relief of shock, and easy transport should be the surgeon's first consideration. The following printed directions have been issued by the London and North-Western and Great Western Railway Companies, and are in use at all stations for the instruction of the officials, accompanied by an Esmarch's elastic tube:—

Rule 1.—When a leg or arm is severely wounded there may be no bleeding. In this case raise the limb on cushions above the level of the body, and carefully watch the wounded part, so that the first bleeding may be seen.

Rule 2.—Should there be much bleeding, put on the elastic tube as soon as possible (see *Rule* 3); but if you have not got the tube near, raise the limb as high as you can above the body, and act as follows:—(*a*) If blood seems to come smartly from one part, place your finger and thumb firmly on that part, and stop up the place from which the blood is coming. (*b*) If you cannot see whence the blood flows, then roll up your handkerchief or cap, and with it press firmly over the bleeding part, not forgetting to keep the limb raised up.

Rule 3.—To put on the elastic tube, let the limb be held up as high as possible, then stretch the tube to the full, and wind it while stretched round and round the bare limb. When this is done, fasten the hooks at the ends to each other.

Rule 4.—The tube must be placed above the wounded part—that is, between it and the body. (*a*) When the leg or foot is injured apply the tube just above the knee; if the knee or thigh be wounded, then place it higher up on the thigh. (*b*) If the hand or wrist be wounded, put on the tube below the elbow; if blood come from the elbow or arm, then put on the tube higher up near the shoulder.

Rule 5.—If the limb be wounded so near the trunk that you cannot put on the tube, then you must do your

best to stop the bleeding by one of the plans named in *Rule* 2.

Rule 6.—If the injured person has to be carried far, either to a hospital or to a house, bear in mind—(*a*) To keep him warm with rugs or clothing. (*b*) To keep the limb continually raised on cushions. (*c*) To watch for bleeding. (*d*) Not to give too much brandy, especially if you have not been able to put on the tube.

Fractures may be treated by temporary splints made out of newspapers, the cushions of railway carriage-seats cut up; and straps and handkerchiefs or shirt-tails will make good bandages.

For the immediate relief of shock, avoid transportation to long distances: utilise cottages or buildings near the scene of the accident; insist on rest and quiet, and freedom from exciting interviews with friends; give diffusible stimulants or alcohol in moderation; also give hot coffee and beef-tea, when possible. For the treatment of nervous excitement after shock, bromide of potassium, in ten-grain doses, combined with the same quantity of carbonate of ammonia, may be given in an effervescent form with good effect.

Opium, chlorodyne, hydrate of chloral, &c., are usually contra-indicated, as they generally increase the nervous excitement. They should be given only in cases of severe organic injury, to relieve pain. With regard to operative measures, fractures and dislocations should be reduced at once, and, in injuries which require amputation, a primary operation is generally best. There is usually little chance of saving limbs, with comminuted and compound fractures especially, where joints are involved; and there is much risk to life in the attempt to do so. Of course, it is often necessary to wait for the first effects of shock to pass off.

The treatment of fright and emotional and functional illness is often a question of difficulty. It may be taken, as a general rule, that the less medicine given the better, and that as little fuss be made and as little anxiety shown as possible. But the surgeon is often in a dilemma. Many patients resent most vigorously any light estimation of their injuries, and any encouragement to resume work or get about is looked on as inattention or ignorance. Then, again, the friends usually interfere, and another and a more sympathetic doctor, so called, is recommended. It follows, therefore, that moral treatment is necessary. The confidence of the patient must be first gained by sympathy and attention, then he may be informed of the nature of the symptoms, and will more readily follow the necessary treatment.

The symptoms which most commonly require active treatment are dyspepsia, constipation, and sleeplessness. For dyspepsia, a dinner pill containing a grain each of gray powder, euonymin, and powdered rhubarb may be given before each meal, and an effervescing saline with ammonia, after meals, is very efficacious for pain and flatulence. For constipation, by far the safest and most effectual drug is cascara sagrada. It does not debilitate nor depress the nervous system like saline aperients and mineral waters, nor is it followed by constipation, like most of the cathartics and other aperients. A very good formula is the following:—Liquid extract of cascara, f℥j.; syrup, f℥j.; maltine, f℥ij. One or two teaspoonfuls to be taken before the evening meal or at bedtime, in water. For sleeplessness, it is a very bad plan to give large doses of bromide, and as for opium, morphia, chlorodyne, and hydrate of chloral, there is no surer way of retarding recovery than to give them. As the general symptoms of shock subside, sleep will return, and good nights may often be obtained by a glass of hot whiskey and water at bedtime or hot beef-tea or gruel. Many of the symptoms of nervous shock are much aggravated by the injudicious use of strychnine and iron. It is not unusual to find that large doses have been given from the date of the accident, generally with the effect of producing palpitation, twitching of limbs, sleeplessness, sensations of pins and needles, headache, and dimness of sight, all of which symptoms are immediately attributed to the accident, and any nervous shock that may have been sustained is thereby materially increased.

In cases of persistent nervous shock, leading to hypochondriasis, hysteria, and other neurotic symptoms, such as paralysis, hyperæsthesia, or anæsthesia, change of air and scene is a good remedy; but when this is recommended, the beneficial effect that would ensue is often retarded by the anxiety and officiousness of friends or relatives who accompany the patient, and never cease to talk of the accident or to enlarge upon his injuries. Again, it is common to find the nature of the symptoms misunderstood, and often escharotic liniments, blisters, and even the actual cautery, are applied.

There can be no doubt that, in such cases, treatment at a hydropathic establishment is most advantageous. Isolation from friends, change of scene and habit, absolute regularity in diet, freedom from stimulants and narcotics, are thus ensured, while there is every convenience for sedative local treatment by shampooing, massage, douching, and compress; and, lastly and most import-

ant, the attention of a medical man understanding the moral treatment of the patient is secured. There is a certain proportion of cases, however, where nothing but money compensation will do any good. Those persons are not always dishonest—the worry of impending litigation, or anxiety about business losses, may keep up the nervous state; others, knowing that pecuniary compensation is certain to be obtained, will not make the slightest effort to return to business and shake off lethargy and laziness.

In cases of concussion of the spinal cord or brain, of course the first necessity is absolute quiet and rest in bed, and, if there is no doubt about the correctness of the diagnosis, the surgeon should insist on a much longer rest than the patient is often disposed to take.

Where there is localised tenderness of the spine, stimulating liniments and unguents (especially oleate of mercury) do good. Blisters and the actual cautery may sometimes be applied with much benefit, but in hysterical and nervous cases they are not to be recommended. Where there are symptoms of inflammatory changes taking place in the cord, iodide of potassium and bichloride of mercury in small doses are beneficial. In spinal anæmia it is found that iron, arsenic, strychnine, and quinine may be given with good effect, and, where paralysis has occurred from this cause, a course of galvanism with the slowly interrupted current should be tried. Where there are symptoms of meningeal inflammation of the brain or spinal cord, the writer has found grain doses of calomel and extract of aconite relieve pain and spasm in a marked degree. THOMAS BOND.

RANULA.—The term 'ranula' has been employed, somewhat loosely, to indicate the various sublingual cysts which project into the floor of the mouth by the frænum. Such a tumour may originate in many ways—by dilatation of one of the excretory ducts of the sub-lingual or submaxillary gland, by enlargement of the sublingual bursa of Fleischmann, or by cystic transformation of the connective-tissue interspaces of the part; or it may be dermoid or hydatid in structure. It is desirable, however, to exclude the two last, reserving the name 'ranula' for tumours having the characters about to be described, until the advance of pathology and diagnosis enables us to dispense with the expression altogether.

Symptoms.—The true ranula appears as a soft fluctuating tumour beneath the tongue, on one or other side of the frænum, encroaching more or less upon the buccal cavity, and often projecting in a downward direction to give rise to a prominence in the sub-maxillary region. It is smooth, bluish, and translucent, of globular or ovoid form, and its surface is often traversed by Wharton's duct. The contained fluid is more or less viscous, tasteless, transparent, and of a tint varying from the palest straw to a deep brownish-yellow; and is occasionally discoloured by the admixture of blood or pus.

When small, it causes little inconvenience, but it may attain such large dimensions as to interfere with deglutition, articulation, and even with respiration. In one case mentioned by the elder Cline, the patient was on the point of suffocation in consequence of the backward displacement of the tongue by a huge ranula, when a timely use of the surgeon's lancet averted the danger. The tumour may appear at any age and in either sex, and can rarely be traced to any exciting cause.

Pathology.—It was once believed that the majority of cases of ranula were due to dilatation of a portion of Wharton's duct behind an impacted salivary calculus, but it is now certain that such a condition is very exceptional, even where a competent source of obstruction has been found; and some authorities have gone so far as to deny its existence altogether. The researches of Recklinghausen tend to show that the tumour is nearly always developed at the expense of the ducts of the sub-lingual gland, behind an inflammatory constriction or closure of the lumen of the tube. It is not, however, a mere dilatation containing an accumulation of saliva, but a true cyst, differing, both in its structural characters and the nature of its secretion, from the gland from which it is derived.

The cyst wall consists of a capsule of connective tissue with elastic fibres and vessels, usually delicate, but sometimes of considerable thickness ($\frac{1}{25}$th of an inch), and lined with a double layer of epithelium, of which the superficial cells are cylindrical and ciliated; and chemical analysis of the fluid reveals the presence of mucus and albuminate of soda, but neither ptyalin nor sulpho-cyanide of potassium. With these peculiar features, it might be doubted whether the condition really arises in the manner described, but Recklinghausen has succeeded, in some cases, in discovering the orifice of the gland-duct in the wall of the cyst.

The share taken by Fleischmann's 'sublingual bursa' in the etiology of ranula is

still uncertain. This anatomical structure may be demonstrated without difficulty in many subjects, and there is no reason why, like other bursæ, it should not occasionally give rise to a cystic tumour; but it cannot be said that any ranula has ever yet been proved to originate in this manner. It is probable that, in a case of the kind, the character and composition of the fluid and the structure of the cyst-wall would be found to vary from the description just given, as that of the typical ranula.

Treatment.—As a preliminary measure, a careful search should be made, by palpation, for a calculus or other source of obstruction, which must be removed if found; but should nothing of the kind be discovered, the surgeon has the choice of several methods by which he may attack the tumour directly.

(1) Complete excision of the cyst. This method was recommended by Marchetti in the early part of the present century, and more recently by Schuli and others, but has seldom been carried into effect. It is necessarily the most radical procedure, and it is less difficult than might be anticipated, as the cyst-wall adheres but loosely to the adjacent tissues. The floor of the mouth must be fully exposed; and after freely incising the tumour in its long axis, the cyst may be removed, partly by traction, partly by small curved scissors. The administration of chloroform must usually be dispensed with, owing to the risk of entrance of blood into the air-passages.

(2) Removal of a portion of the cyst-wall with the superjacent mucous membrane. The operation rarely effects its purpose, owing to the speedy closure of the gap, and is now employed chiefly as a preliminary to other measures.

(3) The establishment of a permanent fistula to allow the continual escape of the contents of the tumour into the mouth. Louth endeavoured to achieve this end by repeated cauterisation of the edges of the opening left by an excision of a portion of the cyst, but without success. Dupuytren's *bouton à chemise*, as modified by Reisinger—a short canula with a button-like plate at either end—was an ingenious device to attain the same object. One extremity of the instrument was inserted into the cyst, the other remaining in the mouth, while the intermediate portion prevented the closure of the wound and provided an exit for the escape of the fluid. Chelius and others have expressed satisfaction at the results, but it has generally been found that the movements of the tongue rendered it difficult to keep the implement in place. A simpler and most effectual method is the insertion of a loop of silver wire, which will lie quietly in the floor of the mouth and act as a permanent drain.

(4) The obliteration of the cyst by inflammation. For this purpose many plans have been essayed, including setons, the injection of iodine and other fluids, cauterisation of the interior of the cyst after the excision of a portion of the wall, and plugging the cavity with lint or other material, plain or steeped in iodine or chloride of zinc solution; but although a cure sometimes follows the means adopted, the general rule is failure, with the occasional addition of troublesome inflammatory complications in parts outside the limits of the tumour.

Sub-lingual Dermoid Cysts are not often met with. They may be diagnosed from true ranula by their congenital origin (of which, however, it is not always possible to obtain a history), their comparatively slow growth, their greater firmness of consistency, and, especially, by the absence of translucency. They usually tend to project chiefly in the direction of the sub-maxillary integument. The appropriate treatment is excision.

Hydatid Cysts in the position of ranula are extremely rare. It might be difficult to distinguish their nature before operation without a microscopic examination of the contents.

Sub-lingual Abscesses and Hæmatomata may generally be recognised without difficulty by the history of the swelling, except where the suppuration or hæmorrhage has occurred within the cavity of a ranula. In cases of doubt, the diagnosis may be established by the examination of a portion of the fluid drawn off by a small aspirator (morphia injection-syringe) or a trocar and canula. W. Anderson.

RAYNAUD'S DISEASE. *See* Arteries, Diseases of; Gangrene.

REACTION.—When a patient recovers from a condition of collapse, he passes on into the state known as that of reaction. The time that elapses between the oncoming of the collapse and the commencement of reaction varies according to the amount and intensity of the former. The stages of reaction are various. In some cases, the patient will rapidly pass from one to the other, so that complete restoration of the impaired faculties is brought about in a few minutes; in other cases, reaction is

slow and improvement almost imperceptible, and complete restoration does not take place for days or weeks.

The *symptoms* of reaction are as follows:—The patient, who has been lying motionless on his back, evinces a desire to change his position; in many cases he soon begins to retch, and perhaps vomits. The pulse improves in volume, tone, and rapidity; the respirations become deeper, and are often sighing; the clammy skin becomes warmer, and the lips assume a redder hue, swallowing is more easily accomplished; the mental faculties are gradually restored, the patient takes notice of surrounding objects, and is able to answer questions rationally. In some cases, complete restoration now ensues without further complication; but in others, after some hours, feverish symptoms supervene, the skin becomes hot and dry, the face is flushed, the eyes are bright, and the mental faculties are all in a state of excitement. The pulse becomes rapid and jerky, the respirations hurried; the patient is restless, and complains of thirst and headache. The temperature also rises to a varying extent. In this condition the patient may remain for a time, varying from a few hours to one or two days. Recovery is often by crisis, and after a long sleep complete convalescence may quickly ensue. In yet other cases, however, worse symptoms may follow, and a condition of 'prostration with excitement' may result; the rapidity and weakness of the pulse increase, respiration becomes gasping and hurried, the tongue is dry and tremulous, the patient becomes restless, and often wildly delirious, the temperature rises, and no sleep can be obtained. Exhaustion gradually supervenes, the pulse becomes running, the delirium becomes of the low and muttering variety, and the patient dies in a state of coma.

The above symptoms may be thus explained:—In consequence of the collapse induced by the injury, there is necessity for increased action of the various vital organs in order to preserve life. But, in consequence of the weakness induced by the same injury, there is a want of power in the organs on which the call is made. If the want of power be excessive and the need of action great, there results 'prostration with excitement;' if power be sufficient, a reaction which soon accomplishes its purpose will ensue.

Treatment.—So long as reaction is not excessive, there is no indication for treatment. If it be excessive or prolonged unduly, the indications are—(1) to support the patient's strength; (2) to moderate the excessive irritability of the vital organs. With regard to the first, stimulants must be sparingly given, and reliance placed rather on strong fluid nourishment, and nutrient enemata if vomiting be troublesome. The second indication is fulfilled by perfect rest and quiet, keeping the head cool, and giving opium or morphia in doses which are sufficient to produce the required effect, but which must be regulated according to the requirements of the case. Hyoscyamus and belladonna are also useful.

ANTHONY A. BOWLBY.

RECTOCELE—Prolapse of the posterior wall of the vagina. *See* VAGINA, Affections of the.

RECTO-VAGINAL FISTULA. *See* VAGINAL FISTULÆ.

RECTO-VESICAL FISTULA. — A communication between the rectum and the bladder, with usually the result of an escape of fæces or flatus into the bladder or urethra, or of urine into the rectum.

It may be congenital, or be caused by accident, operation, or ulceration. If the rectum be imperforate at birth, this condition is sometimes complicated by an arrest of development of the perineal septum between the bladder and rectum, so that a more or less considerable opening exists, through which meconium or fæces can pass into the bladder. If a free passage can be made in the normal situation into the bowel, the abnormal communication may subsequently close. If such a passage cannot be made, or if the recto-vesical communication persist, when a free channel has been made for the fæces in the normal situation, Littré's operation should be performed.

The rectum may sometimes be incised in the operations for lithotomy. It is said to happen more frequently than lithotomists are aware of. If so, the wound generally heals speedily. But, if a permanent fistula result, urine will escape into the bowel, and cause irritation and excoriation. Dilatation of the anus will probably bring the rectal opening into view. If it be very small, the application of the actual cautery will suffice, but if it be larger, the edges should be freshened and united by sutures, as in the operation for recto-vaginal fistula. The patient should maintain a lateral or prone position, and any accumulation of urine in the bladder be prevented until union has resulted. If this procedure be not successful, a grooved staff should be intro-

duced into the bladder, and by division of the intervening structures upon it a perineal fistula established. The wound will then heal by granulation.

A similar fistula occasionally resulted from the now seldom practised operation of tapping the bladder through the rectum, in retention of urine.

In malignant disease of the rectum, perforation from ulceration into the bladder may occur. Diversion of the fæces by the operation of lumbar colotomy would be the most suitable treatment; for the escape of fæcal matter into the bladder would probably induce cystitis, and might also give rise to retention of urine from obstruction of the vesical orifice.

Tuberculosis of the anal channel may sometimes result in recto-vesical fistula. Or the disease may originate in the prostate or vesiculæ seminales, and by ulcerating in both directions produce this condition. In this form of the affection, flatus rather than fæces may pass into the bladder or urethra, and urine may escape into the anal passage. The general condition of the patient must determine the propriety of operative interference. The establishment of a perineal fistula, by which the urine would constantly drain into a portable urinal, might give some relief.

JEREMIAH MCCARTHY.

RECTUM, Injuries and Diseases of the. The anus, from its superficial position, is liable to injury, like the rest of the surface of the body, from contusions, burns, and scalds. These do not require any special treatment or description. The orifice of the anus may be lacerated by the passage of large and hard accumulations of fæces, or of bones or similar substances which have been accidentally swallowed. As a rule these heal spontaneously, but in unhealthy subjects, or if bathed in irritating discharges, they may ulcerate. Attention to cleanliness, removal of the source of irritation, and the application of mildly stimulating lotions or ointments will suffice for treatment. In tedious or instrumental labour, pressure on the recto-vaginal septum may result in sloughing and the formation of a recto-vaginal fistula. Or, in the final effort of parturition, the perinæum may be ruptured, and if the laceration extend into the anus, incontinence of fæces will result. For the description and treatment of these conditions, *see* VAGINAL FISTULÆ; PERINEUM, Rupture of the.

Maniacs, idiots, and persons of depraved or weak intellect, sometimes introduce foreign bodies into the rectum, with more or less injury to the part. Medical literature abounds in instances of this kind. The writer met with a case where a man, in a drunken freak, had thrust an ordinary beer-glass, bottom upwards, into his rectum. It had passed beyond the sphincter muscles, which had firmly contracted. When he applied for relief, after an interval of some days, the rim of the glass was embedded in a deep ulcerated groove in the mucous membrane, which greatly increased the difficulty of extraction. Such cases must be treated according to the conditions of each case, and will sometimes tax to the uttermost the ingenuity of the surgeon. Rough, unskilful introduction of bougies or enema-tubes may sometimes result in perforation of the rectum. If the perforation be below the peritoneum, perirectal inflammation and suppuration will probably ensue. But if the peritoneum be perforated, and especially if nutrient or cathartic enemata have been pumped into its cavity, death from shock or peritonitis will be the most probable consequence. If the injury be recognised at the time, dilatation of the anus and the internal administration of opium and mercury should be employed.

For malformations of the rectum *see* ATRESIA ANI.

The mucous or submucous tissue of the bowel is exceedingly rarely the seat of a *nævoid* growth. Only two instances of this condition have been recorded, for which reference may be made to the *Lancet* and *Medico-Chirurgical Transactions* for 1883. When ulceration occurs, hæmorrhage to an even fatal extent may result. We can only direct attention to the possibility of this condition, and the treatment must be regulated according to the circumstances of each case.

Pain, tenesmus, constipation alternating with diarrhœa, the discharge of mucus, sero-purulent or sanious fluid, or of blood in varying degrees and combinations, are symptoms common to most diseases of the rectum. But, however clearly the history may indicate the nature of the affection, thorough and careful examination of the part must always be made. Patients, especially women, are sometimes most unwilling to submit to this. A surgeon ought never to yield to this objection, however natural. The writer has met with cases where the patient's life had been rendered miserable and the health seriously affected, from treatment directed in accordance with the statements of the patient, and without

examination of the part. Even when the cause may be seemingly apparent, as in fissure, piles, fistula, or the like, careful investigation will sometimes ascertain that these are only secondary results of some lesion higher in the bowel, or of some disease of the bladder or urethra.

Sometimes, especially in women, paresis of the muscular coat of the bowel results from long-continued and neglected constipation. This is known as *atony* of the rectum. From lack of expulsive power, the rectum is enormously distended with flatus or fæces. Careful regulation of diet, and the internal administration of the extracts of nux vomica and belladonna will usually ensure a restoration of the normal condition.

Inflammation of the Rectum. *See* Proctitis.

Inflammation of the Tissues surrounding the Rectum. *See* Periproctitis.

Neuralgia of the Rectum.—This may be defined as an abnormal excitability of the nerves or nerve-centres of the rectum, and the symptoms vary greatly. Sometimes, patients complain of pain in some parts of the rectum, paroxysmal or constant, unaffected by defæcation, for which no objective cause can be ascertained. Such patients are not infrequently of a markedly hysterical or hypochondriacal temperament, and, in the absence of any local cause, the treatment must be directed to the improvement of the mental condition. When there is no evidence of such disposition, the symptoms may possibly be due to a small exostosis pressing on some of the nerves supplying the rectum, or to some localised affection of the brain or spinal cord. The nervous condition of such patients should be carefully examined. The cases are, however, very rare, and the treatment must be modified according to the circumstances of each case. In other patients, this abnormal excitability may manifest itself by an almost irresistible desire to go to stool at unseasonable or impossible times, without any natural occasion. This has been designated by Curling as irritability of the rectum. As the intestine is now known to abound in many varieties of micro-organisms, by whose influence different decompositions are excited in the contents of the alimentary canal, it is not impossible that some specially irritating substance may be produced from such a cause in the secretions or contents of the rectum. Relief has been experienced, in such cases, by washing out the rectum with lukewarm water, and weak carbolic lotions might be tried, together with the internal administration of salicylic acid, by which the development of such micro-organisms is checked. But the mental condition has also great influence in these cases, as sometimes the irritability ceases or greatly abates when the patient is assured that he can, if necessary, satisfy his desires.

Polypus of the Rectum.—A new growth from the inner wall of the rectum. It is sometimes *papillary*, but more frequently *follicular*. The papillary form consists of elongated papillæ studded with secondary papillæ, usually sheathed with cylindrical epithelium and presenting a tuft-like appearance. The follicular variety is an outgrowth covered with mucous membrane, and has well-developed Lieberkühnian follicles. Muscular and fibrous elements also enter into its formation, and, according to the predominant tissue in it, the growth may be classed as adenoma, myoma, or fibroma. Adenoma and myoma are usually met with in children and young adults, while fibroma occurs more frequently in adults. It has been suggested that this is the result of time, and that the mucous membrane of the young growth may atrophy, and the residue become indurated by chronic inflammation.

The rectal polypus is generally solitary, but may be multiple, and may vary from the size of a raspberry to that of a hen's egg. It is very rarely larger than this, but the multiple variety may, in the aggregate, be large enough to obstruct the bowel.

The *symptoms* also vary. Sometimes a polypus is unnoticed during life, and only discovered by accident on the post-mortem table. Usually, however, it causes a mucous catarrh or hæmorrhage. Bleeding from the rectum after defæcation, in a young child, if there be no accidental injury to account for it, is almost certainly indicative of the existence of a polypus. If the peduncle be of sufficient length, the tumour may be protruded through the anus in defæcation, and is sometimes retained in that position by spasmodic contraction of the sphincter muscles. It is thus exposed to injury, and may ulcerate or become inflamed, and will always cause a disagreeable sensation as if some foreign body were lodged there. It is sometimes associated with ulceration of the mucous membrane of the bowel, especially with the variety known as fissure of the anus. It may also induce prolapse of the bowel or be complicated with internal piles. Sometimes an internal pile, indurated by chronic in-

flammation, is clinically indistinguishable from a fibrous polypus. In the multiple form, the mucous catarrh and hæmorrhage may be so great as to seriously impair the patient's health. This disease greatly resembles the villous growths which sometimes occur in the bladder. They are very rare, but are sometimes met with in more than one member of the same family. The growths present club-shaped protrusions, in some parts closely aggregated, in others more isolated. They are very vascular, and microscopically are found to consist chiefly of glandular tissue. *See* Villous Tumours.

The *diagnosis* can only be assured by digital and ocular examinations. In the event of the polypus having an attachment high up in the rectum, the examination should always be made immediately after an action of the bowels, when the tumour will be found either protruding from the anus or within reach of the finger. It could only be confounded with an internal pile, from which the history, situation, and pedicle will sufficiently distinguish it, except in the case of an indurated pile, which is practically a polypus and requires the same treatment. The multiple variety is unlike any other disease of the rectum, and when seen cannot be mistaken.

Treatment, in all cases, consists in ligature of the pedicle and abscission of the growth. Removal without ligature might cause troublesome hæmorrhage. If the pedicle be thin and soft, caution must be observed in applying the ligature, as the pedicle might be torn across and bleeding result. In order to bring the growth within reach of the operator, an enema of warm water is sometimes requisite. In the multiple variety, the growths are sometimes so closely aggregated as to render necessary the removal of the portion of mucous membrane from which they spring. This may be either cut off with scissors or by the galvanic écraseur. The more isolated growths should be ligatured and cut off like the solitary polypus. The growths are usually so numerous as to require more than one operation for their removal. The after-treatment in such cases would be the same as for internal piles. The removal of a solitary polypus usually requires no subsequent treatment.

Stricture and Obstruction of the Rectum.—Stricture of the rectum is an impaired distensibility of some part or parts of this portion of the bowel, caused by structural changes in its walls or in the tissues immediately surrounding it. It must be distinguished from obstruction of the rectum, which may be caused by the lumen of the tube being more or less completely filled by benign or malignant new-growths from its walls, or else compressed by similar growths from the neighbouring viscera or structures. As both impede or prevent defæcation, they may be treated of in the same article, although their origin and pathology are very different.

Stricture may be annular or tubular, and may be situated at the anal orifice, or at the juncture of the anus and rectum, or of the rectum and sigmoid flexure. These are the most usual situations, but it may be at any part of the rectum. It is usually single, and double stricture occurs very rarely. It may be of congenital origin. If the rectum be imperforate at birth, and if perineal dissection be requisite to expose the lower end of the bowel, stricture of the anal passage not infrequently results, and this is inevitable if the mucous and cutaneous surfaces cannot be united at the time of the operation. Stricture of the anal orifice may result from undue removal of the skin in operating for piles or prolapse, or from cicatrisation of deep ulceration caused by disease or accidental injury.

Syphilitic ulceration of the bowel may by cicatrisation induce stricture. If the ulceration continue, the reflex irritation produced by it will enhance the effect of the stricture. Such ulceration frequently occurs at the junction of the anus and rectum, and in the portion of bowel immediately above this junction, but it may occur at any part of the rectum. Any ulceration of the mucous membrane, whether simple, dysenteric, or tubercular, may have a similar result; but this rarely happens unless the deeper structures in the wall of the bowel have been involved in the process. Chronic catarrh of the rectum, with cicatricial contraction of the submucous coat may also cause it, and pelvic cellulitis, induced by disease or inflammation of the pelvic viscera, may be another exciting cause. It may also result from cancer.

When a stricture has existed for some time, the bowel above it becomes distended. Its muscular coats are hypertrophied, and the mucous membrane is very frequently ulcerated. If perforation of the bowel ensue, recto-vesical or recto-vaginal fistulæ may result, or, from peri-rectal suppuration, fistulous channels may open in the perineum or surrounding parts. If the stricture be above the anus, the mucous membrane in the lower part of the bowel usually becomes congested and inflamed. Mucous or purulent catarrh, piles, prolapse, and

anal fistulæ are then very frequent complications.

The earliest *symptoms* of stricture are constipation and difficulty in defæcation. But, as these conditions may result from many causes, a stricture may have existed for some time unknown to the patient. If it be inaccessible to ocular or digital examination, the *diagnosis* may present difficulty. The passage of ribbon-shaped motions was formerly regarded as a characteristic symptom. But if the stricture be at the upper part of the rectum, the motions, if there be any, will not have this form, and 'ribbon-shaped' fæces may be passed without the existence of any stricture, if the muscular structure of the rectum be unduly irritable. Constipation alternating with fluid motions, or the habitual passage of pellet-shaped fæces, are better indications. But these conditions may be due to obstruction as well as stricture. Bougies are sometimes deceptive. A fold of mucous membrane or the promontory of the sacrum may arrest the progress of the bougie, and induce the assumption of a non-existent stricture. It is sometimes useful to introduce a well-warmed and pliant O'Beirne's tube, and to pump some water into the bowel as the tube is advanced. It is, however, liable to coil upon itself, and so cause error. In doubtful cases, bimanual examination may be employed in adults with advantage. For this the patient should be placed in the lithotomy position and completely anæsthetised. The bladder having been emptied, the sphincters of the anus should be dilated, and the operator's left hand, well oiled, should be cautiously passed into the rectum. With the aid of the right hand pressed firmly into the left iliac fossa, the upper part of the rectum may thus be thoroughly explored.

If the passage be only moderately constricted, attention to diet and the use of laxative purgatives may enable the patient to live in comparative comfort. But if there be ulceration, the stricture will always be liable to inflammation, and by œdema and congestion of the mucous membrane may completely obstruct the passage. It has also a natural tendency to contraction, and may thus ultimately produce retention of fæces. If, in this condition, operative interference be delayed, ulceration and perforation of the distended bowel may result, and cause rapidly fatal peritonitis. This ulceration very frequently occurs in the cæcum. The treatment of stricture will vary with its position and cause. If it be at the anal orifice, a plastic operation, planned according to the circumstances of the case, sometimes effects a complete cure. If it be in the lower part of the rectum, dilatation may be employed. For this, laminaria tents are very serviceable. A tent of suitable size, with a long firmly attached tape loop, should, when lubricated with glycerine, be passed into the stricture and left there for twenty-four hours. When it is withdrawn, the passage will be found to be greatly enlarged, and the introduction every second day of a gum elastic bougie, well softened in warm water, will prevent a recurrence of contraction. The size of the bougie may with advantage be gradually increased. The bougie should not be introduced by the patient or any inexperienced attendant, for ill-directed efforts have in some cases led to perforation and a fatal result. If there be ulceration, appropriate treatment must be employed. But if it be extensive, the patient's comfort and prolongation of life will be best attained by the operation of left lumbar colotomy. As a regular daily evacuation can then be insured without discomfort, and as the ulcer will no longer be irritated by the passage of fæces, the patient's health will improve, the local pain cease, and the diseased surface be placed under more favourable conditions for repair.

Lumbar colotomy is also the best mode of treating strictures at the upper part of the rectum, and so inaccessible for dilatation, if they cause retention of fæces; and for all strictures complicated by recto-vesical or recto-vaginal fistulæ, or by perirectal sinuses opening on the perineum or adjacent parts. In some cases, when colotomy has been performed for persistent retention of fæces in consequence of a stricture at the upper part of the rectum, motions will, after a short time, again pass through the rectum. This results from relaxation of the stricture when no longer irritated by the accumulation of fæces above it, and by the straining efforts to expel them. If the condition of the rectum be curable, the lumbar opening may be closed when occasion for it has ceased. But, as a rule, it causes very little inconvenience, which is cheerfully endured by patients who have experienced the discomfort and danger of retention or difficult evacuation of fæces.

Forcible dilatation of rectal strictures by specially contrived instruments, or by water pressure, is very dangerous. The incision of the stricture in one or many parts, though advocated by some surgeons, does not appear to be free from danger of pyæmia or perirectal inflammation. Recently, linear

proctotomy has been performed, with alleged good results, for simple strictures near the lower end of the rectum. For this purpose, a suitably curved trocar and canula should be introduced into the rectum, passed through the wall of the bowel above the stricture in the median line posteriorly, and through the cutaneous surface below the coccyx. The trocar having been withdrawn, the wire of an écraseur should be passed through the canula, and all the structures within the loop of wire slowly cut through. The galvanic écraseur may also be used for this purpose. The wound should be dressed in the ordinary way, and allowed to heal by granulation.

Obstruction of the rectum, due to growths within the bowel or to pressure from without, will cause symptoms similar to those of stricture. Very rarely, a large fibroid polypus may be the cause, or more rarely still some other benign growth. Syphilis may sometimes produce it by broad outgrowths from the mucous membrane. Cancer of the rectum is a frequent cause, and, in these cases, sometimes stricture and obstruction from new growths are combined. Malignant disease of the bladder, or uterus and ovaries, sarcoma of the sacrum, or even hydatid tumours, may occasion obstruction. When a fibroid polypus or other benign growth exists, it should be removed in the appropriate manner. Obstruction from syphilis should be treated with anti-syphilitic remedies, and, if relief be not speedily derived, colotomy should be performed. In obstruction from any other cause, colotomy will be necessary to relieve the immediate retention of fæces, and in some cases as a preliminary to further operations, such as excision of the lower part of the rectum. When the obstruction is due primarily to disease of the uterus, the possibility of obstruction of the cæcum or some part of the small intestine as well as of the rectum, should be remembered, and careful examination of the abdomen be made by percussion and palpation; so as if possible to determine whether left or right lumbar colotomy or enterotomy would be the most suitable procedure.

Ulceration of the Rectum.—The mucous membrane of the rectum is liable to ulceration from many causes. The passage and presence of fæces or flatus have no injurious effect on the normal mucous surface. But, if there be any lesion of this surface, the deeper structures do not possess this immunity, and may thus become the seat of inflammation and suppuration from the irritation of fæcal matter or of intestinal gases. Simple ulcers may therefore result from wounds caused by fish-bones or the like, which have been accidentally swallowed, or by roughly introduced enema-tubes or other instruments.

Chronic catarrh may, by long-continued maceration, render the mucous surface liable to abrasion and so induce ulceration. The solitary lymphoid glands of the rectum are, like those in the other parts of the intestine, liable to inflammation and suppuration, and if the resulting abscesses burst into the rectum, funnel-shaped ulcers of minute size will result. These, if many in number and close together, may become confluent, and so cause destruction of a considerable extent of mucous surface.

Dysentery, tuberculosis, syphilis, and malignant disease of the rectum, frequently produce ulceration.

Leucorrhœal or other vaginal discharges may also cause ulceration of the anal orifice or passage.

Follicular, dysenteric, and tubercular ulcers are not limited to the rectum, and affect a more or less considerable extent of the rest of the intestine. They belong, therefore, to medical rather than surgical practice, and surgical interference is only required if perforation of the rectum has occurred, when pelvic cellulitis, ischio-rectal abscess, and perineal, recto-vesical or recto-vaginal fistulæ may result.

The *symptoms* of simple ulceration will vary with the situation of the ulcer. If it be at the orifice or in the anal passage, the patient will probably experience pain in defæcation, and there may be great spasm of the sphincter muscles. There will always be a discharge of muco-purulent or purulent fluid, and sometimes of blood. If the ulcer be above the anus, there will not usually be any pain, and the discharge alone will indicate that the condition of the part is abnormal. Digital and ocular examination must ascertain the cause. Sometimes, an ulcer may exist without the patient being in any way aware of it.

The *treatment* is sufficiently simple. Attention to diet, mild laxatives, and iodoform in powder or as an ointment, or cotton wool steeped in a two per cent. solution of nitrate of silver applied locally, will usually ensure healing. If there be much pain or spasm, forcible dilatation of the anus when the patient has been anæsthetised will produce temporary paresis of the sphincter muscles, and so expedite the case by relieving pain. If the ulceration result from chronic catarrh, the exciting cause

must be removed and then the above treatment employed.

Syphilitic ulceration may occur in any stage of the disease. The anal orifice or passage may be the seat of a primary sore from accidental infection or unnatural intercourse. It will cause pain in defæcation, and may from irritation by fæcal matter become very large. The induration and the indications of syphilis in lymphatic glands, &c., will render the diagnosis easy. Ordinary anti-syphilitic treatment will, with attention to cleanliness, suffice. Phagedenic ulceration must be treated, as elsewhere, by cauterisation with nitric acid or chloride of zinc, hot baths, poultices, tonics, and abundant nutriment.

The loss of tissue is considerable, and stricture of the orifice generally results. This must be treated by dilatation or a plastic operation, according to circumstances.

In the secondary stage, mucous papules in the anus or condylomata round it may, in unhealthy subjects, suppurate and produce extensive serpiginous ulceration. Iodide of potassium in five-grain doses, hot baths, iodoform in powder, and, if necessary, cauterisation with nitric acid will be the suitable mode of treatment.

In the tertiary stage, the lower part of the rectum is, especially in women, a frequent seat of syphilis. The submucous tissue may be uniformly infiltrated so as to produce rigidity and stenosis of the bowel, or gummata of large size may cause projections into the lumen of the tube, or numerous minute gummata may form and gradually extend for a considerable distance up the rectum. Ulceration of the mucous membrane speedily ensues. The patient will suffer from obstruction or stenosis of the bowel. The discharge of sanious, offensive fluid is abundant, and the pain is often very severe. Perforation into the vagina frequently occurs. The diagnosis is often very difficult. A history of syphilis or evidence of the disease in other parts of the body may indicate the nature of the case; but, when the distance is extensive, it does not yield readily to anti-syphilitic treatment. In such cases lumbar colotomy would be most suitable, and, the ulcerated surface being no longer irritated by the passage of fæces, would be more likely to heal. In less severe cases, irrigation with dilute Condy's fluid, and the internal administration of decoction of bark with biniodide of mercury, will be found beneficial. One-drachm doses of the liq. hydrargyri bichloridi, with five-grain doses of the iodide of potassium, will be found to be a most convenient method of administering the biniodide of mercury.

Malignant Disease of the Rectum.—The mucous membrane of the rectum at, and for some extent above, its junction with the anus, is not infrequently subject to hyperplasia. This at first results in considerable enlargement of Lieberkühn's follicles, and, as secondary consequences of irritation, hypertrophy of the tunica mucosa muscularis and infiltration of the submucous tissue with leucocytes. The growth may be greater at some parts of the circumference of the bowel than at others, with the result of irregular projections into the lumen of the tube. There is also increased vascularity. If this be all, the growth is benign, and forms the superficial adenoma of Klebs. But, if the continuity of the membrana propria or basement membrane be broken through, and if the epithelial cells grow or pass along the lymph-channels among the component elements of the other structures of the bowel, it becomes true cancer. The immigrant cells form centres for new epithelial growths, which produce, by irritation, changes in the surrounding structures. These growths contribute to the obstruction of the bowel, and by pressure may produce atrophy and ulceration of the mucous surface. The disease may in this manner extend along the bowel, or invade the perirectal tissues and neighbouring organs, such as the vagina, prostate, or bladder. If perforation of the bowel ensue, ischio-rectal suppuration and perineal sinuses may result, or fistulous communications form into the vagina or bladder. The lymphatic glands in connection with the bowel, and the liver through the portal system of veins, may be the seat of secondary growths, and cancerous cachexia ensue.

If the irritative process predominate in the growths, scirrhus will result, with induration and contraction of the walls of the bowel. This variety of cancer does not occur frequently in the rectum. If the epithelial growths form the chief part, the cancer is soft or encephaloid. In this variety there is less induration and contraction, but the lumen of the bowel is obstructed by large, very vascular growths, which are sometimes of the cauliflower form and are very liable to slough. The epithelial new-growth tends to develop according to the type of the normal epithelium of the part from which it is derived. Microscopic examination of soft cancer of the rectum usually discloses, therefore, a

tubular structure, the tubules being sheathed with a single layer of cylindrical epithelial cells, and resembling Lieberkühn's follicles. This constitutes what is known as cylindrical-celled or adenoid carcinoma or epithelioma. Colloid cancer will result from the corresponding degeneration of the epithelium, so that elements of the new growth resemble boiled sago-grains embedded in the surrounding indurated tissues. Melanosis also sometimes occurs in the rectum.

The *symptoms* are at first very indefinite. As the disease is usually painless until ulceration has taken place, constipation and difficulty in defæcation are the first indications. When ulcers form, discharge of sero-purulent or sanious fluid or of blood will occur, but, if the case be complicated with piles, the source of the discharge may be mistaken. Careful exploration of the rectum should therefore be made in all cases of constipation or of purulent or other discharge from the bowel. When the growth presses upon the nerves of the sacral plexus, cramps and painful sensations in the lower extremities are often experienced. If the bladder or prostate be involved, there may be difficulty in micturition, and the passage of fæces into the bladder through a fistulous opening will very probably produce cystitis. As the ulceration progresses, pain in defæcation increases, and complete obstruction of the bowels often results; partly from the occlusion of the tube by growths or by contraction, and partly from the arrest of peristalsis, in consequence of the muscular fibres of the bowel being destroyed or impaired. The rate of progress will vary with the nature of the cancer. In the firm, contracting variety, it is much less rapid than in the encephaloid form.

Cancer of the other pelvic viscera may, by direct continuity, invade the rectum. In such cases, obstruction of the bowels will, so far as regards the rectum, usually be the chief symptom.

The anal passage is sheathed with squamous stratified epithelium, and the external orifice is abundantly supplied with anal glands. The epithelium of these glands, or of the rete mucosum, may be the starting point of new growths. When these have perforated the basement membrane, epithelioma of the anus is the result. It usually commences as a small nodule or wart, which has sometimes been mistaken for an external or intermediate pile. The surface, however, soon becomes fissured and ulcerated, and bleeding or sanious discharge results. The disease generally extends along the cutaneous surface round the anus, but it may also pass up the bowel, or in both directions simultaneously. Anal epithelioma is much more painful than rectal cancer. The pain during defæcation is very severe, and it is also more constant than in the rectal disease, and often radiates to distant parts.

The *diagnosis* of malignant disease of the rectum does not usually present much difficulty. Syphilitic ulceration is alone likely to be mistaken for it. The margin of the anus is sometimes from accidental infection, or from unnatural intercourse, the seat of a primary syphilitic sore. If this be of an unhealthy character, it may very greatly resemble an epitheliomatous ulcer. But anal epithelioma is usually an affection of advanced life, and primary syphilis would probably occur in younger persons. The history of the case, the presence or absence of other indications of syphilis, and the result of antisyphilitic treatment, in doubtful cases, should render the diagnosis certain. Syphilitic ulceration of the rectum is not so readily distinguishable from cancer. The lower part of the rectum is a frequent seat, especially in women, of tertiary syphilitic growths, which may be of sufficient size to considerably obstruct the tube, and when ulceration ensues the resemblance to cancer is very great.

Some writers suggest microscopic examination of shreds detached from the ulcerated surface as a diagnostic means; but while it might possibly corroborate a diagnosis formed on other grounds, in really difficult cases it would not be of much service, and the suggestion appears to be theoretical rather than practical. The history of the case, the general condition of the patient, and the effect of antisyphilitic treatment would form the best grounds for a diagnosis; and in bad cases, the palliative treatment of lumbar colotomy would be the same for both affections.

Treatment.—Anal epithelioma must be freely removed as in other parts of the body, unless the disease has progressed too far to admit of operation. If the growth be limited in size and superficial, it may be at once excised, and hæmorrhage arrested by ligature of vessels or by the actual cautery. Iodoform in powder would be the best subsequent application. But if the extent of the disease requires the removal of a portion of the anal wall, the passage should be forcibly dilated, and a curved incision of suitable extent should be made in the healthy skin corresponding in situation to the part that is to be removed. The dissection

should then be carried up through the perineal tissues, until the upper limit of the growth has been passed, and the diseased portion removed by the ordinary or galvanic écraseur, or with the knife or scissors, according to the circumstances of the case and the predilection of the operator.

When the anterior wall has to be removed, the introduction of a full-sized metal catheter into the bladder will be of service in indicating the position of the urethra and prostate gland. If the whole of the anus must be removed, the incision must be made correspondingly, and the isolated bowel excised with the écraseur. Some recommend the preliminary insertion of ligatures a little above the proposed line of excision, which may afterwards be used to unite the mucous and cutaneous surfaces. If this can be accomplished, the liability to subsequent stricture will be greatly diminished; but, as a rule, the tension of the parts is such as to cause the sutures to cut through and be useless.

Cancer of the rectum has latterly, owing to the enterprise of Continental and more recently of English surgeons, been treated by operation much more than was formerly deemed possible or justifiable. Experience has proved that three or four inches in length of the bowel can be removed with safety at the time of the operation, and with the result of complete cure in some cases, and of great amelioration in others. The indications for removal are that the upper limit of the growth should be accessible, and should not be so far from the anal orifice as to endanger wounding the peritoneum during the operation; and that the disease should be limited to the rectum and not involve the other pelvic viscera. The absence of secondary growths in lymphatic glands or in the liver should also, so far as possible, be ascertained. These conditions being fulfilled, an extension upward of the dissection required for removal of the anus until the upper limit of the growth has been passed, and the removal of the isolated bowel by the écraseur, would suffice. Attempts to unite the mucous and cutaneous surfaces are useless. Opening the peritoneal sac very seriously affects the chance of a successful result. In order to so far as possible prevent this occurrence, the bladder should be distended by injections of water, by which the recto-vesical fold of peritoneum would be considerably elevated. If it should be wounded, the aperture, if small, should be closed by a ligature, and, if large, a drainage-tube should be inserted, and opium freely administered. In all such operations, and also when the whole or a large part of the anus is to be removed, lumbar colotomy is, in the writer's opinion, most advisable as a preliminary. When this has been performed, a daily painless evacuation can take place, the nutrition of the patient is not interfered with, the ulcerated bowel is no longer irritated by the passage of fæces, or by the existence of fetid gases resulting from the fermentation of retained fæces; and the wound caused by the subsequent operation is also free from such noxious influences.

In some cases, a portion only of the wall of the rectum will require removal. This can be accomplished after forcible dilatation of the anus, or division in the median line posteriorly of all the tissues from the mucous membrane to the skin, extending as high as the tip of the coccyx. The requisite portion of the rectum can be removed with scissors or the écraseur. Incontinence of fæces is not very frequently a result of these operations.

In cases where removal of the growth is impossible, lumbar colotomy will be the best palliative treatment. Careful irrigation of the rectum, with carbolic acid solution or with diluted Condy's fluid, should also be employed. Scraping the ulcerated surface, and subsequently applying the actual cautery to it, are sometimes of service, and appear, for a time at any rate, to promote a growth of healthy granulation-tissue.

Sarcoma seldom occurs primarily in the rectum, but may invade it from other surrounding parts. It is not impossible that some of the recorded cases of encephaloid cancer may really have been sarcomata, in the days when the microscopic characteristics of both kinds of growth had not been so clearly distinguished as they have been in later times. The treatment would be the same as for cancer.

See also Fissure of the Anus; Fistula in Ano; Hæmorrhoids; Periproctitis; Proctitis; Prolapsus Ani et Recti; Pruritus Ani; Recto-Vesical Fistula.

Jeremiah McCarthy.

REDUCTION EN BLOC, or EN MASSE. *See* Hernia, Strangulated.

REFRACTION, Errors of.—In this article the following abbreviations are employed:—A., accommodation; As., astigmatism; D., dioptre; E., emmetropia; F_h, horizontal focus; F vertical focus; H., hypermetropia; M., myopia; V., vision;

$+^{ve}$, convex; $-^{ve}$, concave; <, less than; ′, one foot or one minute; ″, one inch or one second; ⌒, combined with.—The function of the refracting apparatus of the eye is to bring rays proceeding from external objects to a focus on the sentient layer of the retina, and thereby give a distinct image of such objects. The calculation of the passage of rays of light through the various media of the eye—cornea, lens, &c.—is a very complicated one; in order to simplify it, it has been proposed to substitute for the actual eye a diagrammatic one consisting of a single refracting surface, bounded anteriorly by air and posteriorly by vitreous humour. The dimensions of such an eye have been fixed by Donders as follows:—Radius of curvature of the single refracting surface (the cornea) = 5 mm.; total length of the eye from cornea to retina = 20 mm.; distance of nodal point behind the cornea = 5 mm.; index of refraction = $\frac{4}{3}$. It will be seen that the nodal point coincides with the centre of the cornea. This goes by the name of the 'reduced eye' of Donders; with it calculations about the optical properties of the eye are very simple, and the results are so nearly correct as to suffice for all practical purposes.

The relation between the refractive power and the length of axis of the 'reduced eye' is such, that parallel rays falling on the cornea are brought to a focus on the retina. Such an eye is called *emmetropic*, or is said to be in a condition of *emmetropia* (E.). This relation may be disturbed, so that the focus of entering parallel rays is either (1) anterior to the retina or (2) posterior to it; in the former case the eye is called *myopic*, or is said to be in a state of *myopia* (M.); in the latter the eye is called *hypermetropic*, or is said to be in a state of *hypermetropia* (H.).

In neither of these cases is a distinct image of a distant external object formed on the retina; the image of any *point* of such an object is not a *point* on the retina, but a circle of diffusion, the rays proceeding from the external point having come to a focus before reaching the retina in (M.), or being on their way to a focus behind the retina in (H.). In both cases the image of the external object is a number of overlapping circles of diffusion, and is therefore blurred.

There is a third anomalous condition of the eye, in which the image on the retina of an external point is not itself a point; this is the affection known as *astigmatism* (As.), which we shall describe later on.

These three departures from *emmetropia*—viz. *myopia*, *hypermetropia*, and *astigmatism*—are what we have to consider. They are often collectively described as *ametropia*.

Before the description of these affections a few words must be said about—(1) *the numbering of lenses*; (2) *the accommodation of the eye*; (3) *the determination of the acuity of vision*.

Numbering of Lenses.—Till a few years ago, lenses were numbered according to their *focal length*, generally expressed in inches, and the unit of measurement taken was a lens whose *focal length* was one inch, and whose *focal power*, therefore, being the reciprocal of the focal length, would be expressed by unity. Nearly all other lenses with which oculists have to deal are of a longer focal length than one inch, say twelve or twenty inches. The focal power of these lenses would be expressed by fractions $\frac{1}{12}$ and $\frac{1}{20}$ in the cases we have chosen for illustration. Working out combinations of these lenses necessitated much troublesome calculation of fractions. To avoid this, as well as other disadvantages, the *metrical system* of numbering lenses has been suggested, and is now almost universally adopted.

Here the unit of measurement is a lens whose focal length is 1 mètre. The focal power of this lens is called a *dioptre* (1 D); shortly, the lens itself is called a *dioptre*. A lens of twice the refractive power, and whose focal length is therefore half a mètre, is called 2 dioptres (2 D). A lens of half the focal power of the first will be ·50 D, and have a focal length of 2 mètres, and so on. The focal lengths are better expressed in centimètres; thus the focal length of a lens of 1 D is 100 cm.; of 2 D, 50 cm.; and *generally* the focal length of a lens is found in centimètres by dividing 100 by the number of the lens in dioptres; and conversely the focal power of a lens is found in dioptres by dividing 100 by the number of centimètres in the focal length.

For example, take a lens of 5 D; what is its focal length in centimetres?—$\frac{100}{5} = 20$; therefore the focal length is 20 cm.

Again, what is the focal power of a lens of 40 cm. focal length?—$\frac{100}{40} = \frac{5}{2} = 2{\cdot}50$; therefore the strength of the lens is 2·50 D.

Of course the signs + and − are prefixed to numbers denoting the strength of the lens according as the lens is convex or concave.

To convert from inches to dioptres is equally simple. Only English inches will

here be referred to. A mètre = 40 in. nearly; therefore a lens of 1 D has focal length of 40 in., and therefore a focal power of $\frac{1}{40}$, according to the old notation. A lens of 3 D is three times as strong as the first; therefore its focal power, according to the old notation, is $\frac{3}{40}$, and its focal length $\frac{40}{3} = 13\frac{1}{3}$ in.

The general rule is: to find the number of D in a lens, divide 40 by its focal length in (English) inches; to find the focal length of a lens in (English) inches, divide 40 by the number of D in the lens.

Thus a lens whose focal length is 12″ is $\frac{40}{12} = 3{\cdot}5$ D (nearly); and a lens of 7 D has a focal length $= \frac{40}{7} = 6''$ (nearly).

In the following article lengths will, as a rule, be expressed in mètres and centimètres; occasionally the equivalent in feet or inches being given. It is useful to remember that, approximately, 1 mètre = 40″; 1 cm. = $\frac{2''}{5}$; 1 mm. = $\frac{1''}{50}$.

Accommodation (A.).—All eyes have the power of increasing by a muscular effort their refractive power; this is known as the power of accommodation. This is not the place to discuss the physiology of the act; all we are concerned with is the measure of it. Donders showed that the amount of accommodation was independent of the refractive condition of the eye, and depended only on the age of the individual. It is very convenient to imagine that the eye, in calling into action its power of accommodation, takes to itself an auxiliary convex lens, the strength of which equals the increase of refractive power caused by the accommodative effort. This auxiliary lens ought, strictly, to be imagined as being placed in the position of the nodal point of the eye, but we may, without an error of practical importance, suppose it placed in front of the eye, in the position of an ordinary spectacle-glass. This way of looking upon accommodation, as a power residing in the eye of placing in front of itself a magnifying glass of suitable strength, will be found very useful when we come to examine the various errors of refraction.

The strength of this imaginary auxiliary lens is best expressed in dioptries.

The greatest amount of accommodation an eye can exert is called its *amplitude of accommodation.*

Donders drew up the following table of the amplitude of accommodation possessed by the eye at different ages:—

Age	Amplitude of Accommodation	Age	Amplitude of Accommodation
10 years	14 D	40 years	4·5 D
15 „	12 D	45 „	3·5 D
20 „	10 D	50 „	2·5 D
25 „	8·5 D	55 „	1·75 D
30 „	7 D	70 „	·25 D
35 „	5·5 D	75 „	0·00 D

In making the experiments on which this table is founded, the eye was tested alone, without the co-operation of the other eye. This is hence called the *amplitude of absolute accommodation*; when both eyes are uncovered, the *amplitude of binocular accommodation* is obtained. This is somewhat different from the results in the above table. *See* Accommodation of the Eye.

Determination of the Acuity of Vision.—The standard proposed by Snellen, and now generally adopted, is that a letter should be recognised, under proper illumination, when it subtends an angle of 5′, the breadth of its limbs being one-fifth of its height, and therefore subtending an angle of 1′.

A scale of test-types has been constructed on this principle by Snellen. The scale consists of a series of rows of square Roman letters; each row has a number, which expresses in mètres the distance at which the letters in the row are seen under an angle of 5′, and should therefore be recognised by a normal eye.

A special card is made for testing the sight at a distance so considerable that rays diverging from a point at that distance may be considered parallel. This card has seven rows of letters, which bear the numbers 60, 36, 24, 18, 12, 9, 6; it is most conveniently placed at a distance of six mètres (about twenty feet), that being the distance at which the letters of the row 6 should be made out. The acuity of vision (for which the symbol v is commonly used) is expressed by a fraction, of which the numerator is the distance at which the card is placed—viz. six mètres, and the denominator the number appended to the smallest row of letters which can be read.

Thus, if the smallest row of all is read, $v = \frac{6}{6}$; if row 12, $v = \frac{6}{12}$, and so on. If the types be placed at a different distance, it will be necessary to alter the numerator; for instance, if they be placed at four mètres, and the row 9 of the above card be the smallest read, $v = \frac{4}{9}$; at this distance we

have no types on the card small enough to express unity, which represents the standard of distinct vision; to do this, we should have to add to the card smaller letters still. It is immaterial what distance be chosen, so long as it is great enough for rays proceeding from that distance to be practically parallel; but six mètres, having come into general use, may be conveniently adopted for the sake of uniformity. Before the metrical system was generally adopted, distances were expressed in feet, and the numbers appended to the rows of letters correspondingly altered. Thus the row of largest letters was No. 200, the others being 100, 70, 50, 40, 30, 20.

In this case, the row of smallest letters being seen at twenty feet, v would be $\frac{20}{20}$ instead of $\frac{6}{6}$ as above; decreasing acuity of vision would be expressed by $v = \frac{20}{30} = \frac{20}{50}$, and so on, corresponding to $v = \frac{6}{9}$, &c.

In addition to the distance-test, eyes are often examined with smaller types at short distances; for this, Snellen's series may still be used; but the types of Jaeger are generally preferred. These are numbered 1, 2, 4, up to 20. In testing the sight, the number of the type that is read, and the distance at which it is read, should be noted.

It is necessary to ascertain not only what the unaided eye can read, but also what help lenses afford. For this purpose the surgeon should be provided with a case of test-glasses. This contains a series of pairs of convex lenses of increasing strength, from ·5 D up to 20 D; a similar series of concave lenses, convex and concave cylindrical lenses, prisms, trial frames, &c. Each eye should be tested, and the result noted, separately.

It will be found a great saving of time to set to work methodically; the following procedure is recommended:—A trial frame is fitted on the patient's face, and an opaque disc placed in front of the left eye, so that the right eye is uncovered for testing. The patient is then invited to read Jaeger's No. 1, holding the types at any distance he chooses; if he fails to read Jaeger 1, he is tried with Jaeger 2, 4, &c., still at his own distance, till the smallest type he can read is found. This is noted, and also the distance at which he holds it for reading. Not much stress need be laid on this reading of *near* types as a test of acuity of vision; a presbyope, for instance, with perfect acuity of vision, might not be able to read even large letters near at hand unaided by convex glasses.

The test is now continued with the *distant* types. And here it should be explained that, in ophthalmic works, a *distant* object means any object that is so far distant from the eye that rays proceeding from it may be considered to enter the eye practically parallel. This distance is conventionally put at about six mètres; in the following pages we shall then mean by a *distant* object an object at about six mètres.

The patient is accordingly invited to read Snellen's card of types placed at six mètres; he is told to begin at the row of largest letters, and read the other rows upwards or downwards as the case may be; the result is then noted. Further, the effect of putting + and − glasses in the trial frame is noted; but we must wait till the errors of refraction have been discussed before this effect can be appreciated. Suppose the patient reads Jaeger's 2 at 10″, and at six mètres row 9; the result would be thus noted—

R.E. (right eye.)
J. 2 at 25 cm.
$v = \frac{6}{9}$.

If we wished to examine the *near* vision more closely, we ought to find his near and far point. In the above case, for example, the patient might be able to bring J. 2 up to within 10 cm. of his face, and still read it, or remove it to 30 cm., and still see it.

This might be noted thus: J. 2, 10 cm. − 30 cm. In finding the far point, care must be taken to test the eye with print adapted to the distance of that point from the eye. Thus, J. 1 is too small to be seen by an eye of good visual acuity at a greater distance than 35 or 40 cm. Beyond this distance larger print must be used. *See* Visual Acuity.

The various errors of refraction may now be discussed; these being (*a*) *myopia*, (*b*) *hypermetropia*, (*c*) *astigmatism*.

(*a*) Myopia.—Here parallel rays come to a focus in front of the retina. This may arise either from an increase of refractive power in the dioptric apparatus of the eye, the entering parallel rays being consequently bent more abruptly, or from an increase in the length of the eye. It is usually due to the latter cause—the axis of the eye is too long. It is convenient, however, to consider it as depending on an increase in the refractive power of the eye; as it is only the *relation* between these two factors that we are concerned with, this way of viewing the matter is practically correct

We say, then, that in M. the refractive power of the eye is too great. We may imagine that a myopic eye is an emmetropic eye armed with a convex lens in front of itself, just as we did in considering accommodation. The strength of this hypothetical lens will then express the amount of M. For instance, in M. of 4 D, this lens is 4 D; this will make parallel rays diverging from its principal focus—i.e. from a distance of $\frac{100}{4}$ cm.; such parallel rays entering, then, the emmetropic eye, which we have considered combined with the convex lens to form the myopic eye, will be brought accurately to a focus on its retina, and therefore an external object, at a distance of $\frac{100}{4}$ cm. from this myopic eye, will be seen distinctly. Objects at all other distances will be seen indistinctly, so long as the accommodation of the eye remains at rest.

A myopic eye, however, has the power of accommodation like any other eye; this power, we have seen, is equivalent to placing in front of the eye a convex lens, of the strength necessary to focus on the retina rays from any object which such an eye can possibly see. It is evident that all objects situated farther from this myopic eye than $\frac{100}{4}$ cm. are out of its range of distinct vision. Rays from such objects are already brought to a focus in front of its retina; the calling into action of the power of accommodation would only bring them to a focus still farther in front of the retina, and consequently make the images more blurred. It is different, however, with objects situated nearer the eye than $\frac{100}{4}$ cm.; rays from such objects unite behind the retina, and an appropriate convex lens will bring them exactly to a focus on it; this lens the eye, bringing into play its accommodation, automatically selects when a distinct image of such objects is desired. There is a limit, however, in this direction also. An eye has at its disposal only a certain amount of accommodative power, expressed by a convex lens of a certain number of dioptres; this must not be exceeded.

An example may make this clearer. Keeping still to the eye with M. = 4 D, let us suppose that the amount of accommodation at its disposal = 6 D. Then, with A. altogether in abeyance, the eye will see distinctly only objects at a distance of $\frac{100}{4}$ cm. Suppose now it calls into play 2 D of its A.; it is then in the position of an emmetropic eye with a lens = + 6 D in front of it [4 D for the M. and 2 D for the A.]. The eye then will see objects distinctly at a distance of $\frac{100}{6}$ cm. If 5 D of its A. be used, objects will be seen distinctly at $\frac{100}{4+5} = \frac{100}{9}$ cm.

If the whole of A.—i.e. 6 D—be called into use, the only distance of distinct vision will be $\frac{100}{4+6} = 10$ cm. This is the nearest point of distinct vision. The farthest point of distinct vision is, as has been shown above, $\frac{100}{4} = 25$ cm. This eye, then, has a range of distinct vision between the distances of 10 cm. and 25 cm. measured from itself.

The nearest point of distinct vision is called the *punctum proximum*, or *near point*, and its distance from the eye is denoted by P; the farthest point of distinct vision is called the *punctum remotum*, or *far point*, and its distance from the eye is denoted by R; R − P is then the distance over which the eye has distinct vision, and $\frac{100}{P} - \frac{100}{R}$ = the number of D in the amplitude of accommodation [P and R being expressed in cm.].

Moreover, the lens which expresses the amount of M. is that whose focal length = R, and which therefore = $\frac{100}{R}$ D.

Etiology.—M. does not often appear before the eighth or ninth year; it generally progresses till adult age is reached. It is frequently hereditary, but may be induced by constant use of the eyes on very fine work, as that of watchmakers, &c. It is relatively common amongst the more civilised communities, and the more studious sections of those communities. M. occurs very frequently in those who have had defective sight from childhood; this is probably due to their constantly bringing objects close to the eyes, in order to get large retinal images. Any disease which causes increased curvature of the cornea will also cause M.; the most remarkable instance of this is 'conical cornea.'

The amount of M. varies within wide limits; up to 4 D would be called a low grade; 10 to 12 D is a pretty high amount, but much higher degrees occur—up to 20, 25, and even 30 D. The amount is often not the same in both eyes.

Symptoms.—In the low degrees, the only inconvenience is, usually, that the patient

cannot distinctly see distant objects. For near ones the sight is uncommonly good; in looking at distant things the myope partially closes the eyelids in a very characteristic manner; in this way he is able to narrow the circles of diffusion, and thus get a more distinct image.

In the higher degrees, the eye is seen to be decidedly too prominent; the patient complains of aching of the eyes on working, especially by artificial light; there is a constant feeling of tension; sometimes severe headache; flashes of light and muscæ volitantes. All these troubles are generally the greater the higher the degree of M.; they are worst of all when M. is rapidly increasing. In the high degrees there may be considerable diminution of the acuity of vision.

Diagnosis and Measurement.—If distant vision be improved by concave glasses, it is generally speaking a case of M.; sometimes, however, H. simulates M. This will be referred to later on. In examining a case where M. is suspected, it is most convenient to test the vision for near objects first. If the patient complains of very defective distant vision, whilst No. 1 of Jaeger's test types is read close at hand, it is almost certainly a case of M. To estimate the amount of M., find the *punctum remotum*—i.e. find the greatest distance at which the patient can read Jaeger 1 or 2. We have seen above that R is the focal length of the lens that measures M. Suppose, for instance, R = 20 cm.

$$\text{Then M.} = \frac{100}{20}\text{ D} = 5\text{ D}.$$

But the accurate estimation of M. must be made with Snellen's large test-types at 6 mètres. A myopic eye, we have seen, may be regarded as an emmetropic eye armed with a convex glass, the strength of which is a measure of the M. We know the strength of this hypothetical convex lens, if we know the concave lens that neutralises it—i.e. brings the eye into the condition of an emmetropic one. Now the characteristic of an emmetropic eye is that it brings parallel rays to a focus on its retina, and therefore, if healthy, has the normal acuity of vision for distant objects, i.e.—has $V = \frac{6}{6}$. We find, then, the weakest concave lens, which in the case of the myopic eye gives $V = \frac{6}{6}$; and this lens gives us the amount of M. It may be that no concave lens brings V up to $\frac{6}{6}$; in this case there must be some other condition complicating the M; some astigmatism, perhaps, or some degenerative change in the retina. Here we find the weakest concave lens, which gives the *best attainable acuity of vision* at 6 mètres, and this we take to be a measure of the M. It must be the *weakest* concave lens; with a stronger concave lens V might still be as good, but the lens would not represent the amount of M.; accommodation would be called into play to the amount necessary to correct the excess of strength of the lens; and this latter would represent not only the M. of the eye in a state of rest, but also the amount of accommodation so exercised. Take, for instance, an eye for which, with the small types, we find R = 15 cm.

This would give as a rough estimate $\text{M.} = \frac{100}{15} = 7\text{ D}$ nearly. We put up −7 D in the trial frame, and find $V = \frac{6}{9}$; we hold up in front of this glass an additional − 1 D; we now find that $V = \frac{6}{6}$. M. then = 8 D.

If now we put up − 8 D in the frame and hold an additional − 1 D in front of this, we may still find that $V = \frac{6}{6}$. It would be an error to say, however, that M. = 9 D. What happens when we put up this additional − 1 D is this: − 8 D has brought the parallel rays coming from the test-types accurately to a focus on the retina, as is proved by the fact that with this glass the eye has the standard acuteness of vision; when − 1 D is put up in addition, it makes these parallel rays divergent. To focus these on the retina the eye must increase its refractive power to the extent of 1 D, and this it does by unconsciously calling A. into play to that extent.

If we were to put up −11 D in the trial frame we should still probably get $V = \frac{6}{6}$; in this case 3 D of A. would be in action, neutralising the excess of 3 D in the concave glass. In fact, a concave glass correcting the *apparent* M. of an eye may be supposed to be made up of two parts, one of which corrects the *real* M., the other of which neutralises the amount of A. called into play. The former part is a fixed amount; the latter varies and equals the excess of strength of the glass. We cause the latter to disappear by making the excess of strength of the glass to disappear—i.e. by finding the *weakest* glass, which gives the best attainable distant vision.

To resume: the measure of M. is the weakest concave glass which gives the best attainable distant vision.

This is the most convenient test of M.; but there are others to be applied with the ophthalmoscope, which must be briefly noticed.

In looking into a myopic eye with the ophthalmoscope, the mirror being held at a considerable distance from the observed eye, an inverted image of the fundus is seen. This is formed in the air in front of the eye at its *punctum remotum*. To see it, the surgeon must be farther off the patient than this *punctum remotum*. When the observer, still having the fundus image in view, makes slight lateral movements of his head, the image moves in the opposite direction. As he approaches the patient's eye, this image gets blurred, and then disappears; when he gets the ophthalmoscope into the ordinary position for direct examination, no distinct view of the fundus is obtained unless a concave glass is used behind the mirror. The *weakest concave* glass which gives a distinct view of the fundus in this position equals the amount of M. *See* Ophthalmoscopy.

This is only the case, however, if the eye of the surgeon be in a state of emmetropia at the moment the examination is made. If he be myopic, the amount of his M. must be *deducted* from the concave glass, in order to get the amount of the patient's M. If he be hypermetropic, and have his A. relaxed, the amount of the H. must be *added*.

In retinoscopy the shadow moves with the mirror, unless M. be of very low degree —say less than 1·50 D.

Complications. — These attend the higher grades. The most common is what is called a 'posterior staphyloma;' this is, anatomically, a bulging of the coats of the eye in the neighbourhood of the optic disc; the pathogeny of it is uncertain. It may be well marked, so as in the enucleated eye to be easily recognisable as an ovoid protuberance. It is accompanied by atrophy and irregular pigmentation of the surrounding retina. With the ophthalmoscope, it is generally seen as a crescentic patch of atrophy extending along the outer margin of the disc; as it extends it embraces still more of the disc, and may reach outwards to the macula; or further, assuming then the most irregular forms. It lengthens still more the already elongated eye, and so increases the M. when it extends to the macula, that it seriously impairs v. This patch of atrophy is known as the 'myopic crescent.'

Other complications are fluidity of the vitreous with floating opacities, detachment of the retina, and divergent strabismus.

The latter is a much rarer attendant of M. then convergent strabismus is of H.

Treatment.—Much may be done in the way of preventive treatment by securing good school arrangements, proper lighting, well-constructed desks, &c.

When M. is already developed, what may be called the hygiene of the eye should be carefully attended to. Myopic children should not be subject to educational over-pressure, should not use their eyes up to the point of making them ache; if there be much irritation or fatigue about the eyes, prolonged absence from school should be insisted upon. It is right that M. should be taken into account when the time comes for the choice of a profession.

In all cases we must prescribe well-printed books and good illumination of them. The most comfortable artificial light is a good oil lamp, well-shaded, so that no direct light falls on the reader's eyes; in writing, the lamp should be placed on the writer's left front, so that the shadow of the pen may not interfere with the view. Books or writing must be held at a good distance, and stooping avoided. Frequent rest must be given to the eyes, and if they are irritable the cold douche may be used.

The optical treatment of M. is quite easy in the *low grades*, say up to 4 D. Here, all the patient complains of is that distant vision is imperfect; he can see to read and work quite well, his far point lying beyond the distance at which this can be done with comfort. Here, the glasses that fully correct M. may be ordered.

As these are intended only for distant vision, and therefore for occasional use, they may be worn in a frame or a *pince-nez*, as the patient chooses.

They are to be worn solely as a matter of convenience, and not as being at all necessary to the well-being of the eyes. Patients often want glasses especially for music. Pianoforte music lies usually at about 20″ from the eye; if M. be not greater than 2 D, the far point of the eye being in that case not less than 20″, no glasses are wanted; if M. be greater than 2 D, glasses will be necessary, and the full correction may be worn.

In M. of medium grade, say 4 D up to 8 D, as a rule glasses will be wanted both for distance and for reading; the distance glasses are a matter of convenience, as in

the lower grades of the affection. But reading glasses *must* be worn; without them, the strain on the eyes caused by the excessive convergence of the visual axes necessary for reading will certainly increase M., besides giving rise to much immediate trouble, aching of the eyes, and the other discomforts that have been already spoken of as attending the higher degrees of M. The distance glasses will be the full correction as before, and if the patient be young, and A. therefore good, the same glasses may do for reading. In these cases, however, A. has so long been in abeyance prior to the use of glasses, that it cannot be expected to be so active as in an emmetrope. As a rule, however, we may at first order that the distance glasses should be used for reading also; if no discomfort ensues, they may be continued in use; if, however, they cause pain, a somewhat weaker pair must be ordered for close work. For instance, suppose a patient with M. = 8 D; here $R = \frac{100}{8}$ cm. (4 inches). There is no distinct vision beyond 4 inches, and, further, vision at that distance is probably irksome on account of the excessive convergence necessary to bring both visual axes to bear on the same point.

Here 8 D should be ordered for distance, and in suitable cases also, tentatively, for reading and working. As 8 D brings the eye into the condition of an emmetropic one, the amount of A. necessary for reading at 25 cm. (10″) will be $\frac{100}{25} = 4$ D. Now it is found by experience that, for continuous work, only about one-half of the full amount of A. at the disposal of an eye can be comfortably exerted. The ciliary muscle is in this respect like other muscles; it cannot exercise its full power for a long period without fatigue. The eye we are considering ought then to have 8 D of A. at its disposal, in order to read comfortably with the glasses; the table above given will show whether the patient's age is such that this amount of A. may be expected. Something also must be allowed for the fact of the eye being a myopic eye, and therefore not in the habit of using its A.

Say the patient's age is twenty. The table shows that at twenty the eye has 10 D of A.

This eye, then, will have the necessary amount of A. (8 D) for continuous reading, and still a reserve of 2 D. This may be called, then, a suitable case for ordering, experimentally, the full correction for both distant and near use. If after a week or two's trial the glasses cause pain, a weaker pair may be ordered for reading; the deduction commonly made is 2 D, so that we should now prescribe −6 D for reading, the full 8 D being still used for distance. In wearing −6 D for reading at 25 cm. (10″) what demand is made on A.? We have seen that with the full correction −8 D, 4 D of A. is wanted; with −6 D, only 2 D of A. will be required. The eye ought then to have a total A. = 4 D, or rather more as it is a myopic one, say 5 D. Now, the table shows that A. does not reach so low a stage as 5 D till the age of 40 is approached. Hence, up to this age the glasses above suggested may be expected to suit the patient. Or, it may be advisable to order the glasses in a different way; if the patient's occupation be principally about things that lie near him, the weaker glasses may be used pretty constantly, and when very distinct distant vision is wanted, additional glasses that represent the difference between these weaker glasses and the full correction (in the above case −2 D) may be held up in a *pince-nez* before the other glasses in a frame.

The same rules apply to the higher grades of M. above 8 D. They must, however, be taken as only suggesting the principles to be followed. In no other affections of the eye is it more necessary to treat each case on its own merits.

It is principally in these high grades of M., but to some extent in the medium grades also, that all the discomforts described above are found. V is here nearly always much impaired, on account of changes in the fundus; the glasses necessary to remove the far point to a safe distance diminish the retinal images, and still further impair v. The patient is then tempted to hold his work near again, and then all the evil results of excessive convergence again ensue. If the struggle for binocular vision is given up, and one eye remains in a condition of divergent squint, the patient is often in a better condition. The diverging eye, it is true, suffers and may become amblyopic, but the other one is more comfortable. In addition to the best optical aid that can be given, all the hygienic measures recommended as general treatment should be put into force; if M. be rapidly increasing, and the symptoms of irritation severe, complete rest must be insisted upon, and the eye well protected from light; further treatment might consist in the use of flying blisters on the temples, or even occasional wet cupping with Heurteloup's artificial leech.

(*b*) Hypermetropia.—Here parallel rays come to a focus behind the retina. This is due to a disturbance of the normal relation that exists between the length of the eye and its refractive power. Actually, it is generally the case that the axis of the eye is too short; we shall, however, consider it as being due to a *decrease* in the refractive power of the eye, just as we considered M. to be due to an *increase* in this power. We may imagine that in H. we have an emmetropic eye armed with a concave lens in front of it. The strength of this lens will be a fair measure of H., since it represents the departure from the emmetropic eye.

Let us examine the peculiarities of vision in H., and suppose, for example, we have an eye with H. = 6 D.

This is equivalent to an emmetropic eye with a lens −6 D in front of it. Now this lens will make parallel rays to proceed as if they diverged from its principal focus—i.e. from a distance $\frac{100}{6}$ cm. in front of it.

These rays falling on the emmetropic eye, which we have imagined combined with the concave lens to form the hypermetropic eye, will not be focussed on its retina; only an emmetropic eye can focus parallel rays on its retina while the accommodation is at rest. Hence, distant objects, from which such parallel rays emerge, will not be seen distinctly by the hypermetropic eye. Still less will near objects be seen distinctly. The only rays that can be focussed on the retina in this case are rays which are parallel after having passed the hypothetical concave lens, and which therefore are converging virtually to its principal focus—i.e. to a point $\frac{100}{6}$ cm. behind it. But the rays which proceed from all objects are divergent rays; hence, the hypermetropic eye, being able to focus on its retina only convergent rays, cannot (unassisted) see any external object distinctly. This is only so long as it remains at rest. When it calls into action its accommodative power, which, as we have seen, is equivalent to placing a convex lens in front of it, it can not only neutralise the hypothetical concave lens which represents its H., and so see distant objects distinctly, but, by a further tension of A., it can adapt itself for divergent rays, and so see near objects plainly. Suppose the above eye, for instance, in which H. = 6 D belongs to an individual ten years old. At ten our table shows that the total A. = 14 D. By exerting 6 D of his A., then, this person neutralises his H., and brings his eye into the position of an emmetropic one, and has still 8 D of A. in reserve.

In this condition he sees distant objects distinctly. If he wishes to see near objects, he makes a further demand on his A., the amount depending on the distance of the object. Suppose the object is at 25 cm. (10″) from the eye: a convex lens of $\frac{100}{25} = 4$ D at the eye would make rays diverging from the object parallel, and therefore in a condition to be focussed on the retina of the eye, which by using 6 D of its A. is already in a condition of emmetropia; the additional call upon A. then = 4 D, and the total amount of A. required by this hypermetropic eye for seeing distinctly at 25 cm. is 10 D. Will this eye be able to work for long at this distance? No; we have seen above that, for continuous work, not more than half A. must be in use; here 10 D—the whole of A. being 14 D—is in use. The eye, then, if called upon to work for long at this distance, would tire. An emmetropic eye, on the contrary, at the same age, having 14 D at its disposal, and not requiring to use any of this to correct any H., would want only 4 D out of the 14 for working at this distance, and would therefore do it easily. This fatigue of the eye on working is the type of the complaints of the hypermetrope.

Etiology, &c.—H. is always congenital, and never increases in after-life except slightly in old age; it may diminish, and even change into M., owing to elongation of the eye. After removal of the lens in the operation for cataract, a high grade of H. is produced owing to loss of refractive power: this is called aphakia. The amount of H. varies within wide limits; 2 or 3 D is a very common amount; 8 D would be thought a highest degree; in aphakia in an originally emmetropic eye H. equals about 10 D. The amount of H. in the two eyes is usually nearly the same.

Symptoms.—In low degrees there are often no symptoms till the patient approaches middle life; then, several years before people usually want spectacles, he comes with the usual complaints of presbyopia; cannot see to read, especially by artificial light, &c.

The age at which these symptoms occur depends on the amount of H. and the distance from the eye of the habitual work. At the age of thirty, for instance, total A. = 7 D, and therefore 3·5 D can be exerted continuously.

Now, for continuous work at 40 cm. (16″) an emmetropic eye requires $\frac{100}{40} = 2{\cdot}50$ D of A. Suppose the person of thirty years of age has 1 D of H., then 1 D of his 3·5 of available A. will be used up in correcting the H., and the remainder 2·5 D will just suffice for continuous work at 16″. Such a person would in a year or two probably need spectacles for his usual work.

In the higher degrees, even young people suffer much. Often the break-down of the general health determines the onset of the symptoms. In very high degrees M. may be simulated: distinct images being in no way attainable, objects are held very close so as to get large retinal images, and hence the patient is supposed to be short-sighted. In old people who have never worn glasses, and have a considerable amount of H., vision for near and distant objects may be so defective that the surgeon may, if he neglect to try the effect of convex glasses, diagnose some serious nerve-affection.

Diagnosis and Measurement. — The complaints of the patient usually indicate pretty clearly what is the matter. His 'eyes are weak'; close work soon tires him; the letters run into one another, get dim, &c.

We now proceed to test v in the usual manner, trying each eye separately, and both with near types and distant.

If v for distant objects be improved, or even not made worse by a convex lens, it is a case of H.

The amount of H. is given by the *strongest convex* lens which gives the best attainable vision at 6 mètres. It must be the *strongest* convex lens, in order to secure the complete relaxation of the accommodative power. Contrast this with the rule for M.; there it was the *weakest concave* lens which gave the best attainable vision at 6 mètres. A short consideration analogous to the one set out in the case of M. will show the reason of the rule in H.

There is, however, a difference in the case of H. Here, as we have seen, some amount of A. is always in play, even for distant vision, and a considerably larger quantity for near vision. The result of this is that the ciliary muscle gets into a condition of spasm, and will not relax when its continued contraction is no longer wanted, nay even is injurious to distinct vision.

Suppose H. = 4 D, and that glasses have never been worn; here 4 D of A. has always been in use for distant vision, and 7 D or 8 D for near vision. In testing the eye now with the types at 6 mètres, probably $v = \frac{6}{6}$ without any lens at all, the 4 D of A. being in action; 1 D is put up in the trial frame; as the eye will bear only +4 D in front of it for distant vision, 1 D of A. must be relaxed if v is to remain $= \frac{6}{6}$. Suppose v remains unimpaired, +2 D is now put up in the trial frame; if v is now to remain $= \frac{6}{6}$, another 1 D of A. must be relaxed. If now the ciliary muscle be in the condition of spasm, it may refuse to relax this additional 1 D, even though strongly solicited to do so by the desire of the eye for distinct vision. If it do not so relax, 1 D would be the strongest convex glass that gave the best attainable vision at 6 mètres, and so 1 D would appear to be the amount of H., whereas H. is really = 4 D. In such a case as this, the total amount of H. would probably only appear when atropine or some such agent was used to thoroughly relax the ciliary muscle. The total amount of H. revealed after the prolonged use of atropine is called H. totalis (H. t.); the amount of H. that reveals itself when convex glasses and no atropine are used is called H. manifesta (H. m.); the difference between the two is called H. latens (H. l.). A small amount of H. l. is always present; it is only when it exceeds 2 D or 3 D that this formal distinction between H. t. and H. m. is made. When H. is written unqualified, H. m. is meant.

Ophthalmoscopic Tests. — In looking into a hypermetropic eye with the ophthalmoscope, at a considerable distance from the observed eye, a real image of the fundus is seen. This does not disappear as the patient is approached. When slight lateral movements of the surgeon's head are made, the image of the fundus moves in the *same* direction. When the surgeon gets the ophthalmoscope into the ordinary position for direct examination, the image is still plainly seen, and continues clear when convex glasses are used behind the mirror. The strongest convex glass with which the fundus can be distinctly seen is a measure of the H. (if the surgeon be himself emmetropic).

In retinoscopy the shadow moves against the mirror. It does so also in low M.

Complications.—The only one that need be mentioned is concomitant squint, which is nearly always convergent. *See* Strabismus.

Treatment.—This is simple and very successful. In ordinary cases it is enough to give glasses that neutralise the H.m.

If after a time there should be pain with these, the existence of a considerable amount of H. l. should be suspected. To get at once to the bottom of the case, atropine should now be ordered, and H. t. found. If this differ much from the H. m. originally found, fresh glasses should be ordered. These should be about 1 D weaker than the full correction, to allow for the inevitable slight spasm of accommodation, which will come on as the effect of the atropine wears off.

These glasses need generally be worn only for close work.

In high grades of H. it is best to give the full correction, and order the glasses to be worn constantly. This is especially desirable in children.

In the case of old people, two pairs will be wanted—one for distant vision and one for near work; or even intermediate pairs may be needed, if distinct vision is desired at intermediate distances.

It will be useful here to contrast the diagnosis of M. and H.

In M. distant V is *improved* by a $-^{ve}$ glass.

In H. distant V is *not made worse* by a $+^{ve}$ glass.

In M. the retinal vessels move *against* the observer.

In H. the retinal vessels move *with* the observer.

In M. the retinoscopic shadow moves *with* the observer (generally).

In H. the retinoscopic shadow moves *against* the observer.

The amount of M. is the *weakest concave* glass which gives the best attainable distant vision.

The amount of H. is the *strongest convex* glass which gives the best attainable distant vision.

The amount of M. is the *weakest concave* glass with which the fundus can be distinctly seen by the direct method.

The amount of H. is the *strongest convex* glass with which the fundus can be distinctly seen by the direct method.

A few cases are here given to illustrate the method of testing and noting the vision:—

Case 1.—Low M. The patient, a woman, thirty years of age, complains of being near-sighted. On testing the eyes it is found

R. E. $V < \frac{6}{60}$; with -3 D $= \frac{6}{9}$;

no improvement with cylinders.

J. i. at 30 cm.

L. E. $V < \frac{6}{60}$; with $-3{\cdot}30$ D $= \frac{6}{9}$;

no improvement with cylinders.

J. i. at 30 cm.

Here -3 D was ordered in a *pince-nez* for distant vision; the eyes being used unaided for reading.

Case 2.—High M. The patient, a carpenter, aged thirty-four, complains of not being able to see his work. Examination reveals—

R. E. $V < \frac{6}{60}$; with -9 D $= \frac{6}{18}$.

J. i. at 12 cm.

L. E. $V < \frac{6}{60}$; with -9 D $= \frac{6}{12}$.

J. i. at 12 cm.

On trial it was found that with -7 D he could read J. i. at a fair distance, and the same glasses gave $V = \frac{6}{24}$. As he was satisfied with this amount of distant vision, he was ordered only one pair of glasses, -7 D for constant use.

The above form of noting the result of the visual examination will be found a convenient one. Where V at 6 mètres does not come up to $\frac{6}{60}$, the patient might be brought up to the types till he could see the largest—viz. 60, if an exact numerical expression were desired for V; in most cases it is enough to note that V is less than $\frac{6}{60}$; this is commonly written $V < \frac{6}{60}$.

Case 3.—Low H. Patient, a woman of twenty, complains that she cannot see to work at night.

Here R. E. $V = \frac{6}{6}$; with $+2$ D, V still $= \frac{6}{6}$;

therefore H. $= 2$ D.

J. i. 8″–12″ (8″ the near point, 12″ the far point).

L. E. $V = \frac{6}{6}$; H. $= 2{\cdot}50$ D.

J. i. 8″–12″.

In this case $+2{\cdot}50$ worn for work gave complete relief.

Case 4.—High H. The patient, a girl of twelve, was brought with the complaint that she was *short-sighted*. It was found, however, on examination, that it was one of the cases of H. simulating M.; in fact, after atropine, it was found—

R. E. H. = 9 D; and with + 9 D, $V = \frac{6}{18}$.

L. E. = 10 D; with + 10 D, $V = \frac{6}{18}$.

She was ordered + 8 D for both eyes, an allowance of 1 D being then made for the effect of the atropine; these were to be worn constantly. After a few months with the glasses,

R. E. $V = \frac{6}{9}$; L. E. $V = \frac{6}{18}$.

The refracting surface of the eye has hitherto been supposed spherical, so that the image of external point on the retina was either a point or a circle of diffusion; there are, however, many eyes in which the surface is not spherical, so that different meridians of this surface have different curvatures.

This condition of the eye is called Astigmatism. It is divided into regular and irregular.

The *irregular* is generally due to some disease of the cornea, which has so distorted it that it is no longer any definite mathematical surface at all. It is seldom susceptible of any optical help, and will not be further alluded to here.

In *regular astigmatism* the surface is formed according to definite laws. There is one meridian of greatest curvature; another, at right angles to the first, of least curvature; and the intermediate ones are of intermediate curvature. These meridians are all nearly circular. The meridian of greatest curvature is generally vertical. To save space, it will, in what follows, be supposed that it is always so, and, consequently, that the meridian of least curvature is horizontal. In considering the refraction of rays by an astigmatic surface, we find that the image of an external point is a short horizontal *line* at the conjugate (to the external point) focus of the vertical meridian, and in the neighbourhood of this focus the image is a horizontal *oval*; at the conjugate (to the external point) focus of the horizontal meridian, the image is a short vertical straight line, and in the neighbourhood of this focus a vertical oval; midway between these two foci the image is a circle.

Now, suppose we have a straight line external to the eye; call this AB, and first suppose it to be vertical. Further, let us call the focus of the vertical meridian F_v; that of the horizontal meridian F_h; this line may be supposed made up of a series of points, arranged vertically over one another. At F_v the image of each of these points is a short horizontal straight line, and therefore the image of AB a series of horizontal straight lines, parallel to one another and placed side by side; the image of AB is then a faint, wide vertical stripe.

At F_h, on the contrary, the image of each point of AB is a short vertical straight line, and therefore the image of this external vertical straight line a series of short vertical straight lines which overlap one another; this image, then, is a thin, well-defined vertical line. Now, suppose AB a little inclined to the vertical. Each point of it will, as before, have a short horizontal straight line for image at F_v; but these lines do not now lie directly over one another, but are arranged like the steps of a steep staircase, and they overlap one another a little; the image of AB at F_v is then a stripe parallel to it, and rather more defined than when it was vertical.

At F_h the series of short vertical straight lines, which are the images of the points of AB, overlap, but not so directly as they did when AB was vertical: the image of AB at F_h is then a stripe parallel to it, and rather less defined than when it was vertical.

Hence, if AB in its new position slightly incline to the vertical, at neither F_v nor F_h is a clear image formed; still less is the image clear at intermediate points between F_v and F_h, where the image is formed by a series of overlapping, horizontal, or vertical ovals, instead of horizontal or vertical straight lines, as at F_v or F_h.

As AB departs more and more from the vertical its image at F_v becomes more distinct, its image at F_h less distinct; until it becomes horizontal, when at F_v there is a perfectly distinct image formed, whilst at F_h the image is very indistinct.

Hence, when the two chief meridia of the eye are vertical and horizontal, of only two external straight lines are clear images formed, and these are the vertical, of which a clear image is formed at F_h, and the horizontal, of which a clear image is formed at F_v. If we now suppose the retina of the eye situated at F_h, only vertical lines will be seen quite distinctly: other lines will be seen with increasing indistinctness the more they depart from verticality, and horizontal lines will be the most indistinct of all.

If the retina be at F_v, just the reverse of this will be the case—i.e. horizontal lines only will be seen distinctly, others with varying indistinctness; whilst if the retina

be situated neither at F_h nor F_v no lines will be seen distinctly.

Now, the human eye has the power, by means of its accommodation, of making the position of the retina coincide with either F_v or F_h, or occupy intermediate positions. Hence, generally an astigmatic eye can see distinctly lines parallel to its two chief meridia; not simultaneously, however, but by two different efforts of its accommodative power. But it has no power of seeing distinctly lines in other directions. As the contours of objects are made up generally of lines running in an infinite number of directions, it is easily imagined how indistinctly such objects are seen by an astigmatic eye.

At any given moment, the eye sees distinctly only the outlines of an object parallel to a certain line; by an effort of its ciliary muscle it can so alter its refractive power as to see the outlines running in a direction perpendicular to the first. Probably, an astigmatic eye is thus continually altering its accommodative tension, so as to get clear outlines in two directions of each object that is successively presented to it. This continual change of strain of the ciliary muscle accounts for much of the fatigue from which such eyes suffer.

Regular astigmatism is divided into five varieties; (1) if, A. being relaxed, both chief meridia are myopic—it is called compound myopic astigmatism; (2) if one meridian be myopic, the other emmetropic—it is called simple myopic astigmatism; (3) if one meridian be emmetropic, the other hypermetropic—it is called simple hypermetropic astigmatism; (4) if both meridia be hypermetropic—it is called compound hypermetropic astigmatism; and (5) if one meridian be hypermotropic and the other myopic—it is called mixed astigmatism.

Etiology. — Regular astigmatism is nearly always congenital. After operations on the cornea, however, a considerable amount of regular astigmatism is often seen. It is generally nearly equal in amount and symmetrical in the two eyes. High degrees of M. or H. are nearly always complicated with astigmatism. It often runs in families.

Cylindrical Lenses.—The difference in curvature between the two chief meridians may be corrected by a cylindrical glass. This has no curvature—is plane parallel to its long axis; in the meridian perpendicular to this may be ground to any curvature; whilst the intermediate meridians have intermediate curvatures. The correction of the accompanying M. or H. is of course made by a spherical glass, on which the cylinder can be ground. Generally, the sphere is given which corrects the meridian of greatest curvature in H., or least curvature in M.; this accordingly must be combined with a negative cylinder, strong enough to correct the other meridian. A cylindrical lens has no refractive effect in a meridian parallel to its axis, and this accordingly in the correcting glass, if a negative cylinder be used, must be placed parallel to the meridian of greatest curvature in H. or of least curvature in M. Suppose, for example, in vertical meridian M. = 6 D, in horizontal meridian M. = 4 D; then a $-^{ve}$ sphere = 4 D would be given, combined with a $-^{ve}$ cylinder = 2 D, with its axis horizontal.

It would come to the same thing if a − sphere = 6 D and a $+^{ve}$ cylinder = 2 D, with its axis vertical were given.

Diagnosis and Measurement.—The complaint is generally of 'weakness of the eyes,' so that at first we do not know that it is not a case of simple M. or H. When, however, with the best spherical glass V is considerably below the standard $\frac{6}{6}$, astigmatism may be suspected. This is especially so in the case of H., where degenerative changes in the fundus are relatively rare. The diagnosis can often be made with great certainty by holding up in front of the eye, already armed with the sphere (+ or −) that gives the best V at 20′, a weak $-^{ve}$ cylinder, say, −1 D cyl.

If this be held with its axis parallel to the meridian of least curvature, it will almost certainly improve V. Now this meridian of least curvature is, in most cases, horizontal or nearly so.

We hold this weak cylinder, then, with its axis horizontal, and see if V is improved thereby; if not, we slowly rotate it in front of the eye through a complete half-circle, asking the patient if there is any improvement of V in any position. If not, there is no astigmatism. If there is, the position of the axis that gives the best V is the meridian of least curvature of the eye, and the other chief meridian is of course perpendicular to this. We then hold up stronger $-^{ve}$ cylinders with axis in the same position. The weakest cylinder that gives the best attainable V is the measure of the astigmatism.

In this way many cases can be quickly tested both qualitatively and quantitatively.

There are many other tests for astigmatism, both subjective—i.e. depending on

the answers of the patient like the above, and objective. Of the objective the only one we shall refer to here is RETINOSCOPY. A complete discussion of this method will be found under this heading.

In many cases of astigmatism, a satisfactory result cannot be got without using a mydriatic. This may be either atropine, of which a solution gr. ij. ad f℥j. may be used three times a day for three or four days; or homatropine, a solution of the same strength for three or four times. The atropine completely paralyses the ciliary muscle, and so makes near vision (except in certain grades of M.) very dim. This effect passes off in about a week or ten days. The homatropine does not suspend the accommodation so completely as atropine; but the effect passes off much more completely than that of the other drug; generally, accommodative power is fully restored in twenty-four hours. It may be used as a substitute for atropine, when the patient cannot submit to the week's dimness of sight the latter generally causes.

The vision is to be tested whilst the eyes are fully under the influence of the drug; an interval is then to be allowed for them to recover (say ten days for atropine, two days for homatropine), and then the glasses ordered which give the best v in this condition. These will generally be found to differ from the best glasses under atropine in being about 1 D weaker, this being the usual amount of the tonic spasm of A. before referred to. If there be a great difference between the refraction with and without atropine, glasses 1 D weaker than those giving the best v under atropine should be given for constant use as soon as the atropine is discontinued. It may be asked, why use atropine at all, if glasses are to be finally ordered adapted to the non-atropinised state? The answer is, partly to provide for these cases of excessive spasm, partly to facilitate the objective examination.

In any case where strong glasses are ordered, either spherical or sphero-cylindrical, the patient must expect a few weeks' discomfort till the eyes get accustomed to working under the new conditions. They should be worn continuously and perseveringly. Children adapt themselves much more readily than adults to such glasses.

A case of astigmatism is subjoined:—

Case 5.—As. The patient, an architect, aged twenty-two, suffers from headache all day. This he attributes to wearing improper glasses. These he has used constantly for the last twelve months; they are R.E. $-6{\cdot}50$ D, L.E. $-5{\cdot}50$ D. Tested R.E. $v<\frac{6}{60}$; with -7 D spher. ◯ -3 D cyl., axis 80° up and in from vert. $=\frac{6}{9}$. L.E. $v<\frac{6}{60}$; with -5 D spher. ◯ -2 D cyl., axis 80° up and in from the vertical $=\frac{6}{9}$.

He was ordered these for constant use, and had no further trouble. The symbol used above after spher. (spherical) denotes 'combined with.' The direction of the axis may be indicated as above, or, better still, by a diagram.

Another *error of refraction* must be referred to. This is ANISOMETROPIA. This term is applied where there is a considerable difference between the refraction of the two eyes. Small differences are common enough in M. and As.; it is only when the difference reaches say 2 or 3 D that anisometropia is spoken of. It is often very difficult to treat if the difference be considerable. In slight cases each eye may be fully corrected, or else the correction adapted to the less ametropic of the two ordered. Sometimes the medium correction answers best; but each case must be treated on its own merits. Occasionally, where one is M., the other Em. or H., the former is habitually used for near work, the latter for distance, and no discomfort felt.

It remains to speak of *spectacles*. The fitting of these may generally be left to the optician; but the surgeon should satisfy himself that the glasses have their centres opposite the patient's pupils, unless it is otherwise desired, and that they are of the strength ordered. To test any given lens, a test glass of its alleged focal power but of opposite denomination—i.e. $+^{vx}$ or $-^{ve}$, according as the lens to be examined is $-^{ve}$ or $+^{vx}$, is held in contact with it, and the two held close to the surgeon's eye and moved rapidly from side to side. If the test glass now exactly neutralise the other, any distant object—say the window-bars—seen through the combined glass remains stationary. If the combination is $+^{vx}$, it moves in the opposite direction, if $-^{ve}$ in the same direction.

Patients often ask if they should have pebbles. These have no optical advantage over crown glass, and are much more expensive. Sometimes reading glasses require to be tilted forward at an angle of 10° or 15°—'angled,' as it is called. This is to be indicated in the prescription. The form a

prescription commonly takes is the following:—

[Patient's name.]
Glasses for reading:
+3 D
[Surgeon's name.]

or, in more complicated cases—

[Patient's name.]
Glasses for constant use:
Right eye: +2 D spher. ⌒ −4 D cyl., axis 30° from vertical up and out.
Left eye: +2 D spher. ⌒ −3·50 D cyl., axis 20° from vertical up and out.
[Surgeon's name.]

If any particular form of frame or colour of glass, such as neutral tint, be required, proper directions will have to be added to above. W. CHARNLEY.

REGNOLI'S OPERATION. *See* TONGUE, Operations for Removal of the.

RENAL CALCULUS. *See* NEPHROLITHIASIS.

RENAL COLIC is a term employed to describe a train of symptoms, due to the sudden stoppage of the ureter by some foreign body passing down its lumen, or to some morbid condition of its own walls. The onset is nearly always sudden, the most prominent symptom being pain, usually of a very severe kind, due, on the one hand, to the great sensibility of the ureter, and, on the other, to its own efforts to dislodge the intruding mass by virtue of its involuntary vermicular action. The duration of this pain is determined, first, by the accumulation of fluid behind the obstruction, and by the size and shape of the foreign body, and then by the strength of the muscle-fibres of the ureter. Fortunately, it does not usually last long, the mass either being forced onwards into the bladder, or the ureter becoming more or less accustomed to its presence. The causes of obstruction of the ureter, and consequent renal colic, may be the passage of—(1) a calculus, (2) a blood-clot, (3) a caseous shred of tubercular matter, (4) hydatids, (5) a portion of new growth, (6) the presence of a tubercular ulcer in the tube.

The *symptoms* in an ordinary attack are, usually, as follows. An agonising sickening pain sets in, usually with great suddenness, in the renal region, and radiates from this down the track of the ureter into the genitals and inner part of the thigh. With this there is often faintness and even vomiting, the patient probably at the same time breaking out into a cold sweat all over the body. When the first faintness has passed off, he will probably bend and twist the body nearly double with suffering, and endeavour to relieve himself by contortions in all directions. There will also be, in the male, most likely a retraction of the testicle. In some cases, the temperature is raised, and the pulse becomes rapid and feeble. Then, after a period, usually measured by hours, there is a complete cessation of the pain, as sudden as its onset, and a disappearance of the other troubles as well.

The *diagnosis* is based, first, upon the previous history of the case—i.e. if the patient has passed small calculi or 'gravel' before, or has had attacks of hæmaturia, or evidence of tubercular disease, parasites, or new growth in the kidney. Again, if there has been hæmaturia and the ureter is stopped by blood-clot, the water, previously blood-stained, will be passed clear during the colic, to return to its former red colour with the cessation of the pain, at the same time that small, worm-like clots are passed with the urine *per urethram*. In the same way a small calculus may be passed.

The paroxysms of pain, with which renal colic is most likely to be confounded, are (1) ordinary colic, (2) the passage of biliary calculi, (3) sudden obstruction of the urethra by blood-clots, stone, or new growths. From the first of these it will be distinguished by the seat of the pain and suddenness of the onset, usually after some renal symptom; by the absence of constipation, and then by percussion, which will probably indicate the condition of the intestine. Palpation, too, will often detect the painful spot in the flank where the obstruction of the ureter has taken place, and may even make out the foreign body. From biliary colic a distinction is made by means of the history, the seat of the pain, and in some cases by the occurrence of jaundice. Blood-clots, stone, and new growths in the bladder, leading to sudden obstruction of the urethra, can be demonstrated by the introduction of a catheter or sound, as well as diagnosed from the clinical history.

The *treatment* of renal colic varies with the cause, and resolves itself into palliative and curative. Under the first head will come, rest in the recumbent position, hot belladonna fomentations over the whole side, and the repeated injection of morphia in free doses hypodermically. In the case of blood-clots, calculi, or tissue-shreds, free kneading and manipulation over the track of the ureter, in the hope of assisting the passage of the foreign body into the bladder, may be tried. *See* NEPHROLITHIASIS; NEPHRO-LITHOTOMY. ARTHUR E. BARKER.

REST.—'The first and great requisite for the restoration of injured parts is rest,' was John Hunter's epoch-making generalisation. Than that, no proposition is more worthy of the surgeon's thought, none more fertile for his patient's good. The principle of constitutional and local rest is so interwoven with the whole teaching of this work, that it would be impossible to do it separate justice without time-wasting recapitulation. Yet, as one of those fundamental truths which cannot be inculcated too often or too impressively, an endeavour to methodise some of the most conspicuous advantages of rest may be justified by practical convenience and usefulness.

As movement increases the heart's action and is opposed to blood-coagulation, so this is favoured, and that retarded, by rest. Hence the value of rest in the treatment of disease and injuries of the blood-vessels, in wounds and aneurisms.

To quote from Mr. Hilton's classical lectures on 'Rest and Pain,' 'growth and repair have an exact relation to due physiological rest, local and general.' Accordingly, the repair of solutions of continuity in all tissues, hard and soft, proceeds in closest conformity to the physiological standard and with the minimum risk of pathological complication, the more perfectly divided parts, once re-adjusted, are maintained in a state of absolute repose. On this principle is based the sound practice of infrequent wound-dressing, and of treating broken bones and acute articular affections by immobilising the joints above and below, as well as the seat of mischief.

Mechanical and physiological, constitutional and local, medicinal and manual resources, such as darkness and mental quiet, anæsthetics, opium and allied preparations, position and suspension, cold and pressure, are all, in appropriate proportion, powerfully contributory to rest and repair. Once more experience teaches the great lesson, that complexity in the causation of pathological states necessitates combination of therapeutic resources for purposes of relief and cure.

Rest is something more than a mere negation of motion, as illustrated by the apparently, but not really, simple case of an irritable ulcer on the swollen leg of a big-bellied person. In such a patient, rest in the recumbent posture, and suspension of the foot soon give temporary ease; but recovery is greatly favoured by elastic pressure of the limb, and by administering a brisk purge, which may often be advantageously followed up with opiates. The constitutional and local rest combine in relieving vascular and nerve tension, and favouring healthy nutrition. In anal fissure and fistula, healing is prevented by the contractility of the very sensitive and active sphincter muscle. Divide as much of it as is necessary to insure rest in the particular case, and healing proceeds painlessly and solidly. The pain occasioned by foreign bodies, such as a thorn in the finger, a fish-bone in the throat, or a stone in the bladder, or by a dislocated or broken bone, ceases with the removal of the cause of unrest, be it extraction of the foreign body or restoration of the displaced part to its normal relations. So with the vomiting and pain due to strangulated hernia. Injuries of the chest and abdomen supply further illustrations in point. In such cases rest in the recumbent posture affords great, but not complete, relief. Where several ribs are broken, with or without wound of the soft parts, the chest requires good padding and abundant bandaging with equable pressure. A lattice-work of millboard, or other mouldable splintage, contributes powerfully to comfort; and so does fixing the arm, to rest the pectoral and dorsal muscles completely, on the injured side. Opium is additionally useful; the medicinal and mechanical treatment combining to reduce the number of respirations, and to favour abdominal breathing, during fixity, rest, and repair of the chest-wall. When the abdomen is bruised or wounded, rest is promoted by sedatives, by resting on the back with the shoulders raised and the thighs flexed, equable pressure being at the same time applied over the abdominal wall. Such pressure may be very beneficially practised, according to the requirements of particular cases, by broad bandages over good padding; or by means of a heavy poultice, or a shot mattress; a sand, water, or ice bag.

In painful cases of retention of urine, when ineffectual attempts have been made to pass a catheter, an anæsthetic may render easy what was before impossible. That failing, opium pushed judiciously to its full action, as indicated by contraction of the pupils, often succeeds in lulling pain, relaxing spasm and congestion, and allowing the urine to dribble, and, by-and-by, to flow. When, in such a case, anæsthetics, the catheter, hot hip-bath, purgatives, and opium all fail, and the bladder can only be saved from threatened rupture by suprapubic aspiration or tapping *per rectum*, urine often flows with comparative freedom *per urethram* once engorgement and spasm of

the passage are relieved by a few hours' rest after the operation. These are only a few illustrations of the value of the great therapeutic principle of rest; the reader interested in its further applications may refer to the articles Immobility; Position; Pressure; Suspension; Wounds, treatment of.

Sampson Gamgee.

RETENTION OF URINE.—When the bladder contains urine which it cannot expel, retention is said to exist.

Causes.—I. *Obstructions.*—(1) Imperforate prepuce. (2) Inflammation of the urethra. (3) Abscess in the prostate, penis, perineum, or about the rectum. (4) Stricture of urethra. (5) Hypertrophy and other tumours of the prostate. (6) Calculus. (7) Tumours of the bladder, of the urethra, and of the penis. (8) Pelvic tumours. (9) Foreign bodies in the urethra, bladder, or rectum.

II. *Direct or Indirect Interference with Nerve-supply of Muscles concerned in Micturition.*—(1) Disease or injury of the cerebro-spinal axis. (2) Hysteria. (3) Drugs. (4) Wounds and contusions of bladder or urethra. (5) Surgical operations in neighbourhood of bladder. (6) Urethral spasm.

Symptoms.—The chief sign is a distended bladder, shown by hypogastric dulness on percussion, or felt by the finger in the bowel or vagina. The patient generally complains of painful and urgent desire to pass water, with constant attacks of straining, called 'spasms.' Sometimes, during a spasm a little urine is passed, giving temporary relief, while frequently the bowel itself and piles, if present, are protruded, and the contents of the rectum evacuated. These urgent symptoms may be more or less absent, sometimes almost entirely so, and the medical man must ever be on his guard, and take care that he does not overlook a chronically distended bladder, for such oversight may lead to disastrous consequences. The cause of the retention will usually be obvious enough; but it is well to remember the following points:—(1) If under fifty years of age, the patient cannot have prostatic hypertrophy. (2) If he is over fifty, and with no history of stricture, the cause is probably prostatic. (3) If under fifty, he may have stricture and never know it, until seized with retention. (4) Should the obstruction be beyond six inches from the meatus, the case is not one of stricture.

Treatment.—Immediate relief is demanded. Usually, the patient is in great pain, and the longer the distended bladder is unrelieved the less likely is it to regain its entire contractility. A more remote danger is rupture of the urethra or bladder, with extravasation of urine. A hot bath and an opiate may be taken, or a little chloroform inhaled, and perhaps some urine will be expelled; but usually it is well to resort at once to the catheter. To prevent or mitigate the urinary fever which frequently comes on within the first few hours after catheterism, the patient should be at once put to bed after the operation, and if his urine is healthy, an opiate should be administered (liq. opii sed. ℥xv.), and washed down by some warm demulcent drink. The use of catheters in retention of urine may be considered under the following headings:—(1) Nervous retention, (2) inflammatory retention, (3) calculi in urethra, (4) urethral stricture, (5) hypertrophy or other enlargement of the prostate.

(1) *Nervous Retention.*—Here, retention has occurred although the urethra is perfectly healthy. Either the bladder cannot act from temporary or permanent paralysis or from over-distension; or reflex nervous irritation has produced 'spasm' of the urethra, this occurring when retention follows amputation of the thigh or operations for piles or anal fistula. The simplest catheter is one of vulcanised india-rubber, about No. 7 (Eng.); if this cannot be passed, a soft French coudée or olivary catheter may be attempted; if necessary, an English gum or a silver catheter must be used.

Hysterical retention almost always occurs in women. At first, judicious indifference is best; but the case may become serious if altogether neglected. After a safe interval has elapsed, a soft gum or india-rubber catheter should be introduced, and the bladder relieved. If catheterism in any particular case is undesirable, the patient may be placed in a hot hip-bath, and a jug of cold water suddenly thrown over the back, which will often produce the desired effect. *See* Female Catheter.

(2) *Inflammatory Retention* (*Gonorrhœa, Prostatitis, Abscess*).—It is well to try to avoid the use of a catheter. The patient should be put into a very hot sitz-bath and encouraged to pass water while there. If he cannot do so he may be put to bed, and the perineum freely leeched. An anodyne draught may be given if there is much pain. A brisk purge may prove useful. If these remedies fail, then a No. 7 (Eng.) warmed, oiled, soft tapering French olivary catheter may be gently introduced. If this instrument will not pass, a No. 4 or 5 English gum catheter without a stylet may be tried. A silver catheter is rarely necessary, but

when its use has been determined upon, it will be well to administer an anæsthetic, if facilities for doing so are at hand; especially if much difficulty has been encountered, owing to the swelling of the parts or the unruliness of the patient. If the retention is due to prostatic abscess, the passage of the catheter may be followed by a flow of matter, the abscess having ruptured into the prostatic urethra.

(3) *Calculi in Urethra.*—A small English gum catheter can nearly always be inserted between the calculus and the wall of the urethra into the bladder, and the retention relieved. If the calculus is at the neck of the bladder, it may readily be pushed back into the bladder by a large blunt-ended bougie or catheter. If the stone is in the penile urethra, it may generally be easily removed by the long urethral forceps or urethral scoop. *See* STONE IN THE URETHRA.

(4) *Stricture Retention.*—If, from the symptoms and history of the patient, stricture is suspected, he should be desired to make, if possible, a little water. He may not prove able to make any or more than a few drops; or perhaps a little stream of water will issue. In this case, the size of the stream must be carefully noted. Next, a No. 8 or 9 blunt-ended gum bougie or catheter should be gently passed as far as it will go. This will give a general idea of the situation of the obstruction.

If it is a case of stricture, the instrument will be arrested before it has traversed the first five or six inches of the canal. If the patient has been unable to make water, or can only make it in drops, then the smallest gum elastic catheter must be employed—a No. ½ or No. 1; or, if he has made a small stream of urine, a gum catheter of corresponding size may be selected. The stylet should be removed, the end turned up a little, and a very gentle attempt be made to insinuate the catheter, warmed and oiled, through the stricture. Should the instrument pass fairly into the bladder, the surgeon will learn by the issue of a few drops of water that all is right, and he must tie the instrument securely in. The patient may immediately be able to relieve himself, not only through but by the side of the catheter; for often, in using instruments for the relief of retention from stricture, the mere pressure of the catheter against the face of the stricture will cause urine to flow, and great relief will be afforded. If, however, the stricture is a tight one, urine will not flow outside the instrument; the water may therefore be allowed to drain drop by drop from the catheter until relief is afforded. If this relief is delayed, and the surgeon is satisfied that the catheter is in the bladder, he need not be in a hurry to remove the instrument. The patient may be soothed by a hot bath or by an opiate draught, and in time the stricture will dilate from the presence of the inlying instrument, and urine will be freely discharged by the side of the catheter.

Should the English gum catheter fail to pass either with or without its stylet, a small French olivary catheter may be attempted. If this is not successful, then a No. 1 silver catheter must be used, the patient standing or lying down from time to time, as the surgeon thinks best. The surgeon's left forefinger in the bowel is often of assistance, and not infrequently the introduction of a catheter will be much facilitated by placing the patient under the influence of an anæsthetic. If a catheter is successfully passed, whether a soft or a silver one, it should be tied in. (For the further treatment of the case, *see* STRICTURE OF THE URETHRA.) Should the stricture be a very severe one, it will be a great boon to the sufferer if the surgeon can arrange for catheterism to take place in the patient's bedroom, so that, when once the catheter is passed, it can be tied in, and the treatment of the stricture commenced. Otherwise, if the catheter has to be withdrawn, the second catheterism, which is very likely to be soon necessary, may prove more difficult than the first from the swelling and possible laceration of the parts. Supposing catheterism fails, and opiates and hot baths give no permanent relief, the surgeon has the choice of several modes of giving exit to the retained urine. This question will be further discussed at the end of the consideration of prostatic retention.

(5) *Prostatic Retention.*—If the sufferer is over fifty years of age, and without any history of stricture, the cause is probably prostatic. He should stand with his back to the wall; the surgeon should sit down in front of him, and pass a well-oiled No. 7 or 8 (Eng.) vulcanised india-rubber catheter. No skill is required; if it passes, all is well; if it will not pass, it must be removed, and a No. 7 or 8 French coudée catheter tried. The operator should make some mark on this instrument, so that on looking at the proximal end he can always tell, when the bent end is in the urethra, which way the bend is turned. Holding the penis up against the patient's abdomen, and passing the first five inches of the coudée catheter

vertically down the urethra, the surgeon keeps the penis and the catheter strictly in the middle line, and the bend of the instrument always towards the patient. As about the sixth inch is pushed in, he gradually brings the penis and catheter down to the level line, and as the next and succeeding inches of the catheter pass, slowly drops the penis and catheter until they almost point to the patient's toes. As a rule this catheter will ride easily into the bladder. If it does not enter, it is very probable that the point has caught in the prostatic sinus. To disengage the point of the catheter, it is gently withdrawn for about an inch or more, and turned on its long axis so that the bent-up end points laterally to the right or left, instead of upwards as it did before. An attempt is now made to pass it into the bladder; and repeated if unsuccessful, turning the point first to one and then to the other side. Frequently this manœuvre will prove successful.

If the coudée catheter will not go, a very soft-ended olivary catheter may be tried, and, if necessary, a large coudée (No. 12); for large instruments, although they give more pain than small ones, will often avoid, by reason of their size, an awkward place which will engage a smaller instrument. When all these instruments fail, a bicoudée will sometimes be successful. Here may be mentioned with praise the silk-web coudée catheters made in London, and of recent introduction. They are soft and highly polished, and in the writer's hands have passed when the ordinary coudée has failed. This is due to their softness, which makes them practically bicoudée catheters, and enables them to ride easily over the bar at the neck of the bladder.

If none of these catheters can be passed, the surgeon may take an English gum catheter, No. 8 or 9, and, removing the stylet, may put the catheter into any shape he likes by softening it in hot water, moulding it to his taste, and then making the shape for a time permanent by dipping the catheter into cold water. A very excellent plan is to keep one of these catheters permanently on a stylet which has been overcurved. When required for use the stylet is removed, and the catheter keeps its curve so well in the urethra, that the end will often successfully surmount the obstacle at the neck of the bladder. Another plan of using the English gum catheter, in these difficult prostatic cases, is to introduce it on a stylet. When the catheter becomes engaged at the obstruction, the instrument is held in place with the one hand, while the other hand withdraws the stylet for an inch or two. This movement causes the end of the catheter to rise and come forward in the prostatic urethra, frequently with the happy result of entrance into the bladder.

If the operator is still unsuccessful, silver catheters must be tried, of various curves (prostatic), with the patient either standing or lying. The introduction of the left forefinger into the bowel will often facilitate the passage of these instruments by pressing the point forwards. In the use of all prostatic instruments, when once a catheter is passed, the patient must be closely watched as the water is drawn off, and the catheter at once plugged or withdrawn, should any signs of syncope arise. Speaking generally, it is unwise to draw off more than twenty ounces at the first catheterism. In all cases the patient should at once be put to bed, and for four or five days be kept warm and comfortable in the horizontal position. He must be carefully watched for a recurrence of retention, which will be sufficiently obvious. The great danger, however, consists in the patient after a few hours making some water naturally, without by any means emptying his bladder. This deceives the unwary surgeon, and the bladder is allowed to continue partially emptying itself until obstinate and even dangerous cystitis is set up. Within at least twelve hours from the first retention, with very rare exceptions, the catheter should be passed again immediately after the patient has made water, and the amount of water not passed naturally carefully noted. This amount will determine the future treatment. *See* Prostatic Hypertrophy.

In cases of difficult prostatic catheterism, the question will often arise after the bladder has been emptied—Shall the catheter be tied in or taken out? If the difficulty has been very great, and if the catheter introduced is a soft one, it may certainly be tied in, its orifice securely plugged, and the urine drawn off when necessary. Usually, such a catheter will require changing in four or five days, and it will be well to keep the interior of the bladder free from decomposing urine, by daily injections through the catheter of a warm solution of boracic acid (3 to 4 drachms of the saturated solution to four ounces of water), or of carbolic acid (mij. to f℥iv.). Such a proceeding is justifiable if great difficulty has been experienced, and if the urethra has been much injured; and it is occasionally justifiable in ordinary cases, if the surgeon cannot frequently visit his patient. Here, however, it may be said that, when a man has had prostatic retention

of urine his life hangs in the balance, and whether the balance goes up or down largely depends on the care his surgeon can give him, the most essential part of this care being immediate and easy catheterism directly the bladder cries out for relief. Unless under absolute necessity, a silver catheter must not be tied in. A soft catheter may usually be safely retained—and stress may be laid upon this, as formerly it was taught that a catheter should never be tied in in cases of enlarged prostate. If the retention has with great difficulty been relieved by a silver catheter, and if it is desirable to tie a catheter in, the retention of the metal instrument may be avoided by placing a soft catheter on a stylet, bending it to exactly the same shape as the silver catheter, and passing it directly the silver one is withdrawn.

With patience, gentleness, and skill, the surgeon should always succeed in passing a catheter in a case of prostatic retention. But supposing that from great irregularity of the passage, want of suitable instruments, or in consequence of injury inflicted during previous attempts at catheterism, no instrument can be introduced, what is the surgeon to do? In the first place, for obvious reasons the relief must be immediate; any delay is absolutely wrong; and in the second place the relief must be obtained by the simplest means. The simplest means of evacuating a distended bladder is, undoubtedly, by suprapubic aspiration. Afterwards, with rest and after a thorough evacuation of the bowels, a catheter may often easily be passed into the bladder through the urethra. Should retention, however, recur, and catheterism again fail, a second or even a third aspiration is permissible. But, although the bladder has been safely aspirated many times (ten or twelve), fatal extravasation and abscess have been known to follow a second aspiration, and the surgeon is advised not to aspirate the bladder more than two or three times. Afterwards, if a catheter cannot be passed, suprapubic puncture with trocar and canula is recommended.

There are other methods of puncturing the bladder, notably the rectal one, which still has advocates. These methods are all described under BLADDER, Puncture of the. *See also* BOUTONNIÈRE, the Operation of.

G. BUCKSTON BROWNE.

RETINA, Affections of the.—CONGENITAL ABNORMALITY.—Occasionally, the nerve-fibres regain, at the edge of the papilla, their medullary sheath which had been previously lost at the lamina cribrosa, and we have the condition known as 'opaque nerve-fibres.' The papilla itself often escapes, but sometimes its periphery, and, very rarely, even its entire surface, with the exception of the physiological cup, may be involved and appear white in consequence. The condition usually occurs in the form of a brilliantly white patch, narrower at the end next the papilla, with which it is nearly always continuous. Its broader peripheral end has a teased-out, brush-like appearance, from the separation of the fibres. The affected area is generally at the upper or lower edge of the disc, and the large blood-vessels there present are more or less concealed by it. Exceptionally, it extends all round the disc, and, still more rarely, the patch may be detached from the disc altogether. We get a scotoma corresponding to the extent of the opaque area.

DISEASES.—With the exception of its blood-vessels and its pigment-epithelium, the retina is almost perfectly transparent, and therefore practically invisible ophthalmoscopically. Its diseased conditions then may be recognised by a loss of its transparency, or by changes in its circulation or in its pigment layer.

CHANGES IN THE SIZE, COURSE, AND STRUCTURE OF THE BLOOD-VESSELS.—First, we will consider shortly disturbances of the retinal circulation, as evidenced by changes in the size and course of the vessels and in the structure of their walls.

In judging of the *size* of the retinal vessels we regard chiefly the larger branches on the optic disc, comparing them with the mental impression of those of an average normal eye. Slight departures from the normal may readily be overlooked by such a method, and the observer must be careful to note the number of the branches of artery or vein on the disc, as, the smaller the number of these, the larger each one will be in proportion in the healthy fundus. Again, by the direct method of observation, the vessels will appear larger in the myopic and smaller in the hypermetropic eye, while by the indirect method the opposite effect will be produced (OPHTHALMOSCOPY). It is important to observe any change in the relative size of arteries and veins, the diameter of the normal artery being from two-thirds to three-fourths that of the corresponding vein.

A congenital general enlargement of the retinal vessels, containing unusually dark blood, is met with in congenital defects of the heart with cyanosis. A temporary distension of the retinal vessels exists in active hyperæmia, as from vaso-

motor influence in exophthalmic goître, local overfilling from obstruction in another arterial region, &c. A general reduction in the size of the vessels is sometimes found in general anæmia and in Bright's disease, or it may be due to local pressure on the central artery. The arteries alone may be small in cases of neuritis and of embolism, and occasionally in general anæmia, where the veins appear large from being flattened, owing to their reduced intravascular tension. In true venous distension we find these vessels large, rounded, abnormally dark, and tortuous. This condition of venous distension may be dependent on local or general causes. Locally, it may be due to neuritis, or thrombosis of the central vein, and is found sometimes in glaucoma and in cases of rapidly occurring pressure on the cavernous sinus. The retinal veins may be congested, as part of a general venous congestion in the head from pressure on the jugular or innominate veins. Again, the retinal congestion may be part of a general congestion, the latter being either *acute*, as from coughing or any effort, or *chronic*, as in mitral disease and emphysema of the lungs. An irregular dilatation or varicosity of the veins is sometimes observed in aged persons and in glaucoma.

A *tortuous course* is characteristic of congested veins, but it has exceptionally been found with normally sized vessels in healthy eyes. An antero-posterior curve in the vessels may be caused either by swelling or detachment of the retina, and is recognised mainly by loss of the central light-streak.

Visible pulsation in one or more of the large veins on the disc is not uncommon in the normal condition, and is best seen just at the edge of the physiological cup. It also occurs, pathologically, from the same causes that produce arterial pulsation. This latter is never normally present, but occurs in acute anæmia, in aortic regurgitation, and in increased intra-ocular tension, whether from disease or mechanically produced by finger-pressure from without. It is usually visible only in the vessels on the disc itself, but in aortic cases it may be traced peripherally to branches of comparatively small size.

Changes in the vascular walls are sometimes recognisable by the ophthalmoscope, a distinct white line bounding each side of the red blood-column. This appearance may be due to thickening of the middle or outer coat of the arteries, or to an accumulation of leucocytes in the peri-vascular sheath. Aneurisms may occur either on the primary branches of the central artery, or on the smaller twigs and capillaries of the retina. They are of clinical importance from their being usually associated with a similar condition of the small vessels in the brain and elsewhere.

Apart from circulatory changes, we may diagnose retinal affections by an interference with its normal transparency. Thus, we may have diffuse haze from œdema, red patches from hæmorrhages, black opacities from deposits of pigment, or opaque white areas from exudation or fatty changes. Again, it and its vessels may be elevated in part of the fundus as the result of an exudation or solid growth beneath.

Hæmorrhages may occur in the retina at any part of the fundus, and are readily recognised, when recent, from their bright red colour. There may be only one or two, or they may be practically countless; and they may be of any size, from a barely visible spot or streak to a patch much larger than the optic disc. Occasionally, a single, large, round or oval, sharply defined hæmorrhage occurs at the yellow spot. Hæmorrhages are most commonly found in the neighbourhood of large vessels in the nerve-fibre layer, and then present a striated or 'flame-shaped' appearance, from the extravasated blood lying between the nerve-fibres. Not infrequently they occur in the inner nuclear layer from the fine capillary networks found in this position, and they are then round or irregular in form. If large, they may either burst into the vitreous or cause detachment of the retina. They interfere with sight according to their size and position; those at the yellow spot causing necessarily a large central scotoma. They become darker in colour with time, and absorption takes place gradually, its rapidity being greatest in hæmorrhages of small size and in those not associated with disease of the vessels. Ultimately no trace may be left, or there may be dark pigmentation or again yellowish-white spots.

Causes.—We may meet with them as part of an inflammation of the retina or optic nerve, but more frequently they are dependent directly on general conditions, or on retinal disease consequent on general conditions. The extravasation may be due to rupture of vessels or to diapedesis. The following statement will serve to show the manner of their occurrence.

A. Rupture of vessels from—

1. Increased intravascular pressure, local or general. (*a*) *Local*—e.g. from contusion of eyeball, venous thrombosis, optic

neuritis with much constriction of veins, and all forms of retinitis. (*b*) *General*—as from hypertrophy of the left ventricle, cough or other violent effort, stoppage of habitual discharges, the high arterial tension associated with gout, &c.

2. Rupture from sudden diminution of the vitreous support, as in wound of the globe and in iridectomy for glaucoma.

3. From weakness of a degenerated vascular wall, as in sclerosis, fatty degeneration, or miliary aneurisms of the retinal vessels; sometimes associated with embolism or thrombosis of the small arteries. The vascular change may be a simple senile condition, or may be a concomitant of a general affection such as Bright's disease.

B. Diapedesis may be the result of—

1. Increased intravascular pressure, or

2. An altered condition of the blood. This latter is probably responsible for the hæmorrhages found in cases of diabetes, severe anæmia, leucocythæmia, ague, purpura, scurvy, and pyæmia. Retinal hæmorrhages are occasionally met with in young people without any obvious cause. Such cases are probably due to increased intravascular tension and altered conditions of the blood. They are commonly found in association with the hæmorrhagic diathesis.

The *treatment* of hæmorrhage of the retina must necessarily vary with the general and local states with which it is associated or on which it depends. In recent cases iced compresses may be applied to the lids.

Inflammation of the Retina is usually the result of some general disease, and the classification of its forms commonly adopted is clinical rather than pathological. When the inflammation commences in the retina the papilla is generally secondarily involved, and, again, retinitis—mainly of the inner layers, is not infrequent in cases of papillitis. The principal ophthalmoscopic evidences of retinitis are loss of retinal transparency, dilatation of the veins, and a tendency to the occurrence of hæmorrhages and white patches. Anatomically, we find serous infiltration of the retina, swelling of the Müllerian fibres, fatty degenerations, inflammatory exudations, hæmorrhages in the inner or middle layers, and hypertrophy and sclerosis of nerve-fibres. Sometimes there are numerous opacities in the vitreous. The impairment of vision, both temporary and permanent, varies much in different cases.

The *treatment* must be regulated mainly by the general condition of the patient. All strong light should be cut off from the eyes by wearing dark neutral-tint glasses, and complete rest be ordered. Counter-irritants or leeches to the temples may be advisable.

Hæmorrhagic Retinitis is the term applied to cases where we have numerous hæmorrhages along with evidence of retinal inflammation, occurring in association with disease or disorders of the circulatory system. It usually affects one eye only. The hæmorrhages are small and numerous, and are found widely distributed over the fundus, chiefly in the inner layers of the retina. The papilla is hyperæmic, with blurred margins; there is a slight diffuse opacity of the retina, and its veins are dark and swollen. Occasionally, we find a few circumscribed white spots in the inner retinal layers, probably due to fatty degeneration or to aggregation of leucocytes.

Causes.—This disease is found in connection with diseased cardiac valves, hypertrophy of the left ventricle, aneurism of the great vessels, and with arterial sclerosis. It also sometimes occurs on sudden suppression of the catamenia at the climacteric period. The manner of its production is obscure. It may perhaps be explained by chemical changes in the blood, or by multiple embolism of the small twigs of the central retinal artery. There are usually permanent changes left in the retina and papilla.

The *treatment* must be general; iodide of potassium may be used with apparent advantage.

Albuminuric Retinitis is characterised by the presence of numerous light-coloured patches, and of minute, opaque, very white dots or striæ at the yellow spot. The affection of the papilla varies between slight passive congestion and great engorgement; in the latter case there is a marked tendency to hæmorrhages, which occur principally in the nerve-fibre layer. The soft-edged light-coloured patches occur early, and are found mainly in an annular zone surrounding the papilla. The white punctate spots appear later, and are arranged in the form of a star or asterisk, with its centre at the fovea centralis. Both eyes are practically always affected. The large light patches are usually behind the retinal vessels, and are due to a deposit of fatty granules in the nuclear and internuclear layers. When superficial to the vessels, the opacity is caused by a local hypertrophy of the nerve-fibres. The white dots at the macula are due to a fatty degeneration of the inner ends of the Müllerian fibres.

Causes.—This retinitis is most commonly associated with chronic disease of the kidney, especially the contracting form, but it

is also frequently found in the albuminuria of pregnancy and not uncommonly in acute nephritis after scarlatina. It has been observed in about 13 per cent. of all cases of albuminuria. The occurrence of the ocular changes is probably to be explained by the altered condition of the blood, arising from retention of products that ought to be eliminated and from the hydræmia produced by the loss of albumen. We may have a papillitis or a papillo-retinitis, in connection with albuminuria, without the typical appearance above described. On the other hand, retinitis quite of the albuminuric type occurs exceptionally in connection with intracranial affections, cardiac disease, diabetes or anæmia, without there being any evidence of renal disease.

If improvement takes place in the renal affection the retinal changes may subside, but the star-shaped grouping at the macula lasts for a long time. We often ultimately get optic atrophy, narrowed vessels with double white lines, and disturbances in the retinal pigment. Sometimes, we get a restoration of perfect vision with a normal fundus, as in the cases associated with pregnancy.

Syphilitic Retinitis.—This is an inflammation of a chronic diffuse type without gross ophthalmoscopic changes. The larger veins are somewhat distended and dark, and the outline of the papilla is blurred. The retina itself becomes hazy, especially in the neighbourhood of the papilla and along the larger vessels. White patches and hæmorrhages are rare. Very commonly there are numerous dust-like opacities in the vitreous. It generally occurs secondarily to choroiditis, but may exist alone, and either in one or both eyes. It usually comes on late in the secondary stage, about the end of the first year or later, and is most common in subjects of mature or advanced age. It has been also met with in the congenital form of the disease.

Symptoms and Course.—There is considerable failure of vision, sometimes micropsia, and always marked night-blindness. It lasts for months, but the result is generally favourable, the retina recovering its transparency and the other changes disappearing.

The *treatment* must be energetically anti-syphilitic, mercury being the remedy chiefly to be relied on.

Retinal Disease in Leucocythæmia occurs in about one-third of the cases of the splenic form. It is always bilateral, but often unequal in degree in the two eyes. In a typical case, we find prominent white patches surrounded by a hæmorrhagic border: these are met with at the limits of the retinal circulation—viz. in the centre, and quite at the periphery of the fundus. The general fundus-reflex is of a bright orange-yellow colour; the retinal arteries are bright orange and the veins light carmine. The usual signs of retinitis are also present, such as blurring of the edges of the disc, slight opacity of the retina, and occasionally small hæmorrhages and white spots.

Retinal Disease in Diabetes occurs comparatively rarely, but is always bilateral. Usually we simply find retinal hæmorrhages in this association, but, in severe, long-continued cases, retinitis may occur with appearances much like what we find in albuminuria. In the diabetic form, however, the whitish patches are generally smaller, and there are very frequently opacities in the vitreous. Vision is necessarily much reduced in all severe cases, and the prognosis is unfavourable.

Central Retinitis from Exposure to Direct Sunlight has been met with in several cases after observation of an eclipse. Immediately after the exposure there is more or less loss of central vision, in the form of a positive scotoma. In severe cases this persists, though generally some improvement takes place. Ophthalmoscopically, the macula is found to be more darkly pigmented than usual, and the position of the fovea is occupied by a greyish-yellow spot. It is probable that the pathological changes consist in proliferation of the pigment-epithelium, and exudation between it and the chorio-capillaris. In severe cases with persistent scotoma, there is possibly also destruction of the outer segments of the rod and cone layer.

The *treatment* consists mainly in the use of dark glasses, and leeches or counter-irritants to the temple. Later, strychnine and galvanism have been recommended.

Retinitis Pigmentosa is a term in common use to designate a disease where a certain group of symptoms and definite course are usually found in association with pigmentary changes in the retina. The disease is symmetrical and chronic, usually beginning in early life, and often terminating in blindness soon after middle age. Night-blindness is the earliest and most characteristic symptom. There is next loss of visual field, generally at first in the form of an annular scotoma, but the periphery soon also fails, and a small central field alone remains. Central vision may remain good for a long time. The

affection is often found in several members of the same family, and such patients are not infrequently defective in intellect. It is believed by some that consanguinity of parents may produce it.

Ophthalmoscopic examination shows a yellowish-red waxy atrophy of the optic disc; marked diminution in size of the retinal vessels, especially the arteries; and much pigment in the retina, largely in its inner layers, where black masses, shaped somewhat like bone-corpuscles, lie superficial to the retinal blood-vessels. This pigmentary deposit is found chiefly in a belt situated midway between the centre and the periphery of the fundus, and thinning out at each edge. There is no hyperæmia at any period of the disease. No constant relation exists between the amount of pigment or other ophthalmoscopic change and the loss of sight; indeed, we may have the usual symptoms and course of the disease without the presence of any abnormal pigment in the retina. Similar changes in the retina and optic nerve are found, not infrequently, secondary to choroidal inflammation, but in such cases we have the atrophic changes in the choroid in addition. Ophthalmoscopically considered, pigmentary degeneration of the retina is essentially the same from whatever cause it may arise. But the term *retinitis pigmentosa* has been chiefly used as a clinical designation, and as denoting the group of symptoms, course, and ophthalmoscopic appearances of, practically, the only form of pigmentary degeneration which can occur without retinitis; while the symptoms and course of this disease may be present without the usually associated pigmentary degeneration. The condition is in reality a chronic sclerosis, occurring either as a primary disease or secondary to intraocular inflammation, and generally, but not always, associated with a pigmentary degeneration of the retina. Pathological examination of the retina shows an increase of the connective-tissue framework, atrophy of the nervous elements, and thickening of the walls of the vessels.

The pigmentary changes are partly atrophic in nature, but mainly consist in an infiltration of the retina with newly formed pigment aggregations. These latter follow the course of the vessels, and are found most conspicuously at their branchings.

Galvanism is the only form of *treatment* of any avail in this affection, sometimes causing a marked improvement both in field and in central acuity. It ought to be employed as described previously (*see* Optic Nerve, Atrophy of), and if it prove serviceable, should be persevered with, as otherwise the improvement cannot be expected to last long.

Thrombosis may occur in the central artery, but it is rare, and indistinguishable during life from embolism. Occasionally, thrombosis affects the central vein behind the eyeball or one of its large branches on the fundus, and usually leads to deterioration of vision and marked ophthalmoscopic appearances. The sight fails suddenly, and more or less completely according to the extent of the closure and the size of the vessel affected, but generally it soon improves again somewhat. In a marked case, the veins of the retina are found to be tortuous and enormously distended, the arteries often small, and both sets of vessels near the disc are concealed in great measure by large opaque, white, diffuse masses of exudation and by numerous hæmorrhages. The latter are of all sizes here, and smaller ones extend well out to the periphery of the fundus. The yellow spot region is of a light clay-colour, with the fovea centralis conspicuous as a very minute cherry-red spot. The papilla looks normal, with the exception of slight blurring of its margins. The affection occurs principally in the aged, often with a family history of gout, and nearly always in only one eye.

Embolism may occur in the central artery itself or in one of its branches, and may be either complete or partial. It is seldom bilateral, and is more common on the left than the right side. Embolism in other vessels always co-exists, the usual cause being heart-disease, especially mitral. It may be found in association with atheroma of the aorta, pregnancy, and Bright's disease, and may consequently occur at any age. In complete embolism the plug is generally near the lamina cribrosa, and the leading symptom is sudden blindness of one eye. There is frequently a temporary improvement a few hours after its occurrence, from the establishment of an imperfect collateral circulation, but the usual final result is absolute blindness. In plugging of a branch, the visual defect is usually partial from the first, the final result likewise being loss of vision corresponding to the distribution of the affected vessel.

Ophthalmoscopic Appearances. — The optic disc is pale, with somewhat blurred edges. There is a diffuse, misty opacity of the retina from œdema, best marked in the yellow spot neighbourhood. Corresponding to the fovea centralis is a bright red spot, where the normal choroidal reflex shines through the outer layers of the retina, and

appears specially red by contrast with the surrounding cloudiness. The large vessels are usually small near the disc, the arteries being often reduced to mere white threads or to narrow red blood-columns bounded by opaque white lines. Within the first day after the occurrence of an incomplete blocking of the vessel, the blood may be seen both in the arteries and veins in the form of short detached columns. This appearance is most common in the arteries, where the short columns may be observed to move forward in a jerky fashion. Increased tension from finger-pressure cannot produce visible pulsation in the vessels. Small hæmorrhages often occur near the optic disc. After some days the pulsation on pressure returns in all the blood-containing vessels, the retinal œdema slowly disappears and the disc gradually becomes atrophic. Where a branch only is affected, changes similar to the above are found in its area of distribution.

As regards *treatment*, massage of the eyeball has proved beneficial in several cases, and should be tried. It is probably best effected by alternate, prolonged, moderately firm pressure on the globe and sudden removal of this pressure.

Detachment of the Retina.—In this condition the retina proper is separated from its pigment epithelium, and a serous fluid usually occupies the interval. Except at the fovea centralis and ora serrata, the retina is naturally very loosely attached to its epithelium; and fluid once present between them readily gravitates downwards to the lower part of the fundus, where old standing detachments are most commonly found. Occasionally, the displacing agent is an extravasation of blood, or a solid plastic exudation from choroiditis, or a choroidal tumour pushing the retina forward. Subretinal fluid may be effused, primarily, either as a hæmorrhage or as a serous exudation in connection with inflammation or tumour of the choroid. The common reason of detachment, however, is probably some alteration in the vitreous—either a mere diminution of its support to the retina, or contraction of connective-tissue formations within it forcibly dragging the retina away from its normal position. In such cases the sub-retinal effusion of fluid is secondary.

One of the most common *causes* of retinal detachment is progressive myopia, where we have both choroidal inflammation and alterations in the vitreous. Perforating wounds of the sclerotic may lead to detachment, either immediately, from a loss of vitreous, or subsequently, from contraction of the cicatricial tissue at the seat of puncture. In many cases no cause can be discovered.

Anatomically, the detached retina undergoes a gradual degeneration, the nervous elements being destroyed and its connective tissue hypertrophied.

Ophthalmoscopic Appearances.—On illuminating the patient's eye with the ophthalmoscopic mirror held at twelve to eighteen inches distance, we observe a want of uniformity in the reflex obtained, a greater or lesser extent of the fundus appearing bluish-grey or whitish in contrast to the normal red seen elsewhere. This discoloured portion is usually folded and more or less tremulous, and corresponds to the detachment; on its surface we see the retinal vessels as slender, dark, stiff-looking tortuous lines. In a recent shallow detachment we find no such difference in colour, but its vessels have the characters just mentioned, though they stand out less conspicuously, from the absence of the strong contrast furnished by a light-coloured surface. By careful measurement of the refraction of the vessels, on the affected and unaffected areas of the retina, we can estimate the depth of the detachment, and in difficult cases determine whether really a displacement exists. Having satisfied ourselves of the presence of a detachment, we should note its extent and the character of its boundaries, its mobility on movements of the eye, its colour, its depth, and the degree of folding. We are thus in a position to decide as to the probable nature of the displacing agent. Not infrequently, floating opacities in the vitreous, changes in the lens, or iritic adhesions are present and interfere with our examination; under such circumstances the indirect method of observation is particularly valuable. The grey colour of a detachment is due to the opacity of the retina; the darkness of the blood-vessels is due partly to loss of the central light-streak, partly to contrast, but mainly to the fact that they are principally seen here by *transmitted* light, the greater part of which is absorbed by the blood-column.

Symptoms.—There is frequently a history of sudden impairment of vision, objects appearing distorted or as if covered by a thick black veil. Sometimes we have complaints of flashes of light and of red or blue colour-sensations. Light is diminished in the part of the field corresponding to the detachment. Central vision may remain good for some time if the macula has escaped; but, in the majority of cases, the detachment extends gradually, and the sight

becomes progressively worse until, ultimately, there is complete blindness or only the barest perception of light.

Treatment.—In recent cases we can often get satisfactory improvement of vision for a time at least, though the measures most successful are decidedly irksome. Rest in a dimly-lighted room is particularly to be recommended, the patient lying on his back on a bed or couch, and the affected eye kept covered with a pressure-bandage. All exertion or sudden effort must be avoided, and the bowels are to be carefully regulated. Puncture of the sclerotic at the site of the displaced retina, so as to permit of the escape of the sub-retinal fluid, is, possibly, a judicious preliminary to the above method of treatment. Repeated subcutaneous injections of pilocarpine have also been used and approved of by many, but their employment is not without risk, and the advantage problematical. Neither puncture nor pilocarpine ever does much good without rest, and it is extremely doubtful whether the latter alone does not give results as satisfactory as any.

Glioma of the Retina is essentially a disease of early life. It commences insidiously without inflammation, grows rapidly, and, if left to itself, soon leads to the death of the child. By its growth forwards it soon fills the eyeball, perforates the sclerotic or corneal margin, and involves the other orbital structures, so that, finally, we get the appearance of an enormous red fleshy protrusion without any visible trace of the globe itself. In its extension backwards it travels along the optic nerve, and ultimately involves the brain—not infrequently it causes secondary deposits in the scalp, brain, the neighbouring lymphatic glands, and occasionally in the liver and other distant parts. Rarely it attacks both eyes independently. It has occasionally been met with in several members of the same family.

Diagnosis.—In as far as its onset is painless and unaccompanied by inflammation, the attention of the parents is generally first aroused by seeing a whitish reflex from behind the pupil. The vision is commonly very early affected, while the eye still looks natural and the tension remains normal. By the time the whitish reflex is observed, however, there are often signs of secondary glaucoma, increased intra-ocular tension, dilatation of the pupil, and engorgement of the scleral veins, while the eye is now sometimes tender. By focal illumination we see a yellowish-white, rounded or lobulated, solid-looking mass in the vitreous, with blood-vessels and often small hæmorrhages on its surface. The vessels are easily distinguished from those found on a detached retina by their irregular distribution, different mode of branching, greater breadth, and somewhat brighter red colour.

Pathology.—Its naked-eye appearance is that of a soft, marrow-like growth, of a whitish or reddish-white colour, sometimes studded with small, white, chalky-looking dots. The formation originates in the neuroglia of the retina, usually in that of the inner granular layer. We find here deposits of small roundish cells, closely packed together in a structureless, finely granular interstitial substance. Later on, as the tumour grows, we find large groups of spindle-shaped cells and fibrillated bands (gliosarcoma), and occasionally evidences of fatty and calcareous degenerations.

The *treatment* consists in early removal of the affected eyeball, along with as much nerve as we can conveniently get at. If the other orbital contents are affected while the nerve at the point of section appears healthy, it is advisable to thoroughly clean out the orbit and then destroy the surface with chloride of zinc paste. If the tumour has attained a large size, its removal cannot be expected to save life, and it is often advisable in these circumstances to leave it alone. In such a case, the child's health must be kept up as well as possible, and opiates given, if necessary, to relieve pain and induce sleep. R. Marcus Gunn.

RETINOSCOPY (Keratoscopy).—(In this article the following abbreviations are used:—M. = myopia or myopic, H. = hypermetropia, As. = astigmatism, E. = emmetropia, D. = dioptre, V = vision.)—Retinoscopy is a method of determining by the ophthalmoscope the nature and extent of anomalies of refraction of the eye. It depends on the following optical facts. Supposing a patient, with artificially dilated pupil, seated in the ordinary position for ophthalmoscopic examination, and that we place ourselves at about forty-eight inches from him and reflect the light from a well-defined gas-flame into his eye, by means of a *concave* perforated mirror of about nine inches focal length. If we then look through the perforation in the mirror, we see the ordinary fundus-reflex. Now, if we give the mirror slight rotations about its vertical axis, so that it faces in different directions, still remaining in front of our eye, we then see something that has the appearance of a shadow with a vertical edge, moving horizontally across the illuminated area of the

patient's pupil, either in the same direction as the mirror changes face or in exactly the opposite direction. If, for instance, we turn the mirror to our right, the shadow moves horizontally, either to the right or to the left. Now, if it moves to the right—i.e. in the direction in which the mirror changes face—the patient's eye is M.; if it moves to the left—i.e. in the opposite direction to that in which the mirror changes face—the eye is (generally) H.; if no distinct shadow-movement is seen at all, the eye is E. (nearly).

The observation just described is the germ of retinoscopy. It is convenient to use the terms 'with' and 'against' in describing the movement of the shadow with reference to that of the mirror; for the future, then, we shall speak of the shadow moving 'with' or 'against' the mirror, according as it moves in the same or opposite direction to the change of face of the mirror.

It may be shown that this so-called shadow is really the edge of the image of the gas-flame, formed by one reflection at the mirror and two refractions through the patient's eye, and further, that the change from movement 'with' to movement 'against' takes place, not where the patient's eye is exactly E., but where it is M. about 1·0 D; but as this does not differ much from E. we may say roughly that in M. the shadow moves 'with' the mirror, in H. 'against' the mirror, and that in E. no distinct shadow is seen at all. We have supposed that the mirror is rotated round its vertical axis; this, however, is not at all essential; any axis will do, but perhaps the vertical or horizontal is most convenient. Further on, when we come to treat of As., we shall have to suppose rotations round various axes, and it will be conducive to clearness to abandon altogether this term—rotation round an axis—and speak of the mirror being turned in the direction of a certain meridian of the patient's cornea, this meridian being the one perpendicular to the axis round which the mirror is rotated. Thus, when we speak of the mirror being turned in the horizontal direction, we mean that it is being rotated round its vertical axis; when we speak of its being turned in a direction up and *in* at an angle of 30° with the vertical, we mean that it is being rotated round an axis inclined up and *out* at an angle of 30° with the vertical. Adopting, then, this phraseology now, we say that in cases of M. or H. the shadow moves in the same direction ('with' or 'against') in which the mirror is turned. Further, the edge of the shadow is perpendicular to the direction in which the mirror is turned. It must also be stated here that the above phenomena as regards 'with' and 'against' apply to a *concave* mirror only; with a plane or convex mirror, the directions in which the shadow moves are reversed. We can then by this method at a glance diagnose the *quality* of the refraction; but, further, we can estimate its *quantity*. To do this it is only necessary to fit the patient with a trial-frame, and put in it lenses to correct the refraction—i.e. concave or negative lenses in the case of M., convex or positive in the case of H.; in either case we find what lens causes the shadow-movement to disappear.

We know that now the eye *plus* the lens forms an emmetropic (nearly) combination, and the strength of the lens gives the amount of M. or H. The correct lens is in many cases found only after several trials, but a little practice will often enable the observer to make an approximation to it at once. With this view, he should note especially the *intensity* of the fundus reflex; if this be bright, the case is one of low ametropia (whether M. or H.); if it be dull, it is a case of high ametropia. To take an example:—

The patient's eye shows a dull fundus-reflex, and the shadow moves 'with.' The case then is one of high M. We put up a lens of, say, −7 D in the trial frame. The reflex is now much brighter, and the shadow still moves 'with.' 7 D is then not strong enough to connect the M.; we put up −9 D, and now we get no shadow at all; the amount of M. is then 9 D (nearly). On trial with test-types at twenty feet, we find the M. is actually 10 D, rather more than we found by retinoscopy; this results from the fact mentioned above, that the condition in which no shadow at all is seen is not one of exact E. but of M. of about 1 D. In all cases, it will be found that the actual M. is about 1 D *greater* than that indicated by retinoscopy, and (for the same reason) the actual H. about 1 D *less*.

To proceed now to the phenomena of retinoscopy in *Astigmatism*. In M. and H. we have seen that the direction in which the mirror is turned is immaterial, a shadow-movement being procurable in any meridian by turning the mirror in the direction of that meridian. In astigmatism, however, we get a shadow-movement in the direction of the two principal meridians *only*, and this no matter in what direction the mirror is turned. It follows that if the mirror be not turned parallel to one of the principal meridians, the consequent shadow-

movement is not parallel to the direction of turning of the mirror. This fact at once indicates that astigmatism is present, and reveals the directions of the principal meridians. These being ascertained, we proceed to examine their refraction, turning the mirror for that purpose in the direction of each of them successively. With a little practice this can be done pretty accurately, the direction in which the mirror is being turned being shown by the direction in which the circular patch of light (reflected from the mirror) travels across the patient's face. Take one of these chief meridians: Turning the mirror in its direction, we have, as a criterion of its refraction, a shadow moving parallel to it, and with edge perpendicular to it. All that has been proved of the shadow in any meridian in the non-astigmatic eye is true of this one meridian in the astigmatic: the movement of the shadow shows whether the meridian is M. or H., and the strength of glass necessary to cause the shadow to disappear gives the amount (nearly) of the M. or H. We note the lens required, and then proceed to examine in the same way the other chief meridian. Having thus determined the refraction of the two chief meridians, we put in the trial-frame the indicated spherocylindrical combination, and try the patient with the test-types at twenty feet. To get the best vision, we expect to have to slightly strengthen the spherical lens in M., and weaken it in H., and other slight changes in the strength of the cylinder and the direction of its axis may be necessary before the most satisfactory result is obtained. But, as a rule, the lens indicated by retinoscopy comes very near to the one finally chosen.

Take a case. Right eye. Dull fundus-reflex. Shadow moves 'against.' With + 8 D a well-defined shadow moving 'with' the mirror in meridian 45° up and out; no shadow seen in meridian perpendicular to this; that is, + 8 D corrects this latter meridian, + 6 D gives no shadow in meridian 45° up and out, and a faint shadow moving 'against' in meridian perpendicular to this—that is, + 6 D corrects the former meridian, $\frac{+6\text{ D}}{+1{\cdot}50\text{ D cyl.}}$, axis 45° up and out gives no shadow in any meridian. The lens that gives the best vision is $\frac{+5{\cdot}50\text{ D}}{+1{\cdot}50\text{ D cyl.}}$ axis 50° up and out, and with this $\frac{6}{9}$ is read, v without the cylinder being only $\frac{6}{36}$.

Very often in cases of compound astigmatism the As. is not evident at first, and only appears when, in the course of correcting the apparently simple spherical anomaly, we put up a lens that nearly corrects one meridian; the shadow in the other meridian then stands out clearly. Mixed astigmatism is diagnosed at a glance, the shadows in the two chief meridia moving one 'with,' the other 'against.'

In conclusion, a few practical hints may be given. A mydriatic is often necessary, especially in cases of astigmatism. Where a mydriatic is not used, the patient should be directed to turn his eye so that the light from the mirror falls on the optic disc; in this way the greatest dilatation of the pupil is obtained. The surgeon should get into the habit of sitting always at about the same distance from the patient, and using the same intensity of light.

A dull fundus-reflex, suggesting high ametropia, may be caused by pathological changes in the media of the eye.

Irregular, broken shadows generally mean opacities of the cornea.

The retinoscopic examination must, generally, be considered only preliminary to the usual test with lenses and types at twenty feet.

A much fuller account of the method, especially in its theoretical aspect, is to be found in the *Royal London Ophthalmic Hospital Reports*, vol. x. part iii.

W. Charnley.

RETRO-NASAL CATARRH is a chronic inflammatory condition of the mucous membrane lining the naso-pharynx and the posterior part of the nasal cavities. It is frequently associated with chronic nasal catarrh and granular pharyngitis. Several varieties have been described, such as the follicular, the hypertrophic, and the dry catarrhal, but they would appear to be merely stages of the same disease, and are here treated as such.

The *cause* of the catarrh is not altogether understood. The extension of chronic catarrh from the nose or pharynx, frequent exposure to alternating draughts of hot and cold air, the irritation of particles of dust, which are particularly apt to become lodged in this portion of the respiratory tract, and direct contagion have been regarded as exciting causes; whilst struma, syphilis, and residence in hot and damp climates are thought to predispose to it. It is much more common in America than in this country, and is there thought by Dr. Robinson to depend upon a 'catarrhal diathesis.'

Pathology.—In the earlier stages of the disease, there is simply a catarrhal inflammation of the mucous membrane; later, the mucous membrane and submucous tissue become infiltrated with inflammatory products, and the glands enlarged and stimulated to over-production, when the hypertrophic stage, or the follicular variety, of the disease is reached. Still later—it may be after a few months or many years—the mucous membrane, in consequence of the contraction of the inflammatory exudation, shrinks and atrophies, whilst its glands are destroyed to a greater or less extent. The parts now appear glazed and dry from deficiency of secretion; and in this atrophic stage the disease is spoken of as dry catarrh.

The *symptoms* vary according to the stage of the disease, but space does not permit of their being given in detail. In a well-marked case, say in the hypertrophic stage, the period at which the surgeon is perhaps most frequently first consulted, the chief complaints are of a feeling of stuffiness and obstruction at the back of the nose, a constant hawking up of a viscid, muco-purulent secretion, sometimes streaked with blood, and a peculiar alteration in the voice. At first there may be no fetor, but later the breath, in consequence of the decomposition of the secretion, becomes peculiarly foul, and is then one of the patient's chief annoyances. Headaches, especially in the occipital region, deafness, and dyspepsia where the mucus is allowed to pass into the stomach, may also be present; and epistaxis may from time to time occur. Should chronic nasal catarrh co-exist, there will likewise be a discharge, and often an offensive one, from the nose.

On looking into the throat, the muco-purulent secretion will often be seen trickling down the posterior wall of the pharynx, which may present the characteristic appearances of granular pharyngitis. In the rhinoscope, the mucous membrane of the naso-pharynx, and especially that about the vault, appears thickened and often paler than natural, while the hypertrophied glands give it a peculiar mammillary and granular appearance, similar to that of granular pharyngitis. The mucous membrane lining the posterior pillars of the fauces, the back of the palate, and the orifice of the Eustachian tubes, usually presents similar changes, whilst that covering the sides of the septum is frequently œdematous, and that over the posterior ends of the inferior spongy bones greatly hypertrophied. The hypertrophied ends of these bones appear in some instances as distinct tumours, having a globular shape and a purplish-red colour, and, together with the œdematous septum, may completely occlude the choanæ. The above condition of the mucous membrane is often obscured by the presence of the viscid mucus, and it may not be until this has been removed with the spray or syringe that the actual state of the parts can be made out. In the atrophic stages of the disease, the naso-pharynx appears more roomy than natural, and glazed and dry; whilst the muco-purulent secretion, in consequence of the atrophy of the glands, is not cast off, but becomes inspissated, forming greenish and adherent crusts, beneath which the retained secretion undergoes decomposition and gives rise to the horrible smell. The nasal chambers, if involved in the disease, present similar appearances when viewed from the front. Ulceration does not usually occur in the course of chronic retro-nasal catarrh. Should such be observed in the rhinoscopic mirror, the case will probably be one of a syphilitic nature, and dead bone will, in the majority of instances, be discovered if further search be made for it.

Treatment.—This should be both constitutional and local. When convenient, the patient should reside in a dry and equable climate, and all sources of irritation, —as dust or noxious vapours, alternations of heat and cold, and tobacco and spirits— should be avoided. Internally, cubebs, which appears to have a marked influence on the secretions of the pharynx, should be given in large doses, and chloride of ammonium, ammoniacum, arsenic, salicylic acid, and sulphur may be tried. Where there is evidence of syphilis or struma, appropriate remedies should of course be given. Locally, the parts should be frequently cleansed by weak carbolic or alkaline sprays, and subsequently astringed by sprays of sulphate or chloride of zinc, or tannin; or by the insufflation of powders of eucalyptus (1 part to starch 2 parts), iodoform, catechu, and the like. These remedies should be applied by the brush, the insufflator, or the post-nasal spray apparatus, the nozzle of which must be passed well behind the palate. Syringing, except when the crusts are very adherent, is to be deprecated, and the nasal douche should on no account be employed, as its use is not only attended by the risk of setting up disease in the middle ear, but it also induces a soddening of the mucous membrane, and does not reach the whole of the affected parts.

Where there is much hypertrophy of the posterior ends of the inferior spongy bones,

these should be scored with the post-nasal galvano-cautery, directed by the mirror, and the scoring repeated at intervals of a week to a fortnight, till the parts have been reduced to their normal size. Or, if preferred, the hypertrophied tissue may be removed at one sitting by Jarvis's snare, the wire of which is passed through the nostril, and guided over the end of the spongy bone by the finger behind the palate. Local anæsthesia should be induced by painting a 20 per cent. solution of cocaine over the mucous membrane before using the galvano-cautery; but chloroform had better be given if the snare is used. Should a hypertrophic condition of the mucous membrane of the anterior portions of the nasal cavities also exist, the galvano-cautery should be applied to the inferior spongy bones, the septum being protected by Shurley's ivory speculum; or the hypertrophic mucous membrane may be removed from over the inferior spongy bone by Robinson's forceps; or the whole bone cut away by the nasal pliers. The author can speak from personal experience of the value of the galvano-cautery in these cases, and much prefers it to the rougher treatment with the forceps or pliers. At the same time, he is bound to say that he has never seen any harm follow the evulsion of the inferior spongy bone, and this treatment is certainly more rapid than that with the galvano-cautery.

When the disease has reached the atrophic stage, a complete cure must hardly be expected; the distressing symptom of fetor can, however, be relieved by the use of deodorising and disinfecting sprays, and the sense of dryness by the internal administration of salicylic acid and cubebs. The insufflation of a powder of salicylic acid 1 part, gum acacia 2 parts, will often take away the fetor in a few hours. Should the anterior part of the nasal cavities be also affected by the atrophic form of catarrh, the like remedies should be applied by the anterior nasal spray producer; whilst, at night, Gottstein's nasal tampons should be inserted, or an iodoform and eucalyptus bougie be allowed to dissolve in each nasal chamber. W. J. Walsham.

RETRO-PHARYNGEAL ABSCESS.

An abscess in the connective tissue between the pharynx and the spine.

Cause.—It may be seen at all ages, but is most frequent in children, occurring even in infants; in them it is often idiopathic. It is said to be more frequent in boys than in girls (Cohen). When idiopathic, a history of tubercle or syphilis is generally obtainable. Most commonly it is due to spinal caries, and is then chronic (*see* Caries of the Spine); but may complicate quinsy, and follow acute pharyngitis, especially after the exanthems, acute phlegmonous sore-throat, erysipelas, and syphilis; this last even occasioning caries at the same time. Injury to the pharynx from food, hot liquids, irritants, foreign bodies—e.g. impacted false teeth—may cause abscess.

Pathology.—Predisposition to inflammation of this part exists in its lymphatic structure, its constant mobility, and its liability to injury and variations in temperature. When idiopathic, suppuration begins in the submucous adenoid tissue (Bókai); when it begins in the deeper connective tissue, it is likely to be tubercular (Cohen). Caries of the front part of any of the cervical vertebræ determines the presence of pus behind the pharynx, though it often burrows down and becomes post-mediastinal. Retro-pharyngeal abscess is usually on one side of the middle line, and is accompanied by induration that can be felt below the angle of the jaw on the same side. It may point in the mouth, or on the side of the neck, and has been known to follow the brachial nerves to the axilla. The presence of the abscess causes mechanical dyspnœa and dysphagia, and by bursting may flood the larynx and suffocate. When post-œsophageal, it may open into the lung or œsophagus. Other complications are œdema of the glottis, and opening into the internal carotid artery. Sequestra are often discharged by the mouth, when caries is the cause of the abscess.

Symptoms and Diagnosis.—When *acute*, there is general pyrexia, with local heat and tenderness, dysphagia, huskiness, stiffness in the neck, and dyspnœa which is relieved by the erect posture. When sleeping, the patient snores as in tonsillitis. As the abscess enlarges, the head is thrown more backwards, and a tender swelling appears at the angle of the jaw. The mouth is opened with difficulty, and there may be profuse secretion of mucus (as in œsophagitis), which must not be mistaken for salivation. A fluctuating and very tender and unilateral swelling will be seen or felt in the pharynx, and when in the naso-pharynx it pushes down the soft palate. The more laterally placed, the less the dyspnœa and the greater the resemblance to quinsy.

The *chronic* form, due to caries, often gives rise to no symptoms until there is dysphagia or dyspnœa; possibly the swell-

ing at the angle of the jaw may first attract attention; or the abscess may have become post-mediastinal, and even have opened into a bronchus or the pleura before it is discovered. Excepting the accompaniments of acute inflammation, the condition is as detailed above; and, as manipulation is less painful, fluctuation between the external swelling and that in the pharynx may at times be made out. Left to Nature, the abscess may increase so as to necessitate interference, or it may burst in the mouth, in the chest, or externally; or it may sometimes resolve. Parts of the cervical vertebræ may come away through it. When symptoms of cervical caries are obscure and unnoticed, the abscess may never be recognised; sudden death has been known to occur from atlanto-axoid disease where it was unsuspected, and the autopsy alone revealed a post-pharyngeal abscess.

Diagnosis.—The acute form of abscess in children may be mistaken for croup; but the dyspnœa is relieved by sitting up, is very intermittent, and unaccompanied by the crowing noise of croup. Dysphagia is a prominent symptom, the child even declining to try to swallow. Inspection of the throat reveals the condition at once. The chronic form has to be distinguished also in children from sarcoma; this last grows rapidly, does not fluctuate, though it is soft, and its surface is nodular or irregular. *See* Pharynx, Tumours of the.

Treatment.—Retro-pharyngeal abscess should be evacuated as soon as possible. The old method with trocar and canula through the mouth is for many reasons unsatisfactory. A vertical incision into the tumour, with a bistoury guarded up to its point with sticking-plaster, is easily made, but the left forefinger must hold down and push back the tongue at the same instant, so as to force the epiglottis over the laryngeal aperture, or the first gush of matter may enter the windpipe. When pointing, the finger-nail has been employed to open the abscess. As in other wounds made in the oral cavity, there is but little risk of septicæmia; yet, if desired, the abscess can be opened aseptically by dissecting down upon it behind the sterno-mastoid, and thrusting dressing-forceps into it. *See* Antiseptic Surgery. The simpler plan of opening it in the mouth has the advantage of easily allowing a sequestrum to be removed. The writer does not think the advantages of the external method commensurate with its difficulty of performance and more serious character.

C. Hilton Golding-Bird.

RHEUMATOID ARTHRITIS. *See* Chronic Rheumatic Arthritis; Osteo-arthritis.

RHINOPLASTY.—Under this heading is included a number of plastic operations performed for repair of the nose, in cases of deformity and partial or total loss of that organ. The disfigurement requiring an operation of this kind may be the result of congenital malformation, of injury, or of surgical operation, but in most instances is due to syphilitic, tubercular (lupoid), or cancerous ulceration. The disfigurement, in severe cases of the latter class, is caused partly by destruction of more or less of the nose, and partly by contraction of cicatricial tissue. Although the most favourable conditions for the success of a plastic operation are presented by this region, still the results of rhinoplasty are not usually very satisfactory. The soft parts around the nose are very vascular and well-organised, and thick flaps composed of several layers of varied tissue may be brought over the defect from almost every quarter; but notwithstanding this, it too often happens that, as was pointed out by Denonvilliers, a repulsive deformity has been converted into one that is ridiculous. It has been asserted, however, that the loss of smell and taste, caused by complete destruction of the nose, may be overcome to some extent by supplying a new nose, and there can be no doubt that the patient is thus rendered less liable to attacks of laryngeal and bronchial catarrh. The appearance of a prothetic apparatus of some foreign material is no less unpleasant, especially during transient changes in the vascularity of the adjacent sound parts.

The results of a rhinoplastic operation, with regard to the relief of deformity, will depend much more on the extent of osseous than that of cutaneous loss. If the bones of the nose be preserved, there is always a good chance of restoring a prominent and sightly organ, though most of the skin may have been destroyed. In cases of destruction of the osseous framework of the nose, on the other hand, the surgeon cannot expect to do more than cover the open chasm by a flap, which will remain almost on a level with the cheeks. With regard to the condition of the soft parts, from which it is intended to take one or more flaps, mere superficial cicatrisation would not interfere with the success of the operation. Indeed, scarred skin under certain circumstances, as in the restoration of an ala, would be more suitable material for a flap than skin that is quite sound. When, however, the skin around

the nose has been almost completely destroyed and converted into dense cicatricial tissue, as after a deep burn, the flap would shrink to a considerable extent, and very probably slough. The most unfavourable conditions for rhinoplasty are those in which the nose has been destroyed by syphilitic ulceration or a burn. In cases of destruction by lupoid or cancerous ulceration, by which usually only the soft parts of the organ are destroyed, the prospects of success are more promising.

It has been laid down as a strict rule that, before rhinoplasty be practised for deformity from specific ulceration, an interval of at least six months should follow the disappearance of all signs of active disease. The patient at the time of the operation should be quite healthy, and placed in the best possible hygienic conditions. The complications to be feared during the after-treatment are sloughing of the flap, renewal of the specific ulceration, secondary hæmorrhage, and erysipelas.

For restoration of a completely destroyed nose, the surgeon may transplant a flap from some distant part of the body, as in the old Tagliacotian or Italian operation, or transpose one from the forehead. The former procedure, which, as is well known, consisted in taking a flap of skin from the inner surface of the arm, had from the time of Dieffenbach remained obsolete and of simply historical interest until recently, when it was again performed with much success by Sir William MacCormac in a case of partial loss of the nose with cicatricial deformity of the face, and also by Mr. Hardie of Manchester, who took the flap from the flexor surface of the thumb. The flap has been taken also from the forearm. Though disfigurement of the forehead or cheeks will be thus prevented, the after-treatment in the Italian operation must always be attended with much difficulty, and be found extremely irksome and disagreeable by the patient. The skin of the arm is not so suitable for rhinoplasty as that of the forehead. The primary retraction is certainly very considerable, and, according to Dieffenbach, the subsequent atrophy also was greater in flaps derived from the former source.

In the Indian or frontal operation, performed most frequently by German and English surgeons, a large flap is taken from the forehead and twisted downwards on an inferior attached pedicle, so as to cover the defect. In the first stage of this operation, a commensurate model of the new nose is formed of stiff paper or cardboard, which is then flattened out on the middle of the forehead. A flap of the same shape as the flattened model, but larger to the extent of a quarter of an inch in every direction, is next mapped out by a deep incision down to the pericranium, and dissected away until it is attached merely by a narrowed root near the internal canthus, on one or the other side. The broad base of this flap usually falls just within the region of the hairy scalp. The hæmorrhage from the large wound thus formed having been arrested, the edges of the defect are pared, except below near the lip, the whole thickness of the soft parts being divided. In this dissection the knife should be carried obliquely from without inwards, so as to cut away more of the deeper portion of the skin than of the surface, and to form a shelving wound around the nasal orifice. This is usually the second stage in the operation, but some surgeons commence by refreshing the edges of the defect, and afterwards take up the frontal flap.

In the third stage, the triangular flap, still attached by its pedicle, is twisted outwards, and then brought downwards, over the defect, to the pared margins, to which its edges are fixed by sutures. The edges of the large wound in the forehead are next approximated by needles and twisted sutures. The columna of the new nose may be formed, either by a narrow process of skin extending from the broad base of the frontal flap, or by a separate tongue-like process cut from the middle of the upper lip, and turned upwards to be fixed by its free end to the tip of the new nose, whilst the other extremity remains attached near the lower margin of the nasal orifice. The lower edge and the alæ of the new nose are elevated at first by pieces of lint, and afterwards, during the healing process, by metal or 'gum-elastic' tubes. The seat of operation should be covered by some simple dressing, and over this a thick layer of cotton-wool. After an interval of six weeks, when the circulation in the new nose has been established, and œdema and signs of congestion have disappeared, the pedicle may be divided, and some small plastic operation be performed for relieving the deformity caused by its prominence.

The best material for the sutures used in this operation for fixing the flap is fine silver wire. Silk often causes some slight sloughing around the punctures, and catgut soon becomes soft, and either melts or gives way. The use of stout needles, with the object of elevating the flap, is liable to

cause too much traction on the tissues around the defect, and also to interfere with the circulation in the new nose.

The chief source of failure in this operation is obstruction to the blood-supply of the transposed frontal flap, through torsion of the pedicle. With the view of reducing this torsion as far as possible, many modifications have been proposed in the position of the pedicle and also of the flap. Lisfranc held that one of the incisions limiting the pedicle should be carried half an inch lower than the other, so as to reach almost to the upper margin of the defect; whilst Langenbeck forms the pedicle to one side of the median line, and commences the two incisions just above the internal canthus. Other German surgeons carry the outline of the whole flap more or less obliquely across one side of the forehead, and, in extreme forms of this modification, the long axis of the flap is almost parallel to the line of the eyebrow.

The inclusion of periosteum in the frontal flap, as practised by Langenbeck and Ollier, with the object of rendering the new nose more prominent, does not seem to have been followed by very good results; and, as was pointed out by Serre of Montpellier, might excite inflammatory mischief in the frontal bone, and even give rise to some encephalic complication.

Ollier has endeavoured to impart a good shape to the new nose formed by a frontal flap, by transplanting, in connection with this flap, one of the nasal bones; and instances have been recorded in which Hardie of Manchester, and Sabine, an American surgeon, practised the Italian method, and transplanted the last phalanx of the forefinger.

Rhinoplasty by transposition of lateral or facial flaps—a method to which much attention has been paid by French surgeons—will be found suitable in cases in which the upper part of the nose remains intact. This plan of operation, which is a very old one, and was described by Celsus, has of late years undergone a great variety of modifications. Its simplest form is presented by the operation practised by Syme, which consists in taking two flaps of skin from the cheeks, uniting these in the middle of the face by three or four sutures, and then fixing the outer edges on each side to the raw surface, at a proper distance from the nasal orifice. The wounds of the cheek admit of being nearly closed by a stitch through the edges of each, and what remains of them is of use by the contraction of the granulating process depressing the hollow at the side of the nose, and thus increasing its apparent elevation.

In Nélaton's operation, two thick flaps, each with a pedicle attached near the lacrymal sac, are brought downwards and inwards over the defect, and stitched together in the median line. In making these flaps, the periosteum is removed from the nasal process of the maxillary bone, so that the resulting scar may be dense and closely attached to the bone, and so rendered incapable of dragging on the new nose. A further attempt to prevent flattening of the organ is made by passing a stout needle through both alæ, and compressing these by the action of a weak metallic spring. In the many modifications of this method, the shape and direction of the flaps are much varied. In some cases, the soft parts of the face have been simply glided over the defect after free separation from the subjacent bone. The chief objections to the so-called French method of lateral flaps are the severe primary hæmorrhage, the risk of secondary hæmorrhage, the disfigurement caused by a linear cicatrix in the middle line of the new nose, and the tendency in the organ to become flattened through tension of the soft parts of the cheek.

A combined frontal and facial rhinoplastic operation, first proposed by Verneuil and practised in this country by Mr. F. Mason, consists in turning down over the defect a frontal flap with its raw surface outwards, and covering this by two flaps taken from the cheeks.

In 1867 Mr. John Wood reported a case, in which he had formed a new nose by taking a broad flap from the upper lip. This, after it had been elongated by separation of the cutaneous and mucous layers extending as far as, but not through, the border of the lip, was turned upwards and fixed by sutures to the upper margin of the nasal defect, and, finally, its anterior raw surface was covered by lateral flaps taken from the cheeks.

In cases where but one or both alæ have been removed by injury or ulceration, a flap may be taken from the sound portion of the nose. Where one ala has been removed, the flap is usually taken from the opposite side, and where the end of the nose has been destroyed on both sides, a square flap has been taken from the bridge and turned downwards, with the epidermic surface directed towards the nasal cavity. In cases of this kind, a flap may be taken from the upper lip or even, as proposed by Michon, from the mucous membrane of the nasal septum. Almost innumerable modi-

fications of the rhinoplastic operation by nasal flaps have been devised by Dieffenbach, Langenbeck, Denonvilliers, Busch, and others.

When the nose has been partially removed by injury or surgical operation, immediate rhinoplasty is not, as a rule, indicated. According to Verneuil, in cases of removal of a portion of the skin without perforation of the cartilage, in which the loss is not excessive, the surgeon should leave the wound to heal by granulation, and not attempt immediate union or cover it by a cutaneous flap.

Several operations have been devised for the relief of the disfigurement caused, in cases of destruction of the bony framework only, by depression and flattening of the soft parts of the nose. The aim, in most of these procedures, is to raise and approximate the two wings of the nose after vertical incision of the organ itself, as in Dieffenbach's method, or after extensive separation of the attached margins of the organ and of the soft parts of the cheeks from the subjacent bone, as in the modification devised by Sir William Fergusson. In the latter operation, the alæ having been separated from the parts beneath, and the knife carried on each side between the skin and the bone as far as the infra-orbital foramen, two long needles were passed through the nose from one cheek to the other, and their ends twisted over a small piece of leather applied on each side, so as to cause the cheeks to come closer to each other, and thus render the nose prominent.

In cases of abnormal shortening of the nose from imperfect development, Weir of New York proposes to make a free incision in the soft parts across the middle of the organ, and then, after drawing down the lower part, to fill up the large gap thus formed by flaps taken from the cheeks.

W. Johnson Smith.

RHINOSCOPY.—Inspection of the nose—rhinoscopy—may be practised from the front (anterior rhinoscopy), or from behind (posterior rhinoscopy). For both methods of examination, to make them successful and complete, good illumination and gentle handling of the instruments are essential, even more so than in laryngoscopy.

Anterior Rhinoscopy.—To obtain a good view of the anterior parts of the nose, direct or reflected rays of light must be thrown into the patient's nose in the manner described in the article on Laryngoscopy. The relative positions of the surgeon, the patient, and the source of light, and the methods for illuminating the parts, are identical with those described in that article. Dilatation of the nostrils is necessary for complete examination of all the parts accessible to inspection, and to effect this, innumerable nasal specula have been invented. The writer has found B. Fränkel's fenestrated instrument, and the longer variety of Duplay's cone-shaped bivalve speculum, both of which are provided with a screw arrangement to open the blades, most serviceable, and, indeed, sufficient for all ordinary purposes. The former is especially useful for examination of the anterior and lower, the latter for inspection of the upper and posterior parts of the nose. The patient's head being slightly inclined backwards, the speculum is to be gently introduced into one of the nostrils (which must have been well cleaned previously); its blades are to be opened, by turning the screw to as full an extent as possible without hurting the patient, and light is then thrown into the cavity, either directly, or from the frontal mirror attached to the surgeon's forehead. When a sufficient view has been obtained of the parts which are immediately in sight, the operator, whilst retaining the speculum with one hand in the nostril, places his free hand on the patient's vertex, and by gentle pressure causes him to bend his head in any desired direction, slightly downwards, upwards, to the right and to the left, the inspection being continued meanwhile. This is necessary in order to obtain a view of all that is really visible, and it is more advisable to direct the movements of the patient's head by touch than by words, in order that the movements may not be too sudden or too violent. After completing the inspection of one nostril, the other is examined in the same manner.

The appearances vary very considerably in different cases. The larger part of the septum, which but rarely appears as a thoroughly straight vertical plate and is more frequently deflected into one or even both nostrils, can be satisfactorily brought into view. The colour of its mucous membrane is, usually, yellowish-red. The lower turbinate bone, which is the most conspicuous object after introduction of the speculum, appears as a bright red, oval or nearly semi-globular bulging, the floor of the nose as a rather flat or slightly excavated groove. The anterior part of the middle turbinate bone can mostly, but not always, be brought into view by the patient bending his head slightly backwards, and in exceptional cases a small part of the

upper turbinate bone may be seen. In cases of ozæna, when considerable atrophy of the lower turbinate bones has taken place, it is often possible to look through the nose into the naso-pharyngeal cavity, and to observe the play of the tubal muscles. Professor Zaufal has lately devised long funnel-shaped nasal specula, which are intended to render such inspection, as well as examination of the posterior parts of the nose and certain operations, possible in all cases.

The frequent irregularities of the configuration of the interior of the nose, the physiological deviation of the septum, the common occurrence of exostoses, &c., often make it rather difficult for the beginner to correctly interpret what he sees. Practice alone can lead to more precise information. Examination by means of the blunt nasal probe, under the guidance of the eye, ought under all circumstances to complete the results of mere inspection.

Posterior Rhinoscopy is an excellent, though not always applicable, adjunct to digital exploration of the naso-pharyngeal cavity. Its method consists in the introduction into the patient's mouth and behind the soft palate of a small laryngeal, or, as it is called here, rhinoscopic mirror, with the reflecting surface upwards, when, after proper illumination of the mirror, a reflected image of the parts above will appear on its surface. Simple as this proceeding appears to be, it is in reality sometimes very difficult. Much depends upon the co-operation of the patient, and this is not always easy to obtain. The better educated and less nervous the patient, and the larger his pharynx in its antero-posterior diameter, the more easy will be the examination. The main difficulties dependent upon the patient are threefold—(*a*) involuntary retraction of the velum towards the posterior wall of the pharynx (usually associated with too forcible an opening of the mouth and faulty breathing, or involuntary arrest of respiration); (*b*) refractoriness of the tongue, the middle and posterior parts of which constantly arch upwards; (*c*) excessive irritability of the palate, uvula, and posterior wall of the pharynx, causing spasmodic contraction and retching, so soon as these parts are, however lightly, touched. Previous local application of a strong cocaine solution—the writer uses by preference a 20 per cent. solution—will entirely overcome the last-named difficulty. With some practice and patience, however, such application will generally be superfluous. It is essential to teach the patient to breathe as quietly and naturally as possible *through the nose*, the object of this being that the soft palate should be entirely relaxed. This is indispensable for the success of the examination. A great many palate-hooks, uvula-nooses, and elastic tractors have been invented, with the object of forcibly drawing the soft palate forward, and thus laying the naso-pharyngeal cavity open to inspection. In some very tolerant individuals they may be useful; in almost every case, however, in which posterior rhinoscopy is at all possible, more will be obtained by patience, gentleness, and repetition of the examination, than by artificial means.

The relative positions of the patient, the surgeon, and the source of light are the same as in laryngoscopy. The patient is told to open his mouth, to keep his tongue in, and to breathe quietly through his nose; forcible respiration is as much to be deprecated as holding of the breath. The surgeon now introduces the warmed rhinoscopic mirror, the reflecting surface of which (not more than about five-eighths of an inch in diameter), is directed upwards to the right or left side of the uvula, into the pharyngeal cavity proper. He must guard carefully against touching the posterior part of the tongue, the velum palati, the palatine arches, and the posterior wall of the pharynx. Instead of a small laryngeal mirror, Michel's rhinoscope may be used. In this instrument, the angle of the mirror to the shank can be changed to any desired extent by a spring in the handle, while the shank remains perfectly immobile. The light is thrown on the rhinoscope from the frontal mirror or other source of illumination. The writer's electric rhinoscope (see *Lancet*, March, 1885) dispenses with the difficulty of the last-named proceeding. If a laryngeal mirror be used, its shank will usually answer as a tongue-depressor, but, in some cases, it will be better to gently but firmly depress the tongue with a spatula held in the operator's left hand, whilst his right hand directs the rhinoscope.

A complete inspection of the naso-pharyngeal cavity can only be made by altering the position and slanting the mirror, the rhinoscopic image being a compound picture. It will often be necessary to introduce the mirror several times, before this purpose is achieved.

When the mirror is held more in the vertical position, the choanæ, or posterior nares, come into view. The posterior aspect of the nose shows in its middle the septum, forming a thin, straight, almost white pro-

jection, which above passes over, in the form of two symmetrical Roman arches, into the vault of the pharynx. It is of practical importance to know that these arches are visible in every normal rhinoscopic image; should they not be seen, this proves that they must be obscured by some abnormally developed tissue. On both sides of the septum the posterior ends of the three turbinate bones appear, the middle bone being the most conspicuous. Their configuration is somewhat variable; the superior turbinate bones are rather horn-shaped, the middle oblong, the lower rounded. Their colour, on the whole, is pale, especially that of the middle turbinate bones. Between them are visible, more or less distinctly, the three nasal meatuses. When the mirror is held in a more horizontal position, the vault of the pharynx comes into view. Its appearance is often rather irregular and rough, owing to the adenoid tissue by which it is covered. On slanting the mirror, held at an angle of about 130° to the horizon, and inclined towards one side, the internal opening of the Eustachian tube, with its folds of mucous membrane, and Rosenmüller's fossa come into view. Below and in front, the upper surface of the velum, in the middle of which the so-called 'uvula cushion' is visible, forms the lower border of the rhinoscopic image. Felix Semon.

RIBS, Fractures of the.—These are among the most frequent of all bone-injuries, forming about a tenth of all the fractures we are called on to treat. They are more common in the male than in the female, on account of the greater exposure of the male sex to violence; more frequent in the middle-aged and old than in young people, on account of the greater elasticity and softness of the bones in the young; and they occur more often about the seven upper ribs than in the five lower, on account of the more rigid way in which these ribs are connected to the sternum. In children, the fracture is very often incomplete from the way in which the rib is driven inwards; in such cases, the part of the rib towards the pleura may be fractured, while the outer part remains intact. In this way, damage to the pleura may sometimes arise, while the rib remains apparently intact.

The ribs are most commonly fractured by the application of some strongly compressing force. When the force is applied over a small surface, the fracture is said to be by direct violence, as takes place when a rib is fractured by the blow of a rope's end, or of a fist, or when the body falls upon some projecting point. When the force is applied over an extensive surface, as when the ribs are fractured by a wheel passing over the chest, which thus caves in, the fracture is said to be by indirect violence, the rib in this case fracturing at a distance from the point where the violence is actually applied. The distinction is only of importance in relation to the number of ribs fractured. In fractures produced by indirect violence, the number is likely to be much greater than when produced by direct violence. On the other hand, direct violence is apt to drive the end of a single rib further into the cavity of the thorax, and thus is more likely to damage the thoracic viscera. Fractures of the ribs are also produced by muscular action, as in the act of coughing or sneezing. It is possible that some of the apparently spontaneous rib-fractures of old people are produced in this way.

The number of ribs fractured depends very much upon the nature of the injury. In fracture produced by direct violence, only one side of the body is generally affected; in those produced by indirect violence, one or both sides may be affected, and a rib may even be broken in two places. Fractures of the ribs are scarcely ever compound, except from gun-shot injury.

The *symptoms* of a fractured rib are often rather indefinite. There is pain at the seat of fracture, undue mobility, detected principally by pressure upon the end of the rib, and crepitus, which is often difficult to detect, but which is best done by placing the hand over the chest and making the patient breathe. In this act, a little alternate pressure and relaxation of the hand will often make the crepitus apparent, when it is otherwise difficult to make out; or it may be detected by placing the ear or stethoscope to the chest, and causing the patient to take a full inspiration. Difficulty in breathing and coughing, and more or less 'stitch in the side,' are also commonly present. The respiration is mostly diaphragmatic. The cough is very peculiar; it is slight and suppressed but frequent, and troublesome from the pain caused by it. This pain is probably due to some irritation of the intercostal nerve at the seat of fracture.

Fracture of the ribs is often complicated by damage to the internal viscera. The pleura is the part most frequently injured, and after this the lung. But many other parts are also occasionally damaged. Thus, a case is on record in which a single rib

was fractured by the end of a rope flying loose. The fractured piece was driven in through the pericardium and pierced the apex of the heart, causing almost immediate death. The diaphragm and liver are not infrequently damaged by fractures of the lower ribs, the spleen less frequently so, unless enlarged into an 'ague-cake,' while fractures of the eleventh and twelfth ribs may rupture either the ascending or descending colon. Injuries to the pleura and lung give rise to hæmothorax and emphysema, more or less general. *See* EMPHYSEMA; HÆMOTHORAX; LUNG, Wounds of the; PERICARDIUM, Wounds of the, &c.

Treatment.—The object of the treatment should be to immobilise the fractured ribs, so as to put them in the most favourable state for repair. This is best done by fixing broad bands of adhesive strapping (about two inches wide) from the sternum to the spine. These bands should overlap freely, so that a fair *thickness* of plaster be formed, thus acting as a kind of splint to the side of the chest, causing it all to move together in the act of respiration. If many ribs are fractured, and it is desirable to form a more solid splint or mask for the side of the chest, one or two thin pieces of light wood may be placed outside this strapping at right angles to the course of the ribs, and united to the layer of strapping beneath by other layers laid on superficially to them. This aids in making the whole side of the chest move as one piece, and is especially useful, combined with pads, where the fracture is depressed, and it is thought desirable to attempt to lift the depressed ends out of the chest. Some surgeons prefer to put a single piece of strapping over the whole of the side of the chest. This, however, never fits to the surface as well as the strips, and, if more thicknesses than one are considered desirable, it cannot be laid on so uniformly. Some surgeons, again, prefer to make the strips of plaster surround the whole chest, and some apply a bandage moderately tightly round the chest, even in cases where only one side is injured. This plan has the disadvantage of limiting the movements of both sides of the chest, whereas it is for the comfort of the patient to leave the respiratory movements of the uninjured side as free as possible.

The use of the bandage, though common, is in some cases not absolutely free from risk. Flannel is usually chosen, as being more suitable from its slightly elastic texture. But the writer has seen more than one case in which this rather elastic bandage, from being too tightly applied, has so compressed the chest that it has caused the fractured ends of the ribs to be driven in, so that they wounded the pleura and the lung. An elastic bandage then should be applied with only very moderate pressure, and may generally be dispensed with altogether. The sensations of the patient may, however, be taken as the best test of its utility. If grateful to him, it is certain it is doing no harm, and may be continued; but if it causes oppression and pain it should at once be taken off. Indeed, some patients cannot bear anything upon the chest, and prefer simply to lie motionless in bed. Other methods of treatment have been used—as, for example, a kind of vest made to fit the body very closely, and to be suspended from the shoulder. This, however, is not so efficient as the plaster method.

Constitutional treatment will be necessary in many cases, where the patient is irritable or suffers much pain. An uncomplicated case of fracture will not generally require anything, but if it be complicated by any damage to the pleura or lung, it may be necessary to give small doses of sedatives, combined with expectorants and diaphoretics. Of these, the following is a most useful combination:—℞ Tinct. scillæ, ℥v.; Vin. ipecac., ℥v.; Tinct. camph. co., ℥xx.; Vin. antimonial., ℥x.; Liq. ammon. acet., f℥ss.; Aq. chlorof. ad f℥j. M. Ft. haust. 2ndis horis sumendus.

If the fracture occur in very old people suffering from chronic bronchitic conditions, more stimulant expectorants are required, and carbonate of ammonia (gr. v. doses) with infusion of senega (f℥ss. doses) may be substituted for the squill and acetate of ammonia. In such cases, putting the patient into a steam tent is often a very great relief to him. Where there is evidence of much intra-thoracic inflammation in younger persons, leeches may sometimes be advantageously applied to the chest, and even the advisability of venesection be considered. This method of treatment has almost disappeared from practice of late years, but the writer has seen some few cases in which the patient was in a state of great distress, with considerable dyspnœa, oppressed pulse, and much blueness and congestion of the face, in which a moderate venesection most markedly relieved the symptoms.

The *prognosis* in uncomplicated cases of rib-fracture is very favourable. The fracture nearly always unites by bony union, but often a considerable amount of callus is formed, from the necessary mobility due to the act of respiration. Sometimes a case

of non-union will occur, with possibly abscess and necrosis. Such cases generally indicate some predisposing constitutional condition. The prognosis is least favourable in old bronchitic persons. In these patients, a considerable secretion of mucus normally goes on from the bronchial tubes, and this is expectorated by frequent fits of coughing. After a fracture of the ribs, the pain on movement causes the cough to become suppressed, the expectoration of the mucus no longer takes place, and thus accumulation goes on to such an extent as to choke the smaller tubes and lead to death by apnœa. In fractures of the ribs, complicated by injuries to the internal organs, the prognosis depends upon the organ injured. If the diagnosis be doubtful at first, it is safer, for purposes of treatment, to assume that the major injury has occurred, and to treat the patient accordingly, until the diagnosis has become clear from the after-history of the patient. Emphysema occurring after a fracture is not generally an unfavourable sign; it quickly absorbs if left to itself. H. G. Howse.

RICKETS may be defined as a constitutional dyscrasia resulting from general malnutrition. It is peculiar to infancy (perhaps to the fœtus) as regards its initiatory stages; and, in its later ones, chiefly characterised by changes in the texture, chemical composition, and outward form of the bony skeleton, and by altered function in other organs, transient for the most part, but occasionally permanent. Although the disease has been carefully studied in all its stages, the earliest beginnings are still quite matters of conjecture. Rickets is said to occur 'in every quarter of the globe' (Senator.) The writer has himself seen it in almost every European capital, and in the South African colonies, where the summer lasts nine months, and where overcrowding, fogs, and deficient sunlight are quite unknown. It is especially common among the manufacturing population of Yorkshire and Lancashire; it is found at places on the sea coast, as well as inland. There can, however, be no doubt that rickets is chiefly a disease of large cities, and that its development is favoured by overcrowding, neglect of sanitary and hygienic precautions, and by a cold damp atmosphere, which compels people to shut themselves up in ill-ventilated habitations.

Guérin, Storch, and especially Bednär and Ritter, admit *hereditary influences* in its production, and regard the occurrence of congenital rickets as an argument *ad hoc*.

The writer has seen many cases of direct transmission from parents to children, and at least one case of transmission from the grandparents. The disease, nevertheless, is not generally allowed by clinical teachers in this country to be hereditary. Of 1,000 children under three years of age, including babies in arms, examined in the out-patient department of the East London Children's Hospital — many of whom did not come as patients but simply accompanied their mothers—800 at least bore some traces of rickets; many of these were brought on account of pronounced rickets, but in many others the diathesis showed itself in its less generally acknowledged forms—enlargement of radial epiphyses, slight beading of ribs, late closure of fontanelles, or general backwardness. These children—boys and girls—brought up under conditions (to be presently described) which favour the development of rickets, will grow up, and in due time intermarry. Their children, bred and born under like circumstances, must surely inherit a stronger predisposition to the diathesis than the children of other persons, not so affected in their youth. The growing frequency of the milder forms, and their appearance under surroundings not usually associated with rickets, are only to be explained by this hereditary influence. Jenner 'has no facts to prove that rickets is hereditary'; but, like other authorities, admits that all those conditions which deteriorate the health of the parents, of the mother especially, render the children liable to rickets. Thus, frequent pregnancies, disparity of years in either spouse, advancing years, late marriages, irregular habits of life, acute illnesses, chronic disease (scrofulosis, tuberculosis), inherited syphilis, starvation in the parents—each and all exercise deleterious influences on development of the offspring, which predispose them to rickets. Thus, it is obvious why the poor should not alone suffer from this diathesis; on the contrary, rickets is found among all classes of society, although the advanced and fatal forms are most common among the poor.

The influence of heredity, however, is further proved by the frequency with which many members of the same family suffer, even without the immediate influence of that environment which is known to develop rickets. The absence of any persistent symptoms in the parents is no argument against this view, any more than it would be in the case of gout, or rheumatism, or other disease, the manifestations of which are temporary and generally fleeting.

Period of Onset.—Some of the signs of rickets are not infrequently found in fœtuses (a condition, however, not to be confounded with *fœtal rickets*, which will be briefly considered further on), and still more frequently in children at birth. These signs consist in curvatures of the long bones, with enlargement of their epiphyses; beading of the sternal ends of the ribs, with a tendency to pigeon-breast; an unduly open condition of the fontanelles and sutures, with enlargement of the head. More marked and more generally acknowledged signs have been observed a few weeks later; thus, Gee says: 'Unquestionably beading of the ribs may occasionally be found in infants of only three or four weeks old; at three or four months of age rickets is quite common.' Ritter has described extensive beading of the ribs in an infant of three weeks; Virchow, at five weeks of age. Moreover, he refers to the specimen of a rickety fœtus in the Berlin museum. Henoch also records having seen two children, who were born 'with multiple incurvations and infractions' of the bones, and with great softening of the entire skullcap. The writer has examined fœtuses with unmistakable signs of rickets, and seen many cases, with well-marked symptoms, in infants of one month and upwards.

When it is considered that one of the earliest signs of rickets—enlargement of the epiphyses, according to some authorities the only pathognomonic sign—is not regarded as disease even by the profession, and that children so affected are not generally brought under treatment, it is not surprising that the published statistics show only about four per cent. of rickets in infants under and about three months of age. A recent analysis, by the writer, of one thousand consecutive cases gave the following particulars as to the asserted period of onset of rickets as usually understood. During—

			Per cent.
1st year	1st six months	202	20·2
	2nd six months	278	27·8
2nd year	3rd six months	238	23·8
	4th six months	144	14·4
3rd year		98	9·8
4th year		18	1·8
5th year		14	1·4
6th year		8	·8

The above figures show how great is the incidence of the disease during the earlier months of life, and they suggest a far-reaching and fairly uniform cause, such as congenital predisposition—heredity—to account for it.

Causes.—Enough has already been said to show how largely the constitutional element, in the writer's opinion, enters into the question of causation. Many authorities, on the contrary, regard *artificial feeding* as the chief, not to say sole, cause of rickets. This latter view, however, is very misleading, and leaves out of consideration those factors which are most potent; improper diet, however, is unquestionably a very powerful cause, and it is most likely to lead to rickets in children who are weakly and delicate from birth. That many children who are carefully suckled and brought up, suffer from the early phases of rickets, is a fact beyond dispute, and that many escape who are fed artificially, and indeed never thrive until so fed, is equally true; we must, therefore, be very chary in attributing rickets to errors in diet alone. Moreover, when several children in a family, one after the other, become rickety, the recognition that this depends on debility in the parents at once suggests prophylactic measures which will save much trouble, and greatly increase a future child's chances of recovery, or even its complete escape from the affection. The particular kind of food which is considered so detrimental to these children is that which contains *starch*—that is to say, all *farinaceous food.* It has been found experimentally, but on an extremely small scale, that neither the saliva nor the pancreatic or enteric juices of young infants (and of many animals) can digest starch—that is, convert it into glucose; hence the inference that the administration of starchy foods to infants is the efficient cause of rickets.

There can be no manner of doubt that many children, who are carefully suckled, get rickets even in its pronounced forms, and as little doubt that many children, who are artificially fed, escape. *Protracted suckling* is a not infrequent source of rickets, and is detrimental alike to mother and child. Indeed, the inducement in very many cases to begin artificial feeding is either (1) a deficiency in the maternal milk-supply, itself not seldom an indication of weakly health; or (2) because the child does not appear to thrive on the breast-milk—in other words, because the child already begins to manifest signs of a deficient assimilative power which is congenital with it. That rickets should begin, in the majority of these cases, so early after artificial feeding has been commenced, suggests a strong predisposition thereto; for it is hardly conceivable that such food as

is usually given to these infants—cow's milk or cooked flour in some shape or other—should be able to produce the universal and often profound changes, throughout the entire skeleton, which are found in infants of quite tender age. The amount of unaltered starch contained in a couple of nursery biscuits, or in a teaspoonful of baked flour, oatmeal, arrowroot, or cornflour, made into pap as given to children, is ridiculously small; and it is begging the question to attempt to explain such a widespread disorder on the hypothesis that this starch, one of the blandest and most universally distributed substances in nature, is the *fons et origo mali!* A large percentage of all the children in whom the osseous system is only, or chiefly, affected appear to be well nourished. 'Only thirty per cent. are really ill nourished' (Baxter). When it is remembered that animals fed on starchy diet die of inanition, it must be confessed that the starch theory of causation has yet to be proved. Of great moment, however, are the privation of fresh air and sunlight, and the influence of unhygienic surroundings during the earliest months of life. Ill-ventilated, overcrowded rooms, the re-breathing of expired air, want of cleanliness, are among the most efficient causes of rickets, even in cases where the predisposition thereto is not very marked.

It has been asserted that rickets is a worn-out syphilitic affection, but there is absolutely no truth in the statement. *Syphilis*—like *scrofula* or like *tuberculosis*—is a factor only so far as it deteriorates the general health of the parents, and so renders their offspring weakly and more receptive to any unhygienic influences to which they may be exposed. Thus, rickets is a disease not due to any one cause, but brought about by many acting in concert. It is largely the outcome of civilisation, which tends more and more to aggregate the population, and thereby to enforce that neglect of personal health in adults, which reproduces itself in the children (among other ways) as rickets. It must be borne in mind that other diatheses may be associated with rickets in the same subject. Thus, syphilis and rickets are constantly seen allied, as also rickets and tuberculosis and scrofula. The recognition of these facts is chiefly of interest in regard to treatment.

Pathological Anatomy.— Glisson and almost all subsequent authorities have drawn attention to the frequent association of pallor of skin, flabbiness of muscles, and special liability to pulmonary and to gastro-intestinal catarrh with rickets of the bones, as indicative of a general disease. Nevertheless, possibly because these lesions cannot be said to be special, pathological attention has been chiefly directed to the changes which occur in the skeleton; and yet, the former are by far the most frequent causes of death. When the osseous system is alone or chiefly affected, rickets seldom proves dangerous to life. Some or all of the following lesions may be found *post mortem*.

Viscera.—The *lungs* are often found emphysematous along their margins, with extensive patches of collapse in their interior; the bronchial tubes are full of frothy mucus, the presence of which, by impeding the entrance of air, leads to the collapse. On section, the adjoining lung-substance may or may not show bronchopneumonic changes. Not infrequently, on their surface may be seen signs of pressure from the depressed ribs: in a few cases, the beading of the ribs (generally most marked on the inner surface) produces a series of depressions, where they have pressed upon the lungs. The *stomach* is generally distended, pale, and bloodless; its mucous membrane is thin, soft, and readily breaks down under the finger; there are often local patches of congestion, with abraded surface in some cases, and tenacious mucus adhering to them. The *intestines* are also thinned and pale; they generally contain undigested food and flatus, as evidence of their want of power and tone; the solitary glands and Peyer's patches are often prominent and congested. The *liver* is sometimes enlarged, now and again the capsule is thick and whitish, and the substance firmer than usual; it is, however, more frequently fatty. The surface may be indented, where the beaded ribs have pressed upon it. The *spleen* is more frequently affected, being larger, heavier, and firmer than usual: this is apparently due to a greater or lesser degree of hyperplasia of the connective tissue. There is no reaction with iodine. Occasionally 'white patches' are found on its capsule. It must be stated, however, that changes in the abdominal organs are comparatively rare in the post-mortem room, and that children may suffer severely from rickets in whom no such or other visceral changes can be found.

Nervous system:—Although rickety children are unusually prone to nervous disorders, no pathological changes, except perhaps a slight increase in the cortical white matter in some cases, have as yet been discovered to account for them; in a few cases, the brain-substance is softer, and the ven-

tricles contain more fluid than normal; whether this is the result of a chronic change —part of a general catarrh—or is merely a compensatory transudation, it is impossible to say. There is no abnormal change in the *heart* or *vascular system.* 'White patches' are very common in children whose chests are deformed from rickets (Wilks); and appear due to friction against ribs projecting inwards: the 'chosen seat' (Jenner) is on the left ventricle, a little above its apex; the heart-muscle examined in a severe case, fatal from gastro-intestinal and pulmonary catarrh, showed no appreciable deviation from the normal. The writer, in conjunction with Mr. Shattock, examined the blood in nine living cases of rather severe rickets. In eight of the cases the number of the red corpuscles was in excess of the standard, in one case as much as ·24; in the ninth case the number was reduced, as from 5 to 3; this blood, when drawn, looked very thin and 'hydræmic.' In most of the cases, the discs varied considerably in size and in shape, some being thorn-apple and some crenate; nor was anything, not found in healthy blood, observed. There were no nucleated discs. The granule-masses observed likewise presented nothing remarkable: the colourless corpuscles varied in size as in health; in one case only was there any excess. This negative result is not without interest, in a disease which affects the bones so profoundly, in view of the part which the marrow of bones is said to take in the formation of the blood. It is difficult to say how far any of the foregoing visceral lesions are specific, or whether they are merely accidental complications; their frequent association, however, suggests that they form an integral part of the disease. The occurrence or absence of one or other symptom is only in keeping with the clinical experience, that a general disease may occasionally show itself in one tissue more severely than in another.

Osseous system:—Although variable in amount and at different stages of the disorder, the condition of the bones, especially at the epiphysial junctions, both to the naked eye and under the microscope, is the only one which is constantly present and at all pathognomonic of rickets. The *chemical composition* of the bones presents some striking deviations from the normal, the causation and significance of which, however, are differently interpreted by different authors; analyses of other tissues, with a view to establish whether they too present any variations form the normal, will have to be made on a large scale, before it can be settled whether the changes found in rickety bones are the essence or the consequence of the disease. Friedleben's admirable researches show that the metabolic processes are particularly active in the osseous system of *all* infants during the second half-year of life; and that the chief chemical changes consist in an increase of the organic elements and a diminution of the earthy salts. This is just the period at which also some of the most characteristic of the so-called rickety changes occur, these latter changes being almost identical in kind, but greater in degree. According to this author's observations, the general chemical characters of rickety bones may be thus summarised: diminished quantity of the earthy salts, most marked when the disease is at its height, nearer the normal in the older bone layers, far below normal in the newly-formed (osteoid) parts, and in the latter an increase in the carbonic acid; little difference in the amount of fat, with the exception of the long bones, where it is increased in quantity by the marrow contained in the spongy parts, and in the enlarged medullary canals. The specific weight is lessened in proportion to the extent of the affection. The organic framework undergoes no obvious change, but the unossified cartilage contains more water. The grosser changes consist in peculiar and characteristic alterations in shape, and sometimes in consistence; all the bones, or only some few, may partake in the changes. The flat bones appear to suffer markedly.

In the *skull*, a condition termed *craniotabes*, first described by Elsässer, is frequently found to exist. The cranial vault becomes so thin and soft that it yields to the pressure of the finger; sometimes the bone is no thicker than parchment, and crackles when pressed upon. This condition may be confined to small areas, or involve the greater part of the parietal and upper part of the occipital bones, being generally found most marked in the posterior segment of the skull. In the healthy condition, even at birth, the cranial bones although very thin are nevertheless quite firm, and capable of resisting great pressure. *See* CRANIOTABES. Elsässer distinguishes this softening from actual perforations (which are congenital defects), and from similar conditions associated with hydrocephalus, cephalhæmatoma, inflammatory changes, and the like. Though found in other diseases, there can be no doubt that craniotabes is a sign of rickets *par excellence*: it is rarely found

after the twelfth, and occurs most frequently between the third and fifth months. In other cases, the cranial bones are much thickened owing to proliferation beneath the pericranium; unlike thickening of the long bones, which is more or less uniform, this occurs in patches or along the margins. The thickening may be very considerable and very localised: it differs from healthy bone in being soft and porous. At the sutures and fontanelles, which are the equivalents of the epiphyses, ossification goes on very irregularly; the sutures often become much thickened and sometimes project beyond the level of the adjoining bones. The interior of the skull-bones does not present any abnormal change; the dura mater is always very adherent.

The *scapulæ* and *pelves* are hypervascular, coarsely porous like pumice-stone on the surface, but possess a central, thin, firmer layer of normal bone; this outer deposit may have a distinct lamellar construction, and contains more marrow and less earthy salts than normal cancellated bone. Along their margins the bones are much thickened. The pelvic bones, from their position and the weight which is transmitted through them, often undergo important deformations, the permanent effects of which, in adult women, may interfere seriously with child-bearing. The *clavicles* become acutely bent (a condition which may be easily mistaken for fracture) just outside the attachment of the sterno-mastoid and pectoral muscles. The *ribs* often suffer greatly; normally they are more vascular than the other long bones, and are long in proportion to their size. Virchow teaches that the predisposition of certain bones to manifest rachitic changes stands in direct relation to their physiological use. It will be conceded that the ribs are constantly in use. There are two spots at which rickets manifests itself chiefly—viz. between the tubercle and the angle (which is often greatly thickened): at this spot in acute rickets infraction (spontaneous fracture) may not infrequently be found; secondly, at the anterior end. In cases of chest-deformity in infants, the tip of the rib is bent acutely on itself, the cartilage taking no part in many cases. So-called 'beading' of the ribs results from the proliferation which is going on at the costo-chondral junction; the expanded cartilage appears in some cases to fit on the rib like a cap, the enlargement being generally more marked on the inner than on the outer surface. The chest-deformities of later childhood are different, and follow no regular type, being dependent on, and modified by, the effects of partial repair, of occupation, and of dress.

The *long bones* present certain pathological appearances on their surface, and along the epiphysial lines, which may be summed up as follows. The periosteum is everywhere thickened; it separates more readily than normal, owing to an unusual amount of newly formed hypervascular soft bone on the surface of the shaft; to its under surface, when so separated, will sometimes be found attached minute needle-like spicules of young bone, which have broken away from the shaft. On making a vertical section through the epiphysial junctions, the proliferative zone will be found increased from about half a line (as a normal) to as much as six lines or more in severe cases; and instead of being straight, it presents an irregular outline—that is to say, the cells are not arranged in rows as seen in normally ossifying hyaline cartilage, but are scattered irregularly over the whole ossifying area. The ossifying centre in the epiphyses is larger than usual, and is often of a *diffuse* character (Sutton). The changes consist in an increase, with deficient and irregular ossification, of the cell-proliferation, in the persistence of thickened cartilage-cells in these deficiently ossified layers, and in the formation of numerous small medullary spaces, even in the still unossified cartilage. The long bones undergo marked and quite characteristic deformities, which are usually attributed to a process of softening, and said to be part of the rickety process. On this point Glisson says: 'And first we flatly deny that the bones of children afflicted with this disease are more flexible or less stiff and friable than the bones of others.' The writer has osteotomised many deformed rickety bones in children from three to ten years of age, and has always found the bones remarkably hard; moreover, in the post-mortem room, he has never seen bones *presenting the ordinary rickety curves* in a soft stage, nor have any such specimens ever been demonstrated at the Pathological Society. If the bones were really softened, it seems hardly probable that the resulting deformities would be so uniform as they actually are in practice, while the fact of their spontaneously becoming straight without again softening, suggests some other explanation. The pathology of rickety bones varies of course with the age of the patient, and the stage at which they are examined; if the process is in full vigour, there will

be signs of increased activity, while later the appearance will be one of sclerosis and enlargement. Although spinal troubles are not infrequently complained of, there are no changes in the *vertebræ* which can be said to be characteristic: sometimes they are excessively spongioid, so that they may be cut with a knife (Barlow); the deformities in the vertebral column as a whole are chiefly due to a relaxed condition of the ligaments. Indeed, throughout the body, the *ligaments* suffer more than is generally recognised; they are nearly always more yielding, and as a consequence longer than in health.

Symptoms.—The onset of rickets may be so rapid as to deserve the term 'acute.' More commonly it is slow and gradual; indeed the earliest symptoms of the usual form generally escape observation, and rickets may long since have passed its initial stages, before it is noticed either by the child's parents or even by the doctor. It is very difficult to say what constitutes the first departure from the normal standard in many cases: a somewhat large head, with widely open fontanelles, profuse perspiration about the head, a dislike to sleep covered up, are common occurrences among well-fed, firm-fleshed infants at the breast, and yet the foregoing are signs *par excellence* of the rickety disorder. Presently, the epiphyses, markedly those of the lower end of the radius, begin to enlarge, and in time the child becomes 'double-jointed.' In many cases Elsässer's soft patches on the skull-cap (craniotabes) will be among the earliest symptoms; they are especially frequent in babies with thin, lank hair. In other cases the chest becomes deformed—prominent along the sternum, and sunken-in along the costo-chondral junctions; the tips of the ribs will be found 'beaded;' dentition is irregular rather than late, as generally stated, or both; sometimes the spine grows out, and the child cannot sit up, or is altogether backward for its age. The ligaments may be loose, and the knees or ankles, or both, 'give in' whenever the child attempts to stand or walk. In the earlier months of life, rickety children are especially liable to catarrh of the bronchial and gastro-intestinal tracts; hence bronchitis, with its sequel of collapse, is common; or a weak and easily disturbed digestion, indicated by vomiting, diarrhœa, and offensive stools, will be the sign which betrays the disease. 'Rickets is not a cause of pyrexia; if the temperature rise above the normal level, a complication may at once be suspected' (Eustace Smith).

Convulsive disorders are a frequent and often the only morbid manifestation of the rickety diathesis; they are most common in children under two years of age, and belong to the earlier stages of rickets. These convulsions are usually said to be reflex; laryngismus stridulus and carpo-pedal contractions are practically confined to the subjects of rickets. Tetany also is closely associated with rickets (Abercrombie), and some cases of strabismus are due to the same cause; indeed, not less than two-thirds of all the convulsive attacks to which children are liable will be found due to, or associated with, rickets. In a few cases there is great tenderness; the child objects to being handled, and cries when it is raised up. Such are the clinical signs of rickets, varying a little with the period of life when the diathesis begins to make itself prominent, and with the organs or system chiefly or first attacked. The antecedents, or some of them, to which reference has already been made, on inquiry will almost certainly be made out. Occasionally, fidgetiness and 'growing-pains' point to the onset of rickets, or the bone-deformities come on more or less rapidly without an apparent cause.

As regards *individual symptoms*, it may be said that the *facies* is almost characteristic. There is a disproportion in size between it and the head; the latter tends to become square; the frontal eminences are large and prominent, and the sutures thickened and often distinctly elevated; on palpating the head it feels hard and lumpy. The teeth are said to be less durable than in healthy children, and the alveolar processes altered in form; but these symptoms are not very reliable or well-defined. There is a great tendency to sweat profusely about the head, which is very suggestive, and, as if they felt hot, these children throw off the bedclothes at night and prefer to sleep uncovered. The abdomen is generally prominent; the chest is nearly always flattened at the lower lateral parts, and more so on the left than on the right side; at the junctions of the ribs with their cartilages there is often 'beading.' The spinal column may be affected or not; owing to flabby muscles and loose ligaments, and sometimes to the weight of a larger head than normal, the child cannot sit up firmly; the spine then forms a curve, either backwards or laterally—the direction being determined by the posture which the child most frequently maintains. The deformities of the long bones may be said to differ within rather narrow limits; they

are very similar one to another, and so generally symmetrical that an affection of one side alone would bring the diagnosis into doubt. The tibiæ, of all the bones, are perhaps the most frequently affected; the 'seat of election' is in the lower third, and the common curve is outwards and forwards. In a few cases the stress falls on the crest of the shin, which becomes prominent and sharp and curved. The fibula doubtless participates in these deformities, but from its deep position they are less manifest. The femur is less frequently affected; the commonest curve is in the upper third, and in direction outwards and forwards; in the lower third it curves inwards, and so contributes to the formation of knock-knee. The bones of the arms suffer markedly in a few cases, the humerus suffering more frequently than the bones of the forearm. The ligaments are nearly always flaccid, temporary knock-knees and flat-foot resulting in many cases. Rickety children generally grow slowly, they are large-boned, and their stature is often stunted.

Prognosis.—The prognosis in individual cases will vary with the child's age, the stage of the disease, and the absence or presence of complications. In uncomplicated cases a good prognosis can be given with confidence. By far the commonest cause of death is pulmonary or gastro-intestinal catarrh. The tendency to these diseases lessens as age advances, but they are very fatal to young children. A few children die of the nervous complications, either of convulsions or of laryngismus, especially when their origin in rickets is not recognised. As regards the deformities, it may be said that in ninety per cent. all traces disappear in process of time; in a few, permanent deformity of the bones remains. The thorax, especially, never quite regains its normal shape, if deformity has once been marked; and the same may be said of the skull. But in all other respects the children grow up strong and well, though it may be that their stature is somewhat dwarfed.

Treatment.—A consideration of the causes, just enumerated, which combine to produce rickets will suggest prophylactic measures of great value; for, whatever strengthens a woman's health strengthens that of the child she may be carrying or suckling, and whatever tends to deteriorate the mother's health, either before or after parturition, predisposes her child to rickets. The causes, among the rich late hours and various social exactions, among the poor the debilitating influences of poverty, must be removed as far as possible, and a rational mode of living be insisted upon by medical men for all pregnant and suckling women, rich and poor alike. A large proportion of infantile mortality is directly due to causes acting on the children antecedently to their birth, combined with unsuitable food and attention subsequently. There can be little doubt that the best diet for an infant is its mother's milk, and any conditions or surroundings which tend to lessen either the quantity or the quality must be avoided. The cases in which mothers' milk is likely to be injurious to their own infants are extremely few; the writer doubts very much whether a mother can convey to her own child through the milk any constitutional taint or weakness, which it has not already inherited *in utero*. The excuses for not suckling children are often really trivial, and should be discountenanced by the medical attendant; the health of the mother is improved and her tendency to disease in the breast lessened by suckling, the temporary inconvenience being more than neutralised by the advantages which the proper carrying out of the physiological functions in the breast, entailed by child-bearing, brings with it.

Rickets is essentially curable, and cod-liver oil is the remedy for all forms of the disease. It should be given in doses of one teaspoonful or less, alone, or combined with either steel-wine or lime-water. Very few children fail to become reconciled to it, with perseverance on the part of their parents; when given alone, a teaspoonful of orange wine, or black coffee, or milk, forms an excellent vehicle, and a nicely flavoured lozenge removes the taste afterwards. Its use must be continued for some months, with short intermissions, and it is most useful when given shortly after food for it is then mixed, digested, and absorbed along with the food. Judicious management of individual symptoms is of course necessary. If an infant is suffering from the effects of an improper diet, improvement cannot be expected so long as this diet is continued. On the other hand, let it be ascertained whether *too much* food is not being given, and *too often*, before it is said to be improper. In a few cases the mother's milk distinctly disagrees: this may be a radical fault, or depend upon fleeting conditions of health easily remedied. In the former case, some other food must be tried, and given in addition to, or substituted for, the milk. *Fresh milk* (either cow's, goat's, or ass's), suitably diluted according to the age of the child, should

always form a part of the diet; it may be alternated with one or other of the many artificial (malted) foods now in vogue, that one being finally selected on which the child thrives best.

There must be no hard and fast routine diet for all children; what agrees with one may disagree with another, while a little variety is beneficial to all. But in all cases, some *fresh* food—as opposed to the *prepared* foods—must be given. It is not an uncommon error to give the food too strong, and especially so in the case of weakly infants, who do not thrive; the more feeble an infant, the less can it digest complex or strong food; even cows' milk must be diluted more than usual; it may even be well to partially digest it by means of pancreatine before giving it. A fertile source of mischief is an unclean feeding bottle. Even with the best will it is not easy to keep the bottle and the tube thoroughly sweet; under these circumstances it is well to get new tubes and new teats at short intervals. A little pounded raw, lean meat is of great service in many cases, and can never do harm; from one quarter to half an ounce once or twice a day may be given. Fresh fruits, fruit-juice, part of an orange, or a piece of lemon (well sugared) to suck, a roasted apple or pear free from skin and husks, are valuable aids to digestion, even for quite young infants. For older children, green vegetables, lettuce, cress, celery, tender and fresh from the garden, should be given. A pinch of salt with the food must not be forgotten. It is well to avoid tea, coffee, and stimulants.

Next in importance to the food are fresh air and light in the nursery; for the latter a south or south-west aspect is the best; too high a temperature must be avoided, and the air constantly changed. Bathing is of great value to rickety children: with salt water, if it can be procured, if not, with sea-salt dissolved in the bath water as the next best substitute. The whole body should be well sluiced with a bath sponge for a minute or two, and then be systematically rubbed and shampooed; for an infant, and in winter for older children, the bath should be comfortably warm (90° to 95°), in summer it may be nearly cold; all chilling is to be avoided, and individual idiosyncrasies as to heat and cold carefully respected. When children are ill, and suffering from catarrh, the regular bath may be suspended for a time. Outdoor exercise should be taken every day. Flannel should be worn next the skin; it should reach well up to the neck, and as far down as the knees, in order to protect without constricting the chest and the abdomen; for sleeping, a 'combination' dress is best; the children cannot then get entirely uncovered, as they are apt to do in the ordinary night-dress. The severer lung and intestinal complications must be treated on the principles laid down in the medical text-books; but it is well to say that cod-liver oil often acts like a charm, even in this stage of rickets.

Deformities, unless very marked, may be left alone; the crooked bones tend to straighten spontaneously under the influence of general remedies. In the case of severe deformities, light splints may be worn. The writer never uses splints which pass beyond the feet; if children are so splinted that they cannot walk, they shuffle about the ground, and take more harm from this mode of progression, and the dangers incidental to it, than the wearing of such splints compensates for. If the deformities resist treatment, or continue to progress notwithstanding, and become really severe, then osteotomy may be resorted to. But patience is the great requisite, as time and cod-liver oil are the remedies for such cases. When cod-liver oil causes diarrhœa, a minim or more of tincture of opium may be combined with each dose until the oil is tolerated. In warm weather, also, the opium sometimes proves a valuable adjunct, and permits the administration of the oil to be continued, when otherwise it could not be borne. *See* Bow-Leg; Genu Valgum; Osteotomy.

Acute Rickets.—This term has been used by different authors in rather different senses. By some (Jenner, Ritter, Rehn) it has been used to denote an unusually rapid onset of the ordinary form of rickets; by others (Stiebel, Mauthner, Senator) to signify a very severe form of the disease with an acute onset. By Möller it is used to describe what he regards as a disease distinct from rickets, in which subperiosteal hæmorrhages or effusions are a characteristic symptom; by Bohn as an inflammation of bone in consequence of its over-rapid formation; while Henoch hardly believes in the existence of such a condition, chiefly because he has never seen a case in his own practice.

There is no doubt that rickets—like many other diseases—may have a very rapid onset, and occasionally, also, assume a very severe form, for which cases the term 'acute rickets' is very appropriate. Dr. Mauthner of Vienna, about thirty years ago, recorded some of the first and best cases. Dr. Möller of Königsberg also reported three

cases of 'acute rickets' in artificially-fed children, with enlargement of the joint-ends of several bones, occurring simultaneously or in rapid succession, and accompanied with such considerable persistent pain (which was aggravated by handling the children) that ostitis was suspected. There were no bendings in the bones, but in two subsequent cases, he found, *post mortem*, subperiosteal effusions of blood, with spongy (scurvy) gums and sugillations in one of the cases. Later again, Dr. Rehn of Frankfort described a series of cases of 'infantile osteomalacia,' which evidently belong to the same class as the foregoing. Dr. Thomas Barlow regards the term 'acute rickets' as inappropriate, and suggests that these cases are 'probably a combination of scurvy and rickets, the scurvy being an essential, and the rickets a variable element.'

The clinical history of these cases differs widely. The disease is not confined to the poor: it may occur up to three years of age, but is most common under or at about eighteen months; one of the earlier symptoms is pain, which is aggravated when the child is handled. Most of the cases have been in ill-cared-for, artificially-fed children of either sex, and without regard to season. The writer recently saw a well-cared-for infant with this condition highly marked, which had supervened in the middle of summer at Brighton. The duration rarely exceeds two or three months. In some, treatment has appeared of little avail, in others a cure has been effected in a week or two; while other cases have gradually, and for the most part slowly, recovered spontaneously. The general cachexia has not been at all profound, and, when death has occurred, it has been due chiefly to pulmonary catarrh, and not to the local lesions. In a few of the cases the gums are reported to have been spongy as in scurvy, and in some of the cases subperiosteal hæmorrhage has been found. The bones undergo strange deformities, quite unlike those of ordinary rickets; instead of being curved, they assume sharp angular flexions, termed 'infractions,' the epiphysial changes being usually ill-marked. The writer has examined three such cases *post mortem*, and feels no doubt as to the rickety nature of the lesion. Apart from the pathological appearances, there are the social surroundings which usually obtain in the more common form of rickets; the variation from the ordinary type is easily explained by the personal element present in all kinds of disease, and by the age of the patients when attacked. As regards the subperiosteal hæmorrhage, it is probably traumatic, and brought about by the rough handling to which many of the children are subjected before coming under treatment.

The appearance of the hæmorrhage early in the course of the disease, the absence of profound cachexia and of putrescence, and of stomatitis in many of the cases, distinguish this lesion from true scurvy. The latter disease, when it occurs in children, presents the same features as in adults, and it is brought about by the same causes—long privation of fresh, and the ingestion of improper, food *during cold damp weather*. It is quite exceptional for adults exposed to these conditions to escape scurvy; on the other hand, the cases of so-called 'infantile scurvy' are extremely uncommon, notwithstanding that an immense number of infants are being brought up on what Mr. Herbert Page describes as 'scurvy diet.'

Treatment.—The affected bones must be carefully protected from injury by appropriate splints; the less the limbs are handled the better. A child should be kept in the prone position, and be moved as little as possible. Place the child on a large soft pillow; instead of the usual dress, cover it with soft warm flannel, and in this way dressing and undressing will be avoided. Opiates may be given to relieve pain, if acute. General treatment must be on the lines already laid down—fresh food and fresh fruits being of great value.

Fœtal Rickets.—This term is now reserved for a peculiar form of disease in fœtuses, which consists in profound changes in the skeleton having a superficial resemblance to rickets, but which are frequently associated with absence of the thyroid gland, or with premature synostosis of the basi-occipital and basi-sphenoid, or sometimes with both. This condition is also and more appropriately called 'fœtal cretinism;' the severer forms of the disease appear to be incompatible with life, for the cases described have been still-born fœtuses of varying ages. A few isolated cases had been previously recorded, but Virchow was the first to describe the condition at all accurately. Many cases have since been reported. The extreme shortness of the diaphyses, relatively to the large size of the epiphyses, is the most marked pathological feature; microscopically examined, there is very deficient ossification at the epiphysial line, with intrusion of fibrous tissue from the periosteum, which Mr. Bowlby regards as the cause of the shortening and of the changes in the cartilage. The premature synostosis at

the base of the cranium has been found in several cases; but it is not invariable. Virchow regarded this as the distinct feature of this condition, and the cause probably of the arrested brain-growth. As for the thyroid gland, it has been found absent in some cases and present in others; the part which its absence or presence plays in the causation of this form of cretinism cannot therefore be estimated. A goitre has been found in some cases, and in a few others peculiar masses of fat above the clavicles are met with. Children with the less severe forms of the disease not only survive their birth, but may live for many years. Not infrequently one of the earliest signs of their cretinoid condition is hypertrophy of the tongue, which projects beyond the lips. Then the child gradually assumes the look of hebetude which is characteristic of the disease; intellectual and bodily development are greatly impeded, so that they still appear young children even at sixteen or eighteen years of age.

Authorities agree in regarding this condition as entirely distinct from ordinary rickets. It would be well, therefore, to discontinue the term 'fœtal rickets' and substitute 'fœtal cretinism.' Dr. Barlow points out how the disease attacks the cartilage bones only, the bones which are formed in membrane being all well developed. The enlargement of the *whole* epiphysis; the thickening of the shafts of the long bones, which are hard and compact; and the absence of rarefaction in the medullary part of the bones distinguish the condition from true rickets.

Late Rickets.—Cases of rickets commencing at eight, nine, or ten years of age are by no means rare, though exceptional. Glisson refers to a case of rickets in a man twenty years of age. In the Middlesex Hospital Museum are casts of rickety deformities of the legs in a young man aged twenty, which appeared after an operation for genu valgum. The writer has seen two cases of typical rickety deformity in subjects fourteen and sixteen years of age, which were said to have 'come on quite lately.' Besides these, several anomalous cases of bone-disease in young adults have recently been put on record, in which the epiphyses have shown rickety enlargement, while the shafts have presented other changes less easy to define. By some, the condition is regarded as a juvenile osteomalacia, and an attempt has been made to trace a connection between this latter disease and rickets; the differences between extreme cases are quite obvious, while intermediate ones—that is to say, cases of late rickets and of early osteomalacia—are said to merge one into the other.

The writer is not at all inclined to acquiesce in this view. It is obviously unscientific to argue, because the ultimate outcome of two processes is more or less alike, that, therefore, they are identical. Pathological processes must rather be interpreted in the light of the clinical history. The rickets of infancy and childhood is a general and not a local disease, and death never takes place in consequence of the local bone-manifestations. Osteomalacia, on the other hand, is a disease of adult life, and of bones which were once absolutely healthy. The disease, unlike rickets, is local in its commencement, and remains so for years in some cases, while steadily progressing nevertheless; all the other functions of the body go on unhindered. Women, whom the disease chiefly affects, bear children; their intellectual power is unabated, and all the other functions may go on normally. Osteomalacia is a degeneration, a softening of healthy bones; rickets is an arrested and deficient development, not of the bones only, but a condition in which all the tissues participate. In a few exceptional cases, rickets may come on later in life than usual, just as osteomalacia may occur a little earlier. Rickets, however, is a very uniform disease, especially as it affects the bones, and the resulting deformities resemble each other as closely as the manifestations of the most specific diseases; the same may be said of the osteomalacia of women. The intermediate cases, which differ immensely among themselves, must, for the present, be relegated to a separate category. The causes which lead to this condition are not known. There can, however, be little doubt that late rickets is the expression of debilitating influences, of one kind or another, acting on the organism at large.

Relapsing Rickets.—A term applied to those cases in which the disease, having been apparently arrested for a year or two, again becomes active. Such cases are by no means uncommon when looked for. In the writer's opinion many cases of 'late rickets' may be accounted for on this supposition. Intervals of a year or eighteen months or even longer occur, during which no further signs of rickets manifest themselves. Then, owing either to want of care, to untoward surroundings of various kinds, to acute illness, or to change of air from a dry open country to a cold, moist, overcrowded town, sometimes without appreci-

able cause, a child's health gives way, and rickety (generally bone) disorder again shows itself. The symptoms vary with the age of the patients, and with their early bringing up. Knock-knees and other deformities arising from loose ligaments, such as spinal curvature and flat-foot, generally belong to this category. The treatment of these conditions must be conducted on the principles already laid down.

ROBERT WILLIAM PARKER.

RIDER'S BONE or RIDER'S STRAIN.—In persons who ride much, a hard lump sometimes forms on the inner side of the thigh, near the pubes. It is due to an ossification of the tendon of the adductor longus or gracilis, or to an exostosis growing from the pubes, and extending along the adductor tendon. There is a history of a severe strain, which has ruptured some muscular or tendinous fibres, or torn the tendon partially from its insertion. The subsequent irritation of the saddle causes the growth of bone. No treatment is of any avail, but this does not matter much, seeing that the swelling is more troublesome from its size and situation than from any pain it causes, and is very rarely seen in this country.

A. G. MILLER.

RIGOR is the name given to an aggregation of phenomena, all referable to the central nervous system, which, while frequently heralding the appearance of more unequivocal signs of serious mischief, are not necessarily developed in proportion to the gravity of the illness.

Symptomatology.—A patient, the subject of a severe rigor, lies shaking from head to foot, with tremors (frequently amounting to violent clonic spasms) affecting every muscle; consequently, the teeth chatter, the face twitches, the eyelids and corners of the mouth making opening and shutting movements; the head, supported on each side by the pillow, rarely moves much, the body often rolls in the bed, from the jerking impulses given to it by the violent contractions of the muscles which pass from the trunk to the limb-bones. Indeed, the bed is very frequently shaken by the violence of the tremor.

All this time, although the temperature is rising and may be up to 104° F., the patient complains very much of feeling intensely cold, and covers himself with every possible wrap, or gets close to the fire. There are no symptoms to indicate any active change occurring in the highest nerve-centres, for the patient is always perfectly conscious, and sometimes his special senses appear to be rendered more acute. The clonic spasms, though varying considerably in force, exhibit a fairly constant rhythm, the rate of which appears to be frequently the same as that of ankle clonus, but sometimes of only half that rate.

In addition to the above-mentioned motor symptoms, others are often seen which indicate disturbance of centres for functions besides movement. Thus, vaso-motor changes are observable in the shape of a leaden colour of the skin, which is dry and rough. Other centres in the medulla oblongata are also disturbed, so that the patient may be nauseated or actually vomit, the respirations may be slowed, and the action of the heart enfeebled and quickened. As indicated above, the temperature is usually rising at the time when the rigor occurs, for a rigor customarily occurs when the temperature has gained from one-half to two-thirds its maximum height.

Etiology and Causation.—There is no striking peculiarity about the array of symptoms, familiarly termed a rigor, which furnishes us with the slightest clue to its causation in fully ninety per cent. of all cases; for while we know so little respecting the origin and causation of acute specific fevers, it is clear we shall remain ignorant of that pathological state of the central nervous system which produces the rigor heralding the onset of the disease.

There only remains to us the suggestive fact of rigors being sometimes produced by traumatic influences. It is well known that, after sudden dilatation of the urethra by a catheter, there frequently follows a violent rigor, accompanied by a rise of temperature. *See* URETHRAL FEVER. In such a case, we have simply the irritation of peripheral nerves causing a profound disturbance of the spinal cord and medulla oblongata. Of the accuracy of this pathology there can be very little doubt, but it would be very improper to apply it to explain the occurrence of rigors in pyæmia, ague, &c., until the causes of those diseases are thoroughly known. That rigors are of central origin is obvious, and the only question is the mode of irritation which the nerve-centres suffer.

Treatment.—The treatment of a rigor has almost always been the simple plan of stimulation and heat, in the shape of doses of brandy and hot water, extra blankets, and hot bottles. If it were not for the

concomitant disturbance of the heart, &c., rigors would require but little attention. It has been shown, experimentally, that any drug which narcotises the nerve-centres exerts thereby a powerful preventive effect on rigors and pyrexia. Thus, Dr. Johnson proved that chloroform, &c., would arrest a rigor, and it is well known that morphia and quinine will prevent and arrest rigors due to catheterism, and possibly those occurring in pyæmia. But, for practical purposes, it will be found best to administer a hypodermic injection of morphia (gr. $\frac{1}{4}$ to gr. $\frac{1}{3}$), to cover the patient with blankets, to warm the surface of the body with heated air or hot-water bottles, and to supply him freely with hot alcoholic drinks. For the *prevention* of rigors, *see* URETHRAL FEVER.

Prognosis.—As far as the rigor itself is concerned the prognosis is always very favourable, however alarmingly violent the spasms may be; but, as indicating other mischief, the occurrence of a rigor will always render the prognosis very serious, and, if there is concurrently suppression of urine, &c., it will make it practically hopeless. VICTOR HORSLEY.

RINGWORM. *See* TINEA TONSURANS.

RISUS SARDONICUS. *See* TETANUS.

RODENT ULCER. *See* CARCINOMA; ULCERS.

ROUGE'S OPERATION may be required for the removal of necrosed or carious bone when, either from the size of the sequestrum or from the situation of the disease, this cannot be effected through the nostrils. It may also be resorted to for removing certain forms of nasal and naso-pharyngeal polypi, when more room is required than can be obtained through the natural passages, and when it is especially desired that no external scar should remain. Further, it is sometimes useful for allowing the introduction of the finger into the nasal chambers, for the purpose of thoroughly exploring these parts in cases of long-standing disease attended with fœtor, where the presence of diseased bone is suspected but cannot be detected by the mirror or probe.

The operation is performed as follows:—The upper lip having been seized on each side near the corner of the mouth and turned upwards, an incision should be made, reaching from the first pre-molar tooth on one side to that on the other, through the mucous membrane at its reflection from the lips to the gums. The tissues intervening between the mouth and the nasal cavities should next be rapidly divided, and the cartilaginous septum detached with the bistoury from its insertion into the anterior nasal spine. This is often sufficient to allow of the introduction of the finger and the exploration of the nasal cavities; but if more space is required, the lateral cartilages should be detached from the maxillary bones with the scissors, when the nose, thus completely freed, can, especially when the septum has been partially destroyed by the disease, be turned upwards towards the forehead, widely exposing the orifice of the nasal chambers. Where the septum is intact, it will generally require further separation from the maxillary crest by the scissors. The removal of the dead bone or growth, or the exploration of the nasal cavities, having been effected, the lip and nose should be accurately replaced, care being taken that the base of the septum is placed in exact contact with, and is supported by, the nasal spine. No sutures are necessary; little or no swelling of the lip follows the operation; there is, as a rule, no constitutional disturbance, and the parts are usually soundly healed in a few days. W. J. WALSHAM.

RUPIA. *See* SYPHILIS.

S

SABRE and BAYONET WOUNDS. Sabre wounds chiefly affect the head and upper extremities, bayonet wounds are chiefly on the lower extremities. Neither are very fatal, the bayonet wound being rather more so than the sabre.

Sabre wounds. — The sharper the weapon, the more the injury inflicted will resemble an incised wound. When the sabre is very sharp it may cut a portion of tissue completely away. The blunter it is the more irregular and contused the wound will be, and the deeper the weapon penetrates the more it will gape. When the cutting edge strikes the surface perpendicularly, a straight gaping wound will be inflicted; if obliquely, one margin may be concave, the other convex, or the wound may be more or less flap-shaped, especially on the face and skull. When the

bone is implicated by a blunt weapon, it may be bruised or fractured; if sharp, it will be incised or a portion more or less completely detached. The bleeding is not great unless a considerable vessel be injured or the weapon very sharp. If the large veins in the neck are wounded, sudden death may take place from entrance of air. The amount of pain will depend on the nervous supply to the injured part. When large nerve-trunks are divided, there will be interference with sensation and movement in the parts which they supply.

A blow of a blunt sabre on the head will often produce injury of the brain-convolutions of the opposite side, or fracture the skull; especially will the internal table be injured and extensive fissuring produced. The skull and face are most often wounded; next to these the hands and arms almost as frequently. These wounds are much rarer on the chest and back, and very infrequent in the abdomen and lower extremities.

Punctured wounds are caused in time of war by bayonet, lance, and sabre. They are by no means of frequent occurrence, and as seen in the hospitals are not of great severity. There is no accurate information as to the number which prove fatal on the field. They are chiefly met with in the breast, abdomen, and upper extremities; less frequently on the head, face, and lower extremities. They are usually long blind canals with a triangular or quadrangular wound in the skin, according to the form of weapon. The bone may be perforated or fractured. They often contain foreign bodies or a portion of the weapon which has broken off. The vessels often escape in a remarkable manner, and a comparatively small wound in the vessel may sometimes close after the primary hæmorrhage has ceased, frequently to be followed by a traumatic aneurism. When the wound implicates both the large artery and vein, aneurismal varix may follow; nerves may be punctured or divided, and tetanus is then comparatively common. These wounds often penetrate cavities and injure the contained viscera. Cut and thrust wounds may heal by first intention without suppuration, or their progress may be modified by all the circumstances which influence the course of gunshot injuries.

The prognosis will depend on the depth and extent to which they implicate important cavities or organs.

The treatment consists in the arrest of hæmorrhage, the extraction of foreign bodies, and antiseptic purification.

WILLIAM MACCORMAC.

SACRO-ILIAC JOINT, Disease of the.—This joint is not often the seat of primary disease, but is more usually affected secondarily by the spreading of caries from the adjacent surface of the ilium or sacrum. The disease is generally of constitutional origin, and is for this reason, as well as because of its anatomical relation to the spine and pelvis, to be looked upon as an affection of much gravity. It may, however, originate in injury, and occasionally follows parturition.

The earliest *symptoms* of sacro-iliac disease are usually pain and slight lameness. The pain may be felt in the situation of the joint, or in the course of some of the neighbouring nerves. Most often it is felt along the great sciatic nerve and its branches, so that, in the early stage, sacro-iliac disease is apt to be mistaken for sciatica. Not uncommonly also the pain is referred, as in hip-disease, to the hip and knee, in consequence of irritation of the obturator nerve. The pain, wherever it may be, is increased by movement, and whenever the weight of the body is transmitted through the pelvis, as in sitting or standing; so also, an attempt to lift a heavy weight from the ground will generally elicit or aggravate pain. On the other hand, relief is given by the recumbent posture. The lameness at first is chiefly due to slight involuntary elevation of the pelvis on the affected side. Sometimes there is flexion of the thigh, in consequence of irritation of the psoas muscle. As the disease progresses, tenderness will be felt on pressure over the joint; pain will be produced by pressing together the two iliac bones; the gluteal muscles will become wasted; and suppuration will occur. When matter forms, it will most commonly present over the back of the joint, but it may also make its way to the groin after the manner of a psoas abscess, or outwards along the crest of the ilium, or forwards towards the rectum, from which it may be felt by the finger.

Diagnosis.—It will be observed that, in many respects, the symptoms described closely resemble those of disease of the spine or hip, and in the commencement of sacro-iliac disease a careful examination is needful to distinguish it from those affections. From disease of the spine, it will differ chiefly in that the symptoms are referable to one side only of the body; and that if the pelvis is fixed, flexion of the vertebral column is not restricted or painful. From hip-disease, it may be distinguished by the free mobility of the femur independently of the pelvis.

Pathology.—The disease usually begins either in the bone or periosteum, though possibly, in some instances, the starting-point is an extravasation of blood into the tissue about the joint, the result of direct injury. In advanced cases the articular surface is found carious, the fibro-cartilage loose, the ligaments softened, and the joint surrounded by extensive suppuration.

The *prognosis* will depend chiefly on whether the disease is of constitutional or local origin, and upon the extent to which the mischief has progressed before treatment is commenced. In the scrofulous or phthisical the affection is always a grave one, as it must also be considered whenever suppuration has occurred.

In the *treatment*, the first essential is absolute and prolonged rest in the recumbent position. The immobility of the joint may be aided, moreover, by surrounding the pelvis with a well-moulded leather splint or a padded pelvic girdle. The only local application of any use, is the light and repeated application of the actual cautery over the back of the joint. This is, of course, only serviceable during the early stage of the disease and before suppuration has been reached; but at this period it sometimes gives remarkable relief to the pain, especially to that along the course of the sciatic nerve. Blisters and other milder counter-irritants have no effect but that of adding to the discomfort of the patient.

When abscess has formed it is generally best to open and drain it, with antiseptic precautions. If not opened, abscesses are prone to attain a large size, and to burrow in a manner which makes it subsequently very difficult to drain them efficiently; if aspirated they usually rapidly refill. No doubt cases have occurred in which such abscesses have undergone so-called absorption—that is to say, they have dried up; but this implies a residuum of caseous material which may be the source of future dangers. In phthisical cases it is, perhaps, best not to interfere with the abscess unless it is distressing the patient.

When the disease becomes arrested, and only a sinus remains, it may be useful to explore the part to ascertain if there be any removable dead bone, or for the purpose of scraping away the granulations which supply the pus; but these measures should not be resorted to till every opportunity has been given for natural repair. Besides the local measures which have been indicated, the constitutional condition of the patient should receive attention. As a long period of recumbency will be necessary, it is important to secure the best possible environment; while, at the same time, nutrition should be aided by good food, cod-liver oil, or other suitable tonics.

J. Warrington Haward.

SACRUM, Fracture of the. *See* Pelvis, Injuries of the.

SALIVARY CALCULI are concretions of earthy salts deposited by the saliva, and consist of phosphate and carbonate of lime, with a little magnesia, chloride of sodium, and some organic matter. They are usually of elongated form and small size, but may attain very large dimensions; thus, Albert has seen one removed from Wharton's duct which measured over an inch and a half in length, and was as thick as the little finger; and he mentions another as large as a hen's egg, taken from the duct of the parotid. They are most frequently met with in connection with the duct of the sub-maxillary gland, but the ducts of Stenson, Rivini, and Bartholin may also be involved. The obstruction of the tube is rarely complete.

They may appear at any age, and are said to be more common in men than in women. Their development is seldom explicable, but in a few cases the nucleus of the stone has been found to consist of a grass seed or some other foreign substance.

The *symptoms* are usually slight. The patient complains of a sense of discomfort and tension in the situation of the impacted calculus. The gland, from retention of secretion, undergoes painless swelling, which continues until the imprisoned fluid forces a way past the foreign body; the engorgement then rapidly subsides, to be followed by a new accumulation, and a characteristic alternation of tumefaction and collapse becomes established. Cystic dilatation of the tube behind the obstruction is very rare.

The *diagnosis* is effected by careful palpation along the course of the ducts, aided, if necessary, by the introduction of a fine metallic probe.

The calculus may be removed through an incision made into the distended portion of the duct, or the tube may be laid open from its orifice as far as the obstruction. The continuous flow of saliva prevents any tendency to stricture after the operation.

William Anderson.

SALIVARY FISTULA. — A sinus opening upon the outer surface of the cheek, and communicating with the duct of the parotid gland.

Such sinuses have origin either in wounds of the duct, or in abscess which has burst externally, or in obstruction of the buccal end of the duct, causing its distension and subsequent opening on to the surface of the cheek. Much discomfort is produced by the escape of the saliva upon the cheek; the flow of the secretion being of course increased during mastication.

Treatment.—Fistulæ of recent formation may sometimes be made to heal, if the buccal orifice of the duct be quite free, by covering the opening on the cheek with collodion, a layer of which must be reapplied from time to time, so as to prevent the escape of any saliva; fluid food only being taken during the treatment.

If this does not suffice, the edges of the opening should be pared, and then transfixed with a fine needle, over which a figure-of-eight ligature is to be tied, so as to bring them into accurate apposition. The needle is withdrawn at the end of forty-eight hours, and the wound covered with collodion. Or the orifice of the sinus may be first cauterised with a hot needle and then similarly covered. If the buccal opening is contracted or closed, this must be reopened by passing a fine probe through it; or, if it cannot be found, a probe must be passed along the duct and into the mouth as nearly as possible to the natural orifice (near the second upper molar tooth). Then the duct must be kept open by passing a flexible probe or bougie along it from the mouth, past the fistula, and as far as the gland. This is retained by curving the end which projects from the mouth round the angle of the cheek, and fastening it there by plaster. The fistulous opening is kept covered with collodion, and mastication avoided. J. Warrington Haward.

SALIVATION. See *Mercurial Stomatitis* under Stomatitis.

SALTER'S SWING CRADLES. *See* Cradles.

SANDBAGS are useful for steadying broken limbs, either alone or with splints; and in combination with a drawsheet laid over the chest and abdomen and under the sandbag which is placed along each side of the patient, they efficiently overcome the aching of the spine which occurs in the extension treatment of hip-joint disease. The bags should be made of some fine-textured material, such as bed-ticking, and should be only about two-thirds filled with sand, which must be as fine as possible and thoroughly dried.

SAPRÆMIA is a term which may, perhaps, etymologically include more than it is now generally understood to mean; but, expressing as it does very succinctly the condition in which there is present, circulating in the blood of a patient, one of the alkaloidal products of decomposition (*see* Sepsin), a condition which is otherwise known as septic intoxication—a cumbersome title—or as septic poisoning, which is much too vague, it at least has the merit of brevity coupled with sufficient accuracy to commend it for permanent adoption. By the term sapræmia we understand the condition which is sometimes very wrongly called traumatic fever, or, what is worse, simple traumatic fever. The sapræmic fever is one, therefore, which is evoked by the entrance of a chemical substance into the blood-stream, and, as a necessary consequence, it disappears directly all possible source of absorption of ptomaines is removed.

But in thus entering the threshold of the subject of Septic Disease we must first take note of another pathological (febrile) condition, which is possibly sometimes confounded with sapræmia. We refer to poisoning by the so-called blood-ferment. It has now for some years been recognised that the direct agent in the production of fever is usually a derivative (a non-organised substance) of animal tissues. Volkmann and Genzmer, following the line of thought already pioneered by Billroth and Weber, came to the conclusion that the cause of the pyrexia, in cases which had been operated on strictly antiseptically, was a hypothetical substance, 'pyrogen,' which was a derivative of the damaged portions of the tissues operated upon. The researches of Bergmann's pupils—notably Angerer, Edelberg, Köhler, and others—have vividly illuminated this obscure point by their experiments with blood-ferment and the various constituents of the blood. We will here preface their conclusions by recalling to mind the conditions under which ferment-poisoning most probably arises. In cases where considerable venous oozing has occurred, the wound-cavity is full of black clot or black treacly serous discharge, this bloody débris being frightfully septic if the antiseptic precautions have failed; but, if these are successful, of course it is perfectly aseptic according to the tests at present at our disposal, so that that complication does not exist. Further, it is a necessary condition that the drainage of the wound should have been insufficient, and consequently a positive pressure set up in the interior of the wound, so as to mechanically aid the

absorption of its fluid contents. Both conditions are not infrequently produced by the removal of large tumours, &c., from the fossæ of the body.

The most noteworthy contents of the wound, then, are—(1) partly clotted blood, (2) serum (simple), (3) serous exudation, (4) blood-pigments (hæmoglobin, &c.), (5) blood-ferment (Schmidt). Besides these well-known substances there are, no doubt, others to which perhaps some of the effects to be noted presently are due; among these substances the body recently separated by Wooldridge is particularly to be noted.

All the foregoing components of such wound-discharge are pyrogenous; injected into the blood-stream of a healthy animal, each of them excites more or less pyrexia. The injection of a solution of blood-ferment produces symptoms exactly similar to those which follow the injection of sepsin, for there soon ensue tremors, vomiting, cramps, and bloody diarrhœa, while the temperature rises to over 105°.

Enough has been said to show that in 'ferment-poisoning,' as at present understood, we have a severe pyrexial condition, due to the action of the ferment on the central nervous system (any ferment will do the same thing—viz. pepsin, trypsin, &c.), and that, recognising the possible occurrence of this condition, it must always be eliminated in framing a diagnosis in a supposed case of sapræmia.

The etiology of sapræmia is at first sight simple enough—viz. the setting up of ordinary decomposition in a wound which is imperfectly drained; but, in reality, there are more complex conditions attendant upon the course of the putrefaction. These external conditions determine the form of sepsin produced, and hence indirectly the symptoms. Thus, quite recently, Schmiedeberg and a pupil have found that the original ptomaine, called sepsin, is only to be obtained under certain definite atmospheric and other conditions. The same fact is well known to mycologists to influence the evolution of Davaine's septicæmia.

Similarly, the duration of the 'incubation period,' or rather 'latent period,' which elapses before the first symptoms of poisoning appear, varies directly with the dose, so that no general rule can be laid down on this point.

Next, we must consider briefly the mode of entrance and exit of the poison. As a rule, the poison is absorbed from the cavity of a foul wound by the veins and lymphatics, and it may easily be observed, clinically, that the absorption is largely influenced by the (mechanical) tension of the decomposed discharges in the wound. When, however, there is a septic inflammatory process about the mouth or pharynx, as in cancrum oris, &c., then the patient swallows quantities of putrid stuff; and in that case, of course, the absorption is *per* the lymphatics of the intestine and stomach. Finally, where the nose has been the seat of primary putrid inflammation, sapræmia has followed the inhalation of the poison, and the same thing has been observed in the lower animals.

As described in the articles on Sepsin and Septic Diseases, the poison is mainly excreted by the kidneys.

Symptomatology.—Just as in the lower animal the subject of experiment, so in the human being, the most prominent symptoms are those produced by disturbance of the nervous system. The first effect of absorption of a ptomaine or sepsin-like substance is headache (frequently very severe); this is followed by nausea and vomiting. A slight rigor may announce the commencement of the rise of temperature, which usually reaches 101°–103° F., and very rarely 104°; the pyrexia is a continued fever until the wound is thoroughly washed out with disinfectant lotion and completely drained, when it disappe rs at once. (This immediate effect proves that the sapræmic state is due to the absorption of a simple chemical substance, and is in no sense of the word an infective condition.)

Marked changes occur simultaneously in the blood; the patient becomes anæmic, for the red blood-corpuscles vary directly with the amount of poison circulating. There is some leucocytosis also, but the greatest effect is on the number of red discs.

At the same time the excretory organs, which are occupied in getting rid of the poison, are notably affected. The skin is cold and clammy, the urine scanty and concentrated, and sometimes there is diarrhœa, which more rarely is bloody. Diarrhœa, in fact, is next in importance as a leading symptom to those evoked from the nervous system. In final stages, if not previously relieved, the patient becomes delirious, and then the delirium passes into fatal coma. The symptoms will differ according to the difference in the kind of decomposition set up, since the resulting ptomaine poison will be different. *See* Sepsin.

Pathological Anatomy.—There is little to be found in the post-mortem appearances

of such a case. The most obvious changes are usually found in the alimentary canal, in the shape of violent gastro-intestinal inflammation, the mucous membrane being intensely congested, small extravasations of blood occurring here and there, and Peyer's patches especially swollen and reddened. Similar small extravasations of blood or petechiæ are found beneath the serous membranes. The central nervous system exhibits marked congestion also of the meninges, and occasional hæmorrhagic petechiæ.

The glandular organs, the liver and kidneys, but especially the latter, show well-marked bloody swelling, while the spleen is frequently (but not invariably) swollen. As has been observed in other septic diseases, the corpse of a person who has died of sapræmia becomes putrid very rapidly.

Treatment.—Fortunately, the treatment of this variety of septic disease is easy and almost always very successful, since it simply consists in the thorough cleansing of all putrid stuff from any of the cavities (especially mucous ones) of the body. All wound-cavities, &c., must be freely drained by fresh incision, large tubes being inserted as a preliminary measure, and are then to be freely syringed out with strong disinfectants—e.g. 1 in 20 carbolic acid, &c. In cases where the sapræmic state follows on the advent of a septic inflammatory process, that must be treated by free incision and washing under antiseptic precautions.

Although the local treatment is the one essential point in successfully combating sapræmia, still, there are other factors in the etiology, &c., of the disease which have to be considered and met. Thus, for instance, there is the secondary anæmia and leucocytosis. This is to be treated with iron and quinine. The former is best given as dialysed iron, ℥x. bis die, and the latter simply dissolved in dilute acid, 15 grains per diem to commence with, and increased as soon as possible. But it will be observed of a series of cases that the symptoms differ to an obvious extent. This is doubtless due to the difference in the kind of ptomaine which may be doing the mischief. *See* Sepsin. And it may occasionally happen where there are very distinct minor nerve-symptoms—e.g. dilatation of the pupil, dryness of the throat, &c.—that the condition will be best met by administering the vegetable alkaloid which is antagonistic to the one that appears to be imitated by the particular ptomaine under observation. Thus, if the above-mentioned symptoms were present, it might be of advantage to inject eserin hypodermically. *See* Hypodermic Injection.

Finally, we would repeat that sapræmia is usually a complication of some infective disease, and that altogether it may be treated apparently successfully in a few days. The chance of the patient's having contracted pyæmia, &c., must be borne in mind. This is notably the case where the sapræmia is of puerperal origin.

Prognosis.—Good, if a simple case.

Victor Horsley.

SARCOCELE. *See* Testis, Diseases of the.

SARCOMA. — *Structure.* — The sarcomata may be defined as tumours of connective-tissue origin, composed of connective-tissue cells. There is often no definite stroma, and, when present, it is—with one rare exception—not arranged in the form of definite alveoli, the cells being uniformly distributed throughout the tumour. The sarcomata are generally largely supplied with blood-vessels, the smallest of which are extremely thin-walled and sometimes appear as channels bounded merely by the cells of the growth. No lymphatics have ever been demonstrated. The cells multiply by fission.

The sarcomata may be conveniently divided into four chief groups—(i.) *round-celled*, (ii.) *spindle-celled*, (iii.) *mixed-celled*, (iv.) *giant-celled* or *myeloid*.

(i.) Round-celled Sarcomata.—These tumours are composed of round, granular cells of connective-tissue type, frequently multi-nucleated, not generally varying in size in any individual tumour, embedded in a soft, granular, or homogeneous matrix, abundantly supplied with blood-vessels. In some tumours the cells are no larger than leucocytes—small round-celled sarcoma; in others they are more than double or treble this size—large round-celled sarcoma. The cells have no definite cell-wall, and there is often but little protoplasm around the nucleus.

(ii.) Spindle-celled Sarcomata.—The spindle-celled sarcomata consist of closely packed spindle, oval, fusiform, and oat-shaped cells, generally granular and often multi-nucleated, embedded in a homogeneous matrix. The cells are for the most part arranged with their long axes parallel, but are frequently collected into interlacing bundles. They vary in size in different tumours, but in any individual growth are frequently of

the same diameters throughout. In the small spindle-celled variety their diameter does not exceed that of a leucocyte, and is about one-fourth that of their length, while in the large spindle-celled sarcomas, the cells are sometimes as much as five or six times these dimensions.

(iii.) Mixed-celled Sarcomata.—The mixed-celled sarcomas, as their name implies, are composed of cells of various forms, such as may be met with separately in either of the two previous groups. The cells frequently differ in size as much as in shape.

(iv.) Giant-celled or Myeloid Sarcomata.—These sarcomata are composed for the most part of spindle or oval cells, such as have been already described. Mingled with them, however, are a varying number of large, irregularly shaped cells, often twenty to thirty times larger than their neighbours, granular, flattened, and containing from ten to forty or more nuclei.

Varieties. — Although all sarcomata may be classified in one of the above four groups, yet it is convenient to subdivide them into several varieties, each of which differs in some important essential from the others. The following are the chief varieties.

Melanotic Sarcoma.—These tumours are distinguished by the presence of granules of black or brown pigment, in varying amount, scattered through the growth in a very irregular manner, and often absent in one part of a section, while, in another portion, the structure is hidden by masses of colouring matter. Most of the melanotic tumours belong to the round-celled variety of the sarcomata, but in some cases the pigment is found in spindle-celled growths. The pigment occurs both in the cells and in the matrix. Melanotic sarcomas are also not infrequently 'alveolar' with respect to their stroma. See *Alveolar Sarcoma.*

Lympho-Sarcoma.—The lympho-sarcomata are composed of very small round cells, lying in a slender, fibrillated matrix; the cells are no larger than leucocytes, and a section of such a growth is almost a *facsimile* of the more cellular part of a lymphatic gland.

Glioma.—The gliomas resemble closely the lympho-sarcomas. Their matrix is precisely similar to the neuroglia tissue in the nerve-centres, being a loose meshwork with branching cells. The sarcoma cells are of the small round variety. *See* Retina.

Alveolar Sarcoma.—The cells in alveolar sarcoma are generally round, but may be oval or spindle in shape. They are contained in separate alveoli, formed by bundles of connective-tissue. The amount and consistency of this latter is very variable; it is generally much less than is present in the carcinomata, and is sometimes represented by a few fibres and long spindle-cells placed side by side. It is, in some cases, difficult to distinguish the sections of these growths from the alveolar carcinomata. It should therefore be noted (1) that the cells are generally smaller and more granular, and do not possess a translucent body, as do typical epithelial cells. (2) That in any alveolar sarcoma there is often a portion of the tumour composed simply of typical sarcoma-tissue without alveolation. (3) That the cells may be separated from each other by delicate filaments of connective tissue.

Hæmorrhagic Sarcoma.—These sarcomas belong to the round or spindle-celled groups. Their peculiarity consists in the extreme tenuity of their blood-vessels and the consequent liability to hæmorrhage, for as fast as they grow peripherally their central parts are broken down by extravasation of blood into a soft mass, which soon becomes indistinguishable from altered blood-clot, of which, indeed, it is almost entirely composed.

Plexiform Sarcoma or Cylindroma.—This rare form of tumour is essentially a sarcoma, some of the cells of which have undergone a hyaline degeneration. The unaltered masses of cells thus appear on section to be contained in alveoli, the walls of which are composed of hyaline material. The cells are generally round, but not infrequently polygonal, are closely packed, and not apparently separated by any intercellular substance. In some cases, the hyaline degeneration may be traced as commencing in the walls of the blood-vessels.

Psammoma—Pearl Tumour.—This form of sarcoma has hitherto been found only within the cranial cavity, and, usually, in connection with the pineal gland. It is characterised by the presence of concentric calcareous masses, surrounded by fibrous tissue and attached to fibrous trabeculæ.

Degenerative processes in the Sarcomata.—The most common form of degeneration seen in the sarcomata is that known as 'mucoid.' It usually commences in the most central parts of the growth by the distension of the cells with a clear gelatinous fluid, the cells burst, and the mucous fluid is discharged. In some cases the matrix seems to undergo a similar change. The result of

this process is the gradual liquefaction of the tumour and the formation of a cyst. The degeneration frequently commences at several separate foci, so that multiple cysts are formed. Sarcomata may also be the seat of fatty degeneration.

Mixed Tumours of Connective-tissue Type.—The whole of the connective-tissue tumours originate by the proliferation of connective-tissue cells. In any case where the tendency is for these cells simply to *multiply*, a sarcomatous tumour results; and where, in addition, no tendency whatever to *develop* into one of the adult forms of connective tissue is present, the tumour is composed simply of round cells—a round-celled sarcoma. The first evidence of development is seen in the elongation of the cells into spindles or ovals, and the production of a spindle-celled sarcoma. But in many tumours a further tendency to development is present; and, inasmuch as from connective-tissue cells any of the connective tissues may be built, the sarcoma cells become variously mingled with fibrous tissue, cartilage, bone, fat, &c. Supposing that the bulk of the tumour continues cellular, the name sarcoma is still retained, and an adjective, indicating the nature of the developed tissue is prefixed—e.g. fibro-sarcoma, chondro-sarcoma, &c. It is at this point that great difficulty often arises as to whether a growth is, from microscopical examination, to be considered innocent or malignant. For the fibro-sarcomas merge imperceptibly into the sarcomas on the one hand and the fibromas on the other; the chondro-sarcomas into the chondromas; the osteo-sarcomas into the osteomas, and so forth. From a microscopical point of view, it must be laid down that any tumour in which are collected masses of connective-tissue cells must be placed amongst the sarcomata, whilst those in which no such collections are present belong to the innocent class of connective-tissue tumours.

It may be well to describe briefly the general structure of the four most common forms of mixed growth:—

(1) Fibro-Sarcoma.—This form of tumour generally belongs to the spindle-celled group, and was formerly described as 'recurrent fibroid.' The spindle cells are often large, and are mixed both with young connective-tissue and with broad bands of fully developed fibrous tissue.

(2) Myxo-Sarcoma.—In myxo-sarcoma the stroma of the tumour consists of branching cells enclosing spaces, in which is contained a clear mucous fluid. In these spaces are also sarcoma cells. These growths gradually fade into the class of soft fibromas and true myxomas, and from these it is often difficult to separate them.

(3) Osteo-Sarcoma.—This form of tumour occurs only in bone. It consists of a varying amount of sarcomatous cells, mingled with and enclosed by bone trabeculæ. *See* Tumours of Bone.

(4) Chondro-Sarcoma.—The cartilage met with in this form of growth may be either fibrous or hyaline; the sarcoma cells are either round or oval.

The naked-eye appearances of the sarcomata vary indefinitely. In shape, size, and outline no two are alike. On section, the sarcomas that are unmixed with other tissue may be soft, brain-like, and pulpy, readily breaking down on pressure; frequently they possess a gelatinous semi-translucent structure; frequently also they are of a red and fleshy appearance; in any case they may be more or less infiltrated with blood. In one respect they differ, however, from all other tumours—namely, in the homogeneous appearance of their cut section, for, in a typical sarcoma no appearance of fibrillation or of lobulation is to be found. Of course, in proportion as the sarcoma tissue is mingled with fibrous, cartilaginous, or other structures, so the appearance on section will differ. Again, where degenerative changes have been in progress, a variable amount of cystic degeneration, with varying degrees of consistence, will be found.

On section, the sarcomata often appear to be encapsuled, their edges being rounded and apparently well-defined. But although in some few cases they are contained in a pretty definite cyst-wall, in by far the majority of instances the appearance of a capsule is misleading, and, on attempting to separate the new growth from the surrounding tissues, they will be found almost inseparably blended. In other sarcomata, and these the most malignant and rapidly growing, there is no appearance of a capsule, and the tumour infiltrates the surrounding parts in an irregular fashion, being altogether inseparable from the tissues in which it grows.

To the naked eye the *hæmorrhagic sarcomata* often appear simply as hæmatomas, but if careful examination be made, their cyst-wall will almost invariably show evidence of new growth in some part of its circumference. They generally contain both fluid and clotted blood of a dark colour.

The *myeloid tumours* of bone have in part a red-brown or maroon colour (not

unlike that of the normal heart), which when present gives to them a very typical appearance. These growths often possess a pretty definite bony cyst-wall, from which they may easily be shelled out. They are very prone to undergo degenerative changes, so that the hollow formed by the expanded bone is frequently found filled with a broken-down pulp. In some cases, large vessels open into the cyst-like cavities thus formed and produce an evident pulsation, thus forming the so-called 'pulsating tumours of bone.'

The *periosteal sarcomas* of the long bones grow beneath, and strip up the periosteum; they infiltrate both it and the subjacent bone. The most superficial parts of them resemble the sarcomas as already described, but in their deeper portions they are usually completely ossified. They are never encapsuled. *See* TUMOURS OF BONE.

The Localities in which the sarcomata grow are very various. They may develop in almost any part of the body, for connective tissue is to be found in every organ and tissue to a greater or less extent. There are, nevertheless, certain situations in which sarcomata are more common than elsewhere.

The *round-celled* groups are found in the secreting glands—e.g. the testes, parotid, and sometimes the breast. That variety called 'alveolar' occurs chiefly in the skin; the melanotic variety in the skin and in the eyeball; the lympho-sarcomata in the lymphatic glands.

The *spindle-celled* sarcomata occur chiefly in the intermuscular fasciæ and subcutaneous tissues—as periosteal tumours of the long bones, especially of the femur and tibia; also in some of the glands, especially the breast and parotid.

The *mixed-celled* sarcomata are also found chiefly in the connective tissues of the extremities and in the periosteum of the long bones.

The *myeloid tumours* grow inside the long bones, which they tend to expand in their growth; they are found chiefly in the articular ends of the femur, tibia, and humerus. Apart from the long bones, myeloid growths are most commonly met with in the superior and inferior maxillæ.

The *gliomas* are found either in the eyeball or else in the brain and spinal cord.

The *hæmorrhagic sarcomas* occur almost invariably in the connective tissues of the extremities.

Of the various mixed tumours of connective-tissue type the *fibro-sarcomas* are the most common. They occur in the subcutaneous tissues, in the periosteum of the long bones, and in the breast; they are the most usual form of sarcoma met with in the latter organ.

The *chondro-sarcomas* grow more particularly in the articular ends of the long bones, in the parotid, the testis, and very rarely in the breast.

The *osteo-sarcomas* grow in the bones, especially those of the extremities.

The *myxo-sarcomas* are found in the mucous cavities, such as the nose and antrum. They occur also in the uterus and in the parotid glands.

Clinical Characters of the Sarcomata. In speaking of the sarcomata in general, it is impossible to describe with anything like accuracy the special characters which appertain to the various tumours of this class, for they vary immensely according to their locality.

These growths may be said to occur more frequently in the young and middle-aged than in the old, to follow injuries with tolerable frequency, and to grow rapidly. The more malignant the tumour the more rapidly it grows. The amount of pain caused by such a growth necessarily varies greatly; frequently no pain or tenderness is complained of.

When in a situation favourable for examination, a sarcoma presents itself as an irregularly rounded or oval swelling, sometimes a little lobulated, but with a surface generally smooth, adherent to the parts amongst which it lies, and therefore more or less fixed, and firm, elastic, or semifluctuating to the touch. The more rapid the growth of the tumour, the more soft and fluctuating is it as a rule. It is usually very vascular, and attention is called to this by the enlarged and tortuous veins in its neighbourhood.

Of the varieties of the sarcomata the following points may be briefly noted:—

The *melanotic sarcomata* of the skin generally develop in the site of a previously existing mole or wart, sometimes when either of them has been irritated by caustics or by imperfect attempts at removal. Rapid growth in a mole or wart, previously quiescent, should then always be looked upon with great suspicion, and radical treatment never delayed. In the later stages of melanotic sarcoma multiple growths are common, and pigment-granules may be found in the urine.

The *hæmorrhagic sarcomata* are rapidly forming tumours, evidently fluctuating, situated generally on one or other extremity, with no signs of inflammation, and,

when tapped, yielding usually dark-coloured blood. They rapidly refill after tapping, and continue to increase in size—a point to be noticed, for simple hæmatomas do not increase unless they become the seat of suppurative changes.

The *sarcomas of bone* grow almost invariably at the articular ends of the long bones and in the bones of the face. The myeloid growths, commencing within the cancellous tissue, expand the bone in their growth, and so become covered by merely a thin shell which, on pressure, is readily indented, with a crackling sensation. This bony crackling is never present in the subperiosteal sarcomas. Occasionally, also, the central tumours of bone are the seat of distinct pulsation, caused by the opening of large vessels into the cysts formed by degeneration of the tumour-mass.

The *periosteal sarcomas* are more rapid in their growth than the endosteal; they grow on one aspect of the bone, and do not pulsate. Neither the central nor the periosteal growths often cause glandular affection. *See* Tumours of Bone.

Signs of Degeneration in Sarcomata.—As already described, the sarcomata may undergo degenerative changes, resulting in the formation of cysts containing fluid within the tumour-mass. These collections of fluid necessarily yield a distinct sense of fluctuation, and those parts also which are yet in the process of degeneration, but which, though succulent, are not yet fluid, feel in a corresponding degree softer than the rest of the sarcomatous growth. Thus, in a sarcoma that is degenerating, the whole mass varies in consistency at different points.

Signs of Inflammation in the Sarcomata.—Although, as a rule, the sarcomata grow without any definite signs of inflammation, it must nevertheless be remembered that, very rarely, not only may such tumours show all the local signs of inflammation, but that pus may be formed within the new growth itself, and the abscess may come to the surface and burst, in a manner which differs in no way from that which pertains to simple abscess situated amidst the tissues of the body. So, pain, redness, heat, and swelling are all compatible with the presence of a sarcoma, and, yet further, the temperature may be raised and may continue at 101° or 102° F. for many days, even when there is no suppuration.

Differential Diagnosis of the Sarcomata.—It is not possible in the present article to deal at all fully with the differential diagnosis of the sarcomata; all that is therefore attempted is to point out the chief only of those swellings which may be mistaken for the sarcomas.

To facilitate this, the writers suggest that the tumours in question should be considered according as they are found—A. In the soft connective tissues. B. In the glands. C. In the bones.

A. *In the soft connective tissues* the sarcomata must be especially distinguished from—1. Cysts. 2. Abscesses. 3. Hæmatomas. 4. Syphilitic swellings. 5. Innocent tumours.

1. *Simple or serous Cysts.*—The locality of the swelling may be such as to make it highly improbable that it is cystic. The growth may have been more rapid than is usual in cysts. If large and superficial, cysts are often translucent—sarcomas never. If tapped with an aspirator or fine trocar, a simple cyst will be entirely emptied and its contained fluid will be found clear and serous. If a solid sarcoma be tapped, only bright blood will escape; if one that is undergoing cystic degeneration, the fluid that is drawn off will be dark and blood-stained, and, when it has ceased to flow, some of the swelling will still remain and can be felt to be solid. Fluctuation is much more marked in a cyst, and is readily transmitted from its extreme boundaries. This is not usual in sarcomas, even in those that are undergoing cystic degeneration.

2. *Abscesses* which are chronic and deeply seated may simulate sarcomas very closely, but some of the signs of inflammation will generally be present, and often there is, if nothing else, a little œdema of the superjacent skin. On the other hand, a sarcoma that is inflamed may closely simulate an abscess. In many cases, tapping alone will clear up the diagnosis.

3. *Hæmatomas*, as already mentioned, may closely simulate or be simulated by the hæmorrhagic sarcomas. The rapidity of growth, the rapid refilling after tapping, and the increase in size, independently of any inflammatory changes, will usually serve to distinguish this variety of sarcoma. For it must be remembered that tapping alone will not decide the question, the dark-coloured bloody fluid answering equally well for the contents of either a hæmorrhagic sarcoma or a hæmatoma, and the size being as much reduced in the one as in the other. The latter swellings, however, do not rapidly increase in size unless they become the seat of suppuration.

4. The diagnosis from *Syphilitic Gummata* is sometimes very difficult, and often at first impossible; for although other evi-

dence of syphilis in the same individual will make the diagnosis of gumma probable, it will not necessarily disprove the sarcomatous nature of the growth. As a rule, a decision will be most readily arrived at by placing the patient under antisyphilitic treatment.

5. *From Innocent Tumours.*—The lipomata and soft fibromata are the innocent tumours which, to the touch, most resemble sarcoma, but it is chiefly when growing in unusual situations or existing under unusual conditions, such as being injured, inflamed, &c., that any difficulty of diagnosis arises. A satisfactory conclusion will generally be arrived at by a careful comparison of the physical characters of the sarcomata with those of the innocent tumours. But the rapidity of the growth is the most essential particular into which inquiry should be made, the increase in size of the malignant tumours being very much more rapid than that of the innocent one.

Nævoid growths also may simulate sarcomata. Their congenital occurrence and great vascularity, combined with the fact that their size may be diminished on pressure, will generally, but not always, serve to distinguish them. In cases of large subcutaneous nævi the diagnosis may be very difficult.

B. *In the Secreting Glands.*— In the breast, parotid, and testis more particularly, the sarcomata have to be diagnosed from— 1. Carcinomata. 2. Tumours of an innocent nature. 3. Cysts and abscesses.

1. From the *Carcinomata* the sarcomas may be distinguished, in most cases, by attention to the descriptions already given of the clinical characters of these growths. *See* Carcinoma. Diagnosis is not of material importance, for the treatment of each class of tumours is alike. Carcinomas are rare in the parotid, sarcomas common.

2. From *Innocent Tumours* the diagnosis may be made by attention to the rapidity of growth, the infiltration of the tissues, and the affection of the general health, as well as by the physical characters of the growth itself.

Such special swellings as hæmatocele and chronic orchitis are considered elsewhere. A tumour of long duration must not be judged innocent from that fact alone. For, though of slow growth and apparently innocent, it may after some years begin to grow rapidly and exhibit all the signs of malignancy.

3. From *Abscesses and Cysts* the diagnosis may be made in a similar manner to that already described in dealing with sarcomas of the soft connective-tissues, bearing in mind, in the case of abscesses, any points of special history which may belong to the part of the body affected—e.g. history of recent parturition and lactation in the case of the mammary gland, of urethral inflammation in the case of the testis, &c.

C. *In the Bones.*— In the bones the sarcomas are chiefly simulated by or else simulate—1. Joint-disease. 2. Quiet necrosis without suppuration. 3. Chronic periostitis.

1. From *Joint-disease* the sarcomata may be diagnosed by the healthy condition of the patient, by the rapid increase in size of the swelling, the enlarged and tortuous veins on the surface, by bulging more on one side of the articulation than another, by the frequently painless, though limited, movement of the joint itself, by the evident implication of one bone greatly in excess of the other, by the absence of inflammation and of starting pain at night, and by the failure of all treatment. It must be clearly remembered that the joint may itself become diseased by the encroachment of the tumour. In these cases of sarcoma signs of inflammation are often well-marked, and great care is frequently necessary to establish a diagnosis.

When the tumour grows from the centre of the bone, and more particularly when of the myeloid variety, the presence of 'eggshell' crackling, and occasionally of pulsation, will show clearly the nature of the swelling.

2 and 3. *Swellings on bones the result of quiet necrosis* or else of *simple or syphilitic chronic periostitis* may be considered together. In many cases no difficulty arises in separating such inflammatory swellings from the sarcomata of bone, but, in those instances in which the inflammatory symptoms are but little marked, the diagnosis may be so difficult that, without incising the swelling, it is not possible to be certain of its nature. It is well to bear in mind, in considering such a case, that the sarcomata almost invariably grow at the epiphysial ends of the bones, so that any tumour situated on the shaft is not likely to be sarcomatous. Moreover, in cases where the swelling is due to periostitis, its shape is suggestive rather of enlargement of the bone, with preservation of the general outline, than of a tumour presenting on one aspect alone; whilst, to the touch, the sarcomatous growth is not hard and incompressible in its whole extent, but in parts is often soft and elastic. Reliance must not be too strongly placed on an increase or

abnormally wide variation of the body temperature, for in the sarcomata of bone such increase and variation may be present, and the temperature chart may be indistinguishable from that of hectic fever. Again, if the swelling be due to chronic periostitis, treatment by counter-irritants and absorbents, especially iodide of potassium will often result in its disappearance; though, if quiet necrosis be at the bottom of the inflammation, this disappearance will not take place. In all doubtful cases an exploratory incision should not be too long delayed. And even after such incision has been made the diagnosis is not always easy, for the thickened and inflamed soft tissues around the dead bone may closely resemble sarcoma.

For *Etiology; Clinical differences between malignant and innocent tumours;* and for *Treatment of the sarcomata*, see MALIGNANT TUMOURS.

W. MORRANT BAKER.
ANTHONY A. BOWLBY.

SAYRE'S SPLINT for the hip consists of a metal bar, which reaches, as an outside thigh-splint, from the pelvis to the knee. This bar is composed of two pieces, one of which slides within the other and is capable of being fixed, as required, by a ratchet. The upper end of this bar is connected, by means of a ball-and-socket joint, to a padded metal band, which is meant to encircle the pelvis; from the lower end of the bar two arches pass off with sufficient span to reach over the front of the thigh to the inner side of it, where they become continuous with a short longitudinal bar. At the lower end of both the outer and inner longitudinal bars there is a pulley, and just above the latter there is a buckle. There is also a perineal band which, when the splint is applied, is buckled in front and behind to the pelvic girdle. To apply the splint, two pieces of strapping, with a piece of webbing stitched to one end of each, should be fixed to the inner and outer surfaces of the thigh by another piece wound spirally round the limb, and by a few turns of bandage placed over all. The pelvic girdle and perineal band should next be adjusted, the metal bar being placed in position along the outer side of the limb; and then the pieces of webbing, above mentioned, should be carried round the pulleys at the lower end of the splint, and fastened up tightly to the buckles. By turning a key the splint can be lengthened, and as the thigh is fixed by the strapping to the lower end of the splint, and as the perineal band will check upward displacement of the pelvic girdle, the lengthening of the splint will cause extension at the hip-joint. *See* HIP-DISEASE.

BILTON POLLARD.

SCABIES, or the ITCH.—*Definition.*—A contagious disease of the skin, due to the presence of a small mite known as the Acarus scabiei. See *Acarus Scabiei*, under ACARUS.

Course and Symptoms.—The female acarus penetrates and burrows into the substance of the epidermis, and oftentimes into the hair-follicles. In this burrow or cuniculus, which in the early stages is not well-marked, and in cleanly people is difficult of detection, the female, being unable to retreat by reason of certain projections or spines with which its body is armed, lives, lays eggs, and dies; the male, on the other hand, lives on the surface of the skin, some say in the shallower burrows. The lesions produced depend upon the depth of penetration of the acarus and the susceptibility of the individual attacked. The earliest signs are the formation of minute inflammatory macules, papules, and vesicles. The sympathetic irritation is very considerable, extending to parts far removed from the seat of the acarus or acari. If neglected, the disease spreads daily, until at the end of three or four weeks all the characteristic parts have become affected. The position of the burrow is beneath the horny layer of the epidermis and in the upper part of the rete. The burrow is slightly raised and very tortuous, and its average length is one-fifth of an inch, but occasionally it reaches the length of two or even three inches. In appearance it is of a whitish or yellow colour, and, seen through a glass, is either dotted from ova and excreta or black from dirt. A vesicle is often formed at the point of entrance to the burrow, at the other end of which will be found the acarus. As a rule, burrows are only to be discovered between the fingers and toes, on the wrists, and on the navel and penis; and even on these parts they may be completely destroyed by scratching, or obscured by much pustular eruption and scabs. To remove an acarus, it is necessary to place a needle flat upon the surface of the skin—and not perpendicularly—the point is then inserted into the burrow at right angles to its course, and on slowly moving it away from the vesicular end, the acarus, if alive, will adhere to the needle.

The eruption, which is of an eczematous character, is always accompanied by much

itching at night, produced by the warmth of the bedclothes. Papules, vesicles, and pustules may all be present at the same time. The papules are usually numerous, always small, and, according to Dr. Liveing, generally more isolated and scattered than those of simple eczema, and do not early develop into large excoriated patches. The vesicles are of various shapes and sizes, usually have inflamed bases, and often show parts of burrows on their summits, in which condition they may remain or, passing into pustules, increase to a considerable size and extend. The disease usually begins on the hands, especially between the fingers, whence it is commonly communicated to the penis in urination. In women, it attacks the mammæ about the region of the nipple, and in all cases shows a preference for the softer regions of the trunk, especially the warmer parts, and also the inner surfaces of the limbs. In adults, the disease is never found either on the scalp or face—those parts being much exposed to cold—and only occasionally in infants. In young children, the buttocks and feet are often affected. It displays a preference for those parts of the skin which are subject to any pressure, as, for instance, beneath the stays, garters, or belt, and upon the buttocks of people who sit much. Scratching produces important secondary lesions—excoriations, torn papules, vesicles, and pustules—which result in crusts of blood, serum, and pus, and also general dermatitis, with infiltration, thickening, and pigmentation. Irritation is not always confined to the immediate neighbourhood of the acari, and the sympathetic itching caused by them, in distant parts, accounts for the widespread eruption apparently so out of proportion to the cause. Cases of so-called Norwegian scabies—which is a more serious, exaggerated, and chronic form, or an advanced stage of the same disease, resulting from neglect—have been known to last a lifetime. The whole integument becomes chronically inflamed and covered with pustules and extensive crusts, in which numerous acari and ova are found.

Diagnosis.—The only diseases with which scabies can be confounded are eczema and prurigo, and the following are the exact points which distinguish it from them:—The position of the eruption; the time and amount of irritation; the presence of burrows and acari; and the history of contagion. In scabies, the eruption is limited to certain parts—between the fingers or toes, fronts of wrists; while in eczema the eruption spreads from the margin of the patches, and is never limited to these parts. In prurigo the hands are only slightly affected—usually only when there is secondary eczema—the characteristic parts attacked being the front and back of the trunk and the extensor surfaces of the limbs. The irritation in scabies is always worse when the skin is warm, but as this is also the case to a modified extent in both eczema and prurigo, the other points are the only certain signs whereby scabies may be distinguished from the two diseases mentioned.

Treatment.—This consists in the complete destruction of the acari and their ova. But, in order to do this effectively, it is necessary to open up the burrows in which they are concealed. This part of the treatment is at times rendered somewhat difficult by reason of the secondary eczema. The body should be soaked in a hot bath, after which all parts, where burrows are known to exist, should be freely rubbed with soft soap and a brush, and the entire surface then covered with an ointment containing some parasiticide. In this way the scabs will be removed, the burrows will be torn open, and the acari and their ova destroyed. After the process has been repeated once or twice, according to circumstances, the disease itself will be cured, although some eczema may remain as the result either of the disease or of the treatment. The effect of all parasiticides is more or less irritating, and as some people suffer much from them, care must be taken in their selection.

The two essentials in the treatment—that is to say, the opening up of the burrows and the destruction of the acari and ova—can be combined in one remedy, the lotion known as Vlemingkx's solution, ℞ Calcis ʒss., Sulph. precip. ʒj., Aq. destill. f ʒv. This, rubbed in forcibly for half an hour and followed by a hot bath with plenty of soap, will often effect an immediate cure. But it is a rough method, and should only be used when time is a great object. A milder plan, and one almost as rapid in its results, is to combine the soft soap with the parasiticide, as in Hebra's modification of Wilkinson's ointment—Sulph. præcip. et picis liq. āā ʒvj.; Saponis viridis et adipis āā lb. j.; Cretæ ʒiv. Fiat unguentum.

The sulphur vapour bath is recommended by some authorities, but it is far less effectual than ointments. If the sulphur ointment of the B.P. be employed, it should be reduced to, at any rate, one-third its strength. It is necessary to remark

that the antiparasitic remedies should be discontinued as soon as possible, and that the subsequent eczema should be treated with soothing powders, lotions, or ointments. It is also important to note that the underclothes worn by the patient should be baked in an oven, so that all ova may be destroyed.

The following applications are all most useful for the destruction of the acari:—

℞ Olei cadini et sulph. præcip. āā ʒiij.; Glycerini amyli fʒvj.; Adipis benzoati ad ʒiij.

℞ Styracis liquidi fʒj.; Adipis ʒij.

℞ Styracis liquidi fʒj.; Sp. vini rect. fʒij.; Ol. olivæ fʒj. Fiat linimentum.

℞ Pulv. staphisagriæ ʒj.; Adipis ʒiij.

℞ Balsami Peruviani ʒss. vel ʒj.; Adipis ʒj. Suitable when for some special reason sulphur is not advisable.

℞ Naphthol. fʒss.; Adipis ʒj.

It is quite unnecessary to employ any internal treatment in Scabies.

Malcolm Morris.

SCALDS. *See* Burns.

SCALDS OF THE GLOTTIS are most commonly met with in infants or young children, from attempting to drink out of the spout of a kettle; or else in adults from the inhalation of steam in boiler accidents, or of ignited gas in explosions. In the latter, the lips and face, and even the whole body, are involved; in the former, the scalding steam is drawn into the interior of the larynx, and even into the trachea, by the sudden inspiration which precedes the cry of pain caused by the contact of the boiling water.

The severity of the injury presents considerable variations in each case. The mouth itself may escape so completely that, on casual inspection, there is nothing serious visible, while in reality the edges of the epiglottis are scorched and shrivelled, and the upper and back part of the larynx swollen and blistered; or the lips and tongue may be reddened and covered with vesicles full of exuded lymph, or with shreds of yellowish epithelium hanging down from the swollen papillæ. Sometimes, there is merely a slight degree of hyperæmia; at others, particularly if the fluid has entered the mouth, the epithelium is raised up and detached just as in scalds of the skin.

The *symptoms* are immediate, due to the injury itself, or remote, consequent on the inflammation that always ensues. Severe burning pain is always present: in a child the screaming is incessant until, partly from exhaustion, partly from the œdema which very rapidly sets in wherever there is any loose connective tissue, the voice fails completely, and there is nothing to be heard but a hoarse, croupy inspiration. Often, the child tries to thrust its hand into its mouth or clutches wildly at its throat. Great restlessness and anxiety, or a continual sense of impending suffocation, are always present. Difficulty of swallowing sets in from the first; dyspnœa may also be immediate, but more often it becomes more marked in the course of a few hours, in consequence of the œdema and inflammation.

Exudation and swelling follow rapidly—most marked, of course, in the submucous tissue of the injured part, and particularly where the fibres are loose and yielding. By the root of the tongue, round the base of the epiglottis, and along the course of the folds leading from its sides to the arytenoid cartilages, are the favourite places. The ventricles are rarely much involved, and the true vocal cords, where there is no submucous tissue, hardly ever. The epiglottis itself may appear hard and shrivelled; the folds behind it are swollen up so that they can easily be felt with the finger, or seen, when the tongue is depressed, as smooth, round, semi-translucent masses on either side, reaching nearly across the middle line. Below, in the lower part of the larynx and trachea, similar changes, though of less severity, are not uncommon; probably due to the direct effect of the injury, although perhaps in some instances the result of extension of the inflammation. In short, the appearances are those of acute laryngitis, with more or less œdema of the glottis.

As this stage is reached, generally some few hours after the accident, and often preceded by a period of delusive repose, the symptoms become more and more grave. The dyspnœa, especially, increases slowly and surely, becoming worse the whole time, but interrupted now and then by paroxysmal attacks of asphyxia, each of which seems as if it would prove instantly fatal. Inspiration is much more impeded than expiration, especially in children; the breathing has a hoarse, croupy sound; the voice is completely lost; and with its chest thrown forwards and its chin upwards, so as to secure the greatest muscular aid, the child sits propped up, perfectly quiet, with its whole energy directed to its respiration. The face is pale and cyanosed, the lips dusky, the skin bedewed with perspiration, the pupils dilated, and all the symptoms of

asphyxia are present. At length the child sinks into a state of collapse, or death takes place suddenly during one of the paroxysms.

Later on, if this stage does not prove fatal, inflammatory affections of the bronchi and lungs ensue. The temperature rises, all the signs of fever set in, and a low insidious form of broncho-pneumonia makes its appearance—peculiarly dangerous not only in itself, but also from the circumstances which have preceded it, and the conditions under which it appears.

The *prognosis* is at all times exceedingly grave. The case may sometimes terminate fatally at once, from the shock of the injury. More often the symptoms subside for a short time, and then, especially at night, break out again with a succession of paroxysms, any one of which may be the last; and when this stage has passed, owing to the inflammation that follows, convalescence is always protracted and tedious.

Treatment.—The first object is to confine the inflammation following the injury within the narrowest possible limits, so that there may be free entry for the air, and that the lungs may not collapse or become involved by gradual extension of the mischief. Then, every care must be taken to prevent the access of anything that could irritate the larynx. The mucous membrane becomes intensely sensitive when it is inflamed, and what would hardly be noticed under ordinary conditions, or at most would give rise to a transient cough, may now excite such a paroxysm of spasmodic contraction that death ensues before any relief can be afforded. Finally, there is the question of tracheotomy, or, in children, of laryngo-tracheotomy, either as a preventive measure or to relieve already existing obstruction.

The temperature of the air breathed must be perfectly equable, and it ought to be saturated with moisture. This is best managed by surrounding the cot with curtains, and conducting the steam of a kettle into one corner; in this way cold draughts and dusty air may be completely excluded, but care must be taken not to raise the temperature too high, so as to avoid the intense depression caused by a warm moist atmosphere. Perfect rest is essential; but, as a rule, if the difficulty of breathing is at all great, the patient will remain perfectly quiet of himself. Ice round the neck, applied by means of a collar, and the continual sucking of small fragments, retaining them as long as possible in contact with the fauces, will help to keep the hyperæmia in check and to diminish the sensitiveness. Bromide of potassium has been recommended for this purpose, but as a rule the symptoms come on before the drug has time to act. Leeches applied to the sternum or at the lower part of the neck, purgatives, and emetics—especially those which act like alum, without leaving behind any lasting depression—are of the greatest service in mild cases. Aconite and antimony are of use occasionally when there is a considerable rise of temperature, and small doses of calomel, gr. j. to gr. ij. every hour, until there are free bilious evacuations, enjoy a high reputation.

If, in spite of treatment, the dyspnœa continues to increase, and if, without there being any marked spasmodic attack, inspiration is becoming more difficult and the chest-walls are falling in, the choice will lie between free scarification of the swollen parts of the larynx, so as to procure the evacuation of as much exudation as possible, or opening the windpipe lower down. The former operation, particularly when the most swollen parts are the ary-epiglottic folds, which is usually the case, may be accomplished without much difficulty, either by means of an instrument devised for the purpose or with an ordinary sharp-pointed bistoury, of which all but the half-inch nearest the point has been guarded by a spirally wound piece of strapping. The folds can easily be felt with the forefinger of the left hand, and free incisions may be made on their upper surface. With reasonable care there is no danger of wounding any important structure, and it is surprising both how little of the exudation comes from a comparatively large wound, and how small that wound becomes when the part resumes its normal dimensions. The chief difficulty arises from the degree of dyspnœa from which the patient is already suffering, and from the spasmodic contraction sometimes induced when the finger touches the larynx.

It is best to postpone tracheotomy as long as possible, but it must not be forgotten that spasmodic contraction may come on with the slightest cause, even on movement, when a larynx is inflamed, and that any of these attacks may prove fatal. The operation gives, it is true, protection from one of the great dangers of this accident, and helps also to prevent collapse of the lung and subsequent hepatisation; but in a child it is a matter of some gravity, and it adds an additional cause for the inflammation of the bronchi and lungs which so commonly follows. But if tracheotomy is reserved to the last, and performed only in cases that are almost desperate, the ill

result must not be laid entirely to the credit of the operation. In all probability, if it were done at an earlier period and in a larger number of cases, instead of being reserved for those in which inflammation has already set in, and probably extended into the bronchi, the results would be very different. In any case it is advisable to insert a soft india-rubber tube as early as possible, so as to avoid the ulceration of the mucous membrane and necrosis of the cartilages, not uncommonly seen after the introduction of metal ones.

C. Mansell Moullin.

SCALP, Injuries and Diseases of the. The skin covering the cranial vault is intimately connected, by means of strong fibro-fatty tissue, with the tendon of the occipito-frontalis. These three structures constitute the scalp, whose inner surface, formed by the smooth aponeurosis of the muscle, is attached to the pericranium by loose areolar tissue and small vessels, and is freely movable over it.

Hæmatoma, or a fluid blood-tumour of the scalp, is often the result of a blow. These tumours are situated either beneath the skin, beneath the aponeurosis, or beneath the pericranium. If blood collects between the skin and the aponeurosis, its amount must be very limited, as the tissue here is unyielding; but if it is poured out beneath the aponeurosis, the extravasation may be very extensive—sufficient indeed to lift the scalp away from the pericranium. It is limited in front and behind by the attachments of the occipito-frontalis, whilst laterally it descends as low as the zygoma, for the lateral edge of the tendon is continued to that bony process by a thin membrane which lies superficial to, but not in immediate relation with, the temporal fascia. Fortunately, the vessels in the subaponeurotic space are small, or this accident would be far from rare. A blood-collection which involves the separation of the pericranium from the skull is known as a Cephalhæmatoma, and is necessarily limited to one bone by the dipping in of the pericranium at the sutures. It occurs commonly over the right parietal bone during parturition, or may follow a blow in an infant.

The *treatment* of blood-extravasation of the scalp should be conducted on those general principles which guide the surgeon in the management of hæmatomata occurring in other parts of the body. It should be mainly expectant, for, unless these collections are very extensive, the hope may be indulged in that they will clear up under the influence of evaporating lotions, and an arrest of the movement of the scalp by means of strapping carefully applied. If these measures fail, antiseptic aspiration may be tried; but if any septic or inflammatory change occur within the tumour, free incision at dependent points must at once be practised, and the whole cavity washed out with some efficient antiseptic agent. Free drainage must then be provided for, and the dressing should be either gauze or wood-wool, impregnated with carbolic acid, iodoform, or corrosive sublimate. Shaving of the head is necessary, if the blood-extravasation be extensive and complete antisepsis be attempted.

Wounds of the Scalp partake of the same characters which distinguish wounds of other superficial regions. The incised, lacerated, and contused varieties are the most common. They are peculiar in the facts that they do not gape, and that, even if small, they may give rise to a good deal of bleeding, because the arteries lie in the subcutaneous fibrous tissue and are unable to either contract or retract—partly in consequence of the rigidity of this tissue, and partly as a result of the attachment of their outer coats to it. The partial division of vessels is another potent cause of profuse hæmorrhage from the scalp. This hæmorrhage can always be easily controlled by pressure. The bandages should be carefully applied without undue force, as more than one case has been reported in which a scalp bandage has produced sloughing of the cranial coverings. The hairs of the scalp are so strongly attached that cases are on record in which the scalp had been torn off by force conveyed through the hairs—the latter collectively possessing very considerable strength. Large portions, or even the whole, of the scalp may be stripped off from the vault of the skull without losing vitality, since the scalp carries its blood-supply with it, its arteries lying between the various layers of tissue of which it is composed. The danger of scalp wounds is coincident with and is chiefly caused by the opening up of the subaponeurotic space, the spread of inflammation being so easy in the loose areolar structure which intervenes between the tendon and the pericranium. If the bone is exposed by the stripping up of the pericranium it does not necessarily follow that it will necrose, as it is in most part nourished by the endosteal vessels. It is, however, undoubtedly a fact that the most common cause of intracranial inflammation is injury to the scalp, with stripping up of the pericranium.

Another noteworthy point about injury to the scalp, with exposure or bruising of bone, is that, should unhealthy inflammation ensue, the emissary veins may be the carriers of septic products into those of the diploë, or into the sinuses within the cranium. In either case a fatal pyæmia, preceded by thrombosis and ostitis, is likely to supervene.

Treatment.—Absolute cleanliness and antisepsis are of the first importance in the management of all scalp-wounds. If a large portion of scalp has been stripped off the cranium, infinite pains should be taken to make the whole aseptic by removing the hair and by diligent washing. The torn edges can then be united by sutures, counter-openings being made at dependent points, through which drainage-tubes should be inserted, and over all a carbolic gauze and salicylic wool dressing be accurately adjusted. Thus treated, cases oftentimes apparently the most severe convalesce, especially if the patient be young, with great rapidity. Wounds which do not pass through the occipito-frontalis tendon heal rapidly without any special treatment. Scabs are, however, apt to form over these trivial wounds, and it is necessary therefore to be careful that no wound-secretion remains pent up. Injuries of the scalp are especially dangerous in those cases in which other injuries would be serious, as in patients suffering from alcoholism or albuminuria, or the subjects of hæmophilia. In patients who are sodden with alcohol, delirium tremens, or a low form of inflammation accompanied by a low, muttering delirium, may ensue, which it will tax to the utmost the powers of the surgeon to subdue. In albuminuria, an asthenic form of inflammation is apt to come on which heralds a fatal issue. In hæmophilia, the wounds are best left entirely alone, exposed to the air without any interference. The only treatment which the writer has seen successfully adopted in such cases is the local application and internal administration of turpentine.

After all bad scalp-injuries the patient should be kept at rest for some days, the primæ viæ should be put in order, and the diet should be unstimulating, moderate in quantity, and largely composed of milk and foods made with milk.

Inflammation readily occurs about a wound of the scalp if any secretion be pent up, or if asepsis be not attained. Shaving, free drainage, and poulticing will prevent its extension in most cases. It has, however, a tendency to assume an erysipelatous form, and then the whole scalp may become 'boggy,' and the course of the case will not be so simple. Much redness and swelling are not possible, on account of the anatomical peculiarities of the tissue. Inflammation is most serious when the sub-aponeurotic space is opened, or when the bone is laid bare by the stripping up of the pericranium.

Erysipelas of the Scalp usually follows a wound and may be caused either by the conveyance of infection from another patient, through the air, or by means of tainted sponges, instruments, &c., or may arise *de novo* under conditions which were apparently the least likely to produce it. The early diagnosis between local inflammation, with formation of pus underneath the scalp, and an attack of erysipelas, is in some instances difficult. In the former case the inflammatory focus would be more or less limited and defined, and must have been preceded by local injury. The pus would, moreover (if formed), bag at the dependent and attached borders of the scalp. In the latter case the general constitutional symptoms would probably be more marked, and, at the very commencement of the attack, vomiting and enlargement of the cervical glands would be important points to note. *Cutaneous erysipelas* of the scalp commonly extends to the face, and can usually be with ease subdued by frequently changed warm compresses of lead lotion and by nutritious diet. The temperature may range up to 102° or 103° Fahr., and for two or three nights the patient may suffer from a little delirium. In those cases in which the whole thickness of the scalp is involved and the bone is bare, we have to deal with a *cellulitis* which is extremely dangerous; but, even in the worst cases, free incisions, antiseptic washings, ample diet, perchloride of iron and quinine, with stimulants, will do a great deal to bring about recovery.

Abscess of the scalp is small and unimportant if situated above the aponeurosis, and commonly happens from the scabbing over of a wound before the deeper parts are healed. If pus forms beneath the aponeurosis, the collection may be very extensive and serious. The treatment consists in shaving, free incision at dependent points—above the zygoma, at the upper margin of the orbits or in the occipital region—with antiseptic irrigation and dressings. The *sinuses* which remain after a large abscess of the scalp has been evacuated are sometimes difficult to close. The best way is to adopt Mr. Hilton's plan of securing rest to the scalp by well-applied strapping. *Abscess in the temporal fossa* may be

mentioned in this place. The pus tends to pass down beneath the zygoma, and does not point above it in consequence of the extreme density and strength of the temporal fascia. It should be opened above the zygoma as soon as deep fluctuation can be felt.

Boils and carbuncles occur upon the scalp. A carbuncle in this region may be most serious. It may commence in the soft parts covering the skull or extend to them after first attacking neighbouring parts, such as the back of the neck. *See* Boils; Carbuncle.

Simple and Malignant Tumours are by no means uncommon on the scalp.

Sebaceous cyst is the most usual form of simple tumour. If congenital, it is known by the name of *dermoid cyst*, occurs frequently near the outer angle of the orbit, and often involves the wall of the cranium. When placed in the median line, the diagnosis from meningocele is almost impossible. *See* Meningocele. Sebaceous cysts, which are not of congenital origin, occur at any age after puberty, but most frequently in middle life. They may be multiple, and by their gradual increase in size during many years may, in rare cases, involve the cranial vault. The orifice of the obstructed follicle is generally visible, and the tumour itself is round or oval, tense, freely movable, hard, or fluctuating. These cysts can be removed by dissection, or by transfixion and subsequent avulsion of the wall of the sac. No part of the latter must be left, or troublesome after-consequences will ensue. These operations should never be lightly undertaken, and never except in persons in perfect health. The removal of a congenital cyst is more difficult, partly on account of its greater depth from the surface, and in part on account of the thinness and delicacy of the cyst-wall, and the adhesion of the latter to the bone. When a sebaceous cyst ulcerates, the diagnosis from epithelioma is not easy. The base of the ulcerated cyst is movable and not very hard; the granulations exuberant, and there is no evidence of surface-decay; the discharge is offensive, and the glands in the neck might be enlarged. *See* Sebaceous Cysts.

Epithelioma generally commences as a crack or pimple, and there would be no history of a previous cyst. The base would be hard and fixed, and if at certain points vegetative outgrowths were apparent, the general tendency would exhibit an eroding and destructive character. *Rodent ulcer* not infrequently attacks the scalp primarily, but it may do so secondarily after destroying a portion of the face. *See under* Carcinoma; Ulcers.

The *treatment* of epithelioma and rodent cancer is wide excision. An ulcerated sebaceous cyst must also be excised. In epithelioma the glands in the neck may be implicated so much, by the time the patient is seen, as to make operation unjustifiable. In rodent cancer, the disease must be removed, even if it extends into the bone; and at the close of such an operation, the application of chloride of zinc paste is most useful.

Syphilitic ulceration of the scalp is occasionally most intractable.

The *pachydermatous tumour* of the scalp is very rare. It is a localised fibrous change affecting the skin and deeper tissues. It is movable, and causes much deformity. It has been successfully removed by the knife, but it is best for the surgeon not to interfere. When *multiple subcutaneous fibrous tumours* are found upon a patient, one of them may be discovered beneath the skin of the scalp. Outgrowths from the skull, such as *exostoses* and *nodes*, must not be mistaken for scalp-diseases.

For *Nævus* of the scalp, *see* Nævus.

Pulsating Tumours of the Scalp. 1. *Aneurism* of a scalp-artery takes place after some injury—usually partial division of a vessel. It is rare, has the typical signs of aneurism, varies from the size of a pea to that of a bean, and can be cured by either pressure or excision.

2. The common seat of *cirsoid aneurism* is the scalp. It is formed by a congeries of dilated vessels, which pulsate with a loud systolic bruit. The skin over the tumour is hotter and thinner than elsewhere, and the unaltered cranial vault can be palpated through the worm-like mass of the tumour. *See* Cirsoid Aneurism.

3. *Hernia cerebri.* *See* Brain, Hernia of the.

4. *Encephalocele.* *See* Meningocele.

5. *Sarcomata of the dura mater or cranium*, if rapidly growing, pulsate. The pulsation is not affected by compression of the arteries of the scalp, and pressure upon the tumour does not produce cerebral symptoms. The tumour is perfectly fixed, and evidently attached to or continuous with the bone. Egg-shell crackling may be present. The diagnosis can rarely be made at such an early period as to justify operative measures.

6. *Pulsating hæmatoma* containing cerebro-spinal fluid as well as blood. For a description of this form of pulsating tumour, *see* Meningocele.

For cutaneous and parasitic affections of the scalp, *see* Tinea Tonsurans; Pediculi; Horns. Charles A. Ballance.

SCALPELS are small knives which are used for most surgical operations requiring dissection. There are three patterns of scalpels, which differ from one another slightly in the way the point is made. The common operating scalpel is sharpened on one edge only, and both edges are rounded off towards the point, so that the latter is in a line with the middle of the blade. In another pattern, the back of the scalpel is sharpened for about half an inch near the point; in a third, the cutting edge only is rounded off, and the back of the scalpel runs straight on into the point.

SCAPULA, Diseases of the.—A large variety of tumours is found connected with the scapula. By far the greater number start from the bone itself, and gradually involve the entire scapula, the muscles and soft structures attached to it, the shoulder-joint and clavicle, and are malignant. The ordinary growths, met with in other regions, present the same characters here as elsewhere.

Fibromata spring from the muscular or fascial tissues covering the scapula; they are firm in texture, slow of growth, generally lobulated, circumscribed and encapsuled, not often painful, and when removed, as a rule, do not return.

Sarcomata.—These growths are either parosteal, in the tissues superficial to the bone, periosteal, or central, in their origin; the last form generally occurring in the medullary structure of the neck of the scapula, whilst the first two are usually associated with the body or borders of the bone. The diagnosis between the parosteal and periosteal forms is scarcely possible, as the former often so closely invest the bone that the mobility of the tumour underneath the muscles of the scapula is difficult to detect. Hence, it is not until the tumour has been cut down upon that any determination, as to the extent of the operative proceeding, can be arrived at. The parosteal form may be carefully removed from the bone, whilst the periosteal and central require excision of the scapula.

The *diagnosis* of these growths is always fairly easy. Generally, they have gained such hold, when the patient comes under observation, that the clavicle, and possibly the head or neck of the humerus, and the soft tissues of the head, neck, and axilla, are already involved. The growth is usually well-defined; its surface possibly lobulated, and somewhat elastic on palpation; it is very rapid in development, and the subcutaneous veins are enlarged and prominent. There may or may not be pain; this must depend upon the invasion of the growth.

The sarcomata are most frequent in young subjects at about the age of puberty, and are possibly associated with some injury to the shoulder, although they often appear spontaneously. They are very malignant, and their growth and recurrence after removal are rapid, the latter occurring locally or in some viscus.

Enchondroma is sometimes met with, springing either from the venter, dorsum, or, more frequently, one of the processes. It is uniformly firm in consistence, often nodular, painless, and of slow growth, although occasionally this is not the case.

Gummata are sometimes met with about the scapula. When occurring in the muscular structures, they may assume the appearance of real growth, and, as they are almost invariably of rapid development, may be mistaken for sarcoma. The history of the case will aid the diagnosis, and the exhibition of specific treatment in such cases of doubt is of the greatest value, the gumma speedily disappearing under its use. When gummata are situated superficially, they may simulate abscess.

Abscess may be either quite superficial or develop in the supra- or infra-spinous fossæ, beneath the fascia, as the result of injury, or spontaneously, unassociated with any disease of the scapulo-humeral articulation. It often commences as acute inflammation of some bursa, and the matter remains for a time pent up by the dense fasciæ, and eventually makes its way either towards the surface or into the axilla.

Subscapular abscess not infrequently occurs in the loose connective-tissue between the subscapularis and serratus magnus, and is most frequently a result of some lymphatic absorption, although it may occur spontaneously, and after some local injury. The ordinary symptoms of fluctuation—at first, at any rate—may be absent, as the collection of pus is so deep; but the high temperature, the throbbing pain, and the separation of the scapula from the thorax, together with the increasing inability to move the arm, and the gradual filling up of the axillary hollow, all point to the probability of abscess. An exploratory puncture should complete the diagnosis.

Bursal Tumours.—The large bursa between the inferior angle and the thorax is

sometimes so enlarged as to present the appearance of a rapidly growing malignant tumour. It is usually noticed as the result of some over-strain or exertion, such as may be produced by rowing, cricket, or tennis. It appears as a tense, fluctuating tumour, pushing up the scapula and often encroaching on the axilla. If the growth be of long standing, its walls become much thickened, and it may be readily mistaken for a solid tumour. Occasionally, these enlarged bursæ contain melon-seed bodies, and on pressure or manipulation crepitus is detected; here, again, puncture with a trocar or aspirator reveals the nature of the swelling. Persons following particular trades develop bursæ over the scapula; thus bricklayers' labourers and porters frequently have an enlargement of the bursa immediately over the anterior edge of the trapezius. Such tumours occasionally suppurate.

Periostitis and Ostitis, acute and chronic, are occasionally met with, and may be limited to certain portions of the bone or involve it entirely. They are sometimes due to struma or syphilis, occur spontaneously or as the result of exposure or injury, but more frequently are secondary to disease in the scapulo-humeral articulation or head of the humerus. The symptoms are much the same as in any other region; although, from the dense muscular and fascial coverings, the diagnosis is, at any rate in the early stages, not always easy. There is deep-seated pain referred to the bone itself, a rigor, and rise in temperature; swelling and œdema of the soft parts do not usually appear as rapidly as in the case of the more exposed and less embedded bones, but if the inflammatory attack be severe, suppuration is usually very rapid and diffuse. The resulting abscess points either in the axilla or in the supra- or infra-spinous fossæ.

Necrosis of the scapula, either partial or entire, is generally the result of the above conditions, and when sinuses have formed, a probe will detect bare bone. The periosteum is very often detached entire, so that operative interference is comparatively easy when the diseased tissue is exposed.

Displacement of the Scapula.—The peculiar condition, to which this term has been applied, is a displacement of the lower angle and spinal border of the scapula, whereby the bone seems to be lifted away from the thorax. It was formerly considered to be due to the scapula shifting from under the latissimus dorsi, but it is now known to be the result of paralysis of the serratus magnus muscle, which may be partial or complete. The remarkable tilting up of the bone is due to the preponderance of power in the trapezius, levator anguli scapulæ, rhomboidei, and pectoralis minor.

The *diagnosis* is easy. If the arms are held forward, at right angles to the trunk, the elevation of the spinal border of the affected side is most marked, and the patient can project the sound arm about two inches further from the thorax than the affected one. The movements of rotation of the bone are either feeble or wanting on the affected side; in fact, the serratus magnus is incapable of performing its special functions.

Electricity seems the chief element in *treatment*; and Erichsen states that he has seen much benefit derived from the endermic application of strychnine on a blistered surface, followed by support by means of some properly devised apparatus.

Edward Bellamy.

SCAPULA, Dislocations of the.—Dislocations at the acromio-clavicular joint are sometimes described as dislocations of the acromial end of the clavicle, but they are more correctly classed as dislocations of the acromion process of the scapula. This may be displaced *downwards* or *upwards*.

Dislocation Downwards, though not a frequent injury, is far more common than dislocation upwards, and this is to be explained partly by the direction of the force, and partly by the direction of the articular facet, which on the acromion looks upwards and inwards. The injury is caused by a fall on the point of the shoulder, and the resulting deformity is easily recognised. The acromion process falls below its proper level, and the outer extremity of the clavicle rides upon it. The end of the clavicle forms a very distinct projection immediately beneath the skin, the nature of which it is scarcely possible to mistake. By drawing the shoulder well back and at the same time raising it slightly, the dislocation is easily reduced, but the deformity recurs immediately the support is removed; and thus, both in its tendency to reluxation, and in the extra mobility it occasions, this dislocation forms an exception to the rule. The difficulty of retaining the bone in position is so great that some have given it up as hopeless, and South recommended that no trouble should be taken, the clavicle being allowed to unite by fibrous tissue to the acromion, in its abnormal position. With great care and a tractable patient,

however, it is possible to obtain a cure without deformity. In other cases, the writer would suggest that it may be justifiable to excise the joint and wire the bones together; but it should be remembered that, if the bones are united in the dislocated position, the arm remains useful and but little weakened.

To reduce the dislocation, one hand should draw the shoulder well back, whilst the other is used to raise the elbow. To retain the bones in position, it is usual to place the arm in bandages similar to those used for fractured clavicle, but, in the writer's opinion, bandaging alone is wholly inefficient. He advises as follows:—A little absorbent cotton-wool, covered with zinc powder, should be placed in the axilla to prevent intertrigo; the arm should be carried forward so that the hand rests on the other clavicle, and the elbow be then forced upwards and outwards. Broad strips of Holland plaster (which does not stretch) should next be used to bind the arm to the side, and, to support the elbow and arm, strips should be carried over the opposite shoulder; a soft pad should be placed on the clavicle, and a broad strip of plaster be carried from the back over the pad and under the elbow. When the surgeon has tested the efficiency of the strapping, he should protect any prominences of bone with cotton-wool, and then cover the whole with plaster of Paris bandages. M. Laugier in eleven cases employed a tourniquet to keep down the clavicle. The arm should be fixed for six weeks.

Dislocation Upwards is very rare, and is caused by force applied to the upper surface of the clavicle. Besides rupture of the acromio-clavicular ligaments, the conoid and trapezoid give way. The rotundity of the shoulder is lost, and two bony projections appear, the upper and inner formed by the acromion, and the lower and outer by the end of the clavicle. The humerus rotates without difficulty, but the patient cannot raise his hand to his head. Reduction is accomplished by drawing the shoulder back, after which it is necessary to confine the arm to the side for five or six weeks.

Dislocation of the Coracoid Process upon the Clavicle was described in 1843 by Godemer, who related five cases as having come under his notice in five years, since which time M. Pinjon has added a sixth. Malgaigne throws doubt on the extraordinary experience of his compatriot, suggesting that both in the symptoms and in the effect of treatment the cases resemble each other too closely to be all taken from nature. This dislocation must therefore be left for further experience to establish.

R. Clement Lucas.

SCAPULA, Excision of the. — This operation is indicated in cases of necrosis or of new growths. It is not without its difficulties, and these of course vary with the size or situation of the tumour; hence, any typical operation can scarcely be described. Such operations may be considered as (1) total resection or extirpation, in which the shoulder-joint is opened, and the glenoid cavity removed; (2) removal of the scapula, leaving the glenoid cavity and shoulder-joint, the neck being divided by a saw; and (3) resection of certain portions of the bone, especially of the spine, angles, or acromion process.

If it be necessary to remove the entire scapula, the most convenient method is as follows:—The subclavian artery being controlled by an assistant, and the arm extended from the side, an incision is to be made along the posterior border of the bone, and a second one along the spine, joining the first and terminating at the tip of the acromion. The triangular flaps so formed are next to be dissected off, thus exposing the mass to be removed. The muscles attached to the posterior border are then to be divided close to the bone, so as to allow of its being grasped by the hand and lifted off the thorax. The knife is then carried along the upper border, dividing all muscular attachments. The acromion process may be either disarticulated from the clavicle or cut through with forceps, or, what is preferable, the acromial end of the collar-bone divided. The muscular attachments along the axillary border should next be divided, and it is at this stage of the operation that the bleeding may be troublesome. The vessels should be clamped or tied as divided. The mass is then fairly free, and, being still further lifted up, the joint is next opened and the disarticulation effected, the remaining muscular attachments being divided, and the bone removed, the vessels ligatured or torsioned, and the flaps adjusted as in any ordinary amputation.

Subperiosteal resection is performed in cases of necrosis, and the bone being exposed by the above incisions, by means of rugines the periosteum may be stripped off; the attachments of the several muscles being preserved. There are several instances recorded of the entire scapula and its processes being removed subperiosteally with complete reproduction.

The actual operative proceeding is as follows:—An incision is made from the tip of the acromion to the base of the spinous process; a second incision is next to be made, commencing at the superior angle and following the spinal border of the scapula, terminating at the inferior angle. The incisions are carried through the periosteum. This membrane is first stripped off the acromion, next the spine, taking care to preserve the attachments of the deltoid and trapezius. The posterior border is then to be denuded, with the attachments of the rhomboidei. The periosteum should next be removed from the infraspinous fossa, and the infraspinatus and teres minor separated, followed by the detachment of the supraspinatus from its fossa. The articulation is next attacked on its posterior aspect, and the capsular ligament turned up from its attachment to the neck of the bone. The arm should now be extended, and the inferior angle of the scapula lifted up, and the bone thus tilted from within outwards. This exposes the subscapular fossa, and, on lifting the bone still further from the thorax, the anterior aspect of the capsule should be scraped off and opened. The bone should next be seized by strong forceps and twisted outwards. Such are the directions laid down by Ollier, as an exercise, presumably, on the cadaver, but in actual practice the separation of the periosteum, if not already complete pathologically, is of very easy performance, and has been practised with the most satisfactory results.

EDWARD BELLAMY.

SCAPULA, Fractures of the. — This bone is so movable, its processes are so strong, and it is for the most part so thickly covered with muscles, that it is very seldom broken. Its fractures are almost invariably due to direct and considerable violence; very rarely to muscular action. They are divided into those of (*a*) *the body*, (*b*) *the neck*, (*c*) *the acromion*, (*d*) *the coracoid process*.

FRACTURE OF THE BODY is caused by the passage of a wheel, by falls on the back upon a projecting stone or the like, or by a heavy blow. Though often transverse, its rays may extend upwards through the spine, or obliquely through its anterior or posterior border. It is often starred or comminuted.

Symptoms.—These are mobility of the fragments when the bone is grasped at different parts, or when the inferior angle is grasped, or the hand placed flat on the bone, while the arm is moved by an assistant; accompanying crepitus, often a mere click, caught only on one particular movement. In fracture of the spine or of the borders, particularly in thin persons, displacement may be detected. In fractures below the spine, the lower fragment is generally found in front of the upper, and carried upwards, so that the bone is shortened from above downwards. But this is by no means constant.

Treatment.—Such readjustment as may be possible having been effected by manipulation, the scapula should be covered with a carefully moulded and well-padded gutta-percha shield for protection, and the arm fixed by bandaging in the position in which the fragments are found to be most easily maintained in place. Some deformity will probably remain, but this will usually not impair the functions of the arm.

FRACTURE OF THE NECK.—There appears to be no example in any museum of fracture of the anatomical neck of the scapula—that is, of a fracture detaching merely the glenoid cavity, and it may be very strongly doubted whether this injury ever occurs. There are, however, dissected specimens showing fracture through the surgical neck; that is, through the narrow part by which the glenoid cavity and coracoid process together are attached to the remainder of the bone.

Symptoms. — In this rare accident, always the result of a crush or other form of direct violence, the shoulder is somewhat flattened, as in dislocation of the humerus; the normal outline may be restored, and perhaps crepitus felt, when the elbow is raised; but deformity returns when the arm is allowed to hang down. The humerus is abnormally movable in all directions, and its head can be felt in the armpit. The patient is unable to raise the arm, and passive movement causes severe pain.

Treatment consists in placing a pad in the axilla; raising the arm, and supporting it by means of a firm sling acting on the elbow and forearm, and bandaging the arm to the side and the forearm across the chest. Movement, which is likely to be much impaired, may be improved by manipulating the limb, under an anæsthetic, at the end of six weeks, and subsequently employing passive movements, combined with hot douching and shampooing. Fracture of the margin of the glenoid cavity, or a stellate fracture of this cavity, is sometimes present as a complication of dislocation of the humerus. *See* SHOULDER-JOINT, Dislocations of the.

Fracture of the Acromion is caused by falls on the shoulder or by a blow from above. The size of the fragment varies, and may include merely the tip or the whole process to the root of the spine. The injury is rare. Many supposed fractures with ligamentous union are instances of separation of the acromion, apparently at the line of junction of the epiphysis with the rest of the bone, in the course of rheumatic arthritis. In St. Bartholomew's Hospital Museum is a specimen of this kind, in which the acromion is divided into two pieces, one of which is still connected with the spine by a very narrow bridge of bone, the other, at the tip, being joined to the first piece by fibrous tissue.

Symptoms are dropping and flattening of the shoulder, pain, loss of power to raise the arm, displacement, and the rough edge of the fracture felt on passing the finger along the bone. The deformity is removed by elevating the arm—when probably crepitus can be felt—but returns when the arm is allowed to hang down.

Treatment.—A pad having been placed in the axilla, the arm must be supported in a sling, and bandaged across the chest, as in fractured clavicle. Union is generally fibrous, but there is slight if any impairment of the functions of the limb. Bony union might probably be secured by confining the patient to bed, and raising the arm, so that dragging on the fragment might be prevented.

Fracture of the Coracoid Process, *see* Coracoid Process, Fracture of the.

Howard Marsh.

SCARIFICATION. — A method of local blood-letting, extremely limited in scope and generally of doubtful utility.

The operation consists merely in making a number of small, very superficial cuts, which may be crossed by others, and allowing the blood to ooze from them.

It is sometimes recommended in conjunctival chemosis, in the early stages of acute tonsillitis, in œdema and engorgement about the glottis, and in certain conditions of the os uteri. On the skin it is useless. William H. Bennett.

SCHIZOMYCETES. — *Synon.* Bacteria, bacteridæ, vibrios, schistomycetes, micro-organisms, microbes, microzymes, cocco-bacteria.

Schizomycetes is the classical name, now in general use, to express the whole class of micro-organisms formerly known indefinitely as bacteria, that term being now restricted to one genus. It signifies the fact that organisms of this class reproduce themselves by fission of the parent organism, and this is the case with all species, though not the only method in several.

This class of organisms was arranged by Cohn in the following order of genera, which has been found to be by far the most practical:—

Morphology.—A. *Coccus* forms.—Spherical or oval organisms; subdivided by Billroth into micrococcus and megacoccus. *See* Micrococcus.

B. *Bacterium* (q.v.).— A short, oval, or cylindrical rod-shaped organism, with rounded ends, or also an ellipsoidal shape constricted in the middle like a biscuit (clithridium). In any case the length of the organism does not exceed twice its breadth.

Varieties of bacterium are frequently provided with a flagellum.

C. *Bacillus* (q.v.).—Rod-shaped organisms, in which the length of the adult element is much greater than its breadth. This is perhaps the most important genus.

D. *Vibrio* (q.v.) is practically a curved bacillus, the curves (1–2 in number) being always in the same plane.

E. *Spirillum* (q.v.) is a spiral-shaped thread, which when greatly overgrown has received the name spirochæta, these latter forms being also more flexible.

Habitat.—These organisms are found in varying quantities in the air, in water, and in the soil. The quantity in the air of temperate climates varies according to the height from the earth, to the action of the wind in raising dust, and temperature—i.e. according to the season of the year. Some species attack and inhabit the interstices of living animal tissues, while very many exist as parasites on the cutaneous and mucous surfaces of the body.

Structure.—All the schizomycetes consist of a protoplasmic body, containing small fat and sulphur particles, and staining readily with anilin dyes. This protoplasmic body or core is surrounded by a sheath, which possesses many characters of cellulose, and offers powerful resistance to many chemical reagents. The protoplasm is an albuminous substance, the basis of which is an albuminoid compound termed mycoprotein, which contains no combined sulphur. In several species the protoplasm is pigmented, the prevailing colours being yellow, orange, red, and blue.

Life Changes. — *Respiratory.* — All forms require oxygen, and give out carbonic acid. Most need free oxygen, and there-

fore are termed aerobic; others can probably take the oxygen from combination, and hence have been termed anaerobic; but this division is not satisfactory. In some (bacilli), the growth when exposed to free oxygen tends to spore-formation.

Thermic.—All forms grow best at about 36° C. (96·8° F.). All adult forms are killed at 50° C. (122° F.) moist heat, and by severe cold. Spores, however, survive much greater extremes, viz. 120° C. (248° F.) dry heat.

Very few forms can grow in pabulum which is kept in rapid motion (e.g. blood, &c.). Light appears slightly to retard growth, and electricity also, but this latter probably by electrolysing the pabulum.

Chemical.—These organisms split up both simple and complex substances to gain the necessary elements for their nutrition. They require hydrogen, nitrogen, oxygen, and carbon, while at the same time it is essential that there should be a trace of phosphate in the nutrient fluid. As results of the catalytic action of their life, fats, albuminoids, and carbohydrates are broken up in a way that can be imitated by the action of superheated steam and potash, so that it is probably a process of hydration. Thus, fats become rancid from the development of butyric acid, &c.; the carbohydrates and glycerine are decomposed into alcohol, butyric and carbonic acids; albumins are broken up into glycocoll, leucin, tyrosin, and aromatic compounds, while the former again are resolved into ammonias and lower acids.

On living tissues the schizomycetes appear to exert a progressive necrotic action, partly due to their breaking up the tissue for nutrition, and partly, perhaps, to the effect upon the healthy tissue of the products of such decomposition. *See* Sepsin; Septic Diseases, Classification and Etiology of.

Reproduction.—This is effected either by fission or spores.

(*a*) *Fission.*—According to the elevation or depression of the surrounding temperature, an adult organism will quickly or slowly divide into two, usually first elongating, but in rapid subdivision the daughter elements are very short, so that the primary elongation is slight. In the rod forms, the subdivision is always at right angles to the direction of the long axis. In the coccus forms, the subdivision takes place in every direction, and thus sarcinoid groups of four or more result. Vibrio forms appear to possess the power of vacuolating and then dividing longitudinally (Klein). When organisms grow rapidly by fission, they form masses termed zoogloœa, the individual organisms composing which are held together by an albuminous substance, which sometimes forms a gelatinous envelope.

(*b*) *Spores.*—In the presence of free oxygen, many bacilli tend to grow into long threads (leptothrix), in the interior of which there develop brightly refracting spots which by atrophy of the rest of their filamentous sheath become free, as oval protoplasmic masses surrounded by a very resisting sheath. A similar process of spore-formation may be seen in adult rods. These bodies are spores, and, under suitable conditions, will elongate and develop into single rods. They possess fully three times the power of resisting destruction by heat, chemical reagents, &c., that the adult rods do, and, consequently, play an extremely important part in the etiology of diseases such as malignant pustule, &c.

Practical Importance.—The practical importance, to the surgeon, of the existence and life-processes of these parasitic organisms cannot perhaps be exaggerated; but since this point involves the question of fermentation and etiology of infective diseases, it is fully described in the article on Septic Diseases, and need not be repeated here. The treatment of the different conditions, with which micro-organisms are actively concerned, will also be found under the various septic diseases.

Victor Horsley.

SCIATIC HERNIA.—This form of rupture is very rare. The protrusion escapes through the great sacro-sciatic foramen. The fundus of the sac is found beneath the gluteus maximus muscle; the neck may be either above or below the pyriformis, and will be in front of the gluteal artery, and below the obturator. Sir Astley Cooper has reported a case where a piece of ileum was strangulated in this position. The hernia was not discovered until after death. The hernial orifice could be readily examined by introducing the hand into the rectum.

Frederick Treves.

SCIRRHUS. *See* Carcinoma; Breast, Diseases of the.

SCLEREMA NEONATORUM.—*Definition.*—An induration of the skin, with lowered temperature, occurring congenitally or soon after birth. Until Parrot distinguished between the two affections, sclerema and œdema neonatorum were mixed up together

Etiology.—Sclerema may be primary or secondary. The primary cases are either congenital, or occur in a very few days after birth, without apparent cause. The secondary cases are the sequel of causes which depress vitality, such as diarrhœa or pulmonary affections, like pneumonia, with collapse or atelectasis; it is apt to occur with malnutrition from bad feeding and defective hygiene. Œdema happens, almost invariably, in infants which are premature or of otherwise feeble vitality, and there, too, atelectasis is frequent; bad feeding of mother and child, or exposure to cold immediately after birth, are also causes.

Pathology.—Langer considers the first condition a 'fat sclerema'—i.e. due to solidification of the fat; infantile fat having a much higher melting point than adult fat. On the other hand, Parrot regards it as a consequence of desiccation of the tissues from the drain of diarrhœa, &c.

Œdema is presumably due to the feeble circulation and defective aëration of the blood at a period when vital resistance is always small.

Symptoms.—When not congenital, the induration generally begins in the lower limbs—rarely in the face—within ten days of birth, spreads to the trunk, and is usually complete over the whole body-surface by the fourth day from its commencement; but it may remain incomplete. At first, the skin is of a yellowish-white or waxy appearance, but it soon gives way to a slightly livid tint, and the skin becoming adherent to the subjacent tissues as well as rigid, it cannot be pinched up, and there is no pitting on pressure. The skin is tense, smooth, cold, and hard. The limbs and jaw are fixed, the eyes closed, and the child lies motionless with the exception of slight movements of the thorax and face, the latter being less rigid than other parts; but the stiffness of the lids and cheeks prevents sucking, the pulse, respiration, and temperature sink far below the normal, and life is completely extinguished within a week.

Œdema begins in the third day of life, with drowsiness, swelling of the extremities, especially of the legs, which pit on firm and prolonged pressure, and are cold and livid. The œdema spreads up to the thighs, then to the hands, the genitals, and back; the soles and pubes are especially affected, and are red and hard, sometimes doughy. The drowsiness increases, the pulse gets feeble, the respiration slow and shallow, and complications, such as pulmonary affections, with collapse, diarrhœa, or convulsions, hasten the fatal issue; jaundice sometimes supervenes just before death. Recovery takes place in some cases, if they come early under treatment.

Diagnosis.—Though so much alike in etiology, and in the depression of the vital processes, these two affections may be distinguished by the following points:—

In sclerema, the disease is general; the skin, tense, hard, and waxy in colour, does not pit, and cannot be pinched up.

In œdema, the disease is less widely spread, the skin is livid from the first, not so hard as sclerema, pits on firm pressure, and can be pinched up, while the swelling is always greatest at the lowest parts. In sclerema the joints and jaw are stiff; not so in œdema, or only in a slight degree.

The onset so soon after birth is alone sufficient to distinguish both forms from scleroderma, in which no case under two years has been recorded.

Prognosis.—Death invariably ensues in a few days, when the induration is universal; but in the rare, incomplete cases recovery may be hoped for. In œdema the prospect is not quite so hopeless, though always serious, and the cases last longer.

Treatment.—Efforts must be made to keep up the temperature; the child should therefore be wrapped in cotton-wool, and surrounded by hot-water bottles; friction of the limbs with oil is also a useful measure. As the child cannot suck, food must be introduced into the stomach by a small stomach-pump tube passed through the nose, or by Battam's plan of attaching an india-rubber tube to the nozzle of a glass syringe, passing it into the pharynx, and then injecting the food; peptonised milk and white-wine whey are suitable aliments, for digestion, like the other functions, is at its lowest ebb.

H. Radcliffe Crocker.

SCLERODERMA, or hide-bound disease.

Definition.—A subacute or chronic disease, characterised by extreme induration and rigidity of the skin.

This disease is a rare one, and has nothing in common with sclerema neonatorum, except the hardness of the skin, which is due to a different cause. There are three classes of cases: one in which the skin-affection is diffuse and symmetrical, another in which it is circumscribed, and a third or mixed class which partakes of the characters of both the other forms. The first two require, to some extent, separate con-

sideration, as the symptoms and etiology are in many respects very different.

Etiology.—Females are much more prone to this disease than males, in the proportion of three to one in the case of diffuse, and a still larger proportion in circumscribed scleroderma. It may occur at all ages from two years and upwards, but is most frequent in young and middle-aged adults. In diffuse scleroderma, previous attacks of acute rheumatism and erysipelas are the most frequent remote antecedents, and exposure to wet or cold is the most frequent exciting cause. Cases that follow from definite conditions are generally acute in their onset; while, frequently, no cause can be traced for those which are slow and insidious in their development; and, in many instances, the patient has been in good health until attacked with scleroderma.

The cause of the circumscribed form is quite obscure. In many there is a history of worry, anxiety, or other depressing mental influence antecedent to the appearance of the patches; in a few, chiefly band cases, local irritation or injury appeared to be the exciting cause; whilst the rest seemed to be spontaneous in their development.

Diffuse Symmetrical Scleroderma.

Symptoms.—These cases are seen in two phases: one where the skin is swollen, the other where it is shrunken. The first is usually, but incorrectly, ascribed to hypertrophy, but is really due to infiltration; and the shrunken state is one of atrophy. The swollen stage is the early condition, and may be quite hard from the first, or stiffly œdematous; and the shrunken stage is a sequel to the œdematous variety.

The common history is that the disease came on after exposure to cold or wet, arthritic pains and perhaps the symptoms of subacute rheumatism sometimes attending the onset; or there may be no other symptoms except those of the skin. A feeling of stiffness of the skin is first experienced, hindering movement, and attended by a sense of tension; and the affected part becomes quite hard, rigid, and cannot be pinched up. This symptom may come on quite suddenly, or so slowly and insidiously that the patient is scarcely aware of its commencement.

The upper half of the body is most frequently attacked, the stiffness being first felt in the back of the neck, the chest, shoulders, or arms. Once started, the process may spread slowly or rapidly over a large area, or even over the whole body-surface; but the lower half is never attacked without the upper being involved, though the converse often happens. Whatever be the extent—and the disease is often very erratic in its distribution—symmetry is preserved. The palms and soles are rarely involved, but any of the mucous membranes may be affected. The edge of the affected area merges imperceptibly into the surrounding skin, while the affected part is extremely tense, and, when the parts beneath are affected, the muscles feel as if rigor mortis had set in. No pitting can be produced on pressure, and no fold can be pinched up; the surface is pale and marbled by dilated small vessels, and sometimes pigmented to a varying extent. If the face is involved, the features are as fixed as those of a statue, and when the trunk is attacked, respiration is interfered with; while in the limbs the joints are immovable and more or less flexed from contraction of the distended skin.

There is no alteration in the sensibility, but itching is sometimes troublesome, and sweating is more or less in abeyance. Subcutaneous tubercles, like rheumatic nodules, have been observed in a few instances.

In the œdematous cases, instead of induration a stiff œdema is present at the commencement, and the real nature of the disease may be unsuspected at first. After lasting some weeks or months, the œdema gets absorbed, the skin shrinks, acquires a dead or ivory-white hue, and the atrophic stage is developed. This atrophic condition is usually less widely spread than the œdema which preceded it, and is often confined to the limbs and face, but the symmetry is retained. The skin is now as tense as before, but from contraction, not distension; in the face the skin is strained over the bones, and may be directly adherent to the periosteum from compression-atrophy of the fat and muscles; the lips are drawn up, the gums retracted, and the teeth in extreme cases fall out. The countenance is bloodless, except where mottled by telangiectases, and the fixed features and straining of the skin over the bones give a ghastly corpse-like aspect; the limbs of an adult may be reduced to the size of a child's, the joints ankylosed, and the hand claw-like. In consequence of the tension of the skin over the joints, ulcerations, sometimes attended with necrosis, easily ensue from slight injuries.

The course taken by these two forms varies somewhat; the tensely infiltrated cases tend to clear up sooner or later, the infiltration is gradually absorbed, the skin

becomes less rigid, and after some months, but in some cases not for years, the skin gradually regains its normal softness and elasticity. Some think that these cases may also merge into the atrophic form, but this is not the opinion of the writer. Progress may be interrupted if the patient get a chill, and even extension may then ensue, and, according to patients' statements, the skin is tighter on some days than others. In the contracted cases recovery is less frequent, the disease often remains stationary for years, or it may extend at long intervals. The general nutrition suffers, and the patient gradually sinks or dies from intercurrent disease. It is a long time, however, before the general health suffers, and many seem to be little the worse except from their helplessness.

No special complications, except rheumatism and valvular heart-affections, are found associated with this disease, but other eruptions may be present, and filaria sanguinis hominis has been twice found.

Circumscribed Scleroderma, or Morphœa, is, by some authors, still regarded as an entirely independent disease; but the other view gains ground, and will doubtless eventually prevail.

Symptoms.—It occurs in patches and bands, the former being the most common. The patches, which may be single or multiple, are usually from half to two inches or more in diameter, situated generally on one side of the body, often in the course of a nerve, like herpes zoster, but sometimes in the middle line, sometimes bilaterally, and occasionally symmetrically. They develop gradually, rarely rapidly, without any symptoms. The domain of the fifth nerve, the breasts, and still more frequently the limbs, are favourite positions, but they may come anywhere.

The majority of the patches are of an ivory-white colour, smooth and dry, surrounded by a pink or violet zone of minute dilated vessels; but this zone may be absent, and the patch more or less pigmented in various hues. The edge may be diffused or defined, its shape is as irregular as its size; it may be raised above (M. tuberosa), depressed below, or level with the surrounding skin. No difficulty is usually experienced in pinching up the diseased skin, and as it is rarely adherent to the subjacent tissues, and is quite superficial, it feels like parchment or leather, according to its thickness, which varies often in the same patch. As a rule, when once it is developed there is no increase in size, but sometimes small atrophic spots appear close to the major patch, enlarge, and coalesce with it.

Defects of sensibility are rare, but there is itching in some cases. In the band cases, the lesion is usually single, and, unlike the patches, is often adherent to the subjacent tissues, so that it is sunk into a sulcus below the healthy skin; but if non-adherent it may be raised up into a ridge.

Pathology.—The pathology of this affection is obscure, but the process does not appear to be inflammatory, and the theory most in accordance with the clinical facts is that of an obstruction of the arterial blood-supply to the skin, on the one hand, and the venous and lymph flow on the other; and the varying symptoms of different cases depend upon the relative degree of obstruction in one or other of these vascular systems. But what the primary defect is that brings this about is not known, and it must be inferred that it is of central nervous origin, and in fact that the disease is primarily a central tropho- or vasomotor-neurosis. Diffuse scleroderma has been anatomically examined by many, and the results, omitting minor differences, are as follows:—The changes are, in the main, in the deeper parts of the corium and subjacent tissues, and consist of narrowing of the lumen of the blood-vessels and accumulation of cells round them.

Later on there is destruction of the sweat and sebaceous glands and hair-follicles, and absorption of the fat and cellular tissue by the pressure of these cells, and a great development of connective and elastic tissue bundles, doubtless from fibrillation of the cells; and the skin may become directly adherent to the fascia or periosteum.

The anatomy of circumscribed scleroderma has been examined by the writer. The changes were of very similar character to those of the diffuse form, but were more superficial, affecting the upper part only of the corium, in the early stage; and thrombi were present in many of the vessels, explaining the pallor and thinning present at first. At a later stage there was increase of the connective tissue, and the changes had spread into the deep part of the corium and into the fat layer. In the opinion of the writer, the obstruction to the arterial blood-supply is greater than in diffuse scleroderma, and so atrophic changes are more often produced. Probably the nervous defect is not central, affecting perhaps only single nerves in this class of cases.

Diagnosis.—The wooden induration and immobility of the skin and subcutaneous tissues, occurring symmetrically over a wide

area, with or without the ivory colour supervening, are conditions almost peculiar to diffuse scleroderma, with the sole exception of sclerema of the newborn, in which there is induration with great coldness of the surface; this, and the age of the patient, would be obvious distinctions. There remains only one disease, even rarer than scleroderma, which may give rise to some doubt—namely, diffuse primary or secondary cancer of the skin—the '*Cancer en cuirasse*' of Velpeau. If secondary, it often begins with nodules; this and the previous history would remove all doubt, but in the primary cases there may be more difficulty. The slow, continuous spreading, the lancinating pains and tenderness, the neighbouring inflammatory œdema, the ulceration of the lesions and involvement of the glands, with the more rapid course of marasmus and fatal cachexia, are all points in which it differs from scleroderma.

Circumscribed scleroderma presents even less difficulty. The raised patches might perhaps be mistaken for the keloid of Alibert, but the difference in colour, the ivory-white tint of morphœa being absent, and the presence of vessels upon the tubercle, and the claw-like processes which extend from it, would distinguish this affection. The flat patches are quite distinctive, and no confusion could arise with ordinary care.

Treatment.—In the diffuse form, the indications are to guard the patient against cold, since aggravation and extension are very likely to follow a chill, to which the patients are abnormally prone; secondly, to improve the general nutrition; and thirdly, to restore the circulation in the ischæmic area. For the first, the patient should be clothed in flannel, never allowed to go out in cold winds, and guarded carefully against draughts.

For the second, ferruginous and other tonics suitable to the individual should be given, and cod-liver oil is often very beneficial. The digestive organs should be carefully attended to, since they partake often in the general enfeeblement, and flatulence aggravates the distressing tension when the trunk is affected.

For the third, shampooing should be systematically and diligently employed to the affected areas. Turkish baths are useful before the rubbing, but vapour baths are too depressing.

Where Turkish baths are not available, inunctions with neat's-foot or olive oil, or simple unguents are useful; galvanism is strongly recommended by some, and may be of service, probably, by improving the circulation.

Iodide of potassium, arsenic, and mercury have been repeatedly tried and found useless, and mercurial inunctions have been decidedly injurious in many cases.

The treatment of morphœa is very unsatisfactory; nothing has any direct effect for good, and anything producing local irritation aggravates the mischief. General invigorating measures are useful, and nerve-tonics, such as the mineral acids and nux vomica, are often indicated. Galvanism has been recommended, but must be used so as not to irritate the patch; but if employed in the neighbourhood may be beneficial. Inunction may also be tried with simple ointments, always remembering that, if not worried by injudicious treatment, the patches tend to get well of themselves eventually. Mercury, internally or externally, should be avoided. The mixed cases should be treated in the same way as diffuse symmetrical cases.

H. Radcliffe Crocker.

SCLEROSIS. *See* Induration.

SCLEROTIC, Diseases of the.—*Anatomy.*—The sclerotic is the white, tough fibrous membrane which constitutes five-sixths of the outer coat of the eyeball. In front, it is continuous with the transparent cornea; behind, with the sheaths of the optic nerve and with the connective tissue investing the fasciculi of the nerve (*lamina cribrosa*). That portion of it which may be seen within the opened eyelids, through the semi-transparent conjunctiva, is called 'the white of the eye.' Externally, it is smooth, except where the tendons of the muscles are inserted, and is enclosed by a thin fibrous covering—the episclera—lined with endothelial cells. This covering—the so-called 'capsule of Tenon'—which also furnishes the sheaths to the straight and the oblique muscles, is very loosely attached to the sclerotic, except in front, where, at about one-eighth of an inch from the periphery of the cornea, it beomes intimately blended with both the conjunctiva and the sclerotic, and cannot be separated from either without laceration. The sclerotic is lined by endothelial cells containing more or less pigment, and is loosely connected with the underlying choroid by many delicate connective-tissue fibres, nerves, and blood-vessels. It is chiefly composed of bundles of fine fibrillæ, among which a few elastic fibres are scattered. The bundles of fibrillæ are irregularly arranged into

layers, which interlace at various angles. Most of the bundles have either a circular or an antero-posterior direction, and a smaller number are disposed obliquely. Around the entrance of the optic nerve, as well as near the cornea, the circular bundles predominate. Among and between the layers is a system of lymphatic channels with spaces containing fixed cells, closely resembling those of the cornea. Most of the cells are unpigmented, but a few are pigmented. The latter are found chiefly around the entrance of the optic nerve, and in the deeper layers of the sclerotic near the cornea. In negroes and dark races generally, the proportion of pigmented cells is always greater. Migratory cells also circulate in the lymphatic channels.

The sclerotic has comparatively few blood-vessels and nerves. It receives a few small branches from all the ciliary arteries and veins. These vessels form a wide-meshed plexus, chiefly on the surface, in which, as a rule, two veins accompany each artery (Leber). On the anterior surface, around the margin of the cornea, the distribution of the blood-vessels is peculiar. At about one-twelfth to one-eighth of an inch from the cornea, the anterior ciliary arteries, which are the terminations of those supplying the straight muscles, divide into—(*a*) perforating branches, which pass through the sclerotic to go to the ciliary body, where they join the posterior ciliary arteries, and (*b*) superficial branches, which lie in the episcleral tissue and anastomose by arched communications in the neighbourhood of the corneal margin. The latter are called episcleral arteries. From these arcades two sets of branches arise—one consisting of small straight vessels which run up to and within the limbus of the cornea, and form with the subjacent episcleral veins the marginal vascular plexus of the cornea; the other consisting of vessels which bend backwards, to end in the conjunctiva and anastomose with the posterior conjunctival vessels. The circumcorneal vascular plexus or ring is therefore made up of episcleral and the anterior conjunctival vessels, which freely communicate with each other, and are directly connected with the vessels supplying the anterior portion of the conjunctiva, the sclerotic, the cornea, the ciliary, and the iris. Hence, in inflammation affecting these parts, the marginal plexus, which in health is almost invisible, becomes more or less conspicuous, forming what is generally called 'the zone of ciliary injection.'

Pathology.—Containing few blood-vessels, nerves, cells, and lymphatics, and subserving only the functions of an exoskeleton, the sclerotic is a comparatively indifferent structure; its composition is stable, its nutritive processes are sluggish and not easily diverted. Consequently, it is but little susceptible of disturbing influences, and is subject to few pathological changes. Indeed, when these changes do occur, they are generally associated with and dependent upon morbid states of one or more of the adjacent textures—namely, the ciliary body, the choroid, or the iris, or, much more rarely, the cornea.

It is at first sight remarkable that, notwithstanding the unbroken structural continuity, the sclerotic proper is seldom much affected in inflammation of the cornea; though it readily participates in inflammation of the iris and ciliary body, to which it is contiguous only. The explanation seems to be, that the nutrition of the cornea is, in the main, distinct from that of the sclerotic, and that both these structures are alike primarily dependent upon the integrity of the ciliary body for their organic maintenance.

The commonest inflammatory manifestation, referable to the sclerotic, is now known to involve rather the episcleral tissue than the substance of the sclerotic. The morbid state is still, however, often spoken of indiscriminately as sclerotitis or scleritis and episcleritis. The truth is that though episcleritis may occur alone, it is not infrequently associated with inflammation of the sclerotic. The concurrence is to be accounted for partly by the nature of the inflammation and its exciting cause, but chiefly by the anatomical peculiarities of its situation. From what has been already stated respecting the relations of the episcleral capsule and the sclerotic, it will easily be understood that the further the focus of disease from the cornea, the less likelihood of a concurrence of scleritis and episcleritis, and *vice versâ*. Near the cornea, the union between the two is so close and intimate as to come near to identity of structure, while at a distance the connection is both slight and readily separable.

Nosology.—The principal morbid states of the sclerotic and episclera are:—Hyperæmia, episcleritis, scleritis, staphyloma, and tumours; they are also subject to some slight congenital abnormalities.

Hyperæmia.—Hyperæmia of the scleral and episcleral vessels is usually indicative of a morbid state of the cornea, iris, ciliary body, or choroid; or it may signify obstruction to the intraocular circulation, due either

to increased intraocular pressure, or to some other cause. It occurs in two forms—(*a*) as a pink or, more commonly, a purplish zone, patch, or crescent, at the margin of the cornea; and (*b*) as large varicose vessels running over the surface of the sclerotic, from about the margin of the cornea towards one or other of the straight muscles.

(*a*) The former is the more frequent form. Typically, it consists of a purplish zone, varying in breadth from one-eighth to one-fifth of an inch, immediately surrounding the cornea. On examining this zone more closely, it will be found to be made up of the minute radiating blood-vessels described above by the name of *episcleral vessels*. In some cases the injection does not entirely surround the cornea. With the redness there is usually some swelling, due partly to the engorgement of the blood-vessels, and partly to infiltration of the episcleral tissue. The conjunctiva with its vessels may, by gentle pressure and friction upon the edge of one or other lid, be made to glide over the enlarged vessels, which obviously lie upon the surface of the sclerotic. If the conjunctiva also be inflamed, the scleral and episcleral vessels may be masked to some extent by the congested conjunctival vessels, which are distinguishable by their reticular arrangement, and by being largest and most conspicuous towards the lacunar portion of the conjunctival sac.

(*b*) The varicose state of the scleral vessels is most frequently met with in chronic inflammation of the sclerotic, iris, ciliary body, or choroid, and is generally present in glaucomatous eyes. It may, however, be due to pressure or other disturbances behind the eyeball, either within the orbit or beyond it.

Episcleritis is an inflammation of the loose fibrous covering of the sclerotic. The inflammation may be strictly limited to the episcleral tissue, or it may involve likewise the conjunctiva on the one hand and the sclerotic on the other, or both these structures may be concurrently implicated.

Objectively, episcleritis consists of a more or less circumscribed dusky-red or purplish swelling on 'the white of the eye,' under the conjunctiva, and near the cornea, or within one-third of an inch of it. The most frequent seats are near the corneal limbus, and opposite the insertion of one of the recti tendons, especially the external. The vessels of the overlying conjunctiva are generally enlarged, but the mucous membrane itself is, in the earlier stages at least, freely movable over the swelling. When the swelling is close to the edge of the cornea, the adjacent portion of the cornea becomes hazy from infiltration into its layers and from disturbance of the epithelium. Eventually, the affected area of the cornea may ulcerate. The sclerotic itself rarely if ever ulcerates in true episcleritis. In some cases, iritis complicates episcleritis; and, more rarely, there is cyclitis.

The *subjective* symptoms are variable. The pain is not usually severe, and does not amount to more than a sense of discomfort, with, perhaps, a dull aching sensation when the eyeball is moved or the eye is used for near work. On the other hand, there is sometimes great pain of a neuralgic character, not only in the globe, but also around the orbit and down the side of the nose. In these cases, however, it will generally be found that there is, in addition to the episcleritis, inflammation of the cornea, or the iris, or even the ciliary body itself. Nor is the sight affected, unless one or other of these parts be implicated.

The *course* of the disease is very chronic. As swelling leaves one part, it may reappear in another, and in this way the case may be prolonged for months. The average duration is about from two to four months.

Termination.—The inflammation may disappear without leaving any traces behind it, or at most only some thickening of the episcleral tissue. In a few cases, a faint discoloured patch persists on the surface of the sclerotic. But if the cornea have been involved, a nebula or actual leucoma may remain.

Clinical Varieties.—At least four distinct varieties of episcleritis may be met with—namely, (1) a circumscribed, indolent, purplish swelling appears opposite the insertion of one of the recti tendons and under the conjunctiva. There is little or no pain, watering, or distress of light. This form may occur during an attack of acute rheumatism, and it is probably always associated with the rheumatic diathesis.

(2) The episcleral swelling is not so circumscribed, and is situated near to the cornea. The conjunctival vessels are enlarged, and there is a patch, or may be, zone of injection at the margin of the cornea. There is also congestion of the iris, as evidenced by a small amount of discoloration and a semi-contracted state of the pupil. The eye waters, cannot bear exposure to light or to cold and damp air. The pain is often very great, both in the eyeball and in the brow. Such cases were formerly spoken of as examples of catarrho-rheu-

matic ophthalmia (Mackenzie). In some cases actual iritis may occur.

(3) Episcleritis may complicate, or be complicated, by phlyctenular ophthalmia. In chronic or recurrent marginal phlyctenular keratitis, the inflammation may extend to the episcleral tissue, and in some cases, following the course of the vessels, it may spread thence through the sclerotic to the ciliary body and iris.

(4) An episcleral infiltration-patch forms near the corneal margin. In a few days the adjoining portion of the cornea is seen to be hazy and its epithelium roughened, and, in the course of one week or more, the infiltration-patch may gradually desert the episclera altogether, to invade the cornea. The softened cornea may then disintegrate and a deep ulcer result. The ulcer, too, often assumes a serpiginous character, and spreads along the margin of the cornea and over the surface; or, running down to the posterior elastic membrane, leads to bulging of the posterior elastic membrane, with prolapse of the iris and ultimate perforation. This form is chiefly met with in anæmic and debilitated persons, especially women weakened through suckling or exhausting illnesses. There may not be much pain in this form, though there is usually great distress of light. The serpiginous form of episcleritis is probably neuropathic. In most of the cases which have come under the writer's observation, there have been other evidences of faulty innervation.

Causes.—Episcleritis occurs chiefly in young and middle-aged adults, rarely in children or in old persons, and it is more frequent in women than in men. The common exciting causes seem to be rheumatism, gout, syphilis, and scrofula. It is sometimes associated with uterine disease, catamenial disorders, and occurs during pregnancy or after parturition.

Treatment.—The *local* treatment should be soothing. Irritants of every kind are contraindicated. In recent cases, moist warmth, as steam-spray fomentations, is generally agreeable and useful. Sometimes, however, moist warmth increases the pain. In any case, glycerine of belladonna, or weak mercurial ointment containing extract of belladonna, may be applied with gentle friction to the brow or temple, and a solution of atropine may be applied to the conjunctiva, and repeated if found not to irritate. Pain is generally relieved and the duration of the disease shortened by systematic diaphoresis, whether induced by Turkish or other hot baths, draughts or subcutaneous injections of pilocarpine, or in any other way. Sulphate of quinine, with small doses of calomel (gr. $\frac{1}{6}$ to gr. $\frac{1}{4}$ three times a day), seems, in many cases, to promote the absorption of the inflammatory matters. De Wecker speaks highly of the combination of copious sweatings with the internal administration of salicylate of soda. In chronic cases, blisters may be applied every ten days to the temples, and astringent compresses every night to the closed eyelids. In chronic cases, with opacity of the cornea, *massage* of the eye repeated many times a day has been recommended by Pagenstecher. If there be inflammation or ulceration of the cornea, with a deep anterior chamber and increased intraocular tension, sclerotomy may be tried and repeated at discretion.

Sclerotitis.—Idiopathic sclerotitis seldom, if ever, occurs; inflammation of the sclerotic being generally secondary to iritis, or cyclitis, or choroiditis. *See* Choroid, Ciliary Body, Iris, Diseases of the.

Staphyloma of the Sclerotic is comparatively rare, and is the result either of injury with laceration or of inflammation of some portion of the uveal tract.

The common situations are—the corneoscleral margin, the ciliary region, the equator, and the posterior pole, just outside the optic nerve.

New Growths are very rare, so-called tumours of the sclerotic being really growths which have invaded the sclerotic rather than originated in it. Still, fibrous growths and sarcomata do sometimes occur.

Treatment will depend upon the nature of the growth. Malignant tumours cannot be removed too early, even though the eye be certainly sacrificed by the operation. *See* Orbit, Tumours of the.

John Tweedy.

SCLEROTIC, Injuries of the.—The sclerotic is liable to all and any of the injuries which affect soft parts—namely, blows and concussions, contusions, wounds, ruptures, burns, scalds, the effects of corrosives, and other chemical irritants and caustics.

Blows, Concussions, or Contusions may be *simple*—that is, affect only the sclerotic—or *complicated* by injury to the adjacent parts. The principal complications are, contusion or wound of the lids or the cornea; subconjunctival ecchymosis; paralysis of one or more of the recti muscles; detachment or laceration of the choroid, iris, retina, suspensory ligament, or the capsule of the lens; hæmorrhage into the anterior chamber, the vitreous, behind the retina or

the choroid; concussion or even laceration of the optic nerve; paralysis of the sphincter pupillæ; suspension of the accommodation.

The nature and extent of the injury may be temporarily masked by hæmorrhage into the anterior chamber or the vitreous, or by the early occurrence of inflammation, or by the presence of old or recent opacity of the cornea or the crystalline lens. It should be remembered that lacerations of the retina and choroid from blows upon the sclerotic rarely, if ever, take place at the site of the blow, but are almost always at the posterior pole of the globe, and are more or less concentric with the optic nerve. More rarely, the rupture occurs in the anterior part of the choroid, but then there is also rupture in the posterior part and in the same meridian (Arlt).

Treatment must be to a large extent palliative and expectant only. The eye should be protected by a shade or by a light cooling compress. Complications and sequelæ must be treated according to their special indications.

Wounds of the sclerotic are, as a rule, very dangerous, because, first, of the degree of violence necessary to produce them; secondly, they are often attended by lesions of the cornea, iris, choroid, retina, crystalline lens, and vitreous; thirdly, they are frequently followed by grave pathological changes, such as inflammation, suppuration, cataract, detachment of the retina, glaucoma, or sympathetic ophthalmitis; and fourthly, they are often difficult to close, partly in consequence of the elasticity of the sclerotic, and partly from the tendency of the choroid or other of the intra-ocular contents to protrude into the wound and become entangled therein.

Wounds of the sclerotic may be *simple*—that is, involve only the sclerotic—or *complicated*. The *simple* wounds are—incised, contused, lacerated, punctured, ruptured, and gunshot. The *complicated* are those with rupture, or with protrusion, or even extrusion of the iris, ciliary body, choroid, retina, vitreous, suspensory ligament, or the crystalline lens itself; those with intra-ocular hæmorrhage, or with lodgment of a foreign body in the wound or within the globe.

Uncomplicated wounds of the sclerotic are comparatively rare, there being in most cases some prolapse of a portion of the uveal tract. When the wound is the result of great violence, and is inflicted by a large blunt instrument, there is almost always laceration of the choroid, with protrusion or extrusion of the vitreous or of the crystalline lens. In blows with the fist, the rupture of the sclerotic does not take place at the point of impact, but in the ciliary region on the opposite side of the cornea; the usual situation being just outside the cornea and concentric with it, or opposite the interval between the superior and internal recti. But when the blow comes from above, then the lower part of the sclerotic may be torn. If the rupture take place quite close to the cornea, the conjunctiva is also torn, and the lens is forced out of the eye; but when it is more than, say, about one-twelfth of an inch away, the conjunctiva escapes, and the extruded contents of the globe lie under it as in a cyst.

It may be stated generally, that wounds of the sclerotic are dangerous in proportion to the degree of violence with which they were inflicted, the amount of protrusion and entanglement of the iris, choroid, &c., and their nearness to what is called 'the ciliary region. Other things being equal, a small wound in the ciliary region is much more dangerous than a much larger wound elsewhere; and if there be entanglement of the iris or ciliary body, the risks are very greatly increased. So common is sympathetic ophthalmitis under such circumstances, that this part of the sclerotic is often spoken of as 'the dangerous region.' *See* Sympathetic Ophthalmitis. Again, wounds of the sclerotic, with lodgment of a foreign body within the globe, are necessarily more serious than those without.

Treatment.—The first duty is to endeavour to ascertain the nature and extent of the injury, the second to calculate on the one hand the prospects of good and safe recovery, and of the risks of sympathetic ophthalmitis on the other.

If the eye be obviously destroyed, excision should be performed without delay. Perplexity only arises when, in spite of much apparent injury, there is a fair amount of sight, or when there is only a small wound but in a dangerous region. On the one hand, extensive laceration of the sclerotic may heal and a useful eye result; on the other, even a small wound in the ciliary region, with entanglement, is always, as already stated, a possible source of danger from sympathetic ophthalmitis.

If it be determined to try to save an eye, the lips of the wound should as far as practicable be cleared of all entanglements; all prolapsed tissues being returned or excised. If the wound be large, a stitch may be necessary to prevent escape of vitreous. This should be inserted by using a suture with a fine curved needle attached

to each end, and passing the needles separately from within outwards. The eyelids should then be closed by a light compress of boric or iodoform wool. Atropine, or eserine, according to the special indications, should be instilled two or three times a day.

In cases of rupture of the sclerotic, where there is complete extrusion of the lens under the unbroken conjunctiva, no attempt should be made to take away the lens for some weeks, so that the sclerotic may have time to heal. When this has taken place the conjunctiva may be divided, and the lens let out. If, however, the lens be entangled in the wound, it should be removed as soon as possible, in order to allow the lips of the sclerotic to fall into apposition.

In penetrating wounds of the sclerotic, with lodgment of a foreign body within the globe, excision will, as a rule, be called for, unless the foreign body be a fragment of iron and so placed as to be easily accessible to forceps or to the electro-magnet.

Burns of the sclerotic are always accompanied by corresponding lesions to the Conjunctiva, Cornea, and Eyelids, and do not therefore call for any special notice.

John Tweedy.

SCLEROTOMY. *See* Glaucoma.

SCOTOMA, a blind spot on the retina, the result of disease. *See* Perimetry.

SCROFULA or STRUMA is a condition of malnutrition of the tissues; it is not a disease but a diathesis—in other words, a tendency to certain forms of diseased action, most marked in infancy and youth, yet sometimes occurring in old age, when the body is naturally less well nourished, under the name *senile scrofula*.

The causes of this condition are—(1) Inheritance; (2) bad or insufficient food; (3) overcrowding, ill-ventilation, darkness and dampness of dwelling; (4) insalubrious climate.

(1) Parents suffering from, and in a less degree those who have suffered from, scrofula and its near relation tubercle, beget as a rule scrofulous children. The degree of scrofulosis, in different members of the offspring, varies with innumerable combinations of this cause with the other causes named above; as also with the health of either or both parents at the time of impregnation, and with the condition of the scrofulous or tuberculous mother during gestation. Probably, no child of scrofulous parents is entirely free of the taint, but, if all the other above-named conditions be absent, it may escape any local manifestation. Probably, on the other hand, it may be affirmed that a sufficiently intense combination of the above with faulty hygiene will produce scrofula, in a child of parents however healthy.

(2) The milk of a scrofulous mother certainly increases the evil she has imparted; it is even probable that suckling by a scrofulous nurse may implant the diathesis in a congenitally healthy infant. The administration of farinaceous food, before the secretion of saliva is established, has considerable influence in the production of scrofula, or at least in calling forth scrofulous manifestations. This conclusion has been forced upon the writer by observation of several cases, notably of seven in which, when such mode of feeding was stopped, the outbreak ceased. Insufficient food with excess of starch, bad quality and monotony of diet, all have, in their degree, a like effect.

(3) That overcrowding is a potent generator of scrofula is indubitable. Breathing again and again an atmosphere already exhausted by other lungs is bad enough, even if those other lungs be healthy; but recent researches render it highly probable that scrofulous emanations from one person may produce that disease in another individual. Overcrowding implies also dirt, interfering with the action of the skin, and usually causes darkness. The action of light on the body is hardly sufficiently appreciated. The effect of its absence is analogous to the etiolation of plants.

(4) Scrofula is chiefly rife in climates which, like that of Britain, are damp, cold for the greater part of the year, and always uncertain. We know, however, from history, that two and even three hundred years ago 'the king's evil' was very prevalent, and it must be, in the present day, very difficult to apportion aright its cause between heredity and other conditions. Replies, however, to the writer's inquiries show that strumous families taking up residence in America, New Zealand, and Australia, (save in overcrowded parts of seaboard towns) so lose their proclivity, that the younger members, born strumous here, cease to exhibit manifestations after emigration, and that the parents procreate healthy children.

Pathology.—The strumous diathesis, without local manifestation, possesses no pathological anatomy hitherto demonstrable; it is probable, however, that the faulty nutrition mentioned in the opening sentence consists in some want of equilibrium, structural or functional, between the lym-

phatic rootlets or spaces and the other elements of the connective tissues. Whether this want of balance be primary, or whether it be dependent on some faulty condition of blood, or again whether it produces, or is produced by, minute anatomical variations from normal texture and fabric, more especially of the adenoid constituents of tissue, is not yet ascertained. But it is certain that this diathesis, when strongly developed, is marked by certain characteristics of external form, due to peculiarities in thickness and abundance, or in fineness and paucity, of the connective (areolar) tissue; and these characteristics are more especially impressed on such parts as are largely made up of lymphoid or adenoid structures.

These peculiarities are associated with a proclivity to follow up 'any slight and transient irritation by a chronic inflammatory process, which not only outlasts the irritation, but spreads or continues independently of it, usually resulting in suppuration or caseation, and rarely assuming the form of a pure hyperplasia' (Billroth). And in these conditions it is found that lymphatic tissues, notably the glands and such parts as contain abundance of adenoid elements, are especially vulnerable. But even the parts, thus suffering from strumous inflammation, betray no anatomical peculiarities differentiating them generically from parts affected with non-strumous chronic inflammation, until the resulting products undergo certain degenerations. It is, indeed, this tendency of the inflammation to continue, while its products are averse to organisation, which constitutes the characteristic of strumous manifestations, by producing a great accumulation of the most embryonic of inflammatory fabrics—granulation-tissue. This tissue is, however, common to all forms of subacute and chronic inflammations; in struma, its persistence, and therefore its amount, is alone to a certain extent peculiar.

But here attention must be called to certain minute bodies, very apt to form in the midst of this tissue, wherever interstitial cell-growth has much exceeded the rate of vessel-formation. Thus, non-vascular islets appear in which, equidistant on every side from the great vessels, nodules, are developed consisting externally of a delicate reticulum supporting lymphoid cells; further inward, of epithelioid cells; and centrally of larger branched cells, sometimes of giant-cells. For, wherever a portion of growing inflammatory product becomes extravascular, giant-cells commonly occur. These little spots are named by Rindfleisch, 'newly-developed lymphatic follicles.' It is possible, however, that they indicate a tendency to organisation or to fibrillation—at least an abortive attempt at those actions, for Ziegler, by placing under the skin of dogs two cover-glasses, kept so far apart as to allow of granulation-tissue insinuating itself between them, found on their removal a number of very similar spots (only he called the epithelioid cells fibroblasts) formed of exactly similar elements. These bodies are therefore in no way distinctive of struma, they are found in old indolent ulcers, in the so-called proud-flesh (*caro luxurians*) of unhealed wounds and of burns, in the granulation-tissue surrounding sequestra, and in the thick granulation-material of very chronic synovitis. Nevertheless, though not distinctive of, they are most common in struma, because persistency of inflammatory products is most usual in that dyscrasia.

But to continue the life-history of granulation-tissue, which by its very nature must be merely transitional, and if it will not organise, must of necessity degenerate. Hence, unless fibrillation or cicatrisation set in, suppuration, together with much fatty degeneration, caseation, or tuberculisation will occur.

It is still unknown whether the cause of this imperfect tissue-nutrition is intrinsic in the tissues themselves or in the blood. Some support of the latter doctrine is afforded by two facts—that the blood of a large proportion of scrofulous persons contains an undue amount of lymphoid elements (leucocytes), and that two inflammatory manifestations of scrofula are rarely simultaneous. A belief in the humoral origin of the diathesis originated its treatment by setons and issues, to exhaust the blood of its peccant material.

The *diagnosis* of scrofula, the diathesis in contradistinction to the manifestations, depends on the appreciation of certain personal characteristics which are of two types, corresponding the one to fineness and paucity, the other to coarseness and abundance, of connective tissues. The former is marked by refinement and definition of the features. The curves of the lips, the nasal, aural, and tarsal cartilages are finely modelled. The conjunctiva and sclerotic are so thin that the pigment of the choroid, partially seen through them, imparts a bluish or pearl-grey colour to the white of the eye; the skin, clear and pure of tint, with cool-toned, ash-grey shadows, is so translucent that the bluish, wavy course of subjacent veins is plainly marked, as on the

upper eyelid, the temple, angle of the jaw, &c.; the luscious redness of the lips testifies to the same condition. The eyelashes are abundant and long—a fine down, often rather long, extends from the margin of the scalp-hair some way down the forehead, temples, and nape. The whole aspect is of refined but fragile beauty.

The other type is coarse and ugly. The head large and lumpy, bigger behind than before, is flanked by large, red, puffy ears; the jaws are prominent, the lips thick, ill-defined, and often cracked, sway clumsily apart. The nose is lumpish, the origin of the alæ ill-defined, the eyelids thick and clumsy, often even when not inflamed bordered with red, are frequently lined with dried Meibomian secretion clinging to the roots of sparse irregular lashes. The dull, unclean-looking skin is marked by large orifices of sebaceous ducts. The figure is usually ungainly, the joints and extremities large, the belly prominent; the hair coarse, either of a dull sandy colour or lustreless black. These descriptions are taken from the extremes of each type; to discriminate what degree of tendency either way may justify the practitioner in considering his patient scrofulous, requires acumen and experience. His judgment will be aided by considering the family history, the age of the patient, and the kind of malady he may be required to treat.

The manifestations of scrofula affect: (1) The skin; (2) mucous membranes; (3) lymphatic glands; (4) joints; (5) bones.

(1) The scalp is especially liable to eczema, tinea, and favus; the face to lupus; scrofulous ulcers, though chiefly choosing the neck, also occur at the bends of joints. Chilblain is said to be chiefly common in strumous persons, probably an error due to the obstinacy of all inflammations in such individuals.

(2) Phlyctenular ophthalmia, ulcerative corneitis, tinea tarsi, chronic catarrhs, catarrhal bronchitis, enlargement of tonsils and thickening of pharyngeal adenoid tissues, persistent coryza, ozæna, otorrhœa, purulent vulvitis and vaginitis.

(3) Enlargement of lymphatic glands, chiefly of the neck, probably induced in the first instance by teething, by one or more of the above irritations, or by an exanthem, especially by measles; thus every instance of an enlarged cervical gland is not, of necessity, strumous. The characteristics of the scrofulous enlargement are its very chronic character, its continuance long after the causation has ceased, its spread from gland to gland, and the tendency of the glands to attain considerable size and to be the seats of protracted suppuration.

(4) Most chronic joint-affections, arising between the ages of a few months and eighteen years, are scrofulous, though they may originate (as some believe) in slight traumatism. The affection may commence in the synovial membrane, in the epiphysis, or in the epiphysial junction; in the last two conditions, the hyperæmia of rapid growth affording the primary irritation.

(5) Chronic carious affections of the bones occurring during early life are very generally strumous, absence of syphilis being verified. Spongy bones, as the bodies of vertebræ, the small bones of the carpus and tarsus, the epiphyses of long bones, are peculiarly prone to such affection; the hard cortex of long bones is less often attacked. A peculiar enlargement or distension from within of one or more phalanges bears the name of dactylitis; it is generally strumous, sometimes syphilitic. Rachitis is probably a scrofulous affection in the large majority of instances.

The combination of scrofula and syphilis is by no means uncommon; the manifestations of the mixed diatheses are severe and obstinate. Some writers believe that scrofula is degenerated syphilis, an unproven hypothesis.

The *treatment* of the scrofulous diathesis (the treatment of the above manifestations falls each under its own heading) is first of all improved hygiene, including—residence in large, not over-filled rooms, in preference by the seaside or at a somewhat high elevation on a dry gravelly soil, good ventilation, plenty of light and outdoor exercise. The diet must be regulated according to the age of the subject, and for that age must be of the most light and wholesome description. In the refined delicate forms, fatty matters should especially be pressed; ale or stout also may be given; they are less valuable, sometimes inadmissible, in the other form.

In the administration of drugs a similar distinction is desirable. The former kind of struma indicates cod-liver oil, maltine, iron—what may be called the blood-making tonics; the latter quinine or other bitters, mineral acids (nitro-hydrochloric), iodide of potassium; if iron be employed it should be given as the iodide. Alkalies, when the breath is sour, are often valuable. In this form of the diathesis, an occasional purge and alterative are essential to the treatment, especially when phlyctenular ophthalmia or the other above-named eye-affections are present, while the breath has an evil odour. RICHARD BARWELL.

SCROTAL ELEPHANTIASIS.—The general subject of elephantiasis having been fully discussed elsewhere (*see* ELEPHANTIASIS ARABUM), it only remains here to consider the disease as specially affecting the scrotum, and to describe the measures which have been adopted for the cure of scrotal tumours of this nature.

Several varieties of the disease, as affecting the scrotum, are met with in India and other places where this malady is rife. They may be included in the following categories :—

1. Solid hypertrophies of the external genitals. These may be subdivided into :

(*a*) Simple scrotal elephantiasis. In most cases both penis and scrotum are implicated, but in some cases (i.) the skin of the penis and the prepuce are mainly involved, the scrotum being less affected; and in others (ii.) the scrotum is the principal or sole seat of disease. Under this head also come (iii.) labial tumours in the female. The labia majora are the most common seat of the disease, but the prepuce of the clitoris and the labia minora are also sometimes thickened. In rare cases, the tumour is principally situated in these latter parts.

(*b*) Complicated scrotal elephantiasis. The complication may consist of—(i.) Abscesses and ulcers; (ii.) stricture of the urethra; fistulæ, urethral, perineal, and anal; (iii.) large hydroceles and hæmatoceles; (iv.) hernia. These local complications materially affect the question of operation. (v.) The tumour may be in a state of acute hyperæmia, with accompanying fever, or (vi.) there may exist diseased conditions of the spleen, liver, kidneys, bowels, or adjoining lymphatic glands, or some constitutional disturbance or cachexy. These general complications also raise a doubt as to the propriety of resorting to operation.

2. Condylomatous growths simulating elephantiasis—met with both in male and female subjects.

3. Warty growths implicating the prepuce, penis, or scrotum, that have attained such a size as to constitute a tumour, or associated with some elephantoid thickening, also met with both in males and females.

4. Serpiginous ulcerations, consequent on chancroid, and usually accompanied by some degree of elephantiasis.

5. Lymph-scrotum, consisting mainly or wholly of dilated lymphatic vessels, exuding spontaneously or on puncture a clear or milky fluid. The penis often remains healthy in this variety. Filariæ are found in this class of cases, but in none of the others. This form of disease is rarely, if ever, met with in the female.

It may be laid down, as a result of wide experience, that medicinal appliances are of little or no service in any of these forms of disease. A certain amount of relief may be obtained by recumbency, elastic bandages, and the local and general use of absorbents, more especially preparations of iodine; but, though the size of the tumour can be reduced by such agencies, the disease cannot be cured, and progressive enlargement will be found to proceed by means of those periodical attacks of fever, accompanied by local congestion and exudation, which characterise the development of the disease. It has also been established by a very large experience in India, China, and elsewhere, that by means of operation the local disease can be removed and the periodic fever which is associated with it cut short; and this without sacrifice of the essential organs of generation, or, in the great majority of cases, any risk of recurrence.

The questions which demand consideration here, therefore, are (1) in what circumstances is recourse to operation justifiable or desirable; and (2) what is the most approved and successful method of operating.

The inducements to remove the diseased parts by operation are these :—(*a*) The deformity and inconvenience caused by the growth, especially when it has attained a large size; (*b*) the sexual disability which it entails; (*c*) the discomfort caused by the periodical recurrence of fever; (*d*) the impairment of general health which results from these repeated attacks of pyrexia, which are often of severe character, and from the visceral disturbances, functional and structural, which are apt to be associated with a long-standing and progressive elephantiasis, and which undoubtedly tend to shorten life.

The earlier the tumour is removed, when it has once been fairly developed, the better, because the removal of a mass of moderate size, in a comparatively young subject, is a much less risky proceeding than the amputation of a large tumour in an old subject. Besides, the constitution and vitality of the subject are conserved by cutting short the fever, and preventing the development of visceral disturbance or decay.

The *contra-indications* of operation are:

a. Old age.—In the aged, sexual disablement is not a matter of much consequence, and if the tumour has, as often happens, become stationary in its growth, and the concomitant fever ceases to occur

or becomes less frequent and severe, operative interference, which is always more hazardous in the old, should be considered with more hesitation and caution.

b. Ill-health and visceral disease—more especially of heart, kidneys, or intestines. A weak or damaged heart, albuminuria, and chronic diarrhœa or dysentery, are prohibitive of operation. Cachexia and anæmia, however caused, also constitute serious objections to operating, and diabetes is absolutely prohibitory. Recent and acute enlargements of spleen and liver are likewise prohibitive, but chronic enlargement of either organ, if not accompanied with manifest impairment of health, is not a bar to removal by the knife.

c. Complications. — Reverting to the list of these given above—(i.) If the abscess be acute, it should be treated and cured before operation is resorted to; if chronic, or dependent on hæmotocele or diseased tunics, it may safely be removed along with the tumour. If the ulcer be small, and due to local irritation, or preceding abscess, operation need not be delayed. If large and due to general ill-health or extensive sloughing, caution and delay are advisable. (ii.) A stricture should be fully dilated before the operation is resorted to, because there is often difficulty in passing urine for a few days, and the use of a catheter is by no means an easy and safe matter unless the urethra is of normal size. Fistulæ should, if possible, be cured by dilatation of the urethra or by free incision, accompanied, if necessary, by urethral dilatation; and, if they cannot be closed, operation should be declined. (iii.) Very large hydroceles and hæmatoceles enhance the risk of the operation, but are not a bar to it. If the patient is very old, the propriety of interference is more than doubtful; but in young and middle-aged subjects operation is advisable, and both diseases can be radically cured by the same procedure. (iv.) The existence of herniæ imports a very serious risk to life, and the simultaneous performance of an operation for the removal of the tumour and cure of the rupture has been proved, by experience, to be a very perilous practice. (v.) Operation should never be resorted to when the tumour is in a state of excitement, or while any febrile constitutional disturbance exists. Large size does not constitute so strong an objection to operation as some of the other considerations which have been adduced; for though it is true, generally, that the danger of removal is directly proportionate to the bulk of the mass, still, under improved methods of operating, the risks depending on size have been greatly reduced, and experience has proved that immense tumours of this description, weighing, after removal, from 100 to 120 lbs., may be easily and successfully amputated, the period of convalescence and ultimate result being much the same as in the case of smaller masses.

The removal of scrotal elephantiases has been practised in India since the beginning of the present century, and, at the present time, operations for this purpose are unhesitatingly performed in all countries and places where the disease is met with. The mortality in uncomplicated cases is inconsiderable, and the relief conferred complete and permanent. At first, the operation partook of the character of an amputation rather than a dissection. A clean sweep was made of the whole mass, including the genitals, at the level of the pubes, the vessels being tied as rapidly as possible, and the wound allowed to heal by granulation. Some surgeons transfixed the base of the tumour with a long catlin, and cut flaps from each side of its neck.

Rapidity of execution was considered to be the main point, for the double purpose of saving suffering and blood. Gradually, attempts were made to save the sexual organs. The penis was dissected out, and in small tumours the testes, when they appeared to be healthy; but, when the tumour was large and the testes diseased, no attempt was made to isolate and preserve them. The use of anæsthetics and of appliances for preventing hæmorrhage has allowed greater deliberation to be practised, and it is now very seldom necessary to sacrifice the testes, either on account of the size of the tumour or of disease of those organs. A curious attempt was made in the years 1836–39 by Dr. Esdale, of the Indian Medical Service, to induce anæsthesia by means of mesmerism, and a hospital was organised in Calcutta for the purpose of carrying out his experiments. The annals of this institution are exceedingly interesting, and appear to establish the fact that operations can be painlessly performed on mesmerised subjects. The process of mesmerising was, however, tedious and uncertain, and the introduction of chloroform rendered further experiment unnecessary.

The principles in accordance with which the operation is performed, in the present day, are as follows:—

1. To empty the tumour as completely as possible of blood.

2. To prevent bleeding during the operation.

3. To remove every scrap of diseased tissue and of tissue likely to become diseased.

4. To preserve the essential organs of generation.

5. To secure the testes in proper position by catgut-stitching.

6. To prevent putrefaction in the wound.

A few observations on each of these heads will suffice to describe the steps of the operation.

1. Elevation and elastic bandaging are the measures employed for anæmiating the tumour, and they are perfectly competent to do so. Ten to twenty minutes, according to the size of the mass, are sufficient for the purpose.

2. To prevent bleeding during the operation, an elastic cord should be tightly applied round the root of the tumour before the removal of the bandage, and secured in its position by being attached by tapes to a waist-belt. An easier and equally efficient plan is to take an elastic cord about three feet long, pass the centre of it round the loins, bring the ends over the brim of the pelvis, cross them twice over opposite sides of the neck of the tumour, and, finally, bring these together below the navel; the neck of the tumour will thus be tightly embraced by two turns of the cord on each side, crossing each other on the pubes and just in front of the anus.

3. Experience has proved that if any portion of the diseased tissue be left behind, recurrence is almost certain to take place. Even although the prepuce appears to be healthy, it should be removed close to the corona glandis; and as thickening is peculiarly apt to commence in the raphe of the perineum, that part should in most cases be freely removed by a V-shaped incision up to the verge of the anus. If any attempt is made to cover the penis or testes with flaps, these should be taken from the skin of the abdomen or thighs, and not from the neck of the tumour; but a satisfactory result can be secured in all cases without resort to flaps, which are prone to slough or suppurate and to initiate septic disturbance of the wound and constitution.

4. The first step of the actual operation consists in decorticating the penis. A director is passed into the preputial cavity as far as the reflexion of its lining membrane on to the corona glandis, and, by means of a strong bistoury, the prepuce is slit open by transfixion and cutting upwards. An incision is made from the root of the penis on its dorsum to meet and complete this cut. The penis is then freed by finger and knife, the mucous membrane of the prepuce being carefully detached at the line of its reflexion. The isolation of the penis is completed as far as its suspensory ligament, which should not be injured. A vertical incision is now made from the pubes to the fundus of the tumour, over one cord and testis. By successive bold strokes these are exposed, and then dissected out by fingers and knife, and subsequently held out of the way by an assistant. The other testis is similarly dealt with. The three vertical incisions are then connected at their pubic terminations by two transverse cuts, which must be beyond the limit of the diseased tissue. A circular or oval incision is now made round the rest of the circumference of the neck of the tumour, and by rapid strokes the whole mass is removed. Vessels are now looked for. The largest will be found in the centre of the perineum and on each side of the pubes. By gradually loosening the cord, others will be observed to spring. All bleeding points should be carefully secured, and as many as thirty to forty ligatures may be required. The parts may now be trimmed if, in the hurry of operation, any diseased tissue has been left behind; and if the tunics are redundant or thickened, as much of them should be carefully dissected off as can be done without endangering the vitality of the testes.

5. The testes may now be stitched together by means of prepared catgut, and fastened in proper position by a few tacks of the same material. Depressions or pockets can be very easily made for their reception, by separating the deep layer of the superficial perineal fascia from the subjacent fat and areolar tissue. The skin can then be drawn over them from each side to a considerable extent, by means of a continuous catgut suture.

6. The prevention of putrefaction in an extensive wound, from which there is necessarily a very profuse discharge, situated in such close proximity to the urethral and anal orifices, and to which it is difficult to maintain dressings in close contact, is by no means an easy task.

The use of the spray during operation, or of thorough irrigation with carbolic or sublimate lotion immediately after it, and the dusting of the wound with iodoform, followed by the careful application of antiseptic dressings, suffice in most cases to maintain asepsis and to prevent suppuration. The plan of dressing employed by the writer is — (1) The application to the raw surface of boracic ointment spread on thin gauze; (2) placing outside of this

a piece of boracic lint sufficient to overlap the whole wound and a margin of skin beyond; (3) outside this are applied folds of carbolic gauze, which extend beyond the margins of the wound on to the pubes and thighs; (4) a sheet of waterproof or oiled paper is spread over the dressings, and the whole secured by careful bandaging. The dressings are changed daily for the first ten days or so, while the discharge is profuse and the wound large; then every second or third day, as the wound contracts and the exudation from it diminishes.

The process of repair consists in the filling up of the wound-cavity with lymph, which glazes the wound and forms a medium of union between the testes, and between these and the surface of the perineum. When this lymph undergoes vascularisation and organisation, granulations form and cicatrisation advances over the wound from the borders of the divided skin and preputial mucous membrane. The process of repair is tedious, occupying from six weeks to two months. Care must be taken to keep the penis free, as it is apt to be embedded in and retracted into the mass of granulation-tissue. Should such a result threaten, the granulations at its root may be broken down by the finger-nail, or divided by scissors if they have become firm. The ultimate result of the operation is, in the great majority of cases, satisfactory. Skin is dragged by the process of cicatrisation from the thigh to form a seemly and useful substitute for the amputated scrotum, and the penis acquires a fresh covering of cicatricial epidermis. The sexual functions are restored, and both health and comfort re-established.

The operation above described is applicable to all the forms of elephantiasis which have been specified. If the skin of the penis is quite healthy, the scrotum may be removed alone by a circular incision round its neck, the testes being dissected out as the incision is deepened.

Labial tumours in the female are removed in accordance with the same principles. If very large, their base may be transfixed and tied with whipcord before amputation is commenced; but, in most cases, the prompt use of forci-pressure forceps and sponge pressure suffice to prevent much loss of blood. The edges of the skin can be approximated or brought into contact by sutures, and the process of repair thus very materially shortened. K. McLeod.

SCROTAL SWELLINGS, Diagnosis of.—In the examination of a scrotal swelling certain points must be kept clearly in view, and this may be done by the surgeon asking himself the following questions:—Is this swelling a scrotal one proper, or does it extend into the inguinal canal or abdomen? Is it reducible or no, and, if reducible, is this real or only apparent? Is it fluid or solid? What are its relations to the testis, epididymis, or cord? Is any part of it translucent? Is it of the same consistence all over? What has been its rate of progress?

Scrotal swellings may be divided into: (*a*) those which occupy more or less of the inguinal region as well as the scrotum, and (*b*) those confined to the scrotum.

(*a*) The chief swellings here are:—1, scrotal hernia; 2, scrotal hernia with hydrocele; 3, infantile hydrocele; 4, congenital hydrocele (occasional); 5, hydrocele of cord (occasional); 6, incompletely descended testis; 7, large varicoceles (rare); 8, combined hydroceles—e.g. of the tunica vaginalis and of the cord (rare); 9, new-growths of the cord—e.g. lipomata, malignant (still rarer).

The method of handling any scrotal swelling is important. The left hand should take hold of the upper part or neck of the swelling, so as to steady the tumour; then any impulse on coughing can be felt for, and, at the same time, by a gentle downward squeezing movement, the rest of the swelling is pressed forward, and the scrotal tissues over it stretched, the fingers of the right hand being free to percuss, or otherwise examine into the nature of the swelling.

1. *Hernia* is one of the commonest scrotal swellings, being met with in children as well as later on in life. It may be known by the impulse at the neck, its ready reducibility (usually) on the patient's lying down, with slip or gurgle, the facility with which now the external ring and cord can be felt, its speedy descent when the patient stands up and coughs, and its lack of translucency. The thickened tissue felt in the scrotum after the return of the hernia is merely the sac, and not to be taken for anything more abnormal. If the hernia is irreducible, there will still be impulse, the feeling of coils of bowel or of granular omentum; and the irreducibility will be either temporary—due to neglect of the bowels or disordered digestion—or permanent, owing to repeated 'bowel attacks,' accompanied by slight colicky pains.

2. A hernia is frequently complicated with hydrocele (*see* below).

3. *Infantile Hydrocele.*—A sub-variety of the congenital, in which the fluid usually extends as far as the external abdominal

ring. Its smooth outline, transparency, and history are main points, while its irreducibility, and fluctuation without gurgling, distinguish it from hernia.

4. *Congenital Hydrocele.*—This is dull on percussion and translucent, the impulse is much less distinct; its reduction is generally perfectly easy when the patient is recumbent, but occasionally requires steady pressure; it is unaccompanied by any slip or gurgle unless a congenital hernia is also present.

5. *Hydrocele of the Cord.*—The fluid here is usually encysted, and is most frequently due to part of the processus funicularis remaining unobliterated, more rarely to some independent collection of fluid becoming encysted in the connective tissue of the cord. In the former case it will have been noticed from birth or from early childhood, in the latter it may date from an injury or strain. The swelling is often mistaken for a hernia, and a truss ordered. The following are the chief distinguishing points:—Usually oval in shape, the swelling is found to be limited above and below—i.e. when drawn down it has no neck; so, too, when drawn down, the impulse is less and less distinct. It cannot be completely and distinctly returned; though often tense, fluctuation can sometimes be made out; and by using a candle in a dark room and lifting the swelling up, translucency can usually be observed.

6. A *retained testis* often forms a swelling in the groin or upper part of the scrotum. Its shape, sensitiveness, mobility, and the empty scrotum are decisive. If retained in the inguinal region, a testis may be the seat of orchitis in recurrent crippling attacks. Some of these may be so acute that the swelling may simulate a strangulated hernia. Thus the attack may have come on after a strain, the patient persisting in his statement that he has always had a rupture which came down and went up again. The parts are exquisitely tender, and do not admit of handling; most acute pain may be present in the lower part of the belly, accompanied by nausea and constipation. On careful examination the scrotum is empty, no truss has ever fitted, the rupture has never been really reducible, and unless peritonitis be present, which is not common, the symptoms will be less urgent than those of strangulation; thus the vomiting will not be more than bilious, and flatus at least will be passed. If, after a few hours, treatment does not clear up the case, the diagnosis should be made certain by antiseptic exploration.

A testis retained in the inguinal region is liable, after repeated attacks of inflammation, to become the seat of malignant disease, and form a swelling in the groin and upper part of the scrotum. It will be known by the absence of the testis from the scrotum, the history of repeated inflammatory attacks, the steady increase in size, and painfulness of a swelling, which, chiefly solid, shows fluid at one or more spots. Lastly, the absence of a testis from the scrotum will prevent the surgeon from mistaking a retained testis, which is the site of acute epididymitis, for a bubo.

(*b*) The chief scrotal swellings proper are:—1, hydrocele (vaginal and encysted); 2, hæmatocele; 3, orchitis; 4, syphilitic testis; 5, epididymitis; 6, strumous testis; 7, new-growths; 8, varicocele.

1. A *vaginal hydrocele* is known by the absence of impulse, by its pyriform shape, fluctuation, and almost unvarying translucency. The testis is at the back, as shown by its sensitiveness and opacity. The increase has been slow, painless, and usually occurs in patients of middle or later life, though it is not uncommon in younger men after strain, injury, or in association with acute epididymitis.

An *encysted hydrocele* is recognised by its position to the outer side of, and rather anterior to the testis, its fluctuation, its shape—globose rather than pyriform—and much slower growth.

Swellings in which different hydroceles are combined—e.g. one of the tunica vaginalis and an encysted hydrocele—are met with, and may at first be difficult of diagnosis. A very common combination is hydrocele of the tunica vaginalis with scrotal hernia, and in the later stages of this combination, when the two swellings have come into close contact with each other, the diagnosis is a matter of some doubt at first, especially when the hernia is irreducible; but if attention is paid to the points already given, there will be no real difficulty.

2. A *hæmatocele* will be known, when at all recent, by its rapid onset after a blow or the tapping of a hydrocele; its condition, at first fluid, then more solid; its weight and want of translucency, and the position of the testicle at the back. A little later, especially if the patient get about, tenderness, redness, and œdema of the scrotum will point to an inflamed hæmatocele.

3. *Orchitis*, or inflammation of the testis itself, may be met with as an acute, subacute, or chronic affection. The acute is usually due to a blow; it is rare, though epididymitis (owing to some urethral cause)

is often called orchitis. Subacute orchitis may be due to a blow, the congestion which goes with ungratified and unrestrained sexual desires, or it may occur in the course of an attack of gout or mumps.

Chronic orchitis may be confused with an old hydrocele, hæmatocele, or some of the new-growths of the testis.

4. *Syphilitic orchitis* may present itself as a diffuse chronic inflammation of the testis two or three years after contagion, or later on as a gummatous affection, or the two may be combined. In the former, the swelling may reach the size of a large egg or small orange, the smooth heavy mass being devoid of testicular sensation; both testes may be affected. In the gummatous orchitis the enlargement is less, and the surface may be knotty. Both are insidious, both may be accompanied by subsequent wasting.

5. *Epididymitis*, in its acute and subacute forms, is one of the commonest of scrotal swellings. Its diagnosis will be aided by remembering that it is nearly always due to some urethral irritation, most frequently gonorrhœa. It shows itself as a rapidly forming swelling, acute and tender, at the outer and back part of the testis, from which at first it is separated by a distinct furrow. The swelling is flat-sided, the scrotal tissues red and a little œdematous, and some fluid is usually present in the tunica vaginalis. Nausea, chilliness, pyrexia accompany it, and probably some deep-seated pain has been noticed creeping along the inguinal region and cord, and the vas deferens is thickened and tender.

6. *Strumous testis.*—This obstinate affection usually begins as a painless insidious nodule in the head or tail of the epididymis, which tends ultimately to soften and gradually to perforate the scrotal tissues which have become adherent to it. The condition of other parts—the testis, vas deferens, and prostate—should be examined into for thickening and enlargement: the bladder for cystitis, and the kidney for any evidence of strumous pyelitis. A history of chronic inflammation of joints and glands, or of phthisis, will aid in the diagnosis.

7. *New-growths of testis.*—Where these are rapid in their growth and results, as in the case of encephaloid carcinoma or round-celled sarcoma, the diagnosis is not difficult; but where the progress is slow, where for some time the consistency keeps firm, the cord is not involved, and the patient's health remains good, as is often the case in a spindle-celled sarcoma, a chondro-sarcoma, or in the earlier stages of 'cystic disease of the testis,' the diagnosis is by no means so easy, especially as the history of repeated slight injuries may suggest orchitis. *See* Testis, Diseases of the.

8. *Varicocele.*—This, one of the commonest of the affections in the scrotum, will be known by the soft, worm-like, bluish coils of enlarged veins around and along the cord, the relaxed scrotum, and the dropped testicle. When extending into the canal, a varicocele shows impulse when the patient coughs; but this is less distinct than in hernia, and alteration in the size of the swelling is only noticed when the patient has been on his feet or resting for some considerable time. It is not completely reducible, and if the surgeon, having got up all he can while the patient is lying down, place his finger over the external abdominal ring, and tell the patient to rise, the swelling gradually reappears below the finger.

W. H. A. Jacobson.

SCROTUM, Injuries and Diseases of the.—*Contusions* may occur from falls on the edge of a chair, on a rail, pommel of saddle, &c, and owing to the looseness of the tissues, much extravasation may take place. This is often complicated with hæmatocele, but, if existing by itself, may be known by its superficial position and its crossing the scrotal raphè.

Treatment.—In severe cases absolute rest in bed should be enforced, and the scrotum be kept well raised by a suspensory bandage and a small firm pillow. A smart purge should be given, and its action gently kept up, and a cooling lotion—lead, or lead and opium—constantly applied. Where the coexistence of a hæmatocele is suspected, ice should be applied, but, except in strong and healthy subjects, it will be well to place a layer of lint next the skin. If the ice does not produce material relief within two hours, its use should be discontinued, and lotions, at first cold, then warm, gradually substituted, in order to prevent too rapid changes and sloughing of the scrotum.

If, later on, any thickening of the scrotum be left, it will be well to rub in oleate of mercury (5 p.c.), or to use counter-irritation by iodine.

Wounds.—These may be incised or lacerated, the results of falls, machinery accidents, or attempts at mutilation. In the case of a recent incised wound, after cleansing the parts and arresting hæmorrhage, it will be well, owing to the disturbing effect of the dartos, to draw the edges of the skin together with fine silk sutures, not passing them sufficiently deeply to

open up the cellular tissue. Before inserting these, the testicles, if protruding, must be carefully replaced, and the scrotal tissues relaxed by warmth. Cold lotions should be applied after insertion of the stitches, and the parts be kept well supported to prevent any bagging and strain on the stitches.

In lacerated wounds, stitches must be used with great caution and only in a recent case, a few points of fine silk being employed. Warm lotions, cotton-wool, and even support are here indicated, any stitches used being removed early, and punctures made on the appearance of œdema.

Œdema, Cellulitis, and Erysipelas of the Scrotum tend to run into and complicate each other. They occur chiefly in infants, especially weakly ones of lowly life, and in adults when depressed in health, ill-fed, and exposed to cold, and often in the subjects of visceral disease. The exciting cause is injury, or a much slighter matter, a patch of erythema, an abrasion, fistula, or even merely the trickling of urine. The chief dangers are, in the case of infants, peritonitis, if the processus funicularis be patent, and, at any time of life, sloughing and septicæmia. The scrotum and skin of the penis are, no doubt, well supplied with blood, but the vessels come from a considerable distance, are flexuous, and but ill-supported in the necessarily yielding cellular tissue of the parts, the meshes of this tissue being, furthermore, easily loaded with inflammatory products.

Cases of œdema, cellulitis, and erysipelas of the scrotum are to be carefully distinguished from those of extravasation of urine, which they closely simulate, by the absence of any previous urinary trouble, and by the facility with which a catheter can be passed. The history of a painful, localised swelling in the middle line—e.g. a perineal abscess observed before the appearance of the more general swelling—will also be absent. As long as the œdema or redness is slight, elevation of the parts, keeping them very dry and dusted with zinc and starch powder, will be sufficient, locally. A little later, multiple punctures will probably be required, and when the parts are not only tense and glossy but brawny, free incisions should be made into the cellular tissue. In making these, it should be remembered that the vitality of the parts is already seriously impaired, and that needless incisions will not only, by further interfering with the blood-supply, increase the liability to sloughing, but may also excite further diffuse inflammation. For this reason punctures will probably be sufficient in children, and in adults it will not be needful to make more than two incisions on either side, one close to the raphè, about three inches long, carried well down into the lower and posterior part, and another somewhat shorter and external to this. The hæmorrhage will at first be free, but if any spurting vessels are twisted or ligatured, the oozing will be checked by pressure applied by a pad of lint and carbolic oil, over which iodoform and tannin have been dusted. Later on the carbolic oil may be replaced by saturated lotions of boracic acid, or an ointment of vaseline ʒj., ol. eucalypt. fʒj., iodof. ʒj.; prominent or weakly granulations being treated occasionally with lotions containing copper sulphate or nitric acid. The general treatment requires to be of a supporting kind.

Sloughing and *Gangrene* may follow on erysipelas of the scrotum, quite independently of any extravasation of urine, its most frequent cause. Other, but much rarer causes, are frostbite and the exhaustion of prolonged exanthemata. The changes in colour and temperature are quite unmistakable.

If there is no evidence of lesion requiring incisions, the part should be kept well wrapped up in cotton wool, in which a little powdered iodoform has been dusted, lint soaked in eucalyptus or carbolic acid oil, or poultices of yeast, charcoal, or chlorinated soda made use of, it being remembered that, as in other cases of gangrene, poultices, to do any good, must be changed frequently, and that this has the disadvantage of entailing frequent exposure. Later on, sloughs should be clipped away, and stimulating dressings, such as resin and tinct. benzoini co. made use of, and healing hastened by occasional applications of silver nitrate (gr. x.-fʒj.), and skin-grafting. The reparative power of the scrotum is well known; very large losses will be replaced, though the skin is now thinner, smoother, and less supple than before. Sloughing of the scrotum, and the milder inflammatory affections which may precede it—e.g. œdema and erysipelas—are usually accompanied by symptoms pointing to asthenia, and the treatment should be, from the first, supporting.

New-Growths in the Scrotum.— Of these epithelioma is the most common—'chimney-sweep's cancer'—though this disease is on the decline, owing, probably, to the use of machines in chimney-sweeping.

It usually begins as a small wart on, or as a pea-like swelling in, the skin, the disease starting in the latter case from the

irritation of a sebaceous gland or hair-follicle. In either case induration and ulceration follow sooner or later, though often insidiously, the ulceration presenting the characters of epithelioma elsewhere, viz. edges indurated, everted, and sinuous, the base of uneven depth, here greyish and sloughing, there prominent with unhealthy granulations. If left to itself, the ulceration may go so far as to expose and destroy the testicles, and involve the glands in the groin in large malignant ulcers.

Treatment.—This should be always early and free removal by the knife, aided, if need be, by caustics, such as zinc chloride and flour. As an aid to removal, a metal catheter may be kept in the urethra, and if the testicles are involved leave should be got, before the operation, to extirpate them if necessary. The inguinal glands, if merely enlarged, not densely hard, and if still movable, may be watched for a while. Where removal of the disease is not possible, the surgeon can only support the strength, relieve pain, and diminish fœtor.

A few other scrotal new-growths are very occasionally met with, viz. fibro-cystic, fatty, and fibrous; these last, though originating in the scrotum, often becoming attached to the epididymis or testis.

W. H. A. Jacobson.

SCURVY. — This is a non-febrile general disorder due to defective diet, which is manifested by the ordinary symptoms of debility, by certain scattered lesions caused by effusion of blood or fibrin, and probably by degeneration of muscles and other soft parts. These conditions are always associated with, and doubtless result from, certain changes in the composition and physical properties of the blood. Though it has long ceased to be endemic, and may now be regarded as a rare affection, scurvy is still liable, as was proved during the siege of Paris in 1871, to break out under certain conditions, and to attack large masses of people.

The symptoms of scurvy in its latest attacks differed in no respects from those described by Lord Anson and by Bachstrom, Trotter, and others in the course of the last century, and the forms of the disease, still occasionally observed in crews of merchant vessels, differ only in degree from those formerly described as typical instances. It has been shown by most recorded observations that the essential cause of the scorbutic condition is abstinence, more or less prolonged, from certain succulent vegetables or fruits in a fresh state, or from their preserved juices. It is very evident, however, that scurvy, in its origin, course, and intensity, may be influenced to a considerable extent by other conditions. In a group of individuals deprived of vegetable elements of diet, some will remain free from any scorbutic taint, if not altogether, certainly for a long time, whilst others will present well-marked symptoms at an early period.

The conditions tending to resist an attack of scurvy are good general health, sufficient and proper nourishment, and fair hygienic surroundings. Opposite conditions to these, and such as cause general debility, degenerations of tissues, and alteration in the composition of the blood, favour the scorbutic attack, and often do this so markedly that some have been regarded not merely as predisposing, but also as essential causes of the disease. The most frequent of the many faulty conditions that favour an attack of scurvy in the absence of vegetables, is a generally poor and defective diet, especially a want of fresh meat. Conditions to which much importance has been attached, and which have certainly existed in many recorded instances of sea scurvy, are those of prolonged exposure to wet and cold, and of overcrowding in damp and confined quarters. Other very favourable conditions are chronic disease attended with exhausting discharges, and convalescence from some severe and acutely febrile affection. In instances of scurvy on board ship, the first, and often the sole members of the crew to become affected, are usually the subjects of dysentery, syphilis, or chronic rheumatism. Extremes of climate, both heat and cold, have been regarded as favouring conditions, and also prolonged absence of the sun's light. There can be no doubt that prolonged service in the tropics on board ship, under bad hygienic conditions and with indifferent food, predisposes to scurvy. The fatigue caused by extreme and prolonged muscular exertion has been regarded by many as another favourable condition; whilst, on the other hand, it was asserted by Lind that there is a special predisposition to scurvy in those who, through indolence or enforced confinement, take but very little exercise.

Notwithstanding the important part played by one or more of the foregoing conditions, in most instances of outbreaks of scurvy there seems to be no sufficient reason for regarding any of them as essential causes of the disease, or as capable of producing it, so long as the dietary includes proper vegetable food. It still remains to be proved, by well-observed and properly

tested instances, that scurvy can occur in the absence of such elements of food, or that an abundant supply of fresh meat, of milk, or of blood can, during a prolonged failure in the supply of fresh or preserved fruits or vegetables, or of the juices of succulent vegetables, protect against a scorbutic attack. The long-maintained freedom of the British and foreign navies, and the records of recent outbreaks on board ship, and in campaigns and sieges, help to prove the point argued by Dr. Parkes, in 1848, that 'true scurvy is caused by a deficient supply of the organic vegetable acids, or salts of fresh vegetables.'

The subject of scurvy is usually listless and depressed, and, from the beginning of the attack, complains of stiffness and of 'rheumatic' pains in the lower limbs. In most cases he suffers from pleurodynia, and also much pain, with a sense of constriction, in the region of the heart. The pulse is slow and feeble, and there is a decided tendency to syncope, which, in severe cases of scurvy, may be brought on readily and prove fatal in any attempt at active exertion or change of position on the part of the patient. The temperature in most instances is normal or slightly subnormal. Except in extreme and complicated cases, the action of the bowels is very sluggish. The urine is usually pale, clear, and abundant in the early stages; as the disease advances, it becomes scanty and high-coloured. There is very rarely any hæmaturia; in some few cases—according to Hayem in about one-fifth—there is transient albuminuria. Chemical examination of the urine indicates, according to Dr. Ralfe, a chemical alteration in the quality of the blood, consisting in a diminution of its alkalinity, due to an increase of acid salts and a withdrawal of alkaline salts—chiefly alkaline carbonates. The skin becomes dry, harsh, and wrinkled, and presents a characteristic pale yellow colour. The mucous membranes of the lips, eyelids, and hard palate are usually very anæmic. Occasionally, the skin of the lower lid and adjacent part of the cheek is puffy and of livid tint. The dorsal surfaces of the hands and feet sometimes become œdematous, but beyond these indications there is very rarely any dropsy. The characteristic signs of scurvy are the petechiæ and patches of ecchymoses presented by the skin, and the swelling of the gums. The skin of the lower limbs and, in late stages of severe cases, that of the upper limbs and front of the trunk is marked by numerous small petechial spots, varying in tint from pink to deep red or deep brown, each of which is traversed by one of the hairs. In addition to these are larger, irregularly shaped, livid patches resembling small bruises. A common symptom of scurvy is extensive subconjunctival hæmorrhage.

In the subcutaneous cellular tissue, mostly in the lower limbs, are larger patches of diffused extravasation, which are manifested on the surface by pale blue mottling. More deeply situated under the deep fasciæ, and within the sheaths of muscles, are the so-called 'scorbutic indurations,' large masses of effused blood or blood-stained fibrin, which form hard, indistinctly circumscribed, and very tender swellings. These are most frequently observed at the back of the lower limb along the muscles of the calf and ham, and in the space between the tendo Achillis and the bones of the leg. In the former case the leg is flexed and cannot be fully extended, and movement at the knee is much restricted. The breath of a scorbutic patient is very foul, and in most cases, in the adult subject, the gums both in front of and behind the teeth will be found covered by soft fungous growths of a deep red colour, which are very vascular, and bleed readily when touched. These, like most of the other superficial lesions of scurvy, are probably due to local irritation. They are largest and most abundant about the necks of carious and dirty teeth, and in patients with sound and well-cleaned teeth are very often absent. It has been asserted that the gums of edentulous patients are never thus affected. The larger joints, the knees most frequently, are occasionally implicated in the manifestations of scurvy, becoming swollen and painful in consequence of an intra-articular effusion of a more or less blood-stained serous fluid. A frequent deep-seated lesion is the scorbutic node, formed by the deposit of a layer of organisable fibrin under the periosteum of a long bone, most frequently the tibia. Hemeralopia, as has been pointed out by Blane and Bryson, and also by some French naval surgeons, occasionally occurs in association with scurvy, and, in most of the instances, disappears simultaneously with the special scorbutic symptoms, after improvement of the diet. This affection, however, is very probably not a manifestation, but simply a concomitant of scurvy, and due to general poverty of diet rather than to absence of fresh vegetables.

In the advanced stages of severe scurvy, the superficial patches of ecchymosis in-

crease in number and extent, bullæ containing blood are formed on the surfaces of the limbs and trunk, and an increasing hæmorrhagic tendency is indicated by epistaxis and hæmatemesis, and by a discharge from the bowels of blood-stained stools. In many instances, the patient, sinking from cachexia and exhaustion, is attacked by fatal pericarditis or pneumonia.

In open surfaces, whether from recent wounds or ulceration, the influence of the scorbutic taint is shown by swelling and lividity of the margins of the sore, and by a fungous condition of the granulations. The discharge becomes very fetid, and consists either of blood-stained serous fluid or of pure blood. There is a constant tendency to bleeding from such surfaces, and the dressings are speedily stained by the dark red discharge. Any incision, however small, into the soft parts is followed by persistent oozing of blood. In these scorbutic wounds and ulcers there is usually a tendency rather to spreading than to healing. Recent cicatrices readily break down, and are replaced by open sores with fungating and spongy granulations. The seat of a recent bruise or wound, or of an ulcer, is, in a scorbutic subject, generally surrounded by a very broad zone of intense ecchymosis.

It has been recorded that in scurvy the bones become fragile, and liable to fracture on the application of slight force, and that the fragments show but little, if any, tendency to unite. In some cases of previous fracture in which the fragments had joined, there was a tendency, it has been stated, for the callus to become absorbed. Such results, however, were probably due to an association with scurvy of one or more of the ordinary causes of general debility, and, in some instances, to the action of mercury, which was formerly so freely and indiscriminately administered on board ship.

The proper treatment of scurvy is, as a rule, most satisfactory in its results, as all the symptoms, both local and general, will readily disappear on the supply of a good mixed diet, including abundance of fresh succulent fruits and green vegetables, and lime or lemon juice in the form of lemonade. W. Johnson Smith.

SEBACEOUS CYSTS are among the most common varieties of simple tumours. They may occur in any region of the body except on the palms of the hands and soles of the feet, where sebaceous glands are absent. These latter open, as a rule, into the hair-follicles, but, occasionally, they discharge their secretion directly upon the surface of the skin. The cysts may be either congenital or acquired, and may vary from the size of a pea to that of a large orange. The acquired variety appears at any age after puberty, but most frequently in middle life. These cysts are essentially tumours of and in the skin, and are most frequently seen where the hair is abundant and the sebaceous glands are numerous, as on the scalp and face, about the entrance to the various passages of the body—the anus, lips, nose, and ears—and on the back of the neck, and over the scapulæ. The skin of other parts may be the seat of these tumours. The writer has removed one, the size of a walnut, due to obstruction of the mouth of a follicle, from the skin of the abdominal wall of a young girl. The axilla, though covered with hair and sebaceous glands, is remarkably exempt. The contents of a cyst consist of inspissated sebaceous matter, which has a peculiarly offensive odour. Under the microscope, cholesterine crystals are visible, and, in some cases of congenital scalp-cysts, fine hairs are found as well as epidermal matter. The cyst-wall may be either thin and delicate, or hard and thick, and strengthened within by many epidermal layers. The inner surface of the cyst-wall is smooth, rough, or reticular; and the contents are of no constant colour, and vary from their usual character, as above described, to the pearly tumour of Virchow or to a honey-like consistence.

Sir James Paget has divided the acquired variety of sebaceous cyst into two classes—those in which a black spot can be found upon the surface of the tumour, indicating the orifice of an obstructed follicle; and those in which no such orifice can be detected (as frequently happens on examination of a scalp-cyst), and in which the cyst probably owes its existence to some hereditary taint, and should be classed under the head of new-formations.

A dermoid cyst of the scalp is a congenital sebaceous cyst, and is often seen near the outer angle of the orbit. It frequently involves the wall of the cranium, is usually visible at birth or a few days later, but may be noticed first only at the end of the second or third month of life. When placed in or near the median line, the diagnosis from meningocele is sometimes almost impossible. *See* Meningocele. On the scalp the acquired variety occurs, as elsewhere, most frequently in middle life, is not seldom multiple, and in rare instances, by gradual increase in size during many

years and the consequent gradual absorption by pressure of surrounding parts, involves the cranial vault. The tumour or tumours are hard or tense and fluctuating; round, oval, or, if large, irregular in shape, and movable. When a sebaceous cyst inflames and ulcerates, the diagnosis from epithelioma is not always easy; the proliferating surface and offensive secretion being so like the latter disease. *See* SCALP, Injuries and Diseases of the.

A fatty tumour can be distinguished from one of these cysts—(1) by the locality in which it is situated; (2) by its lobulated outline; (3) by the fact that it lies beneath the skin, which can be pinched up over the tumour, and thus thrown into characteristic wrinkles. Spontaneous changes are apt to supervene in these tumours, without even a history of slight injury. If inflammation comes on in this way, much care must be taken in the management of the case.

Horns not infrequently originate in accumulated sebaceous secretion, and have at their base a collapsed sebaceous cyst.

Of the rare forms of sebaceous cyst may be mentioned those situated completely within the skull, within the abdominal cavity or in the palate, mouth, tongue, testicle, submaxillary region or neck. Those found in the abdomen, which contain hair, teeth, bone, cartilage, &c., can hardly be looked upon as within the scope of this article, though their contents are largely made up of sebaceous matter. *See* ABDOMINAL TUMOURS, Diagnosis of.

The cysts which occur beneath the deep fascia of the neck are interesting from being easily explained as due to the incomplete coalescence of the branchial arches, or the incomplete obliteration of one of the clefts, usually that between the second (hyoid) and third (thyro-hyoid) arches. They form oval or elongated tumours, which are soft and putty-like to the touch, and whose contents are easily displaceable on manipulation. There is, as a rule, one cyst, limited to either the right or left side of the neck, situated in the region of the hyoid bone, and which may or may not have been visible at birth. After its first appearance, it gradually increases in size to a certain point and then remains stationary. No pressure-symptoms are produced on the surrounding organs.

The deep submaxillary sebaceous cysts lie between the mandibular and hyoid arches, are placed laterally or in the mesial line, and are liable to be mistaken for ranula.

Treatment.—A sebaceous cyst can best be removed by dissection, or by transfixion and subsequent avulsion of the wall of the sac. No part of the latter must be left, or troublesome after-consequences will ensue in the shape of continuous offensive discharge, an unclosed wound, and a permanent sinus. Operations upon these cysts should never be lightly undertaken, especially when there is more than one cyst or when the scalp is affected, and never except in persons in perfect health. If spontaneous inflammation occurs, an incision may be made into the cyst and other means be used to subdue the inflammation, but no attempt at removal is justifiable until all inflammatory action has disappeared. An ulcerated sebaceous cyst requires excision; so also does a horn of sebaceous material with a cyst at its base. The employment of caustics has been recommended (e.g. the liquor hydrargyri nitratis acidus), as it is said that erysipelas does not follow their use, and that patients are particularly susceptible to this disease after the more formal operation with the knife. Caustics are very tedious and painful in their action, and the surgeon had much better rely upon the means at his disposal for securing asepsis, than stake his reputation upon the prolonged application of an escharotic. In any doubtful case, the hair should be shaved for some distance around the tumour, the skin washed with soap, cleansed with ether, and every other device employed during and after the operation to keep the wound aseptic. The operation upon a congenital cyst of the scalp is more difficult than that upon the more common acquired variety, partly on account of its greater depth from the surface, and in part because of the thinness and delicacy of the cyst-wall and its adherence to the bone. It is to be remembered that a congenital cyst may completely perforate the skull and lie in contact with the dura mater, so that great caution is necessary in deciding upon operative measures.

On the face these cysts are easily dealt with. The incision need not be long, or much disfigurement will result, and should be made in a direction depending upon the locality. The contents can then be squeezed out, the cyst-wall seized with forceps and dragged out forcibly, through even a very small opening. These face-cysts are most common in the skin of the side of the face, in front of the external ear.

The sebaceous cysts which lie beneath the deep cervical fascia can be divided, from the point of view of treatment, into two classes—(1) those which are very difficult to remove, since they run beneath the carotid sheath, and are often attached to the side of the pharynx and hyoid bone; (2) those

which do not present these difficulties during the operation of excision. In the former case, either the whole or the inner and deeper part of the branchial cleft is represented by the tumour. In the latter, we may suppose that the inner or deeper part of the cleft has been obliterated by the fusion of the branchial arches, whilst the outer part remains open through the cessation of the developmental processes, and subsequently becomes the *fons et origo* of a congenital sebaceous cyst, which is situated beneath the deep cervical fascia, and yet presents no great difficulties in removal.

Excision is the only treatment to be recommended for deep submaxillary sebaceous cysts. Any less radical measure, such as the use of a seton or setons, would almost certainly fail to obliterate the cyst, and would, if attempted, expose the life of the patient to considerable danger, on account of the facility and rapidity with which inflammation can spread to the larynx.

CHARLES A. BALLANCE.

SEBORRHŒA (*Synon.* Steatorrhœa; Dandriff). — *Definition.*—Seborrhœa is a disorder of the sebaceous glands, characterised by the deposit, on the surface of the skin, of oil or dried fatty matter.

Cause.—Frequently ill-health, chlorosis, exhausting diseases, phthisis, cancer, &c. In some cases the condition accompanies good health; occasionally it seems due to personal neglect.

Pathology. — A functional disturbance of the sebaceous glands, probably affecting both the quality and quantity of their secretion, which, instead of lubricating the surface in the normal way, is recognisable as an oily deposit or coating of dried fatty scales. It is commonest in situations where the skin is most abundantly supplied with glands—e.g. the scalp, face, nose, genitals. The deposit is found to consist of fatty matter and epidermal scales. The process may lead eventually to atrophy of the glands and hair-follicles.

Symptoms. — Two varieties are described, according to the nature of the deposit—(1) Seborrhœa oleosa, and (2) seborrhœa sicca.

Seborrhœa oleosa is rarely seen on any part but the face (nose, cheek, forehead), or bald scalp. The skin has a shiny, oily appearance, occasionally a dirty look from the admixture with the fatty deposit of carbon or dust of the atmosphere. The fat can be wiped off with a cloth, the surface is often reddish and cold, the orifices of the follicles being widely open or plugged with comedones. This form of seborrhœa is rare, and is said to specially affect spirit-drinkers with fatty livers.

Seborrhœa Sicca.—The affection varies somewhat according to situation; hence are described—

(*a*) *Seborrhœa Capitis.*—This is by far the most common form: the sebaceous secretion dries on the surface of the scalp into thin, white, branny scales, known popularly as *dandriff*. These scales are constantly being removed by brushing, and fall about the shoulders; or they are thicker and yellowish in colour, caked upon the scalp or matting down the hair. Seborrhœa capitis generally affects the entire scalp, but it occasionally occurs in patches. On raising the scales, the skin beneath is seen to be of a characteristic leaden grey colour; more rarely it is of a pinkish or red colour, from the presence of some amount of inflammation. These latter cases are sometimes accompanied by burning or itching, with epidermal desquamation, and are probably more allied to eczema.

If the affection has been present for some time, there is more or less thinning of the hair, which may go on to permanent alopecia in consequence of the destruction and atrophy of the hair-follicles.

In infants, the scalp is frequently the seat of seborrhœa, which may be considered as a persistence of the physiological seborrhœa (vernix caseosa) of the newly born.

(*b*) *Seborrhœa Faciei.*—The forehead, nose, and cheeks are the parts usually attacked. These present a mask-like covering of greasy scales, in colour varying from a pale yellow to a dark olive-green, according to the complexion of the individual and the admixture of dirt. On peeling off the scales, little processes or plugs are seen on their under surfaces, corresponding to the orifices of the follicles. Some itching and hyperæmia may be present.

(*c*) *Seborrhœa Genitalium.*—The glands in this situation frequently present the seborrhœic condition. A white, soft, cheesy deposit is seen, in the male, on the glans penis and sulcus, in the female about the labia and clitoris; its decomposition may lead to irritation, resulting in balanitis in the male. In young females, the resulting inflammation may be of medico-legal interest.

(*d*) *Seborrhœa Corporis.*—Duhring describes, under this name, a variety of seborrhœa affecting the back between the shoulders, or the sternal and clavicular regions. It occurs in circular patches with pale reddish base, and grey or yellowish

scales; the patches frequently run together, and the appearance may closely simulate tinea circinata. The affection known in this country as lichen marginatus or circinatus is comparable.

Diagnosis from eczema, psoriasis, lupus erythematosus, tinea. On the face or scalp, seborrhœa may simulate eczema; the trivial itching, the absence of serous exudation and infiltration, in seborrhœa, are in marked contrast to the symptoms of eczema. In typical seborrhœa capitis, the pale anæmic scalp is quite different to the red scalp of eczema. On the scalp seborrhœa may simulate psoriasis, but the evenly spread greasy scales, with the pale skin beneath, are unlike the uneven, mortar-like scales of psoriasis, with its constantly accompanying inflamed condition of the skin beneath. In seborrhœa faciei the processes on the surfaces of the scales are very characteristic.

The name first suggested for lupus erythematosus—viz. seborrhœa congestiva—indicates the similarity which may exist between their objective symptoms. Reliance should be placed on the deeper redness or violaceous tint of lupus, its defined limit or line of demarcation, its infiltration and constant scarring, its tendency to affect the helix of the ears and to occur in subjects liable to chilblains.

Treatment.—When indicated, the hygienic surroundings should be improved; fresh air and moderate exercise should be ordered, especially in chlorotic females. Cod-liver oil and iron will be found the most useful internal remedies; the latter may be advantageously combined with arsenic. Calcium sulphide is recommended in doses, gr. $\frac{1}{10}$—$\frac{1}{5}$, thrice daily.

Local treatment is most important, especially for seborrhœa capitis. Scales must first be removed; this is best done by thoroughly saturating the scalp with olive oil at night-time, a closely fitting flannel cap being worn for the night. In the morning, the head should be washed with solution of equal parts of soft soap and alcohol. This is rubbed over the scalp and a lather produced with flannel and hot water. After all soap is removed and the hair is dried, a little almond oil may be applied. Care should be taken to warn the patient that the washing will remove all loose hair. The washings should be repeated, as directed above, every two days until all scales are removed; longer intervals may be allowed if there is much irritation produced by the soft soap.

The after-treatment consists in the use of a stimulant application—e.g. ℞ Acidi carbolici liq. fʒss.; Ol. amygdalæ dulc. fʒss.; Alcoholis fʒv.; Ol. bergamot q.s. To be sponged on the surface of the scalp night and morning; or the following pomade may be rubbed on the scalp with the fingers:—℞ Pulv. hyd. oxid. rub. gr. v.; Adipis præp. ʒj.; Ol. bergamot q.s. It is not necessary to cut the hair.

The above treatment is applicable also to seborrhœa occurring on the non-hairy parts.

For seborrhœa of the genitals, washing with ordinary soap, combined with the after-application of an astringent alum wash, is sufficient. Alfred Sangster.

SENILE GANGRENE. *See* Gangrene.

SEPARATION OF EPIPHYSES.—The traumatic forms only will be considered in this place: those arising from constitutioual causes, or from disease in adjoining parts, having been dealt with under Epiphyses, Affections of.

It is manifest that this accident can only befall individuals in whom the epiphyses have not become joined to the shafts by bony union—that is to say, it can only occur up to about twenty-one years of age; in the majority of cases the patients are much younger. In one case, however, recorded by Bruns, the accident happened to a man in his twenty-fifth year. Apart from the cases occurring during childbirth, of which many instances are recorded by French authorities, undoubted cases occur in quite early childhood. Hamilton mentions a case at the shoulder-joint at thirteen months of age; Holmes one of the femur (lower) at eighteen months. It might be supposed that young children would be most liable to this form of injury; but statistics negative this conclusion, and show that it is most frequent between twelve and seventeen years of age. It seems reasonable to explain the immunity of younger children, by supposing that they are less exposed to the kind of accident which brings about this special form of injury. Owing to the difficulties of diagnosis, it is not improbable that many cases go unrecognised. The separations may be either simple or compound, single or multiple, partial or complete, and accompanied or not by other injuries, which may require independent treatment.

Causes.— Epiphysial separation may result from violence applied directly to the seat of injury, such as the passage of a cart-wheel over a limb near a joint; or from a

fall from a height, as from an upper storey window or into a ship's hold; or from the entanglement of a limb, in the spokes of a waggon-wheel or in moving machinery, exercising traction upon the joints; or from muscular violence, and occasionally from suddenly raising a child by its limbs. The injury has also been produced by traction on the limbs during childbirth. The most frequent cause is a fall from a height, and then, not seldom, several epiphyses may be implicated as well as other injuries inflicted. Thus, Mr. Hutchinson records the case of a sailor boy aged fourteen, who fell from the masthead, and sustained a fracture of his clavicle, and separation of the lower epiphysis of one humerus and of both epiphyses of the other. Mr. Holmes records a case of separation of the lower epiphysis of the femur and of the tibia, and probably also of both epiphyses of the fibula. The case is on record of a girl who pushed her toes under a door; in trying to withdraw them she separated the epiphysis from the shaft of the first phalanx of the great-toe. A boy, aged nine years, when playing at leap-frog, fell, his hand coming violently on the ground, and separated the lower epiphysis of the radius. Mr. Heath reported to the Clinical Society the case of a boy, aged fourteen, who, whilst raising his arm violently to bowl at cricket, felt something give way at his collar-bone. It was found that the epiphysis of the clavicle had become separated. The experimental production of this condition is most easily accomplished, at the ginglymoid joints, by an excess either of extension or of lateral movement; at the enarthrodial joints by an excess of abduction (Gurlt). Traumatic separation of the lower femoral epiphyses has been advocated in, and practised for, genu valgum. Although many cases have been treated in this manner, but very little subsequent interference with the growth of the limbs appears to have occurred, notwithstanding that separation of other epiphyses had been unintentionally produced at the same time.

Pathological Anatomy.—The points of chief pathological interest are—(1) does the injury occur exactly at the epiphysial line or does it involve some part of the shaft also? and (2) what are the effects of such an injury on the future growth of the bone? As regards the first point, there can now be no doubt that the separation may and does occur without any implication of the shaft: for such cases have been seen by competent authorities. In some of the compound cases, the extremity of the shaft has been found projecting from the wound, and has thus placed this question beyond all dispute. What occurs in the case of a compound injury may also occur in a simple one. Nevertheless, the line of separation seldom runs accurately across the line of junction; the displaced epiphysis carries with it some portion of the diaphysis. 'The importance of the question,' says Mr. Holmes, 'about the precise position of the line of fracture is this: if the fracture be really a laceration of the epiphysial cartilage, this structure may be expected to be more or less altered by the inflammatory processes necessary for the cure of the injury. The ossifying tissue may consequently be permanently damaged, and loss of growth may result; on the other hand, if the injury be confined to the diaphysis, no such consequence seems likely to follow.' In some cases a considerable wedge of the diaphysis, together with its periosteum, may be included. The exact condition, as well as the subsequent course of events, is probably influenced by the age of the patient.

If the accident occurs in an adolescent, in whom growth and ossification are nearly completed, there is every probability that some portion of the diaphysis will be torn away; on the other hand, secondary consequences will be less marked; whereas, in a child, the greater amount of soft new bone along the line of junction and the greater general elasticity of the diaphysis render detachment of the epiphysis more easy, and fracture of the shaft less probable. *Per contra*, the repair of such an injury, even under favourable circumstances, must for a while, if not perhaps permanently, interfere with the growth of the bone. The extent of this interference will depend in some measure on the nature of the accident and on the amount of local injury; and when any arrested growth does follow, its effects will always be marked in proportion to the extent to which the bones have still to grow. The relative part played by the different epiphyses must, of course, be borne in mind in estimating the probable loss of growth, which may ensue in any given case: thus the humerus grows chiefly from its upper (in the proportion of two to one), the femur from its lower, epiphysis; and so, too, with the other long bones.

Separation of the epiphyses is by no means uncommon in early infancy, as the result of disease. The absolute integrity which may be re-established sufficiently shows that arrested growth is by no means a necessary sequel of separation, and it can hardly be doubted that many traumatic cases recover without ill-effects. It would

seem, therefore, that the results depend a little on whether, after accident, the parts can be put in thorough apposition. Probably, this depends on whether any and what portion of the shaft is displaced, together with the epiphysis, and to what extent the periosteum has been stripped up. Stripping up of the periosteum, to an extent not usually found in fractures, is quite a pathological feature of separation of the epiphysis, and is explainable by the greater thickness and vascularity of the periosteum, and by the intimate connection between epiphysis and periosteum which normally exists, and especially at the period of life when this form of accident is common. There is naturally great danger of synovitis, purulent or otherwise, with all the sequelæ which such a complication entails. From this cause suppuration not infrequently occurs, necrosis of either shaft or epiphysis being sometimes the result. Among the secondary pathological features, must also be mentioned atrophy of muscles and loss of power in the affected limb consequent on disuse. Mr. Bryant has recorded a case of separation of the lower extremity of the humerus, in which the displaced anterior border of the diaphysis so injured the brachial artery as to occlude it—recovery, however, taking place.

Symptoms and Diagnosis.—(General). The diagnosis of these injuries is often extremely difficult, and rests on a combination of symptoms rather than on any special one. A separation may reasonably be suspected when an injury, in a young person, partakes of the nature both of a dislocation and of a fracture. The crepitus in a separation of epiphysis is not always distinct as in fracture (it may be entirely absent); on the other hand, there is often unusual mobility for a dislocation. Unlike a dislocation, reduction is not accomplished suddenly and with the jerk peculiar to this injury, nor does the patient get the same comfort as after the reduction of an ordinary dislocation; moreover, the displacement recurs much more frequently and readily, where there is separation of the epiphysis than after a true dislocation has been reduced, and it is often a matter of difficulty to maintain the bones in coaptation. The amount and direction of the displacement, in any given case, will vary with those of the applied violence. In all cases of doubt, the symptoms should be contrasted with those usually found in a fracture near, and in dislocation of, the joint in question, and the correct diagnosis be arrived at by the method of exclusion. In many cases of direct injury in the neighbourhood of joints, with open wounds, separations of the epiphysis may be found; the nature of such cases will, however, be obvious. Not improbably, the other injuries will absorb attention and control the treatment; the chief difficulties will be experienced in uncomplicated cases, the symptoms of which will naturally vary with the joint affected. Theoretically, the epiphyses of any of the long bones may be separated by injury; in actual practice, however, some bones are found to suffer more frequently than others. In 100 collected cases, Bruns gives the following ratios:—Humerus—upper epiphysis, 11, lower, 4; ulna—upper epiphysis, 1, lower, 2; radius—lower epiphysis, 25; femur—upper epiphysis, 2, lower, 28; tibia—upper epiphysis, 4, lower, 11; fibula—upper epiphysis, 3, lower, 4; metatarsus, 2; pelvis, 3.

Shoulder-joint (upper epiphysis of the humerus).—Generally there is swelling of the joint, which must almost necessarily be opened, but the amount will depend on the nature and severity of the injury. In all the recorded cases, the shaft of the humerus has been displaced forwards and upwards (the pectoral muscles assist in this) towards the coracoid process, where it can be seen and felt; it is, nevertheless, conceivable that violence applied to the front of the joint would displace the shaft in an opposite direction. The extremity of the bone is smaller and not so smooth as the normal head, nor so sharp and angular as in fracture. The head of the bone can be felt in the glenoid cavity; it can be made to move independently of the shaft, as the shaft can be rotated independently of the head. On making traction at the elbow, with the thumb pushing the shaft back to its normal position, crepitus will sometimes be felt; there is usually no difficulty in placing the elbow in contact with the side, differing in this respect from a dislocation. If the separation is complete there will be shortening, as in fracture of the surgical neck. The axis of the limb is directed downwards, outwards, and backwards; over and above this injury there may, of course, be others.

Elbow-joint (lower epiphysis of humerus).—Here, again, the symptoms and diagnosis may be complicated or not with swelling or external wound. The usual displacement is backwards. Given, an elbow-joint in a young subject having the appearance after an accident of a dislocation backwards, the triceps muscle arched, with

the sharp prominent extremity of the shaft of the humerus visible or tangible in front of the joint, separation of the epiphysis would be a justifiable diagnosis; if the bony prominences (the condyles of the humerus above, and the head of radius and the olecranon below) could be distinctly made out, their proper relative positions in an otherwise obscure case would be strongly confirmatory of this diagnosis. A dislocation after reduction would show less tendency to relapse than a separation, and its mode of reduction would be different: the elbow is flexed.

Wrist (lower epiphysis of the radius).—Mr. Holmes says that this injury 'differs from Colles' fracture in its symptoms, inasmuch as it does not present that obliquity of the hand which is a marked feature in many cases of the other injury.' R. W. Smith gives a further means of distinguishing it by saying that the projection on the palmar aspect of the forearm is more marked than that on the dorsal, and that the sulcus which limits the dorsal tumour is horizontal instead of being oblique. In this, as in most other cases, the relative positions of bony prominences are of importance; in a dislocation of the hand, the styloid process assumes an abnormal position, but in separation from the shaft, the radial epiphysis follows the hand, and maintains its normal relative position. Cases are recorded in which the epiphysis of the ulna is displaced also; in other cases there has been fracture, low down, of the shaft of the ulna.

Hip-joint (upper epiphysis of the femur). The symptoms of this exceedingly rare injury can 'in no respect be distinguished from the fracture within the capsule' (Chelius); the latter, however, occurs almost solely in elderly persons. South records a case in a boy ten years of age, who fell out of a window on to his left hip. 'The foot was slightly turned out, and scarcely any difference in the length of the two limbs could be observed; the hip could be readily moved in any direction without much pain, but, on bending the knee and rotating the limb outwards, a very distinct *dummy sensation* was felt;' he made a good recovery. In another case, there was crepitus, eversion of the foot, and shortening to the extent of one inch (Post). The writer has seen a case which simulated hip-joint disease. De Morgan related the case of a young man age nineteen; while standing on some movable steps, they slipped from under him, and he was thrown four feet on to the flags below, striking the back of his hip with great violence against the edge of some railings. The symptoms were eversion of foot, the outer surface of the trochanter looked backwards, there was one and a half inch real shortening (which was readily reduced, and as easily recurred). The trochanter, less prominent than on the opposite side, rotated with the shaft; there was obscure crepitus. He recovered with bony union.

Knee-joint (lower epiphysis of femur).—Separation of this epiphysis is much more common than the preceding one. It *may* occur laterally. Bryant records a displacement inwards, but the most common displacement is forwards. Speaking of this injury, Bryant says: 'A displacement of the lower epiphysis of the femur may be mistaken for dislocation of the knee, and in young subjects, where this latter accident is supposed to have taken place, the surgeon should always consider the probability of the injury being of the former kind.' Charles Bell records two cases. One was followed by suppuration in the knee-joint, with secondary perforation of soft parts by the femoral diaphysis; the other (caused by the limb becoming entangled in the spokes of a wheel) had to undergo amputation four years later on account of an aneurism caused by the displaced diaphysis. The knee-joint may escape being opened, as in a case recorded by Hawkins.

(Upper epiphysis of tibia).—In a case of double genu valgum, in which Delore had purposely detached the lower epiphyses of the femurs, the patient (a boy, aged seven) dying of measles on the twenty-first day, the epiphyses of the right tibia and of the left fibula were found ruptured. Traumatic cases are recorded with multiple injuries, where amputation has had to be practised in consequence of necrosis and of suppuration in the knee-joint (and ankle-joint also—Fischer).

Ankle-joint (lower epiphysis of tibia). These generally result from a high fall on to the soles of the feet, the momentum carrying the body forwards, so that the epiphyses and the feet are displaced backwards. Such cases will resemble a dislocation of the foot, from which it will be differentiated by the relative positions of the malleoli and feet remaining normal; the sharp edge of the lower extremity of the tibia will be perceptible in front.

As quite exceptional cases, may be mentioned—the 'epiphysial ends of the pubes and ischium separated in the hip-joint in a case of fracture of the pelvis' (Holmes); separation of the epiphysis of the great

trochanter of the femur (Key; McCarthy); separation of the epiphysis of the two anterior iliac spines, along with that of the head of the femur (Bousseau); separation of anterior superior iliac spine from muscular action (Maunder); separation (with suppuration) of the epiphysis of the tuber ischii following a kick (the writer); separation of the symphysis pubis, from being run over (Holmes); separation of the epiphysis of the first phalanx of the great toe—'the head of the metatarsal bone could be felt intact, with a rounded movable piece adherent to it, upon which the toe appeared to play' (Gascoyen).

Treatment.—It has been pointed out that cases of this injury vary very much among themselves, and thus no hard and fast line of treatment can be laid down. In cases of simple injury, the first care, and often the most difficult problem to solve, is to reduce the displacement and apply such a splint or bandage as will maintain the limb in its normal position. Plaster of Paris will be found very effectual; it must be put on carefully, with a good layer of wadding next the skin—not too tight, yet firm enough to prevent re-displacement (by muscular action or the patient's movements)—and the whole limb must be kept at rest. If there be much heat and swelling, an ice-bag may be placed over the joint, and a gutta-percha or felt splint temporarily applied; when these subside, the plaster bandage may then be put on. In compound cases plaster is seldom available, and even in many cases of simple displacement it may be more advantageous to use other forms of splinting.

Reduction of the displacement may be effected with or without anæsthetics. Like all injuries about joints, these cases should be examined from time to time, and passive movements commenced in order to guard against ankylosis. If gently applied, these movements may be commenced at the end of a week, according to circumstances and the joint affected. It is quite evident that, if any adhesions are about to form in a joint, they will be broken down at the end of a week with less pain and more readily than at the end of two weeks or longer. No hard-and-fast line of treatment can be laid down either for compound injuries or for cases of multiple injury. In some of the recorded cases, the extremity of the diaphysis has projected through the soft parts, and has had to be sawn off in order to effect reduction; in other cases, gangrene has resulted from pressure of the displaced diaphysis on the vessels, and amputation has had to be resorted to. In some cases, owing to injury of the periosteum and surrounding parts, suppuration has occurred, with exfoliation of the necrosed epiphysis. The adjoining joint is sometimes destroyed, and amputation becomes necessary.

Quite recently, Bruns of Tübingen has introduced and successfully carried out a new operation in two cases of old separation of the upper epiphysis of the humerus, 'which had not been recognised in the fresh condition, and which had healed with so much displacement that the utility of the arm was greatly impaired.' He deliberately cut down on the epiphyses, effected a separation of the adherent fragments with a small saw, removed a portion of the diaphysis, and then placed the fragments in their proper relative positions. Both operations were successful. Sublimate wool was the dressing used. Bruns also recommends this operation, with or without resection of the diaphysis, in recent cases of irreducible separation. It seems not unfair to anticipate that many cases which, formerly, would have been amputated, may in these days of antiseptic surgery be preserved; and it is also probable that those surgeons who practise rigid antiseptics, will feel themselves justified in cutting down upon detached epiphyses and wiring them to the diaphyses, when other means have failed to keep the bones in juxtaposition.

Prognosis.—This will vary with the exact nature of the injury in different cases, and with the age of the patient. In young children, apart from other possible results, must always be borne in mind the probable impairment of growth in the length of the affected limb, whenever the affected epiphysis is much concerned with this growth. It is not possible to assert positively whether this impairment will occur; the less the amount of local injury, the more complete the reduction and coaptation of the fragment, the less probable will this complication become, while opposite conditions will favour its occurrence. Nevertheless, so far as can be gathered from the hitherto published cases, this arrested growth occurs but seldom. It is true that the cases of arrested growth may not come under observation; but, on the other hand, the original injury would certainly do so, and yet the total number of cases is relatively small when considered beside other forms of fracture. The next point to be considered is the effect on the joint itself. In some cases, ankylosis results even in simple injuries, while in compound injuries, purulent synovitis and periostitis

of the shaft may so complicate the accident that the patient's life is only saved at the expense of the limb. Reference to gangrene has already been made. The adoption of Bruns' method in cases of irreducible displacement will probably save many a limb alike from atrophy, from gangrene, and from amputation.

ROBERT WILLIAM PARKER.

SEPSIN was the name first given by Bergmann to an alkaloidal substance which he, with Schmiedeberg, succeeded in isolating from putrid yeast. This substance was obtained as yellowish acicular crystals of a sulphate salt (sulphate of sepsin); it gave all the reactions of an alkaloid like strychnia, &c., and when injected into the circulation in dogs produced the symptoms of SAPRÆMIA—i.e. rigors, fever, vomiting, restlessness, diarrhœa (often bloody), coma, and death; the post-mortem signs being, as a rule, multiple punctiform hæmorrhages, swelling of the spleen, and œdema of the lungs. Since the publication of this result, numerous observers have obtained similar poisonous alkaloidal substances from various putrid albuminous fluids and substances—e.g. maceration fluids, putrid pus, 'high' game, rotten cheese, hams, sausages, &c. The alkaloidal bodies of the same class, but which are obtained from corpses, have received the name of ptomaines, and this term is sometimes employed, with great advantage, to denote the whole number of putrefactive alkaloids. The claim of all these substances to be regarded as alkaloids rests on the double evidence of chemical test and physiological action.

As to their *chemical reactions*: they are separable from alkaline solutions; they combine like weak bases with the mineral acids; they give a yellow flocculent precipitate with phosphomolybdic acid; with iodine they give a brownish precipitate; with gold and platinic chloride they give respectively a yellow and orange precipitate; they are also thrown down as whitish precipitates by tannin and corrosive sublimate; while, to conclude, they are very frequently crystalline. Fused on platinum, they char and give off peculiar odours.

The ptomaines (using the word for all kinds of putrefactive alkaloids) obtained by Schmiedeberg, Brieger, and others from various putrid substances, meat, fish, &c., by a modification of the Stas-Otto process for extracting alkaloids, may be enumerated as follows:—

(1) Those possessing physiologically active properties—

Cholin.—A derivative of lecithin. Hence found in 'bad' eggs. If oxidised, produces muscarin.

Muscarin, a very powerful poison found in putrid fish, and known for a long time as the poison of fungi.

Mydalein, most important as causing *pyrexia* in addition to the general symptoms of ptomainic poisoning about to be described.

A body resembling *atropin*, producing symptoms closely similar to atropin poisoning, including ophthalmoplegia externa. Found in putrid meat of various kinds.

Sepsin, already mentioned above.

Neurin, a powerful poison, found in putrid fish.

Ethylenediamine, a similar poison, one of the compound ammonias like trimethylamine, prepared from putrid fish.

A body similar to digitalin in its effects, and two others which cause profuse diarrhœa have been extracted from decomposing corpses.

(2) Those which do not exhibit active physiological properties—

These possess very little interest for the practical surgeon, and therefore it need only be mentioned that a series of inert bodies closely allied to those not described have been found in putrid liquids, and have been named by Brieger, neuridin, cadaverin, saprin, putrescin, gadinin, &c.

Clinical Import.—Poisonous alkaloids, of the kinds just described, have been discovered by Bocci and Bouchard to exist in normal urine and fæces, both in the lower animals and in man. The latter writer has made the reasonable assumption, that these bodies are constantly being formed in the process of digestion and as constantly excreted by the kidneys. Unfortunately, putrid discharges from surgical wounds have not as yet been examined for ptomaines, but of course similar bodies must be found, which by absorption may produce the symptoms of SAPRÆMIA, the so-called septic intoxication or poisoning.

Again, the fact of the existence of these substances is of extreme practical importance, in considering the symptoms of acute intestinal obstruction and other conditions in which retention of fæcal matter occurs. In these cases the symptoms—vomiting, salivation, headache, frequency and irregularity of the pulse, generally attributed to reflex irritation of the medulla oblongata through the vagus—may be due to direct poisoning of the same from absorption, by the bowel, of the alkaloidal bodies formed

during digestion. Confirmation of this view may be found in the fact that washing out the stomach considerably relieves the urgency of the symptoms. In connection with this point, it must be remembered that the alkaloidal ptomaines, just described, differ considerably in some points of pathological action. These points we will now briefly consider, as they thus come to have a practical bearing.

Pathological Action.—When absorbed into the blood, the most universal symptom and one common almost to all the substances mentioned above, is diarrhœa, usually due to excessive peristalsis and secretion of mucus, with active congestion of the mucous membrane of the bowel, leading sometimes to extravasation of blood. On the other hand, there is sometimes paralysis of the muscular wall of the gut, accompanied by a 'paralytic' secretion of intestinal fluid. Next to diarrhœa (or purging), vomiting, heralded by a rigor, is a very common symptom, the very frequent association of these two conditions leading one to suppose that they are the result of the action of the poison on the medulla oblongata. At the same time, the vaso-motor centre is irritated so as to lead to general vaso-motor spasm, or at any rate contraction of the arterioles, this being particularly the effect of muscarin and its allies, while vaso-motor dilatation (if not paralysis) is as equally characteristic of atropin, &c. The evidence obtained from the pupil is usually looked on as most important, and, as an index to suggest that the ingestion of a poison has occurred, it is doubtless useful. Most are like atropin—viz. mydriatic—i.e. they dilate the pupil. A few, however, cause contraction of the same. Other directions in which these poisons act are by way of excessive secretion, salivary, &c., like mydalein, or, on the other hand, like atropin they produce a total arrest of such secretion, so that the mouth becomes perfectly dry.

If the ptomaine is taken directly into the stomach, as happens sometimes in taking tinned meats, game pies, &c., the effects are very rapid and violent; the symptoms simulating those of acute irritant poisoning—viz. vomiting and purging, collapse, coma, and even death in four or five hours. The effects are, of course, exactly proportional to the dose absorbed.

Treatment.—This article is merely descriptive of the sepsin compounds. For the symptoms and treatment, &c., of cases poisoned with the same, *see* Sapræmia.

Victor Horsley.

SEPTIC DISEASES, Classification and Etiology of.—It is a hazardous thing, at any time, to attempt to classify and arrange even diseases the pathology of which is fairly well ascertained, and still more dangerous, therefore, to propose any arrangement for such an obscure and complex series of maladies as those which are termed 'septic.' Some writers have endeavoured to avoid the difficulty by assuming the wide differences between one case and another to be a question of degree only, and not of kind; but, fortunately, experimental pathology has come forward and rescued surgical science from the error of regarding the septic diseases as merely phases of the same process, and from concealment of want of knowledge under the plausible verbiage of unification. In fact, the pathology of these diseases is now (theoretically) so clear, that we may say it will be soon much more difficult to find a case of septic disease than to refer it to this or that class, since the prophylaxis of antiseptic surgery is gradually stamping out every variety.

The term 'septic disease' is generally understood to include every disease which can be shown to arise from putrefaction or fermentation. Although it would be more strictly accurate to make it embrace all cases of acute specific disease, the popular acceptation of the term does not include the acute exanthemata, such as typhoid fever, &c., these being unscientifically regarded as a separate family with the appellation of 'zymotic.' In passing, it is fitting to say here that a contracted expression, 'sepsis,' is gradually being adopted, especially abroad, to signify much the same thing as our term 'septic disease;' especially since it is usually employed to denote the fact of the likelihood that a patient, the subject of an operation, &c., may be attacked by the same. But, to return, the term 'septic disease' includes the following *general* and *local* diseases:—

1. Sapræmia.
2. Septicæmia.
3. Pyæmia—
   { central, / peripheral, } or { embolic, / exanthematous. }
4. Puerperal Fever.
5. Erysipelas.
6. Infective Cellulitis, including Poisoned Wounds.
7. Acute Spreading Traumatic Gangrene, including 'Quarter Evil,' 'Cancrum Oris,' &c.
8. Hospital Gangrene.
9. Malignant Pustule.

10. Acute Necrosis or Infectious Osteomyelitis.

11. Farcy or Glanders.

This heterogeneous list, which includes affections purely local and others absolutely general, will suffice to show how hopelessly inadequate any theory must be which regards such diverse effects as being due to one and the same cause only.

It becomes necessary now, in describing these diseases, to separate them on some sound basis. Such a basis can only be founded on an accurate conception of the pathology of each disease. Whatever the nature of the septic virus in any one of the above-mentioned maladies, it is clinically obvious that it acts either by rapidly and directly affecting the whole system, or else, indirectly, by causing local mischief from whence poisonous products are absorbed into the general circulation.

It is therefore most convenient, and scientific withal, to divide the septic diseases into two main clinical divisions—(A) *General* and (B) *Local*; this separation meaning that, in the first class, the whole system is primarily infected, and that local mischief follows; while in the second class local mischief is the first thing, and general systemic poisoning a consequence.

Division A. — General Diseases.— 1. *Sapræmia*—i.e. poisoning by an alkaloidal product (purely chemical and non-vital) of decomposition. *See* Sapræmia; Sepsin.

2. *Septicæmia*—i.e. general infection of the whole system by a rapidly-increasing poison, which is usually inoculated in very small quantities, such poison being probably a parasitic micro-organism. In this variety of septic infection there is no formation of secondary abscesses. *See* Septicæmia.

3. *Pyæmia* (including Umbilical Pyæmia of new-born infants, Farcy, &c.)—i.e. general infection of the whole system by a slowly-increasing poison, which is sometimes inoculated in very small quantities —probably, therefore, a parasitic micro-organism—and which always produces secondary abscesses. *See* Pyæmia.

Pyæmia, as it is seen clinically, is divisible into two classes, which, for want of better terms, may be called 'peripheral' and 'central,' such expressions referring solely to the position of the secondary abscesses. The pathology of these two classes is also different; this, of course, accounting for the difference in position of the lesions. Thus, in the 'central' variety the primary wound is usually a large, septic, inflammatory focus, situated in the neighbourhood of veins of considerable magnitude. As a necessary consequence, septic thrombosis in the veins occurs. The septic clot thus formed is greyish and friable; portions become detached, conveyed to the right side of the heart, hence to the lungs, and so to the systemic circulation through the left side of the heart. Weber showed, long ago, that poisonous emboli could find their way through the pulmonary capillaries and lodge in any part of the general systemic circulation—e.g. spleen, liver, kidneys, &c.; but the assumption that the so-called 'pyæmic infarct' is not a true infarct, as produced by inert emboli, but rather a centre of septic necrosis, is probably the more accurate view of these 'central' lesions; so that their causation is to be attributed to the immediate action of the pyæmic virus, and not to a primary embolism followed by secondary septic inflammatory mischief. Whatever we may regard as the mechanism at work in causing abscesses in the internal organs, the distinction between the two clinical varieties of pyæmia just described must be borne in mind—viz. that there is one kind in which the lesions (abscesses, &c.) are mainly central, and another in which they are peripheral—i.e. confined to the joints, bursæ, fasciæ, &c.

4. *Puerperal Fever*—a vague term which is commonly employed to denote that a patient, who has just been confined, is suffering from either sapræmia, septicæmia, or pyæmia. No further reference in detail will be made in this article to puerperal fever (as it is generally understood), since the condition of a puerperal woman is precisely that of any other kind of surgical liability to infection with one or other of the three septic diseases just mentioned, as a natural consequence where ordinary prophylactic antiseptic precautions have been neglected.

Division B. — Local Diseases. — 5. *Erysipelas* is an acute specific disease, affecting secondarily the whole system, which follows the (primary) inoculation of a wound by a parasitic pathogenic micro-organism (Micrococcus erysipelatosus).

This definition applies solely to 'surgical erysipelas,' so called—i.e. the erysipelas which attacks an open wound—and in no way refers to so-called 'medical,' 'idiopathic,' 'facial' erysipelas, the pathology of which has not yet been completely investigated. The incubation-period of traumatic erysipelas is about twenty-four hours. The organism grows through the lymph-channels of the subcutaneous tissues, producing characteristic local and general

symptoms, for the description of which *see* Erysipelas.

6. *Infective Cellulitis* (including Poisoned Wounds) is a purely local affection consisting in a spreading inflammation, possibly due to a parasitic micro-organism or, indirectly, to the poisonous action of some product of decomposition. The patient is, in addition, secondarily poisoned by the absorption of the inflammatory products. *See* Cellulitis; Poisoned Wounds.

7. *Acute Spreading Traumatic Gangrene, including Quarter Evil*, is an acute, specific, inflammatory process, terminating invariably in gangrene. It is due to the inoculation into the tissues (frequently already injured by traumatism), usually subcutaneously, of a specific poison, which has been proved to be a thick bacillus in the case of 'quarter evil;' and since a similar organism has been found in cases of acute spreading traumatic gangrene in man, it is possible that it (the virus) is always the same bacillus.

The disease known in cattle as 'quarter evil,' the 'charbon symptomatique' of French writers, and the Rauschbrand of the Germans, occurs rarely in England, but has been transmitted (by direct inoculation) to man. It consists in a spreading inflammatory area, the centre of which is gangrenous. The patient thus absorbs the poisonous products of the tissue-necrosis.

Acute traumatic gangrene is the 'gangrène foudroyante' of the French authors. The condition known as noma or cancrum oris is properly included in this class.

8. *Hospital Gangrene* is a rare local affection, consisting primarily in an inoculation of a wound by a poison generated in an ahygienic hospital, and which is probably a parasitic micro-organism (a micrococcus), with a primary effect of causing a steadily progressive necrosis of the wound surface, and a secondary effect in producing general septic poisoning of the system. For details of this affection, *see* Hospital Gangrene; but it must be here noted that allied to this condition (in which the wound becomes covered with a tenacious, adherent, grey and fibrinous slough) are those cases where a wound is covered with a diphtheritic pellicle; and, indeed, cases of sloughing membranous pharyngitis ought to be included under the same heading as cases of hospital gangrene. In every variety of the affection there is, of course, secondary general septic poisoning.

9. *Malignant Pustule.*—An acute specific disease due to the growth of a parasitic pathogenic micro-organism (*bacillus anthracis*). When inoculated locally, it produces a carbuncle of peculiar character. When inhaled, it produces a general poisoning of the system known as 'charbon,' or 'wool-sorters' disease.' *See* Malignant Pustule.

10. *Acute Necrosis or Infectious Osteomyelitis.*—An acute specific disease in which the periosteum and marrow of any bone (usually a long bone) becomes the seat of acute suppurative inflammation very soon after some injury (frequently trifling); such local inflammation being followed by the lighting up of 'central' pyæmic lesions in the lungs, heart, &c. The poison is probably a micrococcus.

11. *Farcy or Glanders.*—A variety of Pyæmia. Glanders is so regarded as a special septic disease that it is mentioned separately here, but it more properly falls under the heading Pyæmia.

Before discussing the etiology of the diseases just mentioned, reference must be made here to a certain causal nexus which exists between some of the exanthemata and the condition of patients after surgical operations, &c. Setting aside cases of so-called rheumatism occurring after gonorrhœa, and which are nothing more than subacute pyæmia, we must briefly notice the following facts:—

1. That scarlet fever is particularly liable to attack children recently operated upon, especially in cases where an operation has been performed for stone in the bladder or cleft palate.

2. That scarlet fever is particularly liable to attack the puerperal woman.

3. That although scarlet fever and erysipelas do not infrequently attack a puerperal woman and run their specific course, yet occasionally it would seem that, although the poison of one of these diseases has certainly been inoculated into a puerperal patient, it has not developed in the specific manner, but as a variety of 'puerperal fever.'

1. The scarlet fever which thus attacks surgical patients is apparently the regular disease, ordinarily endemic in this country, since its mode of onset, symptomatology, &c., are very similar. There is one difference, however, to be noted—viz. that the 'surgical scarlet fever' is very rarely followed by kidney-mischief. The only question that can be raised is whether this condition is not really a form of septicæmia closely imitating scarlet fever; but a discussion of this point would lead us beyond the scope of this article, and we can only note the occurrence of the above-de-

scribed condition, as a point to be borne in mind by the operating surgeon. Without doubt, prophylaxis, in the way of preventing all possible means of transportation of the contagion, is the most important practical bearing of the facts here noted, but extra precaution may be taken in the way of observing the temperature for at least a week before operating.

2. Nothing need be said on the liability of the puerperal woman to contract the disease, since such a patient is in the condition of a person after a surgical operation.

3. With regard to the oft-suggested metamorphosis of diseases, such as scarlet fever and erysipelas, into puerperal fever, all that can be said here is, that although, experimentally, septic diseases can be modified under certain circumstances, there is no reason to suppose that one disease can be started by the virus of another; indeed, all carefully noted facts point in the opposite direction. The true explanation of the supposed metamorphosis is, perhaps, that the exanthem, when inoculated into the puerperal woman (and there is of course the greatest danger of transferring the virus of septic disease or scarlet fever to a puerperal patient), sometimes runs a modified course, the modified disease being mistaken for one or other of the varieties of puerperal sepsis.

We must now leave this general part of the subject—viz. classification—and briefly discuss the circumstances attendant on the causation and etiology of the septic diseases, so far as they bear on the descriptions of the different varieties arranged above.

In the first place, we will consider the etiology of sapræmia only, so far as it is connected with the other septic diseases. For a fuller account, *see* Sapræmia.

It will be obvious, as has already been suggested in the 'definitions' of erysipelas, infective cellulitis, &c., that a large part of the patient's symptoms is due to the secondary action on the system of the inflammatory products resulting from the primary inoculation. These inflammatory products are of importance in two ways. Firstly, by giving rise to tension they cause further stagnation in the blood-vessels, and consequently general diminution in the circulation, thus producing the most favourable condition—viz. rest, for the growth of micro-organisms through the tissues; secondly, among the inflammatory products are the results of the katalytic decomposition of the (albuminous) tissues. Such decomposition-substances are very numerous (*see* Sepsin; Schizomycetes) and of variable importance. Those of them which alone concern us now are, the ptomaines of cadaveric decomposition, alkaloidal substances which being absorbed into the lymph-stream or blood-circulation give rise to chronic Sapræmia.

To recapitulate, it is clear that in cases of septic disease where the local mischief is considerable, the effect on the patient will be twofold—viz. (*a*) effect of the specific virus; (*b*) effect of the inflammatory products in producing a secondary sapræmia. The existence of this second factor explains why, in such cases, early incision and amputation produce such marvellously rapid changes for the better in the general state of the patient—viz. by making a clean sweep of one source of poisoning.

Having thus cleared the ground by eliminating the principal source of complexity in this class of diseases, we may now briefly consider the action of the specific septic poisons, so far as they throw light on the etiology of the septic diseases. It is impossible, in referring to these specific poisons, to altogether avoid entering on the endless question of the nature of the contagion in these cases—i.e. whether it is a living parasitic micro-organism (sometimes absurdly called a disease-germ) or a chemical non-vital substance. As will be seen directly, the evidence, so far, is in favour of the specific virus (which spreads by multiplication) being a pathogenic micro-organism; and, granting this to be the case, we may conveniently abbreviate explanation of the possible modes of action of such an organism, by enumerating the following classification of the possible modes of action of such organisms, a classification suggested by the writer three years ago in a Report on Septic Organisms to the Local Government Board.

1. *Mechanical Mycosis* (mycosis signifying invasion of the system by a fungus), the condition in which the parasitic micro-organism causes some at least of its effects by mechanically plugging blood and lymph vessels.

2. *Katalytic Mycosis* (katalytic signifying a splitting up or decomposition), a term employed here to denote the action of the organisms on the tissues they attack, or the condition in which definite changes are produced in the tissues by the vital processes of the parasitic micro-organisms, divisible into classes (*a*), (*b*), and (*c*).

(*a*) Where the parasitic organism gradually causes death by absorbing and breaking up, for its own nutrition, the tissues of the host.

(*b*) Where the parasitic organism, by the katalytic action of its life-processes on the tissues of the host, causes the production of a poisonous ptomaine.

(*c*) Where the parasitic organism directly or indirectly, by the above-mentioned ptomaine (*b*), sets up an acute inflammation.

We will now see how far experimental pathology has succeeded in elucidating the conditions of septic disease, for the tedious method of clinical observation has, naturally, done little more than bring the subject into the hopeless confusion indicated at the beginning of this article.

The experimental investigation of the causation of human septic diseases—i.e. pyæmia, &c.—is exceedingly difficult, for animals differ so much among themselves, and more especially one class from another, that no one has yet succeeded in isolating the virus of human pyæmia and septicæmia by the means at present at our disposal—viz. cultivation and inoculation. The last disease, however, mentioned in the foregoing classification—viz. malignant pustule—has been thoroughly investigated, and, its causation being now fairly well understood, we will first describe the virus and its action on animals, as being a typical instance of the pathology of an infective disease.

In the first place, the virus of malignant pustule and woolsorters' disease is a micro-organism, the *bacillus anthracis* (*see* Bacillus; Schizomycetes, &c.), which from its size and affinity for staining materials, &c., is readily recognised. This organism, when cultivated purely, kills most rodents (guinea-pigs especially) with certainty in about fifty to sixty hours, the quantity inoculated being extremely small (microscopic). The symptoms produced by its spreading through the tissues are scarcely marked during the first day, but the temperature gradually rises, the animal loses its appetite, becomes lethargic, and ultimately dies comatose. The macroscopic post-mortem appearances are those of death from asphyxia, together, frequently, with marked swelling of the spleen (hence the term splenic fever applied to the disease when it occurs in cattle). Microscopically, it is found that the blood-vessels are crammed with bacilli, in many places completely plugging the calibre of the vessel. Here, then, we obviously have our first variety of mycosis—viz. a mechanical mycosis, the actual mass of organisms forming a mechanical obstruction to the blood-circulation, and not only to the circulation merely, but, by being present in such numbers, they must interfere considerably (from that point of view) with the normal metabolic relations existing between the blood-stream and the tissues nourished by the same. Now, the second mode of mycosis, the katalytic form, plays a greater part than the mechanical mode just described, so we must also consider the bacillus as possibly killing—(*a*) by destroying the tissues of the animal affected, in finding pabulum for the rapidly growing and multiplying organisms; (*b*) by producing a poisonous ptomaine by the action of the organisms in splitting up the fluids and tissues of the host. As yet we have little positive evidence bearing on this point, but attention is being directed to the question, and already it has been found that various putrefactive organisms growing in albuminous fluids form, by reason of their life-changes, poisonous ptomaines. These bodies are specially referred to in the article on Sepsin.

We have mentioned above that the *bacillus anthracis* may act locally or generally, in the first instance producing the form of carbuncle called Malignant Pustule, and, in the second, the general disease called wool-sorters' or splenic fever. This leads us to discuss the next point of importance—viz. the mode of entry of the poison into the body. This factor is of especial importance, of course, and particularly so in discussing the probable modes of inoculation in human septicæmia and pyæmia, and, further, since the splendid prophylaxis of antiseptic surgery rests upon a correct understanding of the theories concerning it.

If the bacillus anthracis or its spores (the latter, doubtless, being the most frequent condition) be inoculated into the subcutaneous tissues of a man by means of a small scratch, raw surface, &c., it grows in the tissues, exciting (see *Katalytic Mycosis* (*c*) above) a gangrenous inflammation of a characteristic aspect. *See* Malignant Pustule. If, however, it or its spores be inhaled in dust (some of which is probably swallowed) it penetrates the mucous membrane possibly of the air-tubes or the thin epithelial lining of the alveoli, and so gains access to the general circulation. In some instances it distinctly appears to have entered *viâ* the alimentary canal, and particularly through Peyer's patches and the other lymphatic follicles. In applying these facts generally to septic diseases, we find that whether the local effects are most marked, or whether, on the other hand, that general symptoms are the characteristic features of the case, in both the most

usual portal through which the poison gains ingress into the system is the subcutaneous tissue. We may abbreviate what must be said on this point by presenting the following table or list of means of ingress, together with the septic diseases the poisons of which enter thereby:—

Entry by—1. *Subcutaneous and General Connective Tissues.*—Septicæmia, pyæmia, so-called puerperal fever, erysipelas, infective cellulitis, acute spreading gangrene, hospital gangrene, malignant pustule or external anthrax.

2. *Respiratory Tract.*—Woolsorters' disease or internal anthrax, sapræmia, farcy (other pyæmiæ ?).

3. *Alimentary Tract.*—Sapræmia, internal anthrax, pyæmia (notably *after* enteric disease—e.g. typhoid, &c.).

The next question bearing on this point is the difference in the interval of time occupied in the absorption of different poisons. Very scanty information is to be gained from the few experiments devised to solve this problem. Davaine showed that the virus of anthrax was absorbed in a much shorter time (about half an hour) than that of sheep-pox. There can be little doubt that most septic poisons are not absorbed in less than fifteen minutes to half an hour, and that energetic prophylaxis may successfully intervene before the expiration of that interval.

The poison having found entrance, a few lines must be devoted to tracing it in the system. We have seen that our type, the *bacillus anthracis*, in one case grows in the connective-tissue spaces (locally), and, in another, spreads through the blood. Now, in the next septic disease the pathology of which has at last been determined by experiment—viz. erysipelas—the virus, a micrococcus, grows through the lymphatic vessels in the subcutaneous tissue. In the local septic diseases terminating in gangrene, the organism simply spreads through the cell-spaces in the ground-substance of the connective tissue, sometimes apparently invading the corpuscles themselves. On the other hand, in the obscurer diseases, pyæmia and septicæmia, the poison soon enters the blood-stream, and is conveyed thence all over the body. It remains entirely an open question how far the poison in these cases causes mechanical mycosis, but it can readily be shown that it sets up local mischief where it lodges. Most septic poisons develop in those parts of the body where the circulation is least active; hence, foci of the disease are found in the capillary meshes of the liver, spleen, lungs, the joints, &c. We may, in passing, draw attention to the fact that this agrees with what we know experimentally of the growth of micro-organisms in tissues, and so suggests that, in all septic diseases where the poison multiplies, it is a micro-organism.

It now remains to see how the poison leaves the body. Apparently, in most instances, this is effected by means of the kidneys. That these organs excrete ptomaines there is no doubt, and from the fact of their being very frequently the seat of active disease in septic cases, organisms being found in the Malpighian glomeruli, in the tubules, and urine, there is good reason to think they play an important part in getting rid of infective poisons. Perhaps most of the excreta contain the virus, but this matter requires further elucidation. As a practical point, for instance, it may be observed that the desquamating epidermis, after erysipelas, should be treated as infectious material until proved to be otherwise.

Hitherto we have considered the septic poisons without regard to the individual peculiarities of the subject they attack. Thus, to return to our type, the *bacillus anthracis*. This organism is able to attack and kill man, most rodents (excepting some kinds of rats), ungulates, young dogs, not old ones, and yet is powerless when inoculated into birds. If, however, the vitality of the resistant animal is depressed—if, for example, the temperature of birds be lowered by immersion in cold water—they then become susceptible to the disease. This fact illustrates an apparently simple law, the details of which, however, are by no means clear. Complexity is introduced here on account of the possibility that frequent contact with septic poisons may confer immunity. Though this is by no means established, and there are facts reported which contradict it (e.g. cases of post-mortem-room porters, &c., who contract fatal septicæmia, &c.), it must, nevertheless, be borne in mind in considering the circumstances which determine successfully the resistance of an individual to any form of septic disease.

The facts concerning immunity, so far as is definitely ascertained at the present time, are that (1) individual peculiarities in the composition of the blood and its relation to tissue-changes, (2) activity of the tissue-changes (metabolism), coupled with free access to fresh air (complete oxygenation), (3) previous attacks (possibly), are the most important determining factors; but further attention cannot be given here

to this point. *See* Poisoned Wounds; Sapræmia; Septicæmia.

In conclusion, we may fittingly close the illustration of the facts on which the classification of the septic diseases is based, by reasserting the fact that all such diseases can be grouped under the two headings of local and general; such grouping depending upon the nature of the primary effects which follow inoculation.

Treatment and Prognosis.—These vary with each disease, to which reference must be made, as also for description of special symptoms, this article being only an attempt to give a brief arrangement of the septic diseases according to the most modern views. The condition known as blood-ferment poisoning, often regarded as a form of septic disease, is not so, properly speaking, but as it is often confounded with Sapræmia, it will be found described at the end of the article on that condition.

Victor Horsley.

SEPTICÆMIA is an expression which has, unfortunately, been used in so vague a manner as to make it difficult to understand what is really meant by it. It will be conceded, we believe, by most of those who have paid special attention to the subject of septic disease, that it is too late nowadays to discuss the etymology of the expression, or to introduce the possibly more correctly constructed term, septhæmia. Septicæmia, possibly from being more euphonious than accurate, is now in general use, and therefore in the classification of the Septic Diseases, it is retained to denote that variety of septic diseases to which it is most usually applied. To repeat that description here, septicæmia is the name given to an acute (specific) infectious disease, the poison of which is usually inoculated in very small quantities, therefore multiplies in the system, and consequently is probably a micro-organism. Finally, no secondary foci of inflammation occur in the course of the disease. In fact, we have to do with a poisoning of the whole system, most of the symptoms perhaps being due to affection of the central nervous organs, a poisoning which, like that of one of the acute specific fevers, is unaccompanied by any complications, such as thrombosis, endocarditis, &c., which frequently are found in pyæmia.

The form in which the disease appears is variable; the difference between one case and another, however, being apparently only one of degree in the virulence of the poison. It is easy, moreover, to divide the disease clinically into two main classes—namely, *acute* and *chronic*. Although, in describing the symptoms of these two forms, we must separate one from the other, it will be more convenient to discuss their etiology together for purposes of comparison. Finally, a word must be added here to protest against the popular use of the term septicæmia, to signify the condition described in this work as sapræmia, in which the poison is a simple chemical substance, whose effects in the same individual are solely proportionate to the dose. The indiscriminate application of the term septicæmia to both these very different affections has caused much useless discussion among the learned, and much confusion to students.

Etiology.—That a patient should be the subject of septicæmia apparently one thing alone is required—namely, the inoculation of the virus into the circulation. The general conditions, which regulate individual powers of resistance to septic disease, do not appear to apply with much force in the most virulent forms of septicæmia; but there is one fact which either shows that constitutional peculiarities modify somewhat the course of the malady, or else is indicative of the existence of a specific difference between the acute and chronic forms of the disease. We refer to the observation (frequently made by the old surgeons) that *acute* septicæmia more often attacks people apparently very healthy than bed-ridden patients, while, on the other hand, the latter class are more subject to suffer from *chronic* septicæmia.

Not proposing to waste space by discussing this point, we will pass on to the conditions surrounding the inoculation of the virus. Although, of course, it is highly probable that septicæmia in both forms may arise from absorption of the virus by the alimentary canal or respiratory tract, it appears to be very rarely caused in this way; and, as all the cases which throw light on the clinical history of the disease have been obtained from instances of inoculation into the connective tissues, and possibly also directly into the blood stream, it will be best to describe in detail this mode only of the entry of the poison into the system.

1. *The source of the virus*: this in the very large majority of cases has been some putrid substance (usually the corpse of some person recently dead of a septic disease); next, the disease often occurs as a result of operations performed without antiseptic precautions, in these instances almost always being introduced from with

out by dirty fingers or instruments, the possibility of its arising autochthonously being very slight. 2. *The dose*: this may be excessively small, practically invisible to the eye, for some of the most fulminating cases have followed a very slight needle-prick; it is this feature in the etiology of the disease which makes the nature of the (to say the very least of it indirect) virus very evident. 3. *The mode of introduction*: this has already been indirectly referred to, and, in brief, consists merely in a wound of the skin which opens the subcutaneous tissue. Punctured wounds are more often followed by infection than incised ones, for the reason that there is but little flow of blood to wash out the poison.

We now arrive at the debatable point whether the poison finds entrance at once into the blood, or indirectly and later by the lymph-stream. It would seem possible that either event may happen, and, if so, it suggests a part explanation why the incubation-period differs in the large majority of cases. *Vide infra.* As a rule, there seems to be no affection of the lymph-glands as a direct effect in uncomplicated cases; swelling and suppuration, when occurring in these structures, being evidently the result of local inflammatory poison inoculated at the same time as the special septicæmic virus. Although this fact is suggestive, we cannot conclude therefrom that the poison is always absorbed directly into the blood-circulation. The poison having gained access to the system, now occupies a certain period of time (the 'incubation' period) before the first symptom manifests itself. The determination, however, of this most important point is beset with many difficulties, since it must of necessity but very rarely happen that an *absolutely uncomplicated* case even of *acute* septicæmia can arise. In a few instances, however, a person, apparently in perfect health, has been inoculated with an excessively small quantity of infective material, and has subsequently developed acute septicæmia; in these cases the incubation-period has been found to be from six to eight hours.

It is only right to state here that some authors, including Gussenbauer, regard these cases of short incubation-period as instances of *acute sapræmia*, but, especially in the absence of any reliable work on the micro-organisms of human septic diseases, we consider that this view is completely negatived—(1) by the fact that the dose of a ptomaine necessary to produce such a powerful effect would have to be very appreciable in quantity of the substance, and certainly not such as could be contained in a minute trace of pus on a needle; and (2) that when a ptomaine produces powerful effects, the incubation-period is usually a twentieth part of that in the case now under discussion. It is impossible, however, to decide accurately the incubation-interval in septicæmia until the virus of the disease has been isolated. Any attempt to form an estimate of the same period in chronic septicæmia, would be infinitely more hopeless, since that condition, so far as we know, is never uncomplicated, and the co-existence of sapræmia will mask the obscurer symptoms of septicæmia. We must, therefore, leave this question, and, after glancing at the mode of excretion of the poison, turn to the symptomatology of the disease. So far as is known (and that is very little), the poison is excreted in the urine, and organisms have been found to some extent in the kidney; if analogy is justifiable, it is possible that the renal tract excretes the poison of septicæmia, just as we know it does the virus of sapræmia.

Symptomatology.—The symptoms of septicæmia differ, in the acute and chronic forms of the disease, rather in degree than in kind, although quantitative differences may appear to be qualitative variations. In the acute form, the patient feels very depressed and ill at the end of the incubation-period; to this is very soon added severe headache, followed by vomiting, and then there frequently occurs a severe rigor, though this latter is not a perfectly constant feature. The temperature now will have risen to 104° or higher, and falls a little each morning of the illness, rising again in the afternoon or evening. For the first two days there is little else to note in the general state resulting from the specific poison, but, within the first twelve to twenty hours, the seat of inoculation will be violently inflamed and produce symptoms due to sapræmic changes or pain, &c. *See* Sapræmia. By the end of forty-eight hours, however, delirium will have succeeded to the headache, and, still later, subsultus tendinum indicates the extent of poisoning which the nerve-centres are subjected to. Alternating with delirium is stupor, and, as the case approaches a fatal termination, this becomes coma—a stage from which the patient is never successfully roused. As might have been expected, the centres in the medulla oblongata gradually fail,

the *respiratory* movements becoming shallower and more frequent, while the *pulse* grows smaller, usually quick and irregular, indicating the gradual weakening of the cardiac centre. Provided no further complication co-exists, acute septicæmia causes death in from four to seven days, the temperature ordinarily falling very rapidly a few hours before death, often subnormally. In addition to the above constant symptoms, others frequently occur, which, however, are possibly due to sapræmic poisoning and not to the specific septicæmic virus. The most prominent of these is diarrhœa, which usually comes on about the second day, and as a rule is not bloody, as in sapræmia.

The effect of the poison on the kidneys is evidenced, in its turn, by a scanty secretion of albuminous urine, the albumin almost always appearing towards the end of the disease.

Chronic Septicæmia. — As will be understood from what has just been said, it is doubtful whether this disease is an uncomplicated condition. The incubation period alone is a matter of complete uncertainty, so that it is impossible to define the limits of the disease. Speaking generally, we may say that a patient, the subject of a wound infected with the septicæmic virus, shows at the commencement of the disease the same symptoms, only much less marked, as in the acute form. However, the disease in the chronic form preserves throughout a subacute progress. The temperature, although constantly above normal, does not rise so high, and the morning remissions of pyrexia are greater than in the former case. The most obvious pathological feature in chronic septicæmia is swelling of the spleen, this organ often becoming enormously enlarged. Swelling of the spleen occurs in every case of septicæmia, acute or chronic, but notice of it has been reserved until now, because it is more easily noted in the subacute form.

The frequency of swelling of the spleen in septic diseases is an extremely important fact, the interpretation of which, however, is proportionately as difficult. Suffice it to say, that the concurrence of leucocytosis, together with profound changes in the other constituents of the blood, is extremely suggestive in connection with the fact of splenic swelling. The other parenchymatous organs, the liver, &c., show marked degenerative changes, commencing as cloudy swellings. Rarer symptoms found are: rashes on the skin, lung-complications, and inflammatory affections of the serous membranes. With regard to the skin-eruptions, there is no doubt that a scarlatiniform rash not infrequently appears in acute septicæmia, but (*see* Septic Diseases, Classification of) is not to be confounded with surgical scarlet fever. Much more rarely, papular and pustular eruptions occur, and still more rarely an urticariform rash. Lung-complications are, usually, bronchitis and pneumonia, and finally the serous membranes are invariably the seat of petechial extravasations of blood, their cavities being frequently filled with blood-stained serum, and more rarely with highly infective pus. These conditions give rise, of course, to the ordinary symptoms of pleurisy—empyema, pericardial effusion, &c. The other symptoms are the same as those of acute septicæmia, and, in comparison with the latter malady, chronic septicæmia runs a course of nearly treble duration, cases often lasting three to four weeks.

Pathological Anatomy.—The changes in the internal organs, in septicæmia, are naturally relatively very slight where the poison is so extremely infective and rapid in action. We have already indicated the changes in the principal viscera, and have only to add a few additional observations on these points. In the first place, the nerve-symptoms and mental derangement are found to be produced by extreme congestion of the pia mater; similar congestion, and occasionally punctiform extravasation, being found in the deeper parts of the central nervous system. Moreover, the heart is occasionally the seat of ulcerative endocarditis, which gives rise, as usual, to secondary embolism.

Treatment.—It is of little use to point out here the absolute prophylactic value of antiseptic precautions in preventing the absorption of the septicæmic virus, since these are already referred to in the articles on Antiseptic Surgery and Poisoned Wounds.

The direct treatment of acute septicæmia is most unsuccessful, which is natural enough when we consider that the virus has not yet been isolated. Proceeding on theoretical principles, we may, for the sake of classification, divide the treatment into local and general.

Local Treatment.—The first thing to do is undoubtedly to destroy what remains of the poison, and to prevent any further formation of the same at the point inoculated; and this is best done by laying the wound freely open, irrigating it with 1 in 20 carbolic acid solution or chloride of zinc, 40 gr. to f℥j., &c., and then treating it with hot boracic fomentations and hot antiseptic baths.

General Treatment.—A vigorous attempt to attack the poison in the system should be made by administering large doses of quinine and salicylate of soda (20 gr. of the former and 60 to 70 gr. of the latter per diem). Warburg's tincture and antipyrin (the latter in 15-gr. doses until the pyrexia is reduced) are likely perhaps to be valuable. Useful adjuncts to the above antipyretic treatment are ice-packs and sponging, and the ice-cap. Special treatment of ordinary kind must be employed for the rarer complications noted above.

For diet, &c., general rules must be followed, and, as regards stimulation, the pulse is to be the sole guide to the administration of alcohol, ammonia, ether, &c.; stimulants only being given when heart-failure is distinctly marked, the depression which follows over-stimulation being particularly dangerous. *See* PULSE.

Prognosis.—Acute septicæmia is commonly regarded as necessarily fatal, unless vigorously treated within the first twenty to thirty hours of the disease, and even then the outlook is extremely serious.

Chronic or subacute septicæmia is a more manageable affection, but probably 50 per cent., if not more, of the cases die.

VICTOR HORSLEY.

SEPTUM NARIUM, Affections of the.—DISPLACED SEPTUM.—The displacement is generally the result of an injury such as a fall or blow upon the nose; but it may be due to a congenital defect in development. It may come on spontaneously, either about the second year, when it appears to depend upon an overgrowth of the cartilage at its junction with the vomer, similar to that which occurs at the epiphysial line in rickets, or else a little after puberty, a period at which there is normally a great increase in the growth of the septum. The extent and character of the displacement vary considerably. Thus, the whole septum, especially when the displacement is due to an injury, may be bent to one or other side, or dislocated from the maxillary crest, whilst there is generally, at the same time, some lateral deviation or depression of the lateral cartilages, or more rarely of the nasal bones. Again, the displacement may be limited to the line of junction of the septal cartilage with the vomer, the displaced part then forming a prominent ridge in that situation; or, again, the anterior portion of the septum may be dislocated from the anterior nasal spine, forming an unsightly red prominence just within the nostril. When the displacement is extreme, the septum may come into contact with the outer wall of the nasal fossæ and even adhere to it, producing complete obstruction of the passage.

Symptoms and Diagnosis.—The patient generally complains of a feeling of stuffiness or obstruction in the nostril on the side towards which the septum is displaced, an alteration in the tone of the voice, and a chronic discharge from the nose. Less frequently he suffers from frontal headache, a feeling of giddiness, slight deafness, and still more rarely from epiphora, epistaxis, and even dropsy of the antrum, symptoms referable to the spread of the nasal catarrh to the frontal sinuses, nasal duct, &c., or to their obstruction by the displaced septum. The red prominence just inside the nostril and the external deformity, however, are, when present, perhaps the patient's chief annoyance. On looking into the nostrils, the displaced septum will at once be seen more or less completely blocking up one of the nasal chambers, whilst, on the opposite side, a corresponding depression will be discovered, and will at once serve to distinguish the affection from a polypus, an hypertrophied spongy bone or a septal growth, for which it has, however, before now been mistaken.

Treatment.—This will depend upon the nature of the case. Where the whole septum is displaced it should be forcibly straightened, and the lateral cartilages or bones, if also displaced, rectified at the same time. For this purpose, the writer's modification of Adams's forceps will be found convenient, as in their use the columna is not injured. In rectifying the bones great force has to be used, but the writer has hitherto seen no harm follow. Should the septum, as is occasionally the case, be very resilient, and resume its faulty position on removing the forceps, its resiliency must be destroyed either by well breaking up the cartilage with the forceps, or by making a stellar incision in it with a properly shaped knife. Whilst the replaced septum is undergoing consolidation in its improved position, some form of retentive apparatus should be used. Thus, for the first few days Adams's screw instrument may be worn, and subsequently for some days longer suitably formed plugs. The writer has of late substituted hollow vulcanite plugs for those formerly employed, so as to allow of nasal respiration being carried on during their use. For retaining the lateral cartilages in position, several contrivances have been invented. The writer uses for this purpose a mask accurately

fitting the face, as affording the best means of obtaining a fixed point from which to bring pressure to bear upon the nose. When the anterior portion only of the septum is dislocated from the nasal spine, a suitably shaped flap of mucous membrane should be dissected up from over it, and the projecting portion be shaved off.

Tumours of the Septum. — Blood-tumours and abscess have been described in the article on the Nose. The other tumours that have occasionally been met with are myxomatous, cartilaginous, and osseous, and more rarely sarcomatous and epitheliomatous growths, whilst syphilitic gummata are far from uncommon. The *diagnosis* of these affections is easy if care be given. In blood-tumour, the history of an injury, and the presence of a rounded fluctuating swelling on both sides of the septum, unattended with signs of inflammation, should distinguish it from an abscess, in which there is inflammatory redness, pain and swelling, and often much œdema of the upper lip. Syphilitic gummata may also occur on both sides of the septum. They are at first hard, but softening usually soon sets in, and necrosis and perforation of the septum may result. Concomitant signs of syphilis, the history of their commencement, and the result of treatment, usually serve to distinguish them. Cartilaginous and osseous tumours may be known by their slow growth and excessive hardness, and may be distinguished from a deviated septum by the absence of a depression corresponding to the swelling in the opposite nostril. Sarcomatous and epitheliomatous growths may here, as elsewhere, be recognised by their rapid growth, involvement of surrounding parts, and the other characteristics of malignancy. The microscopical examination of a small portion snipped off the growth should clear up any doubt as to its nature.

The *treatment* of abscess is an early and sufficient incision, so placed as to favour drainage. For syphilitic gummata the usual syphilitic remedies must be employed. Cartilaginous and osseous tumours, if small, may be removed with small bone-scissors, or better with the small circular saw of the dental engine, taking care not to perforate the septum. When large, the growth must first be exposed by Rouge's Operation, or by one of the other methods of exposing the anterior openings of the nasal chambers described under Nasal Polypus; Naso-pharyngeal Growths.

Œdema of the Septum Narium.—This condition, which is usually limited to the posterior part of the septum, has only been recognised since the introduction of posterior rhinoscopy, and would appear to be not very uncommon. It gives rise to symptoms of nasal obstruction similar to those produced by nasal polypi far back, or by hypertrophic nasal catarrh. On each side of the posterior border of the septum the mucous membrane appears swollen, forming two whitish, oval, cushion-like prominences, soft and elastic to the probe, projecting into, and more or less blocking up the choanæ, and contrasting strongly with the general red colour of the mucous membrane around. This appearance should at once distinguish œdema from polypus.

Treatment.—Puncture, or tearing away portions of the œdematous mucous membrane with forceps has been recommended; but the best results are obtained by the application of the post-nasal galvano-cautery. When the œdema is associated, as it frequently is, with hypertrophic nasal or retro-nasal catarrh, these affections first call for treatment.

Perforation of the Septum is generally due to the softening and breaking down of syphilitic gummata, and consequent death and separation of the underlying bone or cartilage. Less commonly it results from strumous ulceration or periostitis, or from the erosion of a lupous patch within the nostrils. It may also follow an injury, blood-tumour, or abscess of the septum. Workers of chrome are especially liable to perforation of the septum in consequence, it would appear, of the irritating and corrosive action of the fumes. The perforation in these cases occurs with great rapidity, and generally within a few days after exposure. It is usually preceded by congestion of the mucous membrane, attacks of epistaxis, and a profuse purulent discharge. The discharge, however, has no fetor, probably in consequence of the antiseptic action of the chrome, a fact which is of value in distinguishing this form of perforation from that due to syphilis. The limitation of the process and its amenability to simple remedies further aid the diagnosis. When the perforation, however caused, is small, it is frequently productive of a peculiar whistling sound during respiration, and when extensive may lead to the falling in of the bridge of the nose, though very large portions may sometimes be lost without this happening. Small perforations may be closed by plastic operation, or if this fails, the opening may be sufficiently enlarged to prevent the whistling.

W. J. Walsham.

SEQUESTRUM is a term used for dead bone, when it is quite loose and detached from the living. It is oftentimes used as a synonym for necrosis, but should be more properly employed only as above described. *See* Necrosis.

H. H. Clutton.

SETONS.—A seton is a sinus produced artificially, and prevented from healing by means of some material passed along the track of it. Setons are chiefly used as counter-irritants, and in that case they are established in the subcutaneous tissue near the part it is desired to influence, e.g. in the temple or behind the ear in certain affections of the eye. As local irritants setons are not now much employed, but they used to be passed through cavities such as chronic bursal effusions and cysts, in order to excite inflammation and adhesion of their walls; in the form of drainage-tubes they are, however, still employed. Setons have also been used as a means of slowly evacuating the contents of chronic abscesses.

The orthodox material to use for keeping open a seton is known as a 'seton-tape,' and consists of a flat piece of gum-elastic tissue; it is introduced by a seton-needle, which is a broad, flat needle, with two cutting edges, and furnished at the heel with a clip, instead of an eye, for holding the tape. Both seton-needle and tape may be dispensed with, and instead of them, ordinary needles with eyes of suitable sizes for carrying one or more strands of wire, silk, worsted, or other material may be used. To establish a seton in the subcutaneous tissue, the skin should be pinched up between the finger and thumb, and the needle passed through the base of the fold, at such a depth that it is entirely below the skin, and the punctures at a sufficient distance apart that the vitality of the bridge of skin be not interfered with. The material used to keep open the sinus should be well oiled, and, after suppuration has been set up, a fresh piece of it should be daily drawn into the wound; if the gum-elastic seton-tape be used, it is only necessary to move it daily and keep it clean. The seton should be covered with some moist dressing, so as to prevent scabbing at the orifices and retention of discharges. If not itself sufficiently irritating, the tape may be smeared with savine ointment or iodine.

Bilton Pollard.

SEX.—It is not possible to define sex; for it is not only the presence in the body of certain organs and functions, and a certain state of the nervous system. It is a condition affecting the whole body, from the moment of conception; and the presence of visible sexual organs in the fœtus marks not the beginning of sex, but its advanced development. Van Helmont's saying, 'Propter uterum est mulier,' should be 'Propter mulierem est uterus.'

To the surgeon, the sex of a patient may be important in diagnosis, treatment, and prognosis; and sex is included, together with age, habits, and temperament, in that broad general view of each case which distinguishes those who wish to treat the patient as well as the disease. It is also of interest from the limits which it imposes on the transmission of disease and on its distribution, and from its relation to the comparative health and length of life of men and women.

We must first distinguish the *transmission* of disease from the *distribution* of it, and we must consider the influence of sex on each.

The relation of sex to the *transmission* of disease is to be studied in Darwin's *Animals and Plants under Domestication*, chap. xiv., and in Sedgwick's articles in the *Med.-Chir. Review*. It is well shown in those families where deafness, deaf-muteness, or imbecility has occurred among the daughters only. Ichthyosis also has been thus limited in transmission—in three families, to women; in one, to men. A malformation of the left ear has been transmitted to males alone; and malformation of the digits has gone, through ten generations, to females alone; but, in another family, to males chiefly. Albinism has affected only males, and only females. Many defects of the eye, especially myopia and colour-blindness, have been similarly limited; out of a total of thirty-two men and twenty-nine women, belonging to branches of a colour-blind family, there were twenty colour-blind, of whom eighteen were men, and only two were women; but in another family, there were in five generations thirteen persons colour-blind, all women.

Nor are malformations alone thus limited in transmission to one sex; every peculiarity tends to be transmitted in a greater or lesser degree to that sex in which it first appears (Darwin). This is shown in phthisis, and, sometimes, in other forms of scrofula. In these cases, 'the sons or daughters inherit the peculiarity, whatever it may be, from their father or mother, and transmit it to their children of the male sex.'

Or only a certain *disposition* to disease may be transmitted, as in cases where typhoid fever or measles has attacked one sex in a family more than another. Or it may be mere weakness, mere 'inability in one sex or the other to maintain life or to live beyond a certain age,' as in those families where one sex lives, but the other dies. Or, as in one instance (Sedgwick), two diseases may be transmitted, each limited to one sex, each having its proper distribution in the family.

Again, disease may be limited in its transmission as regards the sex *by* which it is transmitted. 'Generally with the hæmorrhagic diathesis, and often with colour-blindness, and in some other cases (gout, ichthyosis ?) the sons never inherit the peculiarity directly from their fathers, but the daughters alone transmit the latent tendency, so that the sons of the daughters alone exhibit it' (Darwin). The same tendency, though less marked, has been observed in phthisis; here the father transmits the disease to his son in about sixty per cent. of the cases, and to his daughter in about forty per cent.: the mother transmits it to her son in about forty per cent., and to her daughter in about sixty.

The general conclusion is, that disease tends to remain in that sex in which it first appears, but is often transmitted in a latent state through the opposite sex. To this conclusion must be added Darwin's two rules (*Descent of Man*, chap. viii.): that varieties, which first appear in either sex at a late period of life, tend to be developed in the same sex alone; and that variations, which first appear early in life, tend to be developed in both sexes.

These facts as to the transmission of disease make it evident that sex is, from the very moment of conception, a property of the ovum. Further proof of this may be found in the fact that in all cases of joined twins, as the Siamese and others, the two are always of the same sex, as though there had been a double or imperfectly-divided ovum, and each half had retained the sex which was the property of the whole ovum in the beginning.

If this be so, it is impossible that any influence should, after conception, affect the sex of the fœtus.

The Distribution of Disease.—We must remember the difference between the *transmission* of disease, to one sex, or by one sex, and the *distribution* of it to men and women. The two things are wholly separate. Thus, where deafness and deaf-muteness have been transmitted to one sex only, it has generally been to girls; but of 534 collated cases, 300 were boys. And colour-blindness may be limited in transmission either to boys or to girls; but of 200 cases, 180 were males.

The influences which decide the distribution of diseases among men and women are many. There are some diseases, as tumours of the breast, which are related to physiological changes in the part attacked. Others, as hernia, are related to the anatomy of the parts. Others, as chorea and hysteria, are related to perversion of the nervous system. Others, as some forms of cancer, are related to age, habits, and work. But in others, as in myxœdema (195 women to 15 men) and diabetes (738 men to 248 women—Brunton) it is hard to see what causes the unequal distribution.

At the moment of birth, male children are at a disadvantage; for they are, on an average, ten ounces heavier and half an inch longer, and their skulls are larger and more completely ossified. This may cause obstruction of the circulation, followed by inspiratory efforts, putting the child in danger of being choked by the fluids in the maternal passages (Hicks, *Croonian Lectures*). Also, hæmatoma is more common in new-born male children (Treves).

Before birth, two dangers beset the child—those of congenital deformity and inherited taint.

Congenital deformity is more common among boys than among girls; the following numbers, from various authors, show this clearly:—

	Boys	Girls
Harelip	44	20
Harelip with cleft palate	17	4
Ectopia vesicæ	14	2
Talipes, four simple forms	229	167
Malformation of rectum or anus	68	32
But on the other hand we have—		
Spina bifida	879	1102
Congenital dislocation of hip	13	47

The rare congenital deformities of the chest (fissured sternum, absence of ribs over the præcordium, malformation of the heart and great vessels) are more common among boys.

It may guide us to a possible explanation of this strangely unequal distribution of the chief congenital malformations, if we divide this list into deformities of the face, deformities of the pelvis, and nervous deformities.

The deformities of the face are, perhaps, more common among boys because of their more advanced cranial ossification; either because some of the total energy of development is spent on the cranial bones at the expense of the facial, or because the greater size of the cranium, and its firmer ossification, tend to hinder union of the facial bones in the middle line.

Dr. Hicks's theory, that male children are more liable to deformities of the anterior median line, and females to those of the posterior median line, is not enough to explain all the facts; for deformity of the rectum and anus, which he says is commoner among girls, is really the opposite; nor is it, anyhow, to be counted among deformities of the posterior median line.

But the fact that arrested development of the acetabulum (congenital dislocation of the hip), and of the pelvic part of the large intestine, occurs mostly in girls, while arrested development of the symphysis pubis (ectopia vesicæ) occurs mostly among boys, may be related to the special shape and purpose of the female pelvis; just as in fœtal life the female sacrum is already smaller than the male.

As to the prevalence of spina bifida among girls, it may be due to a less complete ossification of the spine, agreeing with the less complete ossification of the cranial cavity.

As regards hereditary taint, scrofula is equally divided, and so is rickets (but Guérin gives 148 boys to 198 girls). Inherited syphilis is equally divided; but certain forms of it are commoner among girls. Hutchinson, in his work on *Syphilitic Diseases of the Eye and Ear*, gives the following figures:—

	Boys	Girls
Keratitis	38	64
Iritis	5	18
Deafness	6	9

On the other hand, there is some reason for thinking that the rare tertiary forms of inherited syphilis are more common among boys.

In the first two years of life, the more advanced ossification of the skull is disadvantageous, as it is at birth, to male children. When irritation and hyperæmia of the brain occur, as often during dentition, the solid skull tends to increase the effects of pressure, as compared with the more yielding and mobile skull of the female. 'For, where the sutures or fontanelles are late in closing, the effects of dentition are not so severe' (Hicks). Hence the greater mortality of male children from convulsions and from nervous affections of the larynx (Trousseau). Talipes is also related to a similar cause.

In 1866, the deaths registered from convulsions were:—

	Boys	Girls
During first year of life	12,438	9,353
„ second „	1,668	1,513
In 1868:—		
During first year of life	11,689	8,905
„ second „	1,480	1,367

After the second year, the distribution of nervous diseases between boys and girls becomes more equal. Chorea is more common among girls: 'As 3 to 1, and this proportion is still higher after puberty' (Trousseau). Of 422 out-patients at the Children's Hospital, there were 300 girls to 122 boys (Hillier). Incontinence of urine has a similar distribution; the common nocturnal form of it is more common among little boys, but the grave diurnal form is more common among girls about puberty. So sleep-walking (Chambers) becomes, after childhood, commoner among women.

'The period of puberty produces a greater disturbance, and causes a more rapid general development in the female than in the male. At this time, and at no other, the female, inferior to the male in stature and weight from birth onwards, rapidly catches him up and surpasses him; so that, between the ages of 12½ and 15 or 16, females are both taller and heavier than males. It is probable that this excessively rapid growth, together often with some drain upon the strength from the menstrual flow, renders the female sex an easier prey to tubercle than the male. At 10 to 15, in tables of phthisis drawn from different nations, in all the tables the female deaths are nearly twice as many as the male' (Handford, *Medical Times*, Nov. 1885). At this time also, hysteria, and the imitations of disease, and neuralgia and epilepsy are common among women; so also are anæmia, and malaise, and leucorrhœa, and inability to bear up against infection (Allchin). Some of these, as epilepsy, may also attack males first at puberty. But in women, the catamenia are a guard against disease, as well as a cause of it; thus the freedom of women from gout may partly be referred to the occurrence of the catamenia as a great safeguard (Garrod).

Other diseases, which frequently arise at or near puberty, are exophthalmic goître (42 females to 8 males—Trousseau; 77 to 12—Beigel); ulcer of the stomach (in 234

cases of perforation, 160 were females—Brinton); and lateral curvature (151 to 22—Noble Smith). But these numbers are drawn from hospital practice, and there is need of statistics of the same diseases among the upper classes of society.

As regards marriage, and its influence on health and length of life, a few lines will suffice for the following statistics, drawn from the French registers by M. Bertillon (*Medical Times*, ii. 71). The deaths per 1,000 males yearly are—

	25–30	30–35	35–40
Bachelors	10	11	13
Married men . . .	6	7	7·5
Widowers	22	19	17·5

And so for all other ages. But very early marriages give results of their own: young married men, aged 18 to 20, die at the same rate as men aged 65 to 70. To women, the gain from marriage is less evident: thus, from 30 to 35, the deaths per 1,000 yearly are 11 single women to 9 married. Of women of 25 to 30, the deaths are 9 unmarried, 9 married, and 17 widows. Of women under 20, the deaths are 7·5 unmarried to 11·8 married.

The calculation of probabilities shows that a man aged 20 to 25 adds five years to his life by marriage, and a woman of the same age adds 4 to her life.

Pregnancy, says Dr. Allchin (*Medical Times*, Dec. 5, 85), though it brings the risks of nervous disturbances, or of albuminuria, only raises the death-rate by ½ to 1 per cent. Primiparæ die at the rate of 1 in 62, multiparæ at the rate of 1 in 124. The deaths of pregnant women, from causes not connected with their delivery, were only 55 in all the year 1883. Among diseases related in some way to pregnancy, and so more common among women, are floating kidney (87 to 10 men—Landau), and mollities ossium (85 females, in whom the disease either appeared during pregnancy, or was modified in its course by this condition—35 others—11 males. See *Erichsen*, ii. p. 307).

The menopause, though it may bring neuralgic pains, flushings, and other congestions, or a revival of slight diseases of girlhood, long in abeyance, may have a good effect on the organism, ridding it of chronic ailments, or stopping the growth of uterine fibroids (Allchin).

Old age, in relation to sex, is best comprehended in a short survey of male mortality and longevity, as compared with female. (*See* Dr. Allchin's Lectures.) In 1883, of 1,000 persons living, there were 487 males and 513 females; and at all periods of life females are either equal in number to the males, or exceed them. But, for every 100 females born, there were born 103·5 males. Therefore (though this greater number of male births is now somewhat diminishing), there must be a higher male death-rate, and we find that for every 1,000 persons there died 19·5, in the ratio of 20·6 males to 18·4 females. Again, in both sexes, the mortality is becoming less: thus in 1871–80 the death-rate was only 21·27 per 1,000 yearly, which is less than it was in any previous decennium; but while the male death-rate sank only 4·24 per cent., the female sank 6·02. Again, though infant mortality is becoming less, the mortality of adults is increasing; but while the male adult death-rate is increasing for all over 35, the female death-rate is increasing only for those who are over 45.

Hence, the mean expectation of life of a male child at birth is 41·35 years, and of a female child is 44·62. But the mean expectation of annual sickness, estimated by Mr. Sutton, is almost exactly the same for the two sexes:—

Age in years	Weeks of sickness in a year: For men	For women
15 to 20 . . .	·666	·666
20 to 25 . . .	·737	·737
25 to 45 . . .	·995	·995
45 to 65 . . .	2·736	2·751

Since women have as much sickness as men, and yet have a lower death-rate, they must either be more favoured by circumstances, or they must also have a superior vitality. Evidence for the latter view may exist in the heavy mortality of male infants, and in the fact that most very old folk are women. Thus, of centenarians, the numbers were, in 1873, 79 to 10; in 1881, 66 to 25; in 1882, 54 to 17 (Humphry, *Lancet*, May, 1885). In phthisis, the statistics of different nations are widely different; in England, during 1871–80, they show that, from 5 to 25, women suffer more; but after this they suffer less than men (Handford); and this also may be evidence of superior vitality.

Here we may consider how, as surgical patients, men and women differ. 'As a rule,' says Mr. Savory (*British Medical Journal*, i. 1873), 'women are unquestionably better subjects, in respect of temperament, for injury or operation, than men; not because they usually have more courage, in the ordinary acceptance of the term, but because they have, in this sense, more endurance. It is the passive, rather than

the active quality, which avails them. If they can do less, they can suffer more. And, again, see the advantage of calmness and resignation as opposed to impatience and restlessness. A man will often meet the suggestion of an operation as a soldier will volunteer for a forlorn hope, while the hint of such a thing to a woman will sometimes prostrate her. But then each has to submit to it, and, when the thing is done, as time goes on, qualities of another kind come into play, in which, in her turn, the woman surpasses the man.'

'Persons of an irritable and nervous disposition do not bear operations so well as those of a more tranquil mental constitution. Those also of a feeble and irritable habit of body, especially nervous and hysterical women, with but little strength of circulation, cannot bear up against severe surgical procedures, and often sink after comparatively slight ones; being apt to become depressed and to sink without rallying' (Erichsen).

As regards operating during the catamenia, Mr. Savory says: 'If the period of the catamenia has been miscalculated, or they appear irregularly at the critical moment from anxiety or excitement, much must depend on the patient and the disease; but I believe that by running whatever risk there is, I choose the less evil of the two.' 'As with menstruation, so, much more, during pregnancy, you would not willingly operate. And yet, with the exception of the danger of producing abortion, I know no facts that would imply a greater than the average risk; while it would be mere recklessness to operate on such patients without good cause, yet if good cause for operating exists, they may be treated very hopefully. When women are suckling, they will bear operations with no more than the common risk that might attach to persons who may be in comparatively feeble health. But an exception must be made, I believe, for operations on the breast' (Sir J. Paget, *Clin. Lectures*).

Last, as regards the relative frequency of a few of the chief diseases.

1. Stone in the bladder is especially rare in female children. Among men and women the proportion is 1 to 20, or more, of cases operated upon. 'Owing to the shortness and large size of the urethra in females, many small stones are voided by them that would be retained in the male' (Erichsen). Perhaps the prevalence of tumour in the male bladder (eighteen out of twenty cases—Thompson) may also be related to the anatomy of the parts concerned.

2. Of rectal diseases, fissure, prolapse, and stricture are commoner among women: of 28 cases of stricture, 20 were women; 'and in 9 of them the disease commenced after labour, in some instances being distinctly attributed to an injury at that time' (Curling). But piles, fistula, and cancer are commoner among men; cancer, from different authorities, is 44 to 23.

3. *Hernia.*—Mr. Birkett has constructed the following table, from Mr. Kingdon's statistics in 1860–61:—

Ages	Inguinal		Femoral	
	M.	F.	M.	F.
1 to 20 . . .	2,435	249	23	38
20 to 40 . . .	2,954	322	139	432
40 and upwards	2,154	128	144	278

4. *Aneurism.*—All diseases related to arterial degeneration are commoner in men—e.g. angina pectoris (80 to 8—Forbes; but see Trousseau, *Clin. Med.*, vol. i.) and senile gangrene. Of Crisp's 551 cases of aneurism, more than seven-eighths were in men. But aneurism of the carotid, and internal aneurisms, are more evenly distributed.

5. *Rodent Ulcer.*—Of 42 cases, 20 were women (Hutchinson, *Medical Times*, Oct. 1860). Of cancer of the lip, Hutchinson gives 127 cases, including 5 of the upper lip or angle of the mouth. Of these 127, only 6 were women; and 3 of these women were smokers. As regards cancer of the tongue, Sibley, in 1857, gives 9 men to 5 women; Hutchinson, in 1860, gives 13 to 6; Humphry, about the same year, gives 7 to 9; Baker, in 1862, gives 19 to 11. But a recent set of private cases gives 44 to 2; and the cases in St. Bartholomew's Hospital in 1883 were 23 to 1. (Compare Mr. Barker's tables in Holmes's *System*.)

Mr. W. R. Williams has just published full statistics of the distribution of the various diseases, medical and surgical, to men and women, in his valuable work, *The Influence of Sex in Disease*.

STEPHEN PAGET.

SHAMPOOING. *See* MASSAGE.

SHOCK.—*Etiology, &c.*—Shock is that state of general depression of vital activity, into which a person passes who has been subjected to severe injury, emotional disturbance, &c.; or, in other words, who is suffering from the general depressing effect produced upon the central nervous system by a violent stimulation of the peripheral nerves and nerve-endings.

The general effect of the excessive 'irritation' of the central nervous system will consequently, *cæteris paribus*, vary directly

with the degree of the stimulating force, as will presently be shown to be the case, while, at the same time, this effect is modified by the very obvious differences between the circumstances of individual sufferers.

The condition, in most cases, is not merely produced through direct irritation of the nervous system, but is very frequently deepened, and the symptoms rendered much more severe, by such simple though fundamentally important complications as exposure to cold, loss of blood, previous acute illness, &c. In fact, the first two of these predisposing conditions are to be looked upon occasionally as themselves causes of shock, and will be referred to as such below.

The effect, moreover, is not always the same, although the exciting cause may be identical, for two distinct kinds of shock were observed by Travers—viz. one in which great prostration is the principal feature of the case, and another in which the patient, although apparently exhausted, passes into a condition of traumatic delirium. The consideration of the latter of these, termed prostration with excitement, will be postponed until the more ordinary case of depression has been described.

I. Shock with Depression.—*Causation.*—(1) *Seat of Injury.*—Shock is especially apt to follow injuries of the head, abdomen, urethra, testicle, digits, and thorax. Thus, it occurs as a result of lesions of those parts which are most richly supplied with sensory nerves, and also those which contain the most important viscera, and are consequently intimately connected with the medulla oblongata by means of the vagus (and trigeminus) nerve. The liability of urethral operations to be succeeded by shock, is undoubtedly due to the intimate relation between the lumbar enlargement of the spinal cord and the process of excretion of the urine. *See* Urethral Fever.

(2) *Mode of Injury.*—The commonest kind of injury which produces shock is the result of a crushing force applied to the body—one, therefore, which damages a number of branches of the sensory nerves. For the same reason, blunt and large instruments cause shock by the wide area over which they operate, and also from the fact that they inflict a contused or lacerated wound, which causes more energetic irritation of the nerves. So with burns of the surface of the body: it is an old axiom that the important factor in the causation of fatal shock, in these cases, is not the depth or degree of the burn so much as the extent of the injury.

The converse injury—namely, cold—probably acts in the same way, and is a powerful adjuvant in helping to produce shock in operations, which from their nature and seat would not specially cause it. Here it may be noted that Hewson found shock to be most severe in the extremes of winter and summer—i.e. when the system is most depressed.

But while the influence of the extent of the injury has been long recognised, further inquiry shows some particular operative measures to be more active than others in producing this condition, and these may be summed up as those which involve laceration of the nerve-fibres. Thus, Mr. Jordan has shown, in cases of amputation, the strikingly sudden effect produced on the pulse and temperature by the simple act of sawing the bone; so that while the rapid division of the soft parts with a keen-edged knife had very little effect on the narcotised nerve-centres, the laceration of the few osteal nerves caused immediate and marked depression. This phenomenon is not very comprehensible, except on the assumption that it is the mode of injury which wholly determines the effect, when it is remembered that division of a bone with the saw is not a very painful process, unless the section be carried through the bone near the point of entrance, into the marrow, of the trunk of the nerve supplying it.

A practical illustration of the same fact is noted by Pirogoff, who, in the days before anæsthesia was employed, observed that patients sank with extraordinary rapidity immediately after division of the bone.

(3) *Influence of Age and Sex.*—The question as to whether either sex is less liable to shock, is quite indeterminable with our present means of information, and any surgical procedure should not, consequently, be based upon such generalisations—as, for instance, the fact that women do not, generally speaking, meet with so severe a struggle for existence as men, and therefore have a greater reserve of power to fall back upon—but must be decided upon according to the peculiarities of each case. As for the influence of age, all surgeons are agreed as to the especial severity of shock when it occurs in people already the subjects of senile degeneration, it being of course understood that such degenerative change is not nesessarily the accompaniment of prolonged life.

As regards the occurrence of shock in children, it is to be observed that, like adults,

they suffer extremely from the causes of shock when those causes are applied over a large area of the body, as for example in cases of burns and exposure to severe cold. In fact, their liability to suffer under these circumstances would appear to be greater than in the adult. As far, however, as operative measures alone go, there is no doubt whatever that the nervous system of the child is less influenced by traumatism than that of the adult. Elaborate clinical evidence in illustration of this point is not to hand, but its general truth, being supported by abundant experimental evidence, cannot be doubted, and is therefore to be considered as forming safe ground for action under circumstances of doubt.

(4) *Nervous Temperament.* — In all neurotic, excitable subjects, the effects of shock are naturally more severely felt, and, on this point, may be mentioned the changes, in the time of onset and duration of this condition, which are wrought by the mental condition of the subject at the time of receiving the injury. Thus, if the patient is harassed by expectation, from actual foresight, of the impending mischief, the effects will develop with great rapidity and cause urgent symptoms. On the other hand, if the patient's mind is attentively occupied with some idea of absorbing interest when he is injured, the symptoms of shock will be postponed, but will be more marked when they do occur, owing to the previous exhaustion of the nerve-centres. Such cases are of common occurrence after battles, &c.

(5) *Previous Loss of Blood.*—This acts so obviously as a predisposing cause of shock—viz. by depleting the nerve-centres—that it needs only mention here; at the same time it should be remembered that the failure of the heart, which occurs in cases of severe hæmorrhage, and which therefore gravely deepens the symptoms of shock, is in many cases due simply to emptiness of the heart's cavities, and thus its urgency can be removed by transfusion. See *Treatment*.

(6) *Previous Illness.*—The effects of previous illness upon the occurrence of shock vary according to the following simple rule—namely, that where previous illness has not caused any visceral disease or degeneration, and has (owing to treatment, &c.) practically only had the effect of confining the patient to bed, so far from predisposing to shock, it is a prophylactic against it. Where, on the other hand, it can be shown that previous illness has caused chronic changes, especially in the excretory organs, severe shock is to be expected. This fact is, of course, of great importance in deciding the propriety of performing a severe operation upon a case of long-standing joint-disease, &c.

Symptoms.—A person, who has been subjected to one or more of the foregoing causes of shock, exhibits the following symptoms, which are here classified according to the anatomical centres, the derangement of which leads to their production.

General Neurotic Symptoms. — The patient lies flat on his back, usually conscious but not emotional, and exhibiting all evidences of general paresis of volition. Thus, the limbs lie flaccid, usually just where they are placed; he makes no so-called spontaneous movements; the upper eyelids fall so as to half-close the (frequently upturned) eyeball. The eyes are sunken, the skin of the face expressionless and showing well-marked longitudinal folds. The sphincter ani is usually relaxed, and the urine retained in the bladder. Speech is clear, but feeble and sometimes slow, while the intellectual operations preceding an answer to a question are often delayed, and ability to think and reflect, for even a short time, is abolished.

Bulbar Symptoms. — Frequently, no doubt, as an effect of direct reflex action on the vagus centre (cardiac centre), the pulse, slow (according to Jordan) soon after the injury, becomes frequent and remains so till death in fatal cases, as if, apparently, the inhibitory action of the vagus centre were removed. At the same time, it is irregular both in force and rhythm, the force gradually diminishing until the pulse becomes imperceptible, the respiratory movements continuing.

Respiratory Centre. — Respiration throughout is enfeebled and the action of the centre becomes irregular, while inspiration is often accompanied by sighs of variable depth and frequency.

Vaso-motor Centre.—Cases of shock are so frequently complicated by hæmorrhage, that it is difficult to accurately account in all cases for the customary pallor of the skin and mucous membranes; as far as can be made out, there is, first, vasal constriction, which, however, is soon followed by paralysis of the vessel-walls, so that while most of the surface of the body is of a dead white colour, certain portions are darker and even cyanotic, which condition is also kept up by the feebleness of the circulation.

Temperature.—The temperature of the body is customarily lowered from one to three degrees, in fatal cases frequently sink-

ing below 95° F. In some cases which end fatally, the temperature has been observed to rise again after the preliminary fall, and it may even reach 99° before death, the other symptoms also undergoing slight relaxation.

Deglutition Centre.—Voluntary swallowing is impaired, as are all voluntary acts, but the centre in the medulla for the constrictor action of the pharynx, &c., remains active, except in very severe cases, when its function may be abolished.

Vomiting Centre. — The sensation of nausea, which is felt by persons who are suffering from impending syncope, finds its highest illustration in the vomiting produced by shock. The occurrence of vomiting is very variable in time, but very constant in appearance. Thus, it may occur very soon after the accident or at any period afterwards, when some of the other symptoms have disappeared.

Sensory Symptoms: Special Senses.—The perceptive centres, &c., for the special senses are usually unaffected, except in very severe cases, when there may be almost complete anæsthesia and analgesia. Indeed, severe operations have been painlessly performed in this condition, even while the patient was watching all the details. Sometimes paræsthesiæ are well-marked, and sensation of cold (frequently, of course, of actual objective origin) and numbness are complained of.

Miscellaneous Symptoms.—Owing, probably, to vaso-motor changes rather than to direct activity of secretion ('paralytic'?), the skin is moistened by a cold clammy sweat, which occasionally collects in large drops, but, as a rule, is less marked than is usually stated. In accordance with this view, it is to be noted that secretion from other glands is arrested; thus, for instance, there may be absolute suppression of urine.

Pathological Anatomy, &c. — Besides the anæmia of the body-surface, described above, there is also found, in many cases, anæmia of the central nervous system, while the heart is in a state of diastole and the right side full of dark blood. The veins of the abdominal viscera are also said to be engorged, and, if the case is one of uncomplicated shock and one in which the splanchnic system is obviously engorged, we have an easy explanation of many of the vaso-motor symptoms; but on this point post-mortem evidence is by no means complete. In three cases of simple shock examined by the writer, the mesenteric vessels were not markedly full at all. Of course, if there were reflex paralysis of the splanchnic nerves, or depression of the vaso-motor centres governing the splanchnic vessels, then it is quite probable that the anæmia of the surface and the brain is due to the blood filling the dilated visceral vessels. As the symptoms, however severe, have been shown to be due to simple diminution of function, it is not surprising that no grosser changes than those just described are to be found in this condition.

Diagnosis.—Confusion of this condition with others is scarcely possible, save with concussion of the brain and syncope. Since in the former we have, as the principal effect, diminution of function of the central nervous system, the two states are really nearly identical and do not require separating except for purposes of treatment. General considerations will always suffice to decide, and Fischer points out that the pulse is a fair guide to differentiate the two conditions, being slow and regular, often full, in the case of direct injury to the brain, small and irregular in cases of shock. The complication of anæmia from loss of blood will be easily discovered, and treated accordingly.

Prognosis.—The prognosis depends so entirely on the details of each individual case, that nothing can be said here save that all judgment must be based solely on the evidence afforded by the pulse and temperature. There is, however, a most important prognostic question connected with shock, which may fittingly be discussed here —namely, at what period and under what circumstances is it justifiable to operate upon a person suffering as above described.

First, all surgeons are agreed that it is in no sense justifiable to operate on a person the subject of shock, except in the special case when it is perfectly clear that the damaged portion of the body is (by causing pain, &c.) prolonging and adding to the severity of the condition. Guthrie laid down, as a practical rule, that the surgeon should wait until the patient recovered his sensibility to the pain of the injury, or, in other words, until reaction or gradual recovery has led to the nearly complete re-establishment of function in the nervous system.

Next, most surgeons are now agreed upon the fact that an anæsthetic does little to deepen shock. It certainly depresses the temperature of the body, but equally certainly appears to give rest to the nerve-centres in their progress to recovery, and of course to a large extent protects them from experiencing further depression. Therefore, we may clear the ground by saying that anæsthetics should always be

given, and further, that as a rule ether is the best narcotic agent to employ, since it is at the same time a powerful cardiac stimulant.

In short, the ordinary practice is to wait for some reaction except in the case referred to; but, in all instances, the consideration of the peculiarities of each case will guide the surgeon in modifying the application of these principles, which consequently can only be expressed in general terms.

Treatment.—The treatment of shock may be very conveniently summarised under the following heads—Pulse, Respiration, and Temperature, it being understood that the cause of shock has been removed as far as possible.

Pulse.—The pulse practically is the main guide in the direction of treatment, especially as it affords direct evidence of the condition of the heart, failure of the action of which appears to be almost always the immediate cause of death.

The choice of stimulants, alcoholic or otherwise, must depend upon the degree of shock, the mode of injury, and the state of the patient's heart, &c. If there is not much nausea, hot strong beef-tea should be given in small quantities by the mouth, or if vomiting has already set in, it must be injected into the rectum, the anus being plugged if the sphincter is relaxed. Ammonia (liq. ammon. aromat. f℥j.), ether (f℥j. in aromatic water), alcohol f℥j. (as brandy or champagne, preferably the latter), may be given every half-hour (more or less frequently according to the necessities of the case) until the pulse is improved. The pulse must be carefully watched, and the stimulant diminished as soon as the quality of the heart-beat is improved. In this way, post-stimulation, depression, and over-excitement of the heart's action will be avoided. If the injury or operation is causing much pain and therefore reflex depression of the heart, morphia (gr. ¼) should be given hypodermically, and the dose increased if not sufficient, but it must be remembered that the action of morphia is cumulative.

The momentary application of a very hot cloth or plate to the cardiac area will often spur up a sluggish heart, and in severe cases hypodermic injection of ether should be given, f℥ss. to f℥j.

Respiration and Temperature.—The bodily heat and the respirations commonly vary together, and, as they are intimately connected with one another causally, may be considered in terms of the temperature. If the temperature falls, loss by radiation must be prevented, the patient must be well but lightly covered with blankets, and hot bottles put by his extremities, and one on each side of the thorax. (It will be remembered that sensibility to pain may be deadened, and that hot bottles must be guarded from the skin.) As soon as the temperature of the body returns to normal and remains so for about half an hour, the hot bottles should be removed or only left at the feet.

Hæmorrhage.—So much of the urgency of shock being due to loss of blood, it is necessary to consider the two immediate effects it exerts on the system. The first of these is insufficient supply of blood to the nerve-centres (bulbar especially), with the production of dyspnœa and, often, jactitation as symptoms; while the second is cardiac failure owing to the heart-cavities being insufficiently filled with blood.

The first condition is best met by lightly bandaging and raising the limbs, while artificial respiration is kept up gently but industriously. In one case in which the natural respiratory movements ceased three times, recovery was ultimately obtained by this method. The second symptom, which is sometimes accompanied by a semi-comatose state, must be treated by bandaging and raising the limbs as before. If this does not speedily (fifteen minutes) produce a change in the heart-beat, transfusion should be performed at once. It is not necessary to use blood for this purpose; several saline fluids have been used with success, and one consisting of water 1000 parts, pure sodium chloride 6 parts, sulphate of soda 2 parts, carbonate of soda 1 part, appears to combine the advantages of most which have been put forward since Schwarz established the scientific value of the operation. A quantity equal to the amount of blood supposed to have been lost should be injected into a vein, after careful filtration and warming. Not less than 500 cubic centimètres should ever be injected. *See* Transfusion.

Prophylaxis.—When shock is to be expected to follow an operation, the patient should be given a small dose of morphia (gr. ¼) hypodermically a quarter of an hour before the operation, and then the limbs should be lightly bandaged with cotton-wool.

II. Shock with Excitement.—*Pathology.*—Travers, who first drew attention at any length to the condition which passes under the above title, considered that the nervous system was affected, as in the ordinary case of shock, by depression with

atony; but that, instead of this ending in paralysis, it passed into a state of hyper-excitability which led to absolute exhaustion. In fact, he described the condition as one of premature and excessive 'reaction.' The pathology of this certainly rare condition has been rendered rather obscure by some writers, who have clearly included under the same heading distinct cases of sapræmia. In the majority of instances, it will be found that the first symptoms appear very early—viz. two to four hours after the operation, that the excitement rapidly reaches a violent degree, and that the fatal coma follows in from fifteen to forty-eight hours after the accident or operation. From this, it does not seem unscientific to conclude that the whole series of phenomena are those of atonic hyper-excitability of the nerve-centres, although it is always to be remembered that there is almost invariably an open wound, and always some extravasation of blood; so that, the possibility of the symptoms being due to pyrogenic absorption never being absent, the question of its true pathology must be left entirely open.

Symptoms.— The patient usually recovers rapidly from the anæsthetic, speaks very hopefully of his condition, and seems in a very favourable state. In a very few hours, however, he will be found to have distinct delusions (the same thing is often seen in patients recovering from the effects of ether), and to be suspicious of those around him. He talks volubly and soon quite incoherently, the respirations are hurried, the apex-beat thrilling and the pulse weak; he tries to get out of bed, is evidently insensible to pain, as he tears off dressings and freely moves the injured part. In this state of excitement the patient cannot be calmed by reason, and finally becomes wildly maniacal. As a rule, very little force is required by way of restraint, as the muscular power is so much reduced. After some hours the signs of shock with depression gradually come on, the pulse becomes very small and quick, the temperature falls, the pupils dilate, &c., and the patient dies exhausted. In some cases, the maniacal state is interrupted by short intervals of comatose apathy and exhaustion.

Prognosis.—Practically fatal, and the condition continues till death.

Treatment.—Nothing has been added to the treatment advocated by Travers—viz. opium, food, and stimulation. Any narcotic to the nervous system, such as hyoscyamus, chloral, paraldehyde, may be tried, but probably without much success.

VICTOR HORSLEY.

SHOULDER, Diagnosis of Diseases and Injuries about the.—The angle of the shoulder is formed by the acromion process of the scapula and the outer extremity of the clavicle, whilst rotundity is imparted to it by the upper end of the humerus and the deltoid muscle. Broad square shoulders are usually taken to indicate manly strength, and depend on a wide chest, long clavicles, and well-developed deltoids; while sloping narrow shoulders indicate delicacy. One shoulder higher than the other is nearly always due to LATERAL SPINAL CURVATURE. It is common in girls about the age of puberty, but usually takes origin in rickets of an early period, and at this climax becomes more pronounced as the result of habit or weakness. High shoulders may so appear because associated with a congenitally short neck, but, when amounting to deformity, they usually indicate ANGULAR CURVATURE OF THE SPINE in the upper dorsal or cervical region. Drooping forwards of the shoulders gives rise to projection of the posterior margins of the scapulæ, and is a sign of *general muscular weakness* such as is seen in too rapidly growing youth and in the decadence of age. Drooping shoulders and rounded back, the so-called 'round shoulders,' are also frequently the result of CYPHOSIS. An oblique direction of the scapula may result from paralysis of the serratus magnus, and rotation with projection of the lower angle from slipping of the latissimus dorsi muscle.

A fall on one shoulder may give rise to fracture of the clavicle, dislocation of the acromio-clavicular joint, fracture of the acromion, dislocation or fracture of the upper end of the humerus, or fracture of the neck of the scapula. *Fracture of the clavicle* occurs most frequently just externally to the middle; the shoulder drops downwards and forwards, and the outer fragment is almost invariably below the inner. The line of fracture can be felt, and crepitus can be elicited by drawing back the shoulder. Fracture between the ligaments (conoid and trapezoid) may be attended with no displacement, and is then to be detected only by pain and crepitus. *See* CLAVICLE, Fracture of the.

In *dislocation at the acromio-clavicular joint*, the acromion process is almost always displaced downwards and inwards beneath the clavicle, and the outer extremity of the latter forms a well-marked projection above the point of the shoulder. In the rare cases in which the acromion is displaced upwards, its free end can be readily felt

riding over the clavicle. *See* SCAPULA, Dislocations of the.

In *fracture of the acromion* the outer fragment drops with the shoulder; the interval can be felt, and pain and crepitus will be produced by pressing up the head of the humerus. The acromion is sometimes united to the spine of the scapula by fibrous tissue, and, if the surgeon is in doubt as to this condition, he should examine the other shoulder, as the condition is usually symmetrical. *See* SCAPULA, Fracture of the.

An angular appearance of the shoulder may be due either to atrophy of the deltoid or to displacement of the upper end of the humerus. *Atrophy of the deltoid* may be consequent upon disease or ankylosis of the shoulder-joint; it may follow injury to the muscle or to the circumflex nerve; in children it may be due to infantile paralysis, and in adults to progressive muscular atrophy. When due to paralysis, the joint-movements are free.

Dislocation of the head of the humerus invariably renders the angle of the shoulder more acute; this appearance is most marked in the subglenoid, and least evident in the subspinous form. Further, there is limitation of movement, the elbow projects from the side, and the head of the bone can usually be felt in one of the four characteristic positions. *See* SHOULDER-JOINT, Dislocations of the.

Fracture of the neck of the scapula is met with in two forms, both of which are rare. In the commoner form, the coracoid process is broken off with the glenoid cavity and is movable; in the other, the fracture is external to the coracoid process, which remains fixed. The shoulder is more angular than normal from dropping of the humerus with the glenoid cup, but there is no fixation, and the arm is lengthened. Crepitus is obtained by pressing up the humerus; at the same time the deformity disappears, but recurs when the force is withdrawn. *See* SCAPULA, Fracture of the.

Fracture of the surgical neck of the humerus is not uncommon, and gives rise to a marked deformity. The upper fragment is displaced upwards and outwards by the muscles attached to the great tuberosity, and immediately beneath it there is a slight depression; whilst the lower fragment is drawn in beneath the coracoid process, where it can readily be felt, especially when the elbow is raised upwards and outwards. There is increased mobility, and crepitus is elicited by extension, the deformity recurring when extension is removed.

Separation of the upper epiphysis of the humerus may occur under the age of twenty. The deformity is the same as in fracture of the surgical neck, but the end of the lower fragment is less angular and bony crepitus is absent. *See* HUMERUS, Fractures of the; SEPARATION OF EPIPHYSES.

Diseases about the shoulder are numerous, but less complicated than the results of injury. LIPOMATA are not uncommon; they are painless, movable, semi-fluctuating, but feel solid and lobulated when pressed laterally. A BURSA is sometimes met with on the point of the shoulder in those who carry weights; it is adherent, has a thickened margin, and a fluctuating centre which yields clear glutinous fluid on puncture. GUMMA may be met with at the back of the shoulder; the history and concomitant tertiary signs of syphilis would assist the diagnosis. SEBACEOUS CYSTS are known by their relation to the skin, which they thin out and are adherent to; they fluctuate, and the skin is often discoloured over them. HÆMATOMA or ABSCESS may follow injury. Other tumours commencing in the superficial structures are rare.

On the bones *nodes* (*see* SYPHILIS) may occur, attacking either the clavicle, acromion, spine of the scapula, or humerus. They cause thickening, pain at night, sometimes fluctuation and tenderness, and are associated with other syphilitic symptoms present or past. EXOSTOSES are known by their slow growth and extreme hardness; ENCHONDROMATA by slow growth and rounded elastic nodules on the surface. SARCOMATA are more uniform on the surface and of more rapid growth; they sometimes lead to spontaneous fracture. *Myeloid sarcoma* may attack the upper extremity of the humerus in young persons, gradually expanding and absorbing the bone till a thin shell-like layer is left, or only periosteum.

Inflammatory conditions of the bones are at first associated with local or general fever, and, should necrosis follow, sinuses will form, and new bone be deposited around the old. *See* PERIOSTITIS.

Disease of the acromio-clavicular joint is very rare. The joint being subcutaneous, the consequent swelling is readily detected. The writer once saw this joint suppurate in the course of pyæmia.

Sprains and injuries of the shoulder-joint are apt to lead to pain and limitation of movement, lasting for weeks or months, accompanied by *circumflex neuralgia*. This neuralgia is especially felt about the middle of the outer side of the arm, over

the insertion of the deltoid, where the circumflex terminates in cutaneous filaments. In consequence of the deltoid covering the shoulder-joint, Synovitis causes no very characteristic appearance, but when the effusion is great, swelling may become evident below the acromion behind, and external to the coracoid in front.

Chronic disease of the Shoulder-Joint gives rise to muscular fixation, which causes the scapula to move with the arm, a sign of the utmost importance when examining a child. In a young person of strumous diathesis, the joint-disease may take the form of *pulpy degeneration of the synovial membrane*, or it may be that the disease commenced in the bone as *strumous epiphysitis* or *articular ostitis*, and extended to the joint. In the cases of pulpy disease, there is usually a doughy white swelling about the joint, and little pain till the later stages, when the cartilage has been removed; whereas in epiphysitis or articular ostitis the pain is severe, and the swelling at first confined to the region of the bone. *Syphilitic epiphysitis* occurs in infants the subject of inherited syphilis, and gives rise to 'pseudo-paralysis.' Sometimes the epiphysis becomes separated, when increased mobility and cartilaginous crepitus may be detected on manipulation.

The foregoing inflammations have a tendency to suppurate in the later stages, whereas the *rheumatic*, *gouty*, *ataxic*, and *osteo-arthritic* have little tendency to suppuration. The rheumatic and gouty may be referred to the constitutional habit; the ataxic (Charcot's joint-disease) is associated with locomotor ataxy; and osteo-arthritis occurs most frequently after the middle period of life, and gives rise to a creaking joint having bony outgrowths around. All chronic diseases of the shoulder-joint lead to wasting of the scapular muscles.

Subdeltoid bursitis may be confused with joint-inflammation. It gives rise to a uniform fluctuating swelling beneath the deltoid, and pain is felt during active movements in which this muscle contracts, but passive elevation of the arm relieves the pain.

R. Clement Lucas.

SHOULDER-JOINT, Amputation at the.—Amputation at the shoulder-joint is one of the greater surgical operations, which, as a rule, is attended with excellent results. The cases indicating it are compound comminuted fractures (frequently the result of gunshot injury), malignant tumours, extensive necrosis, and aneurism. They are, in truth, so various that no one method can be specially recommended. These amputations are six in number—(1) The circular method (Alanson, Velpeau); (2) the oval method (Larrey); (3) the antero-posterior flap method (Lisfranc, Desault); (4) modified oval method (Spence); (5) external square-shaped flap (La Faye, Richeraud); (6) semicircular flap by transfixion (Dupuytren).

To Alanson is due the credit of having first performed and described amputation at the shoulder-joint by the *circular method*, the principle of oblique division of the muscles being adhered to. He commenced the circular incision through the integuments a hand's breadth below the acromion, and then obliquely divided the muscles up to the capsular ligament. 'The tendon of the biceps and the capsular ligament upon the anterior and posterior part of the joint were now cut through. One of the circumflex arteries, which bled a good deal, was next tied. The great pectoral muscle, the rest of the capsule, and all the other parts except the vessels and nerves were then divided, but previously to cutting the vessels a temporary ligature was put around them.' This operation with slight modifications has been practised and advocated by several operating surgeons of repute, notably by Velpeau, who believed that no method gave better results or could be performed with greater expedition than the circular. However, notwithstanding these high credentials, this operation is now seldom, if ever, performed, chiefly on account of its being, as Mr. Lane observes, 'more difficult of performance than the other methods.'

In cases of fracture or tumours of the arm indicating amputation at the shoulder, the *oval method* of Larrey, or Spence's modification of it, is preferable. The former is thus performed. A straight incision is made on the outside of the shoulder, from the tip of the acromion vertically downwards for a distance of an inch and a half or two inches. The deltoid is thus divided into two equal parts. The integuments being drawn up towards the shoulder by an assistant, the anterior and posterior flaps are formed by 'two oblique strokes of the knife made from within outwards and downwards, so as to cut through the tendons of the pectoralis major and latissimus dorsi.' The flaps are then raised and the joint exposed. An incision over the head of the bone divides the capsule and tendons in immediate connection with the articulation. The head of the bone being rotated outwards, the posterior ligamentous structures are divided; the knife is then carried

downwards and outwards through the incision on the inner side, an assistant at the same time compressing the artery in the flap; and finally the knife is directed backwards, dividing the axillary vessels. These are then tied, the divided circumflex vessels being subsequently secured.

Mr. Guthrie has also described a method of amputation at the shoulder by an oval incision, which in the main is closely analogous to Larrey's operation.

The late Prof. Spence, of Edinburgh, described a modification of Larrey's operation, which it is alleged, results in a more shapely stump, and in which disarticulation is more easily accomplished. Another advantage claimed for it is that only the terminal branches of the posterior circumflex artery in front are divided. The operation had best be described in Prof. Spence's words:—'The arm being slightly abducted, and the humerus rotated outwards, I cut down upon the head of the humerus immediately external to the coracoid process, and carry the incision down through the clavicular fibres of the deltoid and pectoralis major muscles till I reach the humeral attachment of the latter muscle, which I divide. I then, with a gentle curve, carry my incision across and fairly through the lower fibres of the deltoid towards, but not through, the posterior border of the axilla. Unless the textures be much torn, I next mark out the line of the lower part of the inner section by carrying an incision through the skin and fat only, from the point where my straight incision terminated, across the inside of the arm to meet the incision at the outer part. If the fibres of the deltoid have been thoroughly divided, the flap, together with the posterior circumflex artery, can be easily separated by the point of the finger from the bone and joint, and drawn upwards and backwards so as to expose the head and tuberosities, without further use of the knife. The tendinous insertions of the capsular muscles, the long head of the biceps, and the capsule are next divided by cutting directly on the bone. Disarticulation is then accomplished, and the limb removed by dividing the remaining soft parts on the axillary aspect. In cases where the limb is very muscular, I dissect the skin and fat from the deltoid at the lower part, and then divide the muscular fibres higher up by a second incision, so as to avoid redundancy of muscular tissue.'

The operation by *antero-posterior* flaps, the anterior one being made by transfixion and the posterior by cutting from within outwards, is the one the writer, as a rule, prefers. It closely resembles one of the methods advocated by Dupuytren. It is comparatively easy of performance, results in a shapely stump, and admits of greater facilities for freely opening the articulation than the other methods. On the other hand, it is not suitable in cases of malignant tumours of the arm, or in cases where, owing to extensive fracture, the leverage of the arm is not available to raise the head of the bone from the glenoid cavity.

The operator standing at the side of the patient, and the arm being raised and abducted, the point of a catlin is entered immediately below the posterior border and at the greatest prominence of the acromion, and the instrument, carried across the outer and anterior aspect of the head of the humerus, is made to emerge below and internal to the coracoid process. A flap involving the entire of the deltoid muscle, down to its insertion, is then made. This is then held back, and the capsule opened. The tendon of the biceps and the muscles attached to the great tuberosity are next divided, and the arm being rotated outwards, the subscapularis is divided at its insertion; the head of the bone can then be easily displaced forwards and the knife passed behind it, and the postero-internal flap, somewhat shorter than the anterior one, cut from behind forwards and downwards. In doing this the surgeon, when operating on the right side, can compress the vessels with his left hand before they are divided. On the left side this can be done by an assistant. The axillary vessels, the posterior circumflex artery, and smaller muscular branches, will require ligatures.

Mr. C. Heath describes a somewhat similar operation; but he prefers cutting the anterior flap from without inwards, as it gives, according to him, a 'larger and more satisfactory flap.' This method is clearly preferable in cases where the operation has to be done in proximity to any form of malignant growth. He describes the operation as being done by grasping the limb with his left hand, and bringing it across the chest; and he then 'enters the point of an amputation knife at the most prominent point or angle of the acromion process. With a sawing movement he marks out a flap of skin and deltoid muscle, taking nearly the entire muscle down to its insertion, and bringing the incision up to the coracoid process, at the same time drawing the arm away from the side. An assistant grasping the flap draws it up so as to expose the shoulder-joint, which is to be opened by one semicircular sweep of the knife laid on

close to the anatomical neck of the humerus, the bone being rotated by the left hand of the operator so as to bring the several parts of the capsule into view successively. The tendon of the biceps is divided with the capsule, and the head of the bone is then readily dislocated, so as to allow the blade of the knife to be passed behind it to form an inner flap.'

In controlling hæmorrhage during the performance of this amputation much assistance will be derived from compression of the subclavian artery against the first rib, which can be done by an assistant, either by means of digital or instrumental pressure.

Other modes of performing this operation might be mentioned: for example, the single square-shaped flap method of La Faye, the modification of it by Richeraud, who added an internal or inferior flap; the anterior semicircular flap method made by transfixion of Dupuytren; the antero-posterior flap method as performed by Desault and Lisfranc, as well as many others; but the procedures to which the writer has already directed attention appear to him to be sufficient to meet the cases requiring scapulo-humeral disarticulation.

William Stokes.

SHOULDER-JOINT, Diseases of the. A notable feature of the shoulder-joint is the very free movement which it allows in every direction; and one of the earliest and most valuable signs of disease of the articulation is an impairment of this free mobility.

The joint is best examined by standing behind the patient, and, while the scapula is firmly grasped near its neck and thus fixed by one hand, the lower end of the humerus is held by the other hand and can be moved in various directions. In the natural condition, this can be done without movement of the scapula upon the ribs, unless the arm be raised beyond a right angle with the trunk; but if the joint be inflamed, very little movement of the humerus, especially in the direction of raising the elbow, causes a corresponding alteration of the position of the scapula. Moreover, if the outline of the joint is carefully scanned both in front and from behind, and compared with the sound side, swelling may be detected by the alteration of shape and diminished distinctness of the surface-markings.

The shoulder is liable to all those forms of inflammatory disease, both acute and chronic, which are common to the articulations; but is much less frequently affected than the other joints of corresponding size and importance.

Acute synovitis may be of traumatic, rheumatic, or pyæmic origin. There are the usual symptoms of swelling, heat, and pain, together with the restriction of movement above alluded to.

Rest, by bandaging the arm to the side, leeching, and the application of cold, are the appropriate remedies, and with the use of these the simpler forms of inflammation usually subside.

Pyæmic synovitis, which is not very uncommon in the shoulder, usually leads, however, to early suppuration. Matter points most commonly at the inner side of the deltoid, but may burrow along the intermuscular planes in other directions. Suppuration of this joint may also have its origin in an epiphysitis, or in an acute articular ostitis of the upper end of the humerus. It is a not uncommon seat of the syphilitic form of epiphysitis met with in young infants.

Suppuration here, as in other joints, calls for free incision and drainage; and, even when the destruction of the articular surfaces leads to extensive adhesions, the limb may be very useful, owing to the compensatory mobility of the scapula.

Chronic synovitis and pulpy degeneration must be treated by rest, counter-irritation, and attention to the constitutional condition in which it has its origin. Should the disease progress to ulceration of the cartilages, ankylosis may be regarded as a not unfavourable result. Slight adhesions, occurring without much destruction of the joint-surfaces, may be ruptured and good movement obtained; but if the adhesions or the diseased area are extensive, it is very difficult to prevent the recurrence of ankylosis, owing to movement taking place, involuntarily, rather by means of the scapula than at the shoulder-joint. In the scrofulous and other cases associated with great synovial thickening, the disease is apt to be slowly progressive and attended with troublesome suppuration; and in these, if the health is deteriorating, it is better to excise the head of the humerus, an operation which gives free access to the joint and allows of the removal of the diseased membrane, and which generally leaves a very useful limb.

The joint is a rather favourite seat of *osteo-arthritis*, recognisable by the usual symptoms of aching pain, crepitation, and impaired movement, alteration in the shape of the joint-surfaces, and fraying of the tendons which play over them. This disease,

occurring usually in the elderly whose tissues are degenerating, admits only of palliation, the most useful measures being friction, warmth, and aids to nutrition, such as cod-liver oil.

It may be well to mention here that the bursa beneath the deltoid is liable to both acute and chronic inflammation, giving rise to symptoms somewhat simulating those of disease of the shoulder-joint, but to be distinguished from it, chiefly, by the localisation of the swelling and pain, and the mobility of the humerus on the scapula.

J. Warrington Haward.

SHOULDER-JOINT, Dislocations of the.—Dislocations of the upper extremity of the humerus are very frequent, owing to the shallow glenoid cavity, the loose capsule of the joint, and the exposed situation of the bone. The shoulder-joint is, indeed, far more frequently dislocated than any other joint in the body. The displacement is usually occasioned by a fall on the shoulder, sometimes by a fall on the elbow or hand, and, in rare instances, by such accidents as a jump from a height into water with the arms extended, falling through a trap-door, catching hold of a ladder to prevent falling, or a direct blow delivered on the upper end of the humerus. It has also been occasioned by muscular action. There are four regular dislocations of the shoulder-joint named from the position in which the head of the humerus is found—viz. (1) *subcoracoid*, which is by far the most common; (2) *subglenoid*, the next in frequency; (3) *subspinous*, which is uncommon; and (4) *subclavicular*, which is very rare. Besides these, certain anomalous dislocations have been described — viz. the *supracoracoid*, when the coracoid process has been broken and the head of the bone lies upon its base, and the *luxatio erecta*, a variety of the subglenoid. Dislocations of the shoulder are very uncommon under the age of fifteen, and much more frequent in males than in females, the proportion being about five to one.

Signs common to all forms.—There are certain signs of dislocation at the shoulder-joint which are common to all forms. These are—the angular appearance of the shoulder and depression beneath the acromion; the projection of the elbow from the side; the limitation of both voluntary and passive movements; the increased vertical measurement when a tape is carried through the axilla and over the shoulder (Callaway's test); inability to bring the elbow to the side when the hand is directed to the opposite shoulder (Dugas's test); a ruler applied to the dislocated humerus may be made to touch the acromion and external condyle at the same time (Hamilton's test); finally, the rounded head of the humerus will be detected lying in some abnormal position.

The Subcoracoid.—This variety, which includes many cases that were described formerly as dislocations into the axilla, and some that were regarded as dislocations forward beneath the clavicle, has been proved, both by pathological demonstration and clinical observation, to be the most common form of displacement at the shoulder. It comprises both the intracoracoid and subcoracoid varieties of Malgaigne.

The *symptoms* which distinguish it are as follows:—The angular appearance of the shoulder is well marked; the elbow projects from the side, and is directed slightly backwards; the pectoral fold is widened and somewhat prominent; the head of the bone can be felt from the axilla and beneath the coracoid process, and its position can be made more evident in the axilla by raising the elbow; there is great pain from pressure on the nerves, and, usually, neither lengthening nor shortening, but the measurement from the tip of the acromion to the external condyle may vary to the extent of half an inch in either direction. Malgaigne described as subcoracoid only those in which the head of the humerus lay on the anterior edge of the glenoid cavity, and all those in which half or two-thirds of the head of the humerus lay to the inner side of the coracoid process he termed intracoracoid. The head of the humerus lies on the venter of the scapula beneath the subscapularis muscle. A *partial dislocation* in this direction was described by Cooper and Malgaigne, the head of the bone being supposed to partially escape on the edge of the glenoid cavity, without rupture or with slight tearing of the capsule. In Soden's case, believed to be of this nature, the escape of the biceps tendon from its groove was found to be the cause of the pain, fixation, and deformity, and in other cases this tendon has been found ruptured. In a case reported by Eve, in 1880, classed by him as complete, the capsule was found to have been lifted up with the periosteum from the front of the scapula, and a mark on the cartilage at the back of the head indicated the spot where this had lodged on the margin of the glenoid cavity.

The Subglenoid variety comes next in point of frequency to the subcoracoid, with which it presents many points of similarity. The angular appearance of the

shoulder is more strongly marked than in that form, and the deltoid is rendered very tense. The elbow projects farther from the side, and the depression beneath the acromion is more evident, and is equally perceptible both in front of and behind the joint. There is lengthening of about an inch, and the fingers, placed in the axilla, readily detect the head of the humerus, which is lodged on the margin of the scapula between the long head of the triceps and the subscapularis. Lengthening is often apparent rather than real; the external condyle being approximated to the acromion by the abduction and loss of rotundity at the shoulder. The pectoral fold is much widened, but less prominent than in the subcoracoid variety, and, on pressure being made, an interval will be detected between the head of the bone and the coracoid process. Pain and numbness are felt from stretching of, and pressure on, the axillary nerves. This form of dislocation, if left unreduced, is liable to become converted into the subcoracoid, partly as the result of muscular action and partly from attempts to bring the elbow nearer to the side.

The Subspinous is an uncommon form of dislocation, of which the writer has seen but two instances. It includes both the subacromial and subspinous varieties of Malgaigne. In stout subjects it is more liable to be overlooked than any other form, but in thin persons it is easily detected. The angular appearance of the shoulder, though present, is less marked than in any of the other varieties. The elbow is directed forwards and outwards, but not far from the chest-wall. There is usually no alteration in the length of the arm. The head of the bone may be felt in the subspinous fossa, where it lies below the acromion or spine and beneath the infraspinatus muscle. The anterior part of the shoulder is depressed, and the coracoid process is abnormally distinct. The subscapularis muscle is liable to be detached from its tuberosity by the force which produces the dislocation, and the infraspinatus is damaged by the head beneath it.

The Subclavicular is the rarest of the four regular dislocations of the shoulder-joint. In this form, the head of the bone is driven forwards past the coracoid process, and lies internal to it beneath the clavicle. The arm lies close to the chest-wall, and the elbow is directed outwards and backwards. The head of the bone is easily felt in its new position, and sometimes it becomes subcutaneous between the pectoralis major and deltoid. There is usually shortening of about an inch. The shaft of the humerus, but not the head, can be felt in the axilla, and the back of the shoulder is particularly flattened.

Anomalous Dislocations.—*The Supracoracoid.*—Malgaigne first described, under this term, the case of a man, aged sixty-eight, who fell from a load of faggots upon his shoulder and arm. The head projected upwards and forwards, lying on the coraco-acromial ligament, corresponding externally to the inner edge of the acromion and internally covering the coracoid process, whilst the deltoid was much thinned over it. Reduction, apparently not quite complete, was accomplished when seen two and a half months after the accident, by raising the elbow and pressing on the head. Holmes has since published an account of a dissection of a case in which the head had passed though the deltoid, had broken the coracoid process, and lay upon the stump.

The luxatio erecta is a curious and interesting variety of the subglenoid. Two cases have been described by Hulke and one by Cleland. The peculiarity of the dislocation is that the arm is raised and fixed in that position, the hand being above the head. Cleland's case was caused by a fall when using crutches; one of Hulke's by a fall through a trap-door; the other occurred in a sailor as the result of a fall from aloft, the arm being caught in the rigging.

The Treatment of dislocations of the shoulder is to replace them without delay either by *extension* or *rotation*, after which the arm should be fixed for a fortnight or three weeks (according to the amount of damage present), and then gentle passive motion be commenced, followed by frictions and perhaps galvanism, to restore the activity of the muscles.

The methods of reduction by extension are applicable to all forms, whilst the methods by rotation, which have lately come rather more into favour, are supposed to require some modification for the different dislocations.

The Extension Methods.—*Extension with heel in the axilla* is perhaps the most certain of all the various methods, and is carried out as follows. The patient lies on his back upon a couch, and the surgeon, having uncovered his right foot, if for the right shoulder, thrusts his heel (not sole) into the axilla. Seizing the forearm with both hands at the wrist, he makes extension in the direction of the dislocated humerus, and then draws the arm across the patient's trunk. In this way the heel acts as a

fulcrum, by means of which the head of the humerus is forced outwards into its socket. If no anæsthetic is at hand, the aid of assistants may be required to overcome the resistance of the muscles. They may help by pulling on a jack-towel fixed by a clove-hitch to the arm above the elbow, and they should follow the motion inwards made by the surgeon.

Knee in the axilla (Astley Cooper's method).—The patient sits in a chair, and the surgeon, standing behind, places one foot on the edge of the chair, using the right knee for the left shoulder and *vice versâ*. The dislocated humerus is drawn over the surgeon's knee and forced downwards, by which movement the head of the bone is thrown out into its place. A somewhat similar plan, originally described by Hippocrates and revived by Morgan, is that of drawing the arm over the back of a chair. Slinging the patient over the surgeon's shoulder by the dislocated arm, or over the step of a ladder, are both methods mentioned by Hippocrates. The weight of the patient's body would then be the extending force. Cooper mentions the case of a farmer, who learnt to reduce a frequently recurring dislocation by leaning over a gate and seizing the third or fourth bar on the other side. The fist, the forearm, and an iron knob have also been used in the axilla.

Upward extension (White's method).—A dislocation may be reduced by drawing the arm directly upwards, or upwards and backwards. The bone impinges first on the margin of the glenoid cavity, then against the acromion, and is thus partly raised and partly levered into place. If without assistance, the surgeon should stand behind the patient, and placing one hand on the shoulder should seize the wrist or elbow with the other, and draw the arm forcibly upwards and backwards. Another way, that of La Mothe, which gives more power, is to seat the patient on the floor; the surgeon then places one foot on the shoulder to make counter-extension, whilst with both hands he grasps the wrist and makes extension on the forearm. With two assistants, one should fix the shoulder and the other raise the arm; the surgeon is then free to manipulate the head of the bone into place. Upward extension is said to have been practised by Brunus as early as the thirteenth century.

Lateral extension may be made by placing the patient on a couch and fixing the trunk by a round towel, split to allow the arm to pass through. The arm may then be seized and extended at right angles to the trunk. Another way suggested by Gordon is to lay the patient on his sound side, then to raise the dislocated arm at a right angle with one hand, whilst the other is used to press on the head of the bone; or, assistants may attempt to lift the patient by the arm, whilst the surgeon uses both his hands in manipulating the dislocated head of the humerus. A different method of employing lateral extension has somewhat recently been advocated by Kelly, and appears to be efficient if not elegant. The patient lies on his back at the edge of a couch, with his arm at right angles to the trunk. The surgeon presses his hip into the patient's axilla, and folding the arm around his pelvis holds it by the wrist against the unengaged side of his pelvis, then by rotating his body outwards he makes extension and pressure on the arm, which effect the reduction.

Lateral extension may be also made by pressing the foot against the patient's chest-wall for counter-extension, whilst pulling the arm directly outwards; or, as recommended by Nathan Smith, the counter-extension may be made from the opposite wrist.

When *pulleys* are used for unreduced dislocation (a method now seldom employed), extension is usually made in the same direction, the trunk of the patient being fixed by a split towel, and the girth for the pulleys being applied to the arm above the elbow. Skey's iron knob had branches to project in front and behind the axilla, by which the shoulder was fixed, so that the pulleys might act in the same direction as when employing the heel in the axilla.

The Rotation Methods, like those by extension, are very ancient, but are constantly being re-invented with slight modifications by modern writers. Hippocrates describes reduction by flexing the elbow, drawing it back, and rotating the arm. It is somewhat curious to note that different authors advise rotation in opposite directions for the same dislocation, and their efforts appear to be followed by equal success. It is evident the mechanism of reduction must differ in the two cases. Most authors now agree in advising *rotation inwards* for the common forward dislocations and rotation outwards for the dorsal dislocation. Supposing the ordinary subcoracoid dislocation to have occurred, the capsule will be ruptured at the anterior and lower part, whilst the upper and back part, with which the muscles of the great tuberosity are incorporated, will be very tense. Raising the arm and rotating it inwards

will cause the head to travel along the edge of the glenoid cavity and slip over as in reduction by rotation at the hip. Much assistance will be given by, at the same time, pressing the head outwards.

Kocher's method consists in flexing the forearm to a right angle, pressing the elbow towards the side, rotating the arm outwards till resistance is experienced, then raising the arm and rotating it inwards so that the hand drops over the opposite shoulder. *H. H. Smith's method* differs little from this and was published earlier. He directs that the forearm should be flexed and raised from the side; secondly, the humerus should be rotated upwards and outwards; and thirdly, this movement should be reversed, the humerus being rotated downwards and inwards, and the elbow carried to the side. Malgaigne also, following the Hippocratic method of rotating inwards, found that he could reduce nearly every subcoracoid case on the cadaver by this means.

Rotation outwards would seem to be a more recent practice, and to have commenced with Syme, whose method was to fix the acromion with one hand, then flex the forearm to a right angle and draw the elbow suddenly back, at the same time rotating the arm outwards. Professor Gunn, quite recently, has advised rotation outwards for the reduction of dislocation forwards, believing it right to relax the upper and back part of the capsule. He advises that an assistant should fix the shoulder, whilst the surgeon raises the arm to a horizontal position, carries it backwards, rotates it outwards, and draws it into position. For similar reasons, he advises that for subspinous dislocations the arm should be raised and rotated inwards.

The writer has found the following method very efficient. Standing behind the patient, he seizes the forearm just below the elbow, flexes it, raises the arm to a right angle and rotates it outwards; then, placing his disengaged fist in the axilla, he makes circumduction outwards and brings the elbow backwards and downwards to the side. R. Clement Lucas.

SHOULDER-JOINT, Excision of the. *See* Joints, Excision of.

SICK-ROOM, Management of the.—In this short article it is intended merely to sketch the duties of the surgeon and nurse as regards nursing surgical patients. The ward of a hospital is, or ought to be, so placed, apportioned, and hygienically arranged, that it needs not the strict surveillance, in preparation and choice, that a room in a private house for the reception of the sick necessitates. When selecting a sick-room, or a room for operation and subsequent rest in a private house, look after the following points:—(1) Get a room on the top floor, or, at any rate, not lower than the second. (2) The room window should look southerly, light and sun-penetrated air being life itself to the patient. (3) Choose as quiet a room as possible. (4) A room of a good size is essential. By that is meant a room of such a size that it can be ventilated without draughts.

The Dimensions of a Room in cubic feet can be obtained by measuring, and multiplying the length by the breadth by the height, in feet. Supposing these were 15 by 10 by 7, the dimensions of such a room would be 1,050 in cubic feet. This is the smallest room any sick person should be put into. In a hospital, each bed should be allowed not less than 100 square feet of superficial area, and a cubic space of not less than 1,000 cubic feet.

To prepare a Room to receive a Patient.—Remove from the room every piece of furniture and clothing which can be dispensed with. Remove the carpets; empty the cupboards and chest of drawers; remove trunks, boxes from below the bed, &c., as these occupy space and so diminish the breathing air available for the patient. Dust the room out, not by flapping the dust from the mantelpiece on to the floor, but by carefully wiping the walls with a damp cloth, cleaning out the cupboards, pulling out each drawer and inverting it. When the dust has settled upon the floor, use a broom with a piece of moist flannel tied over it—this is the means to be employed always in a sick-room when the patient is *in* the room: in this way wiping and dusting are done without causing inconvenience or dampness. All dust from the sick-room floor is to be burned in the fire in the sick-room itself. Remember that below the bed, the chest of drawers, and the basin-stand dust lies unseen, but is not the less dangerous, and requires removal if the room is to be kept *sweet*. The floor is then washed, the metal bedstead wiped, the fire lit, the window opened widely, and the room left for a while. When the floor is dry, put the bedstead in its place—which ought to be against a partition wall, between the door and window, so as to be out of the air passing towards the fireplace from each of these.

The bedstead ought to be of metal, six feet three inches long, and three feet six

inches wide. Rheocline springs or a wire mattress may be used, and a hair mattress placed thereon; but in case of fractures these luxuries must be dispensed with, and fracture-boards used instead — i.e. deal boards, perforated with many holes, cut about one foot six inches in width, and in length equal to the breadth of the bed. Four such boards would ordinarily be required. A woven wire mattress with a thin hair mattress laid thereon is apt to be very cold. If two mattresses are used, the lower may be of straw; the straw must be burnt afterwards. If much discharge is expected, place a piece of macintosh over the mattress; instead, a blanket is used by some, but it is apt to act like a poultice and cause bed-sores.

Over these a sheet is now laid and tucked tightly beneath the upper mattress, if two are used. Do not wrap the bolster up in the under-sheet. It is the nurse's bounden duty to be continually pulling the under-sheet straight: this she cannot do without displacing the bolster and patient down the bed, if the bolster is wrapped up in the under-sheet. Complete the covering by an upper-sheet, blankets according to the season of the year, and a light chintz quilt. Avoid heavy counterpanes sweeping the floor on either side; exclude also a valance and curtains.

The Fire.—Place coals on the fire by the hand, to avoid noise. Coals are laid on a piece of canvas or paper on the floor; a large glove is hung, say, on the bell-pull above, and, slipping the hand into that, lift the coals. Dispense with a coal-scuttle and all fire-irons, except a poker. Should the room be full of smoke, cover the patient's head with the sheet, open the door and window wide; the room will be thereby cleared in a minute or two. Should the chimney require sweeping, have it swept, but previously put an extra blanket over the patient and a hot bottle in bed. It is the putting out the fire, especially in cold weather, wherein the danger lies—not in the smell of soot. The temperature of the room ought, in surgical cases, to be kept about 60° Fahr.; it should never be allowed to fall below 58°. When lung-troubles arise, the temperature ought to be kept between 65° and 70°. Hang the thermometer at the head of the bed close to the patient.

Ventilation.—In a room of 1,000 cubic feet, each person requires the air changed thrice per hour. Fresh air comes from the window, not from the door. The air is to be admitted in such a way that it has an upward direction as it enters. In the case of an ordinary two-sash window, the plan recommended by Bird is the most simple—throw up the lower sash, and, placing a board along the gap made below, shut the lower sash down upon it. By this means air can only enter by the centre of the window, when it is sent upwards to the ceiling, where, meeting the hot air of the room, it is warmed and falls gently like spray from a fountain on the patient, and not as a torrent, which it would do were the top of the window opened. The board used may vary from one to six inches in depth, according to the season of the year.

To Wash a Patient in Bed.—Use tepid water, soap, and a flannel cloth. Place a towel on the pillow to protect it; wash the face, neck, and hair of a boy or man daily, wash a woman's hair once a week. Now, bring an arm from beneath the bedclothes, place a towel lengthwise below it to protect the sheets, and tuck the bedclothes round the shoulder; wash and dry the limb, and put it back beneath the clothes. Repeat this process with all the limbs *seriatim*. To wash the *front of the body* pull the night-dress up, and the bedclothes down; tuck a towel on either side of the body so as to protect the sheet; wash and dry the part exposed. To wash the *back*, turn the patient on one side, thus: standing on the floor, the nurse places one hand behind the patient's far-off shoulder, the other behind the far-off hip; if the patient is able to do so he ought to place his arms around the nurse's neck. The nurse can then turn the patient gently over upon the side; bare the back, tuck a towel below to catch the water, wash and dry the parts, and replace the patient. A patient is thus washed without more than a small part of the body being exposed at a time.

To make a Bed without moving the patient from the horizontal position.—Without removing the bedclothes, glide the patient to the edge of the bed next the fire. Place three or four bedroom chairs along that side of the bed, with the backs next the fire. On the chairs lay a bolster or pillows until this temporary couch is on a level with the mattress. The nurse, reaching over the backs of the chairs, now glides the patient, who can very rarely assist her, on to the improvised bed, where, covered over with blankets or a rug, the patient lies whilst the bed is being made. If the nurse even have two beds at her command, she will not, working by herself, find it so easy to move a patient on to the spare bed as by the method given, if the horizontal position is to be maintained. Do not use a sofa

or couch instead of the chairs. In making the bed, throw the blankets one by one, not all in a heap, over chairs, &c., in the room; or, if allowable, on the stair-rail outside the bedroom door. Turn the mattress, or hold it up, to let the air get at its under surface. When the bed is made up, retain around the patient the blanket in which he is enveloped, and glide him back into bed; remove the blanket around him when he is warm in bed.

To change Sheets.—Warm and 'air' the clean sheet; roll it up lengthwise; lay it thus rolled on one side, say the right, of the bed. Pull the soiled under-sheet from below the bolster, roll it up lengthwise, and unroll the clean sheet, up to the patient's right side. The nurse goes round to the left side of the bed, turns the patient on his left side, as directed for washing, and continues the process of rolling up and unrolling the sheets up to the patient's left side. Then, replacing the patient, he lies on the clean sheet, and the two appearing at his left side, the soiled is removed and the clean one tucked in. The sheet can also be changed by rolling or dragging it down from the top to the bottom of the bed. This is easily done when two are engaged in it, or when the patient can sit up in bed, but otherwise it is a rude proceeding. It is necessary, however, in a case of fractured leg, when the patient dare not be turned on the side.

Soiled Linen must be immediately removed from the sick room, placed in a jar outside the room, and, if non-infectious, sent to the laundry immediately; if infectious, boiling water is poured over it and a solution of 1 in 80 of carbolic acid, until the linen is covered and a strong odour of carbolic is smelt. Filthy *bandages* are to be burned immediately, it may be in the fire of the sick room. Bandages used for fixing splints may, after disinfection by boiling in soft soap and soda, be used again.

Utensils.—Cleanliness of the utensils in the room, whether in sickness or health, is a necessary axiom. Carbolic-acid solution (1 in 60) may be placed in the wash-hand-basin, in the bed-pan, in the chamber-utensil, the bleeding bowl, the dressing basin, &c., or carbolic powder may be sprinkled in them instead. This provides for the presence of a disinfectant in the room, which, by its decided odour, satisfactorily asserts its presence and activity. All slops must be removed at once, carried to the water-closet (or cesspool) and there emptied. The utensil should be there rinsed out, dried, have carbolic powder sprinkled therein, and not be brought into the sick-room until it is wanted. Every pail and bed-pan used should be of white glazed earthenware, and have a tight-fitting lid. Place no utensil under the bed, not even when dried and disinfected; it cannot get sweet there—it must have a free circulation of air around it.

Feeding Patients.—It is needless to tell medical men to be careful about the time of feeding, the kind of food to be given, the method of its preparation, the needful time for changing it, &c. These are the first duties and requirements of practitioners; but how to administer the food few can tell the mother, sister, or wife of the patient—the nurse for the time being. When fluid foods, such as beef-tea and milk, are being given, attend to the following points:—A drinking cup may be useful, but see that its spout is wide, otherwise the patient gets tired of sipping the insipid fluids: he prefers a good mouthful, to get the feeding process over quickly. To give beef-tea, say at night, when the patient is asleep, have the beef-tea in a large warmed cup or jug, set on a small table by the bedside. The nurse then, without speaking or whispering—and this is the difficult thing to do—slips her left hand and forearm behind the patient's pillow and raises the head slightly. Then she can—if the bed is narrow, as it ought to be—reach with the other hand the basin and convey the food to the patient's mouth by a spoon. Use a large spoon—a tablespoon—and put little in it, otherwise the beef-tea will be spilt on the sheets, blankets, night-dress, or beard. A convalescent patient should be fed with dainty bits, under, rather than up to, his capacity and appetite.

The Nurse must wear a dress which causes no noise as she moves about, and which is pleasant to the patient to touch. She should have no pins about her, whereby to scratch the patient; she must be quiet and quick, resolute and gentle, cheerful, but expressionless in regard to untoward symptoms. She has to observe order and punctuality; and preserve not only cleanliness but sweetness in her apartment, in her patient, and in her person; but above all has she to cultivate gentleness and cheerfulness of behaviour towards her patient.

It is essential that a nurse's health be preserved by securing her rest in bed for at least six hours daily; and she ought, except in cases of great emergency, to get a daily walk for an hour. A nurse's meals should not be taken in the sick-room, where the patient must necessarily smell the cook-

ing, and thereby get disgusted for food himself; and the nurse ought to be allowed plenty of time for her meals, which should be served as punctually as those of the patient. JAMES CANTLIE.

SIGAULT'S OPERATION. *See* SYMPHYSIOTOMY.

SINUS.—A *sinus* is an unnatural suppurating canal which opens externally. When it communicates internally with one of the normal canals or cavities of the body, it is usually termed a *fistula.*

The primary *causes* are wounds, abscesses, or suppuration in deep-seated structures, such as bone or periosteum, or in cavities, such as joints, serous sacs, or the sheaths of tendons. The secondary causes are—

(1) *The presence of a foreign body*, introduced from without—e.g. a bullet or a piece of glass, or arising from inflammatory processes within—e.g. a sequestrum, the fang of a dead tooth, or a caseous gland. In this class may also be placed the discharges from ulcerating surfaces, such as those of a diseased joint. Of the same nature is the irritation set up by the escape of secretions or excretions through an unnatural opening, but the form of sinus which gives passage to such materials is described under the head of FISTULA IN ANO.

(2) *The size and position of the external aperture.*—If this be too small, or if it be some distance above the lowest part of the abscess-cavity, there will be an obstacle to the free discharge of pus, and the walls of the cavity will be unable to contract and coalesce. This may be due, in a wound, to the more rapid healing of the superficial tissues, and, in the case of an abscess or deep suppuration, to the difficulty of penetrating the strong fasciæ which lie beneath the integuments.

(3) *Want of rest*—e.g. where muscular movements prevent the walls of the cavity from uniting. Hilton, in his work *On Rest and Pain*, has given numerous instances of sinuses kept up by the contractions of the occipito-frontalis and other muscles. A frequent example is that form of sinus called a blind external fistula, in which the proximity of the sphincter ani prevents the healing of an anal abscess.

(4) *Want of apposition* of the sides of the cavity from which the pus is discharged. This is often exemplified in the slow repair of the sinuses which follow the removal of a sequestrum, or the opening of the pleural sac in empyema. It is probable also that, after extensive destruction of the fatty tissue in the ischio-rectal fossa by suppuration, this may be one of the causes which prevent the closure of the resulting sinuses.

(5) *A feeble condition of health.*—This may be due to some inherent defect in the constitution, such as the scrofulous diathesis, in which the reparative lymph is so apt to undergo caseous changes; or it may be the result of loss of blood and prolonged suppuration, as in the debility which sometimes follows an amputation.

(6) *Local deficiency in reparative power.* The hard and evascular condition of the parts from the long continuance of a sinus may prevent its healing, even when the original cause—e.g. a sequestrum or foreign body—has been removed; or there may be some local influence, such as the enfeebled circulation from paralysis, or the congestion from a dependent position, which may tend to retard recovery.

Condition of the Parts.—The orifice of the sinus may vary in size from a hardly visible puncture to a large ulcer. It is sometimes concealed by a thin scab; at other times, especially when the parts are vigorous and vascular, it is indicated by a prominent mass of florid granulations. Where it has existed for some time, if it lead to deep structures such as bone, there will be some depression of the adjacent skin, at the bottom of which the granulations projecting from the aperture of the sinus will be seen, like the button upon a chair-cushion. The course of a sinus may be straight or tortuous. Its calibre may be uniformly narrow, or it may be varied by wide dilatations. The walls of an old sinus will be hard, pale, and insensitive, and they will not bleed readily when irritated. Their interior is sometimes so smooth as to resemble mucous membrane. In more recent cases they are covered with soft, sensitive granulations, and bleed readily. The adjacent structures are infiltrated with more or less developed fibrinous deposit, or even with bone, as in a *cloaca*, which is the part of a sinus passing through ossifying periosteum. The pus which exudes from a sinus is usually thin and watery, and it frequently contains fatty or calcareous débris from the deeper parts.

The *treatment* of sinuses constitutes a large part of the practice of surgery, but it is only possible to mention here the principles upon which it rests, and a few of the methods by which they are applied.

After obtaining a history of their formation, and observing the condition of the

apertures and the adjacent parts, it is necessary to examine their direction and extent by means of a probe, which may be straight, or, if the passage should prove tortuous, it should be slightly bent near the extremity. In the case of multiple sinuses, it may be desirable to use an injection to ascertain whether they are all in communication with one another. The presence of any hard foreign body or sequestrum will usually be easy to recognise, and at the same time an opinion may be formed as to the firmness with which it is fixed in the tissues. By an appropriate operation such a body may be removed, and the sinuses will usually heal up at once. If the opening be small, or not sufficiently dependent, it will be necessary to increase its size or to make a fresh opening in a more favourable position. Where this is not possible, as in the case of an iliac abscess penetrating deeply into the pelvis, the same end may be obtained by other means, such as keeping the patient lying in the prone position. An india-rubber drainage-tube should also be introduced, to ensure that there shall be no obstruction to the emptying of the abscess-cavity.

When want of rest or apposition is a hindrance to recovery, the parts may be kept quiet and in contact by the pressure of carefully applied compresses or strapping. If the sinuses are in the lower extremity, the patient should be kept in bed, and some form of splint or plaster of Paris apparatus may be necessary to ensure perfect rest. In other cases, the division of an adjacent muscle or tendon may be called for. The closure of the pleural cavity in empyema has sometimes been facilitated by the removal of portions of the ribs. Where the debility of the patient is the cause of delay, nourishing diet, cod-liver oil, iron or quinine, and a moderate allowance of stimulants will be required, and a change to the country or the seaside will be beneficial. The local weakness which prevents healthy repair may be combated by stimulating injections of iodoform dissolved in ether, or of sulphate of zinc lotion (five grains to the ounce of water).

In many cases, however, these methods will fail, especially when long-standing disease has induced a callous condition of the granulations. It will then be necessary to carefully slit up and explore the sinuses. This should generally be done under an anæsthetic, as to do it thoroughly necessitates often a tedious and painful operation. At the same time we should search for and remove any material which may be keeping up the discharge. Thus, all caseous masses of gland-tissue and the carious surfaces of bones should be scooped out, and the degenerated granulation-tissue should be scraped from the interior of the sinuses; the thin, livid, undermined skin around their orifices should also be clipped off with the scissors. A large wound will thus be formed, which should be stuffed with lint or carbolic gauze, to prevent the primary union of the divided parts. In a few days, a granulating surface will be developed, and cicatrization will usually proceed rapidly, for the extensive margin of healthy skin will aid materially the process of repair. In some cases it may be expedient to make use of the elastic ligature for the division of the soft parts covering a sinus, so as to avoid all risk of hæmorrhage.

N. Davies-Colley.

SKIN-DISEASES. — During the last half-century great progress has been made in the scientific study of skin-diseases. This has not been confined to any one country, but has extended over the greater part of Europe and North America, and at the present time there is a general agreement amongst dermatologists on all the more important points connected with the subject. It is only necessary to look over the leading text-books in use in England, Germany, and America to see how close this agreement is. French literature does not follow in exactly the same path, but the differences, even there, are not many or important. This general agreement has led to the adoption of a uniform system of nomenclature, which until lately was almost impossible. This system has no doubt grown up gradually from the time of Willan, but has been much modified and improved by recent writers and observers. The process of improvement will continue, but the field for change has been greatly narrowed. The nomenclature lately published by the London College of Physicians fairly represents the one in general use, though some of the very rare forms of disease have been wisely omitted. Another fact of practical importance, which recent observations have tended to establish is, that skin-diseases cannot be looked upon as mere eruptions, but must be regarded, with few exceptions, as definite diseases, which do not change from one disease into another because there is a change in the form of the eruption, nor have they more tendency to become mixed than is the case with other diseases. Lastly, a knowledge of their morbid anatomy is almost entirely the result of recent

observations. The classification of skin-diseases, though interesting as an exercise or study, is of very little practical value. The following list is chiefly intended as a key for facilitating reference, and does not pretend to strict scientific accuracy in grouping.

Skin-diseases may be divided into three groups:—

I. Eruptions of an inflammatory character.

II. Diseases of nutrition unattended with inflammation.

III. Morbid growths of the skin.

The first of these includes all *eruptions* properly so called, and therefore forms a large group, which, for convenience, may be divided into two sub-groups:—A. Moist eruptions; B. Dry eruptions. The other groups, being smaller, require no sub-division.

The three *chief* groups of skin-diseases are quite legitimate divisions; but the sub-division of Group I. is simply a matter of convenience for purposes of diagnosis. Group I. comprises the skin-diseases attended with *inflammatory* eruptions. The degree of inflammation varies much, not only in different diseases, but even in varieties of the same disease; its presence, however, forms a bond of union, and, as a consequence, all eruptions belonging to this group are more or less associated with subjective sensations of pain, burning, or itching—a fact which is of some diagnostic value.

If, then, the reader has before him a moist eruption, and is in doubt as to its nature, he should first refer to Sub-group A, and having looked down the list until he comes to the disease which seems most nearly to correspond, he should then refer to the detailed account of the disease given in the body of this work. If the eruption is a dry one, he should refer in the same way to Sub-group B.

The moist eruptions which make up Sub-group A are the following:—Eczema, erythema with vesicles (i.e. hydroa), herpes, hyperidrosis, impetigo, pemphigus, phthiriasis, prurigo, scabies, syphilides (moist), zoster. The distinctive diagnostic features of each disease are given below in the following order:—(1) Character of the eruption; (2) subjective sensations; (3) characteristic (but not the only) regions affected.

1. *Eczema.*—Redness and swelling, with eruption of vesicles; surface denuded of epidermis, discharging gummy fluid; pain and itching; flexor surfaces and scalp; symmetrical.

2. *Erythema with Vesicles* (Hydroa).—Wheal-like spots of erythema with central vesicle or small bleb; itching and pain; backs of hands, forearms, lower lip and mouth; symmetrical.

3. *Herpes* (H. catarrhal.).—Discrete vesicles in small groups on red skin; not itching, pain slight; lips and prepuce; lasts about a week.

4. *Hyperidrosis* (including Bromidrosis). The excessive sweating leads to a maceration of cuticle and artificial eczema; hands and feet.

5. *Impetigo* (Impetigo Contagiosa).—Vesico-pustular; thick, discrete, yellowish scabs, *covering* superficial sores; occiput, corners of mouth and nose; unsymmetrical; easily inoculated by finger-nails; lymphatic glands in neighbourhood enlarge quickly.

6. *Pemphigus.*—Crops of large blebs; pain and itching; skin generally and mucous membrane of bowels; constitutional symptoms severe; fatal in old people.

7. *Phthiriasis.*—Papules, excoriations and bleeding points from scratching; itching intense without pain; parts covered by clothes, especially back.

8. *Prurigo.*—Large papules mixed with an eruption of eczema, pigmentation and enlarged lymphatic glands; itching intense; extensor surfaces, especially lower limbs; symmetrical; begins in early life; very chronic.

9. *Scabies.*—Papules and vesicles discrete, with marks like pin-scratches; itching severe at night, without pain; flexor surface of wrist and between the fingers, lower part of abdomen and buttocks, also feet in infants.

10. *Syphilides* (Moist).—These simulate ordinary skin-diseases, such as eczema or impetigo, but are not common forms of syphilitic eruption, and are always associated with other symptoms of syphilis. *See* Syphilis.

11. *Zoster* (Herpes Zoster).—Large discrete vesicles in groups on red base; unsymmetrical; neuralgic pains before and after eruption; follows course of intercostal or other nerves; duration of eruption about a fortnight.

The dry eruptions (pimply or scaly) which make up Sub-group B are the following:—Acne, acne rosacea, eczema (dry), erythema (nodosum and papulatum), lichen, psoriasis, steatorrhœa, sycosis, syphilides, urticaria.

1. *Acne.*—Pimples in young adults; not itching, slight pain; face and back; very chronic.

2. *Acne Rosacea.*—Red patches and pimples in middle-aged women; sensations of burning; face only; symmetrical.

3. *Eczema* (Dry).—Red, slightly scaly patches; great itching, no pain; flexor surfaces.

4. *Erythema* (Nodosum).—Raised, oval, red, bruise-like patches, painful and tender when touched; not itching; symmetrical; front of the legs; often associated with rheumatic pains. E. papulatum, much smaller spots affecting backs of hands and forearms.

5. *Lichen Planus.*—Large, raised, dark red, flat-topped, shining papules, leaving brown pigmentation; itching intense; flexor surface of wrist and front of forearm; symmetrical.

6. *Psoriasis.*—Raised patches covered with silvery white scales, healing first in centre; no pain; itching very slight in the young, often severe in the middle-aged; extensor surfaces of limbs, especially elbows and knees; symmetrical; very chronic and recurrent.

7. *Steatorrhœa* (Seborrhœa).—Greasy, scaly eruption; itching; scalp and eyebrows; partial loss of hair; often called pityriasis capitis.

8. *Sycosis.*—Red patches and acne-like pimples, with a hair passing through each; confined to the hairy parts of the face in males; very chronic. In this disease there is sometimes slight exudation from the hair-follicles. This, however, is not an essential feature, and the general absence of it is one of the distinctions between sycosis and pustular eczema of the hairy parts of the face.

9. *Syphilides* (dry eruptions) resemble the scaly and papular non-syphilitic eruptions, but are more mixed in character (polymorphic), with little or no itching and more pigmentation; they are associated with other symptoms of syphilis. *See* Syphilis.

10. *Urticaria* (Nettlerash).—Wheals and red raised patches; stinging sensation and intense itching.

II. Diseases of Nutrition. — These are *non-inflammatory*, and are therefore free from those subjective sensations which are chiefly due to inflammation, such as pain, burning, and itching. This serves as a rough and ready distinction from the diseases of Group I. The only exception to this rule is tinea tonsurans (ringworm), which is often associated with very slight inflammation and itching, but the vegetable parasite interferes, in such a marked degree, with the nutrition and growth of the hair, that this forms a much more distinctive character of the disease than the slight and almost accidental inflammation set up. The following are the diseases which belong to this group: Alopœcia areata, chloasma, favus, ichthyosis, keratosis pilaris, leucoderma, lichen scrofulosus, striæ atrophicæ, tinea tonsurans, tinea versicolor.

The distinctive diagnostic characters of each are given below.

1. *Alopœcia Areata.*—Smooth, roundish, bald patches surrounded by luxuriant hair; scalp, especially occiput and hairy parts of the face; hair falls rapidly with atrophied roots.

2. *Chloasma.* — Yellowish-brown pigment-patches; forehead and neck.

3. *Favus.* — Cupped, sulphur-coloured crusts and dry scaly patches; scalp; almost unknown in England; parasitic.

4. *Ichthyosis.*—A dry and scaly condition of skin, which has a dirty appearance; the cuticle is apt to crack, so as to form small lozenge-shaped plates. Body generally, but most marked about the knees and ankles; the disease is congenital, but shows little during infancy.

5. *Keratosis Pilaris* (Lichen Pilaris).—Papules with a hair passing through each; resembles exaggerated persistent 'goose skin;' outer surface of limbs, especially upper arms; symmetrical.

6. *Leucoderma.*—White patches of skin, surrounded by healthy skin often browner than usual.

7. *Lichen Scrofulosus.*—More or less rounded patches of minute pale pimples; no itching. Trunk, scrofulous children.

8. *Striæ Atrophicæ* (Linear Atrophy).—Glistening bluish-white stripes, resembling those met with in the abdomen of women shortly after parturition.

9. *Tinea Tonsurans* (Ringworm).—Roundish, scurfy, partially bald patches, with short, stumpy, broken hairs; slight itching; scalp; almost confined to children under sixteen years of age; parasitic.

10. *Tinea* or *Pityriasis Versicolor.*—Yellowish patches with a tendency to symmetry, almost confined to the trunk. Met with in adults who perspire freely; parasitic.

III. Morbid Growths. — This group includes hypertrophic as well as other growths of the skin. As a rule, growths of the skin compared with eruptions are of slow development. Inflammatory eruptions occupy days or weeks, and morbid growths months or years in development. Morbid growths are firm solid structures, more or less raised above the surface of the

skin, and for the most part have an unsymmetrical distribution. The only exception to this is met with in lupus erythematosus, which cannot be described as a solid structure, and belongs at least as much to inflammatory eruptions as to morbid growths. The following diseases are included in this group: Acrochordon, fibroma, keloid, lupus vulgaris, lupus erythematosus, moles, molluscum contagiosum, nævus, rodent ulcer, scleroderma, syphilitic growths, warts, xanthelasma. The diagnostic characters of these diseases are given below.

1. *Acrochordon.* — Very small cylindrical or cordlike outgrowths; loose skin of neck.

2. *Fibroma.* (Molluscum Fibrosum). Small fibrous tumours; usual size from a pea to a filbert; often pedunculated, often congenital.

3. *Keloid.*— A fibrous growth which develops in scars; smooth and shining, and often vascular; pain or itching.

4. *Lupus Vulgaris.* — Reddish-brown tubercles and raised patches of new tissue, which have a strong tendency to ulcerate and form open sores; leaves scars. Face and mucous membrane of nose and mouth. Unsymmetrical; first appears between the ages of two and fifteen.

5. *Lupus Erythematosus.*—Red patches very little raised; often symmetrical; no ulceration, but leaves superficial scars; itching and burning; face, scalp, and ears. Does not appear before puberty.

6. *Moles.*—Congenital malformation of patches of skin, with more or less hypertrophy of the connective tissue, pigment, and hair.

7. *Molluscum Contagiosum.* — Small, round, umbilicated, translucent tumours; usual size from pin's-head to pea; face and neck; contagious.

8. *Nævus* is essentially a congenital vascular growth of the skin.

9. *Rodent Ulcer.* — Small translucent nodule, yellowish colour, streaked with minute vessels, of very slow development; ultimately ulcerates and spreads, destroying tissues. Face above the lower jaw, especially sides of nose. Rarely met with in those under thirty.

10. *Scleroderma* (Morphœa).—A fibrous growth in the form of patches of a pale yellowish-white and wax-like or ivory appearance, often with a pink areola of vessels; very little raised above the skin; pain and itching; often followed by atrophy of skin; very chronic.

11. *Syphilitic growths* are generally multiple, and develop more rapidly than most other growths of the skin; have a strong tendency to ulcerate, and are associated with other symptoms of syphilis. *See* Syphilis.

12. *Warts.* — Small rounded raised growths, formed by hypertrophied papillæ, flat granular top; usual size, split pea. Hands in children, scalp in adults.

13. *Xanthelasma* (Xanthoma).—Sharply defined small bright yellow patches, resembling chamois leather; very slightly raised; upper eyelid and round the inner canthus; painless; seen chiefly in elderly people.

Robert Liveing.

SKIN-GRAFTING. *See* Grafting.

SKULL, Deformities of the. *See* Meningocele; Rickets.

SKULL, Diseases of Bones of the. *See* Craniotabes.

SKULL, Fracture of the.—*Preliminary Observations.*— The anatomical relations of the skull and its coverings, relatively to the age of the patient, are important considerations in the determination of fractures of the cranium. The free movement of the head upon the spine, and the density and mobility of the scalp, tend to protect the skull by diminishing the impact of force from without. The construction of the vault in arch or dome shape increases its strength and power of resistance. The consistence and physical properties of the cranial bones, the intimacy of their union with one another, and the condition of the sutures vary greatly according to age. In infants, a complete fracture of the skull is rarely seen, on account of the elasticity of the unossified bones, and the gaps filled with membrane which exist between them. The consistence of the bones in young children enables them (practically) to bend rather than break, and indentations or bulges, with the convexity inwards, are formed. The same pliability is evinced in the gradual rectification of the deformity by the force of the brain's impulse. The relative consistence of the bones, in children and old people, has been aptly compared to sheet tin and earthenware. In adult life, and especially during the period of adolescence, the skull is still so fibrous as to permit of cuts being made into it without the production of fracture. Not only can instruments, and such materials as glass and earthenware, be driven into and sometimes through the skull by clean cuts, but by a sharp instrument portions may be cut or cleanly

scooped out. In early life, the lack of union between the bones is of value in distributing the pressure of a blow upon any given point, and the sutural membrane, at this period of considerable thickness, acts as a kind of buffer, which interrupts the force. In adult life this membrane disappears, and the sutures begin to be obliterated at about forty years of age. This complete union of the bones is first met with in the sagittal suture, and last in the squamous. The skulls of old people have lost much of their fibrous tissue, and have become more earthy and brittle.

The skull may be said to be made up of a series of arches, all resting upon and radiating from the basilar process. If these arches were of a definite and calculable thickness and consistence, and occurred with anything like uniformity in the human species, then, given the force applied to the cranium, it would be easy to estimate the exact position, the course, and the extent of the fracture. But as these factors are not constant, and as, besides, there are in the cranial bones a series of buttresses upon which the force is broken, interrupted, and distributed, it is impossible to arrive at a precise and accurate conclusion as to the course and extent of the fracture in the great majority of instances. While this is so, the nature of the injury and its mode of production assist in determining approximately the extent and character of the lesion. It is of use to know the usual manner in which force is transmitted through the various parts of the skull, as it explains how fractures are resisted in certain points, and shows how and where indirect fractures are likely to occur. It may be premised that a blow from a sharp instrument generally causes local lesion, while severe impact with a blunt body is apt to lead to a general injury.

When a blow is received on the vertex, the upper borders of the two parietals tend to be driven inwards, while their lower borders are forced outwards, this outward tendency being resisted by the squamous and the great wing of the sphenoid. It is supposed that the facial pain, often felt after such blows, may be explained by the force being transmitted from the squamous to the zygomatic arch, and so to the malar and frontal bones. A blow from a hard body may produce a fracture of the vertex, which may end there if the force is thereby exhausted; if not, a fracture of the base may arise from the head being driven down upon the summit of the spinal column. If the weight striking the vertex is of a yielding material, then fracture at this part will not ensue, but fracture of the base alone from impact with the spinal column; or if the yielding force strikes the sides of the head, it may drive it against some obstacle outside the body, producing fracture at that part. The same is seen when a person falls from a height on the head: the entire weight of the trunk, with the superadded momentum, is concentrated round the condyles of the occipital bone, and the central fossa of the base of the skull is broken across. The force of a blow on the upper part of the frontal is communicated to the parietal bones. Force applied to the anterior aspect of the frontal may produce either direct fracture or fracture of the anterior compartment of the base. Blows on the occiput are very prone to fracture that bone, and this may also lead to longitudinal fracture of the posterior and middle fossæ. Injuries to the temporal region are followed by fractures of the middle fossa and petrous bone.

Fractures of the skull may be divided into those of the *vault* and those of the *base*; while under the former, the fissured, punctured, and depressed fractures are usually considered.

Fractures of the Vault.—Fracture of the vault are generally caused by direct violence. They include most of the punctured fractures and incised wounds of the bone. They are commonly compound, and the brain-injury associated with them is as a rule, local. They are frequently comminuted. Fissured fractures of the vault are generally associated with basal fractures, the one running into the other. Compound fractures are usually confined to the spot to which the force is applied, while simple fractures are most apt to spread.

Fissured Fracture.—As seen in the cadaver, a fissured fracture is easily discovered by its red outline, contrasting with the general white surface of the skull where denuded of periosteum. The fissure is red from the blood existing between the lips of the fractured bone. In this way fissure fractures contrast with the sutures of the skull, while the latter are further distinguishable by the irregularity of their interdigitating processes. This is best seen in children and young adults before synostosis sets in. It must be remembered that a fissure may actually pass through a portion of a suture, which would then present a red appearance from extravasated blood. As met with in practice, when uncomplicated by a scalp-wound, a fissured fracture cannot be discerned. The probability of its pre

sence may be indicated by certain symptoms arising from the outpouring of blood into or from the cranial cavity. When there is a wound of the scalp exposing the fracture, it may be discovered by the eye, or felt by the finger-nail, or by means of a probe. When the wound is examined shortly after the accident, blood may be seen to ooze from the fracture, and to reappear as often as the wound is sponged out.

There are two sources of fallacy. The sutures may be mistaken for a fissured fracture. Their anatomical position, the irregularity of their outline, coupled with the fact that there is an absence of oozing of blood from between their edges, is sufficient to enable a distinction to be drawn. The other mistake is one which the writer knows has been frequently made, and is all the more liable to occur inasmuch as it has not been pointed out. It arises in scalp-wounds which have penetrated the periosteum, dividing it cleanly, but leaving one side of the periosteum closely adherent to the skull, while the other is raised so as to expose the bone. If the probe be used in such a case, it glides over the surface of the exposed bone until it meets with the sharply-cut edge of the periosteum, which is so thin, tense, and firmly adherent to the bone as to convey the impression that the probe has caught in a fissured fracture. This error may be avoided by digital examination, when the periosteum may be detected by raising a small portion on the finger-nail, as also by the sensation from the membrane itself. It must be remembered that when a scalp-wound does not also penetrate the periosteum, the fissured fracture will be difficult to make out, more especially as there is frequently a quantity of blood effused from the fissure between the periosteum and the fracture.

Punctured Fracture of the Skull.—When the skull has been punctured, the blow which inflicted the injury must have been delivered with considerable momentum, and by a linear or sharp-edged body. Under this heading there are many cases included which might with more propriety be described as wounds or cuts of the skull, inasmuch as the instrument or material with which it has come in contact has actually cut its way into the bone, and has not fissured or fractured it. Such punctures are frequently the result of violent blows with glass or earthenware; and when this is the case, a portion of these substances is often found embedded in the skull, and broken off so flush with its external table that it presents merely a rough-ened edge, barely distinguishable by the probe, though more easily discerned by the finger. Knives seldom produce punctured fractures, and it is comparatively rare to find portions of them embedded in wounds of the skull, although this has been seen. When the fracture is linear, and there is nothing driven in between its edges, it may not be easily made out in the first instance. A scalp wound, in communication with a punctured fracture, does not always expose the fracture to view, the opening in such cases being more or less valvular. This arises from the mobility of the scalp over the skull. A lad who suffered from two punctured fractures of the skull, communicating with two valved wounds, was examined by a surgeon of considerable experience, who did not detect their presence until, at a second examination, he used his finger instead of the probe, when they were made out, and a small portion of bone removed from one of them. Punctured fractures are almost always compound, though the writer has seen one case in which there was a simple punctured fracture, the scalp being intact, but driven into the narrow osseous gap. In primitive forms of warfare, punctured fractures of the skull, arising from blows from arrow-heads, daggers, and from thrusts by spears, were much more common than they are at present.

Depressed Fractures of the Skull.—These fractures are generally easily recognised by the fact that, at a given spot, the normal contour of the skull is broken by an evident pitting or depression. When compound, this depression becomes very obvious and is often visible. As a rule, the periosteum has been torn and the bone exposed, but it occasionally happens that the periosteum remains intact, when the effusion of blood, issuing from between the fractured edges, strips and raises it from the skull until the depression is obliterated. Not only so, but, owing to the great tenseness of the over-stretched periosteum, a firm feeling is imparted to the finger, the nature of which, if not carefully examined into, might be misleading. This tension disappears in a few days with the shrinking of the blood-clot, when a more accurate diagnosis may be made. The depression may involve one or both tables of bone. When fracture of the outer table alone occurs, the depression is extremely slight, as the outer table can only be depressed to the extent of the depth of the diploë, except in the frontal region, where the outer table may penetrate the frontal sinuses. The inner layer of bone is occasionally fractured

alone, and this generally happens when the agent acts on the outside of the cranium, and the force is at the same time not severe.

When the force with which it acts is greater, and it impinges on the outside, both tables are generally broken, but the inner one is more depressed and more comminuted than the other. It is also found that, when the force acts from without, the inner table gives way first, and is fractured to a greater extent than the outer. When the force acts from within the cranium, the reverse is the case, the external giving way first, and being more severely fractured than the internal table. This occurs when bullets, after entering the skull at one place, strike the inner table at another point in their outward course. There are various reasons why the inner table gives way to a greater extent than the outer, on the application of external force. In the first place, the inner table is both thinner and more brittle than the outer. Secondly, the force as it travels through the diploë becomes distributed, and strikes the inner table over a wider area; and thirdly, the inner table forms a smaller curve than the outer one.

In children, depression of the bones of the skull is said to take place occasionally without fracture. There is generally an over-stretching of the osseous fibres, which is probably always associated with greater or less rupture, or *green-stick* fracture. It is true that the bones of infants are sufficiently elastic to bend without rupture of the fibres, but such indentations in the skull will not remain after the withdrawal of the bending force, the elasticity of the bone restoring the form. M. Péan has had several autopsies on the bodies of newly-born infants affected with this form of injury, and found that these *enfoncements* were always co-existent with fracture of the internal table, and sometimes of the outer one also. As to the *prognosis* of depressed fractures or indentations in the bones of infants, either of two results may follow. If the bone so bent be sufficiently elastic, it will, within a comparatively short period, assume its former contour. If, on the other hand, there has been a considerable rupture of the osseous fibres, especially of the inner table, and plastic infiltration quickly occurs, the deformity is apt to become fixed, and may remain permanently so, unless relieved by operation.

In relation to simple depressed fracture of the skull, it is well to bear in mind that an appearance closely resembling this condition is brought about in some contusions of the soft parts. Where this occurs, there is a somewhat circular elevation of the scalp with a soft and sometimes depressed centre, which simulates a depression in the bone. This appearance is generally attributed to the effusion of blood, which coagulates round the circumference, while it remains fluid in the centre. The writer has had numerous opportunities of seeing this condition, both in the cadaver and on the living subject, and explains it as follows:—The central portion is the point which has been subjected to violent compression between the impinging body and the skull. In this part the cellular tissue has been broken up and scattered centrifugally, its elements, together with the neighbouring cellular tissue, causing a heaping up and condensation of the cellular tissue at the circumference, which soon becomes more dense by the infiltration of blood. The central portion of tissue on rare occasions remains adherent to the tendon, but it is usually separated from it by a quantity of fluid blood. There being no tissue intervening between the skin and the tendon, or, if any, it being in a highly rarefied condition, the centre has a peculiar soft yielding feeling, as if there was a complete hiatus in the osseous wall. This condition is differentiated from fracture with depression by the fact that the application of *firm* steady pressure, exercised by the finger, dispels the raised margin. The word 'firm' is italicised, as in some cases it requires considerable steady pressure to dislodge a portion of the margin.

Fractures of the Base.—Fractures of the base may arise from direct violence, as when a sharp body has been forced through the orbital or nasal roof, or through the pharynx into the middle fossa. The posterior fossa may be fractured by violence applied to the nape of the neck. Basal fractures are, however, most generally produced by indirect violence. A blow upon the nose, by driving in the ethmoid, may cause fracture of the anterior fossa. The cribriform plate of the ethmoid and the orbital plate of the frontal have been fractured by blows on the anterior aspect of the frontal. The writer has seen a case of fracture of the orbital plate of the frontal, which had been caused by a blow with the fist on the brow. This history was well authenticated, and there was no other injury of the patient's person which might have suggested a different conclusion. Falls upon the chin have been known to result in the driving of the condyles of the lower jaw through the glenoid fossæ into the interior of the skull. Fractures in the

occipital region have arisen from falls on the feet, knees, or buttocks, the force being transmitted through the vertebral column to the occipital condyles. Many basal fractures occur through the person falling while walking, the head coming into violent contact with the pavement. It used to be believed that many fractures of the base were due to *contrecoup*; this belief is now generally abandoned, though there are a few cases which may be explained in this way, such as a fall on the back of the head occasioning a fracture on the right side of the occiput and, at the same time, a fracture of the orbital plate of the frontal, on the left side. There is little doubt that the majority of linear fractures of the base are associated and continuous with fractures of the vault. It is well to bear in mind that fractures of the base may arise from what are considered to be comparatively trifling accidents, such as falls on the pavement.

In all cases, the head ought to be carefully examined for marks of violence. In the case of dark, dense-haired persons, bruises of the hairy scalp are easily overlooked, unless sought for in a good light. Where there is difficulty, and the case is a serious one, shaving of the head reveals the livid patch. In light-haired persons, no difficulty of this kind is experienced.

Fracture of the Anterior Fossa.—A fracture produced by a blow on the anterior portion of the frontal bone will probably be situated in the anterior fossa, though, if more severe, it may spread beyond it into the middle fossa. Blood sometimes escapes from the nose in fractures of the anterior fossa. This blood is derived from the meningeal vessels or torn mucous membrane of the roof of the nose. In one instance it came from the anterior portion of the superior longitudinal sinus, which had been torn; the *crista galli* having been driven upwards and backwards, while the cribriform plate of the ethmoid was crushed. If cerebro-spinal fluid escapes from the nose in a case of fracture of the base, it will show not only the mucous membrane on the roof of the nose, but also the brain-membranes, to have been ruptured.

In fractures of the anterior fossa, the blood may not escape externally, but may infiltrate the tissues surrounding the eyeball and also the conjunctiva of the eyelids. This appearance may be simulated by extracranial infiltrations. First, there is the common bruise of the eyelids, known popularly as a 'black eye,' and, secondly, there is the very common infiltration of the eyelids which follows wounds or bruises of the brow. To attempt to differentiate between fractures of the skull and these two affections by the colour of the eyelids is altogether erroneous. The other signs generally advanced as diagnostic require to be carefully considered in relation to the supposed injury. The appearances differ in fracture according to its precise locality, and particularly whether the orbital plate of the frontal bone is implicated; or whether the fracture involves the orbital ridge of that bone. In the former, the reflection of the fibrous tissue from the periosteum to the tarsal cartilages is maintained intact, preventing the effusion of blood into the eyelids before, at least, it has passed into the conjunctiva; while in the latter it is ruptured, thereby permitting the blood to infiltrate the eyelids directly.

When fracture is confined to the orbital plate, there is observable, soon after the accident, a prominence of the affected eyeball. This is followed by the infiltration of blood into the conjunctiva, which takes place from behind, gradually implicating the anterior parts. Then the lower eyelid becomes puffy, much the same at first as in œdema, but deeply situated in the tissue a discoloration is discernible, which becomes more and more apparent until the colour is a pronounced shade, varying from a dark red to purple. The upper eyelid may escape the infiltration, or it may become involved at a later period, but it is seldom so distended or discoloured as the lower eyelid. In bruises of the eyelids—the ordinary 'black eye'—the eyelids swell with great rapidity, and are often so distended, shortly (two hours) after the injury, that they can with difficulty be opened. When forcibly opened, the conjunctiva is found to be frequently, though by no means always, free from infiltration. When it is devoid of discoloration at the beginning, it generally remains so throughout. In bruises situated on the brow above the orbit, the eyelids swell first, the upper sooner than the under, and the conjunctiva is seldom involved. On the other hand, when the fracture extends through the orbital ridge, the discoloration and swelling take place rapidly into the eyelids as well as into the conjunctiva; so that such a fracture could not be distinguished by the appearances of the eyelids from either of the foregoing. It is comparatively seldom that the strong orbital ridges give way. A surer sign of the fracture in this region is paralysis of some of the muscles of the eyeball, indicating injury to the orbital nerves.

In fractures of the anterior fossa, even when accompanied by severe injury to one

of the frontal lobes, there is frequently, at first, either very slight indications of brain-complication, or there may be absolutely none. In such cases, forty-eight to seventy-two hours have elapsed before serious symptoms have arisen, indicative of contusion or laceration in this region.

Fractures through the Middle Fossa.— Blows on the vertex and temporal regions and falls on the occiput are prone to produce fractures of the middle fossa.

The diagnosis of this injury is based on three points: a discharge of blood, an escape of cerebro-spinal fluid, and a facial paralysis. A flow of blood from a healthy ear may possibly asise from a rupture of the membrane of the tympanum, and in that case the bleeding would be derived from the vessels of the membrane of the tympanum. The blood which flows from an injury of this kind is generally bright in colour and very small in amount, and, owing to the contraction and retraction of the vessels, it ceases spontaneously. On the other hand, the blood which issues from the external auditory meatus in a case of fracture of the petrous portion of the temporal is generally dark-coloured, wells slowly and continuously for hours and sometimes for days or longer, during which its colour gradually becomes lighter, from the admixture of cerebro-spinal fluid with the stream. This blood comes from some of the larger vessels inside the cranium, and not infrequently from the lateral sinus. Subsequently, the discharge from the ear consists entirely of clear fluid, which often continues for days to stain the pillows. Before this cerebro-spinal fluid could come away, the tubular prolongation of the brain-membranes surrounding the seventh pair of nerves must have been torn, and the fracture must have passed through the internal auditory meatus. There must likewise have been a rupture of the membrane of the tympanum, and a communication between the internal ear and the tympanum.

Where there are wounds on the face, head, or neck, blood in considerable quantity may be found in one or other ear, and it then becomes necessary to determine whether it comes from the wounds or from the interior of the skull. The blood as it passes from the wounds to the ear may leave a track, which would be of value if it were not for the fact that blood, issuing from the interior of the skull and flowing from the ear, may leave a track of the same kind, the blood from the ear mingling with that of the wound. In any case of doubt, the ear ought to be wiped out with a piece of lint in a pair of dressing-forceps. The wounds on the scalp or face should then be dressed, and the ear carefully watched for reaccumulation of blood. If this does take place, the fact that it comes from the interior of the ear will be established. There are instances in which the fracture of the petrous portion has occurred, accompanied by the rupture of the other parts as already described, with the exception that the membrane of the tympanum has not been torn. The flow of blood takes place from within, but, as it cannot escape from the external ear, it follows the course of the Eustachian tube and thereafter escapes from the mouth and nose. The blood may also be swallowed, and hæmatemesis may follow subsequently. Occasionally, even when the tympanic membrane has been ruptured, the blood finds its way through the Eustachian tube, as well as through the external ear; there is then bleeding from the mouth, nose, and one ear. In some cases of fractured base, infiltration is observed at the posterior aspects of the pharynx, and when the mucous membrane of the pharynx has been ruptured, persistent bleeding is apt to occur. From such a fracture, with rupture of the mucous membrane of the pharynx, there may also be a discharge of cerebro-spinal fluid. Whenever there is clear evidence of the escape of cerebro-spinal fluid, the diagnosis of fracture of the skull may be regarded as almost certain. If, in addition to the flow of blood at the beginning of the case, and the escape of cerebro-spinal fluid, there is loss of sensation and motion of the parts supplied by the fifth and seventh nerves, the diagnosis becomes complete.

The cerebral symptoms accompanying fractures of the base are very varied. At first there may be nothing wrong mentally, and in such cases it may be difficult to persuade the patient or his friends that he has sustained a serious injury. More often, there is confusion of thought and unsteadiness of gait. If the fracture be accompanied by considerable brain-pressure, there will be insensibility. In most cases there is insensibility, as an early if not an immediate feature in fracture of the base, though the insensibility be not necessarily indicative of pressure. Given an insensible person who has met with an injury, and who has bleeding from the ear, the presumption is that he suffers from fracture of the middle fossa of the base. The great majority of fractures of the base are of the middle fossa.

Fracture of the Posterior Region of the Skull.— There are few cases in

which there is fracture of the posterior, without also the middle fossa being implicated. When they do occur separately, their differential diagnosis is very difficult, except when there are local signs to guide one. Blood, extravasated over or in the neighbourhood of the mastoid and occipital regions and at the sides of the neck, is frequently seen some days after the posterior fossa has been fractured. Occasionally, there is also tenderness on pressure on the mastoid process. These signs are of special value, when the seat of external violence is at a distance from the parts into which the infiltration occurs. If the functions of the eighth and ninth nerves were specially involved, as evidenced by impairment in swallowing and in the movements of the tongue, a guide to the lesions in this region would be established. These indications are, however, generally lost in the insensibility which is apt to be present in traumatic cases affecting this region.

Treatment of Fracture of the Skull. As the gravity of fracture of the skull depends on the degree and the extent of the cerebral involvement, the treatment will naturally be directed, first, towards the prevention of cerebral complications; and, second, to their relief when they arise. As the latter are fully treated of under the headings of Concussion, Compression, and Encephalitis, the former only are dealt with in this article.

The fractures which are most apt to be complicated by cerebral affections are the compound, the punctured, and the depressed. All compound fractures must be rendered aseptic and maintained so throughout. This is the surest way of preventing meningitis and encephalitis, as a septic state of the wound is the most frequent cause of these affections. To render the part aseptic, the hair should be shaven and the scalp thoroughly purified, first by soap and water, then by turpentine, for the removal of greasy matters, and finally by the application of an antiseptic solution. Drainage ought to be attended to, and an antiseptic dressing applied, which should be fixed in position by elastic webbing. Iodoform dusted round the circumference of the wound is a valuable aid in keeping the wound-secretion aseptic. A dressing of antiseptic gauze or sublimated wood-wool ought to be applied. In fracture of the middle fossa, with rupture of the membrane of the tympanum and the escape of blood and cerebro-spinal fluid, the same precautions ought to be adopted. An antiseptic powder, such as iodoform, may be put into the external ear, provided it does not so completely occlude the orifice as to prevent the escape of discharge. All operations on the skull and its contents must likewise be conducted under rigid antiseptic precautions.

Regarding depressed fractures, all surgeons agree that the depressed bones ought to be elevated, when they produce symptoms of compression. But the same unanimity does not prevail concerning the treatment of depressed fractures, when unaccompanied by cerebral symptoms; most advising that they be left alone, while a few recommend their elevation. A considerable depression of bone is required to produce immediate and pronounced symptoms of compression, and there can be no doubt that a large number of cases of depressed fracture recover without elevation of the fragments. But there is reason to believe that, in not a few instances, although immediate recovery has taken place and the patient has been discharged from the hospital as cured, yet in the course of months certain cerebral changes become developed, as evinced by motor, sensory, or psychic phenomena; and in some, these affections become permanent or ultimately lead to a fatal issue. It may be alleged that such cases may have had brain-lesions independent of the depression of the bone; but of this there was no evidence, while the fact of the depression of the skull was clearly established. Besides, one never knows by the external appearances to what extent the inner table of the skull has been depressed, although it is safe to state that it is depressed to a greater extent than the outer table.

The chief reason against the elevation of the depressed bone lies in the fear of exciting inflammatory action in the membranes or in the brain itself. There was good ground for this fear so long as wounds were not kept aseptic; but with the means at present at the disposal of the surgeon it is no longer tenable, and what remains for the surgeon to make sure of is, that the depressed bone or spicula which may be driven through the membranes do not maintain compression or incite irritation, which may lead to inflammatory action of an acute or chronic character. Therefore, when there is marked depression of the skull involving both tables, it ought to be elevated, without waiting for the development of symptoms of compression or of irritation, provided the surgeon has the means of preserving the wound in an aseptic condition. Punctured fractures ought to be treated in the same way, as far as the

antiseptic precautions are concerned. They ought to be carefully explored and all loose fragments elevated.

The depressed portions of bone may be raised by means of an elevator placed under the extremity of one of the fragments. The instrument rests on the border of the sound skull as a fulcrum, while the elevator is used as a lever to lift the fragments outwards. There are many cases, however, in which the elevator cannot be used in this way at first, owing to the fact that there is no gap in the depressed bone into which the elevator may be passed. In such cases, an aperture requires to be made at the side of the depressed bone by means of a saw or a trephine. In using the latter, the central pin of the instrument ought to be placed on the sound skull and made to penetrate its substance sufficiently to steady the trephine, thus preventing slipping, and permitting the rotatory action of the circular saw to be maintained until it has made a sufficient sulcus for itself to enable it to run without the central pin, which should then be withdrawn. As the inner table is reached, great caution must be observed to prevent penetration of the membranes. This risk may be lessened by frequently inserting a probe into the grooves and removing the bone-débris produced by the saw, at the same time exploring the depth to which it has penetrated. When the sawing is completed, the elevator may then be brought into use and the disc removed. The aperture thus made will permit of the depressed bones being elevated.

After having elevated the portions of bone from a depressed fracture, instead of leaving the brain and its coverings exposed, the bones so removed should be carefully preserved under aseptic conditions until the completion of the operation, when they may be replaced in part at least, so as to form an osseous wall over the aperture. The writer has frequently adopted this practice with complete success.

In all fractures of the skull, the patient ought to be placed in bed in a quiet room, the head shaved, a brisk purge administered, and a low diet given. He ought to remain in bed for at least four weeks, and be kept under observation for months afterwards.

Contusion of Bones of Skull.—Blows on the head may produce contusion of the skull, with or without the production of wounds, and they are sometimes followed by inflammatory action in the bone, which may induce hypertrophy, or may lead to caries or necrosis. In some instances, the periosteum and the dura mater may be separated from the bone at the injured part, when necrosis of both tables may ensue. In others, the periosteum may alone be separated, and the external table may be driven into the diploë, resulting in a separation of the external table. In one instance, at least, a considerable portion of the internal table of the calvaria was found separated from contusion. In such cases, inflammatory action may take place in the diploë, and from thence the inner table is apt to be affected. There is danger of the inflammatory action spreading from the bone to the brain-membranes, or even in ducing pyæmia through the infection of the veins of the diploë.

When the inflammation spreads to the membranes, the dura mater becomes separated from the bone by a layer of plastic effusion, or of pus. The bone, if denuded, becomes dry, and by-and-by discoloured. If the scalp remain intact over the contused bone, an œdematous condition of the soft tissues frequently takes place coincidently with the purulent effusion into the diploë, or under the skull. Accompanying this condition there is persistent headache, frequently localised pain, corresponding to the seat of inflammatory action, and an increased temperature. In a few cases these symptoms set in early, but in the majority they occur from two to three weeks after the accident. When the inflammation spreads beyond the dura mater, involving the arachnoid, it no longer remains localised, but becomes diffused over the surface of the membranes; and if the inflammatory action be intense, the visceral layer, the pia mater, and the surface of the brain become implicated. Rigors, at this stage, are frequent, with occasional vomiting, drowsiness, coma, and paralysis.

These symptoms are prone to arise in contusions of the bone, complicated with wounds which are permitted to become septic; seldom do they set in under thoroughly aseptic conditions. When such symptoms do arise, the first thing to be attended to is the condition of the bone; and if it be dry or necrosed, it ought to be removed, thus giving exit to any inflammatory products which may exist between the dura mater and the skull. If the pus be under the dura mater, and especially if an abscess has formed, this membrane will not evince the cerebral pulsations and will probably bulge into the trephine-opening. If this is the case, the membrane should be opened, and the pus permitted to escape. *See* further under Encephalitis and Meningitis.

Wm. Macewen.

SLOUGH and SLOUGHING.—When gangrene occurs in the soft tissues, the dead portion is called a *sphacelus* or *slough*; whilst the gangrenous process by which the slough is produced, and the ulcerative process by which it is separated, are often spoken of as *sloughing*. Sloughing, therefore, is not a pathological process distinct from gangrene and ulceration, but a term conventionally applied to certain forms of these morbid processes. Thus when, after an amputation, from deficient blood-supply or other causes, portions of the flaps die and are cast off in the form of shreds or semi-solid masses, they are said to be sloughing. When a wound or ulcer takes on an acute inflammatory action, and rapidly enlarges by the death, in visible masses, of its edge or granulations, it is called a sloughing ulcer; whilst again, when under certain circumstances a portion of tissue—a tendon, for example, in the case of a whitlow—becomes gangrenous, the process of ulceration by which it is separated is spoken of as sloughing. But not every process of gangrene is so termed. Thus, when the whole foot dies in old persons, or gangrene rapidly spreads up a limb, the foot or limb is not said to slough, but to mortify, or to be in a state of gangrene; neither is the separation of such gangrenous masses, as a rule, designated sloughing. *See also* Hospital Gangrene; *Sloughing Ulcer* under Ulcers.

W. J. Walsham.

SLOUGHING PHAGEDÆNA. *See* Hospital Gangrene.

SMITH'S (NATHAN) ANTERIOR SPLINT for the lower limb is best made of two stout wires fixed together by transverse bars; the splint should reach from the lower part of the abdomen to the toes, and should be bent slightly opposite each of the three joints of the limb; the splint should be suspended over the limb, and the latter bandaged to it from the foot to the groin. It is a useful splint for treating wounds and compound fractures involving the posterior part of the limb.

SNUFFLES. *See* Congenital Syphilis.

SPECTACLES. *See* Accommodation, Disorders of; Cataract-Glasses; Refraction, Errors of.

SPECULA are instruments employed to conduct the rays of light into some of the internal passages of the body, and also to separate the walls of those cavities so that their entire surfaces may be successively brought under observation, either for the purposes of diagnosis or operation.

Bright daylight, when obtainable, affords sufficient illumination for most purposes; for the examination of the nasal cavities the light reflected from a white cloud serves admirably, if focussed on the diseased parts with a mirror. If the light be bad, or if it be difficult to obtain owing to the position of the patient, artificial illumination must be employed. For the examination of the middle ear, a strong artificial light should be reflected into the meatus with a mirror.

The specula here described are grouped according to the regions for which they are most employed.

Vaginal Specula may be classed under four heads, according to their mode of action—viz. the tubular, the duckbill, the bivalve, and the three- or four-bladed dilating specula.

Tubular Specula.—The best known speculum of this shape is Fergusson's. It is made of silvered glass, coated externally with gum elastic. The diameter of the tube is the same throughout. The distal or uterine end is bevelled, so that one side—the anterior—is shorter than the other. The proximal end is trumpet-shaped. The great objection to Fergusson's speculum is its liability to break, but this may be obviated by substituting metal for the glass. Hall Davis's speculum differs from Fergusson's in being made of metal or celluloid, and in tapering slightly towards the uterine extremity. It is claimed for this instrument that it is easier to introduce, that it possesses more illuminating power, and is not so fragile as Fergusson's speculum. Tubular specula act by distending the vagina longitudinally, and pushing the uterus before it; they afford good illumination, but unless as large a size as possible be employed, the folds of a lax vagina often obstruct the view.

Duckbill Specula.—Sims's speculum is made of plated metal, and consists of two specula or blades of different sizes, united together by a handle, which may be either rigid, or hinged in the middle so as to allow of its being folded up to half the size. Each blade is hollowed on its anterior surface, and its end is turned upwards so as to resemble a duck's bill; the blades of the real Sims's speculum are set at right angles with the handle, but in some modifications of it (Bozeman, Battey), the blades are set at an acute angle with the handle. This speculum is employed with the patient in

the semiprone or in the lithotomy position, and its blade is meant to lie on the posterior wall of the vagina with its extremity behind the cervix of the uterus. If the anterior wall of the vagina is lax, it falls down and obstructs the view; to obviate this a loop of wire may be so hinged to the base of the speculum (Griffith's), that by depressing the external end of it the uterine one may be raised so as to support the vaginal wall.

The modification of Sims's speculum, known as Neugebauer's, is divided transversly in the handle but capable of being joined together again; the ends of each blade are, however, open and in a line with the general curve of the instrument, instead of being turned up or inverted like the duck-bill. The lesser blade can be fitted into the larger in such a way that a bivalve or tubular speculum is produced. The posterior blade should be introduced first, so that its extremity lies behind the cervix, and then the anterior one should be introduced with its borders turned to those of the other blade, and in such a way that they fit within them. When in position, the blades work on one another like a bivalve speculum, and, consequently, by approximating the handles the opposite ends of the specula become separated, and the deep part of the vagina dilated. Barnes's crescent speculum is a modification of the last-mentioned, in which each blade is crescent-shaped, and each extremity of the blades is like the uterine end of Neugebauer's instrument.

Bivalve Specula are composed of two blades hinged together so that they may be separated either in an antero-posterior or lateral direction. Bennett's, Barnes's, and Cusco's specula are instances of the first kind, and Ricord's of the second. Both Barnes's and Bennett's specula are tubular when closed, but as their uterine ends are not bevelled, a plug with a rounded end is used to facilitate their introduction; by means of a screw one of their blades can be raised or depressed. Cusco's instrument does away with the necessity for the plug, for it is composed of wide and almost flat blades which, when they are shut, fit accurately together, both along their borders and at their extremities. The blades may be plain or fenestrated. By means of the screw, which acts on both blades, the instrument may be opened. Cusco's speculum should be introduced with its blades looking laterally, but before it is pushed completely in, the instrument should be rotated so that they look antero-posteriorly. The blades of Ricord's speculum are hinged together at a little distance from their external extremities, and, by approximating the handles, the uterine ends of the blades may be separated laterally. Reeves's dilating speculum is a bivalve instrument, the blades of which open laterally; by means of screws and levers it is possible to separate the blades either at one or other of their extremities or along their entire length. Nott's speculum is a three-bladed instrument, but its principle of action is similar to Cusco's bivalve; instead of the single upper blade of the latter, Nott's speculum has two narrow blades.

Dilating Specula are three- or four-bladed instruments which distend the vagina both antero-posteriorly and laterally. Meadows's three-bladed instrument consists of a lower blade, which has a duck-bill shape, and of two narrow upper blades, which are bent at a right angle a little in front of the hinge by which they are attached to the lower blade; when the upper blades are separated from one another, they are also raised equally along their entire length. Meadows's four-bladed dilating speculum has an anterior and a posterior duckbill-shaped blade, and two narrow lateral blades; the latter are forced outwards when the former are opened by means of a Cusco's screw. Scanzoni's speculum consists of four stout metal rods with inverted extremities: when the blades are shut the instrument becomes a fenestrated tubular speculum, which is easy to introduce; by means of handles and screws all four blades can be separated.

Rectal Specula.—Many of the vaginal specula are equally servicable for examining the rectum.

Fergusson's rectal speculum is made of silvered glass coated with gum elastic; it is a tubular instrument with a rounded end and a narrow opening on one side. Gowland's specula are made of plated metal, and further differ from Fergusson's in having a much wider opening along one side, in being open at the distal extremity, and in tapering slightly from the outer to the inner end. They are introduced with a plug. Hilton's speculum is made of metal, and resembles Fergusson's except that it tapers a little towards the distal end; it is provided with a plug and with a metal handle, which is fixed by a hinge to the proximal extremity. Bryant's speculum consists of two duckbill blades, each of which is attached to a separate handle; one blade fits into the other so as together to produce a tubular speculum with a closed end; after introduction the blades can be separated

after the fashion of a bivalve speculum. The two handles can be fixed together so as to produce a speculum very much like Sims's duckbill. Allingham's speculum is a four-bladed instrument, which, when the blades are closed, occupies very little room and is consequently easy to introduce; when the blades are opened, the whole circumference of the rectum can be seen at one view. Lane's speculum is a three-bladed instrument; the blades are much broader than those of Allingham's speculum. Hogan's speculum is composed of two metal rods, each of which is bent at an angle in the middle; one of the ends of each rod is fixed to the extremity of one of two levers, which can be separated by handles; the other end can be fixed into notches along the side of the levers. When the levers are approximated and the blades released from the notches above mentioned, the speculum becomes very small and can be easily introduced. By separating the levers the rectum becomes distended laterally, and by depressing the free ends of the bent bars and fixing them in one of the notches on the sides of the levers, the rectum becomes distended antero-posteriorly also. *See* Endoscope.

Urethral Speculum.—Bryant has introduced a small speculum and dilator made of box-wood or ivory, which he finds of great use when removing vascular growths from the female urethra The speculum is a hollow conical instrument with a broad cleft along one side.

Nasal Specula.—For examination of the anterior portion of the nasal cavities Fränkel's speculum is one of the best; it consists of two skeleton blades hinged to a transverse bar, through which a screw works so as to act by means of levers on both blades. The blades of the instrument should be introduced closed into one nostril, and then separated sufficiently to afford a good view and to be self-retaining. The handle of the instrument hangs down over the lip, and is quite out of the way. The skeleton blades may be replaced by solid ones (Von Tröltsch), and the screw arrangement for separating the blades may be replaced by a loop of wire, which has sufficient elasticity to keep the blades apart (Goodwillie). Sliding ivory plates may be adapted to the fenestrated blades, so as to protect the nostril during the applications of the cautery. Thudichum's speculum consists of two flat blades of metal or bone united by a loop of wire, the elasticity of which keeps the blades well apart. Lennox Browne's speculum is an ivory cylinder with a blunt end and an open upper surface; it is introduced by means of a plug.

Elsberg's speculum is composed of three blades, which are set at an angle of 90° or a little more with the handles. The two lateral blades are separated by approximating the handles, either quickly by the hand or more slowly by means of a screw. As this is done, the lower blade is depressed by means of two levers united to a rod connected with it and the handles of the instrument. Duplay's speculum is a very useful instrument for displaying the deeper parts of the nasal cavities; when closed, it has the shape of a hollow cone with flattened sides and a rounded apex; it is a bivalve instrument, and its blades can be separated by turning a screw. The inner blade is more flattened than the outer, and it is continued into the trumpet-shaped proximal end of the instrument. The outer blade is the one which is moved by turning the screw. Schuster's and Votolini's specula only differ from the last in the means adopted to separate the blades. The bivalve specula afford a good view of the deeper parts of the nasal cavities, but if it be desired to examine the posterior wall of the pharynx and the region of the Eustachian tube through the anterior nares, Zaufal's funnel should be used. It consists of a long hollow cylinder of polished metal with a funnel-shaped outer extremity.

Aural Specula.—The best speculum for most purposes is Keene's; it is a hollow cone of plated metal with a short cylindrical extremity. Toynbee's and Wilde's specula taper gradually from a trumpet-shaped outer end to a small elliptical or circular inner one. Specula, of similar shapes to the three already mentioned, are made of vulcanite and are very useful when substances which would tarnish silver are being used. Kramer's speculum is a bivalvular instrument, whose blades are set at right angles to long handles, by means of which its blades may be separated. It is rather inconvenient, because one hand is required to hold the instrument. Woakes' speculum is a useful bivalvular instrument; its principle of action is the same as that of Duplay's nasal speculum; it is self-retaining.

Eye Specula are employed to separate the eyelids. They are made of wire, and have two blades, which are so formed that they fit securely on to the borders of the lids. When the blades are separated, the eyelids are opened widely. The blades may be separated by a contrivance similar to that employed by Fränkel for his nasal speculum,

or by the elasticity of a spiral twist of the wire which unites the blades. If the latter method be employed, the instrument should be provided with a stop-screw, by means of which the separation of the blades may be checked when they have opened the lids sufficiently. The handle of the instrument should be curved, so that it may rest just above the zygoma, and be out of the surgeon's way. BILTON POLLARD.

SPERMATIC CORD, Diseases of the. In this article only abscess and the solid tumours of the cord will be considered. The fluid tumours and varix of the cord are described under HYDROCELE; HÆMATOCELE; VARICOCELE.

ABSCESS.—*Causes.*—Inflammation of the cord, running on to acute abscess, may be the result of injury, or complicate urethritis and epididymitis. In tubercular disease of the testicle, nodules of the same character are sometimes found in the cord, and they may soften down into chronic abscesses.

Symptoms and Diagnosis.—Acute inflammation of the cord causes a rapid, painful, and very tender swelling of the part, and, when abscess forms, the skin over it becomes œdematous and reddened, and fluctuation is detected. Tubercular disease of the cord usually causes a uniform enlargement of the vas deferens to the size of a quill or so, but it may lead to nodular swelling of the part, at first rounded and hard, and then softening down into a fluctuating swelling, which bursts and discharges thin, flaky, curdy pus. The diagnosis will be at once made by noticing tubercular disease of the testicle, and perhaps of other organs also.

TUMOURS.—The commonest of the solid tumours is lipoma; these growths spring from the scattered nodules of fat normally found in the cord, and which are continuous above with the subperitoneal fat. Myxoma and a mixture of mucous and fatty tissue—myxo-lipoma—also occur, especially late in life. Sarcomata may grow from the cellular tissue of the cord. Colloid and encephaloid cancer have been found springing from the vas deferens, and possibly also from the remains of the funicular process of peritoneum. These various forms of tumour have their usual pathological characters: the lipomata are often pedunculated; the sarcomata and carcinomata infect the lymphatic glands in the iliac fossa and other internal organs, and they and the myxomata may recur after removal.

Fatty tumours grow slowly, and, after attaining a certain size, may remain stationary for years. They are painless, smooth, soft, often lobulated in outline, and generally very movable. In some cases, when the patient stands up, a little swelling falls down through the external ring, and then, on the patient's lying down, it slips up again within the inguinal canal; this apparent reducibility of the tumour is unattended with gurgle, and, by careful manipulation, it is generally possible still to feel the tumour over the internal abdominal ring, especially if the finger be passed up into the inguinal canal. Where the tumour lies partly within the inguinal canal, it has a thrusting—not an expansile—impulse imparted to it by a cough. When the testicle is pulled down so as to put the cord upon the stretch, the mobility of the tumour is greatly lessened. From the position and apparent reducibility of these tumours they may be mistaken for hernia. From an enterocele they are to be distinguished by their greater mobility, dulness on percussion, constancy of size, absence of pain, absence of gurgle on reduction, and of expansile impulse on coughing; and by the fact that traction on the cord fixes the tumour and prevents its reduction. To epiplocele the resemblance is much closer, as both alike consist of masses of fat, and, like the tumour, the hernia may be irreducible. Lipoma is, however, free from pain or any sense of dragging, such as is met with in epiplocele; it is also more movable, often slipping about freely on its narrow pedicle; while its position, mobility, and apparent reducibility are affected by traction on the cord to a much greater extent than is an epiplocele. An epiplocele can always be traced quite up to the internal abdominal ring; many lipomata spring from the cord lower down, and when this can be distinctly demonstrated there can be no difficulty in the diagnosis.

Myxo-lipoma can only be distinguished from simple lipoma by careful microscopical examination, and by its tendency to recur after removal. Myxoma of the cord grows more rapidly and continuously than lipoma, is very soft, rounded in outline, and does not infect the iliac glands; the tumour may attain a considerable size. No differential diagnosis can be made between sarcoma and carcinoma of the cord: both alike are rare as primary affections. The tumours are firm, more fixed than lipoma, grow steadily, and generally rapidly, infect the iliac and lumbar glands, and become adherent to and fungate through the skin over them if left alone; in their later stages, the tumours

become uneven in outline and unequal in consistence.

Malignant disease of the testicle often spreads up the cord to the groin, and may form considerable masses in it, and after castration the disease may recur in the stump of the cord. Nothing is known of the causes of the primary solid tumours of the cord.

Treatment. — An acute inflammatory swelling of the cord is to be treated by rest and cold, or, if that fail to relieve quickly, by hot belladonna fomentations. Should an abscess form, an early incision is to be made into it; if considerable induration of the cord be left behind, it may be removed by a succession of small blisters. Tubercular disease of the cord requires the same treatment as the similar affection of the testicle. *See* Testis, Diseases of the. If a lipoma of the cord do not cause any trouble or inconvenience, and have ceased to grow, no treatment is required. Where, on the other hand, the tumour is still increasing in size, or from its size or position is a source of annoyance to the patient, it should be removed through a simple incision down to it, care being taken to enucleate the entire growth, but without inflicting injury upon the vessels or duct of the cord. To wear a truss for a small lipoma in the inguinal canal simulating a hernia is neither beneficial nor injurious. When, in operating for a hernia, one of these growths is detected, it should be removed. If, in a patient believed to have a lipoma of the cord, symptoms of intestinal strangulation come on, the surgeon should cut down upon the tumour and explore the part, as a small hernia might be concealed beneath it. A myxomatous tumour should be removed as early as possible, care being taken to keep outside the delicate capsule surrounding the growth. Malignant tumours of the cord should be excised if the iliac glands are not evidently infected, and as these growths infiltrate the cord and have a great tendency to recur, the entire cord, and the testicle, should be removed with the tumour. In the removal of benign tumours of the cord, castration is never justifiable. A. Pearce Gould.

SPERMATORRHŒA. — The term spermatorrhœa is in every respect a bad one, and has been much abused. In its true etymological sense it means the discharge of the spermatic fluid or semen, without sexual desire or sexual excitement; and the malady from which the patient suffers has come to be regarded as the direct outcome of the loss of the seminal secretion, when it is really due to the condition of the patient's mind, which, as Sir James Paget says, 'in reference to his sexual organs, is unsound.' The term has also been much abused, and often loosely applied by patients to the discharge of mucus, either prostatic, urethral, or vesical; to the gleety discharge due to a stricture or inflamed patch on the mucous membrane of the urethra, and even to the flocculent cloud of mucus which occurs in healthy urine, or the white deposit of phosphates when the urine is alkaline in some forms of dyspepsia.

Furthermore, the term has been applied to a frequent or even an occasional involuntary emission occurring during sleep, attended by erection and under the influence of lascivious dreams. These frequently occur, especially in early manhood, and often denote an excess of health and strength, and are simply the result of a hyper-secretion of the testes, occurring most frequently in young men of an excitable temperament.

By the term spermatorrhœa is meant a peculiar condition of hypochondriasis, engendered and maintained by an irritable condition of the sexual organs, which causes the frequent escape of seminal fluid, with or without the patient being aware of it. It is extremely doubtful, however, whether this latter condition, when the semen is passed without the knowledge of the patient, ever occurs; and such conditions as those spoken of by Lallemand, where seminal emissions occurred during micturition, and where there was a constant loss of semen with the urine, must be received with a considerable amount of doubt.

Such a condition as that described above, though happily a rare affection, undoubtedly does exist, and requires most careful consideration on the part of the surgeon, since it entails the greatest suffering, not only on the patient himself, but also often on those with whom he is associated by the closest ties.

Causes.—There can be no doubt that the most potent cause of spermatorrhœa is to be found in the habit of self-abuse, or in repeated venereal excitement in sexual intercourse. But other forms of local irritation, such as balanitis, phimosis, varicocele, rectal irritation from hæmorrhoids or fissure, intestinal irritation from the presence of worms, constipation or some derangement of the digestive organs, have all been accredited with causing this disease. Dicenta states that, in 500 cases of spermatorrhœa, he met with about 100

cases of some derangement of the digestive organs, generally constipation or dyspepsia, and about 50 of hæmorrhoids. Any of these conditions may excite the habit of masturbation, or, on the other hand, masturbation may cause most of them.

The exact manner in which the irritability of the sexual organs is induced, and what connection it has with the habit of self-abuse, is still the subject of considerable doubt. Trousseau believes that spermatorrhœa is due to some imperfection in the nervous system of organic life, since it is so commonly found in men who have suffered from incontinence of urine in early years; and regards masturbation as an indirect proof of a vitiated condition of the nervous system.

Dr. T. Clemens believes that hyperæsthesia of the urethral mucous membrane is a frequent cause of spermatorrhœa, and that the hyperæsthesia is due to some affection of the spinal cord, which has become 'exhausted' from misuse and excessive irritation of the genitals.

Lallemand, on the other hand, takes a very different view of the cause of spermatorrhœa, and believes that the disease is almost exclusively the result of irritation of the spermatic ducts arising from chronic inflammation, and that an old attack of urethritis is the most frequent cause of the seminal emissions.

Symptoms.—Almost always, if not always, spermatorrhœa begins with frequent nocturnal emissions, at first with, and afterwards without, erotic sensations. As the disease advances, these emissions become more frequent, occurring twice or thrice or even oftener in the same night, and unaccompanied by erection and even without any sensation being experienced by the patient. In consequence of this, partly as a result of the discharge, but also to a far greater extent from the mental disquietude which is produced, the patient becomes weak and irritable; he complains of heaviness and languor, disinclination to go about his ordinary occupations, and inability to fix his attention on any kind of work. As the malady progresses, emissions take place during the day, as well as at night, and from any slight cause, such as friction of the clothes in walking or riding; or, a mere reference to sexual matters or licentious talk may occasion an emission, without the usual amount of erection or sensation. If sexual intercourse is attempted, ejaculation takes place almost immediately, even before the introduction of the organ, and the act is therefore not properly accomplished. This adds to the mental disquietude of the patient, who imagines that he has become impotent, and constantly broods over the subject, thus increasing his mental distress.

As a result of this uneasiness his digestion becomes impaired; he suffers from flatulency, heartburn, oppression in his breathing, and shortness of breath and constipation. He complains of aching pains, especially in the loins, and at last sinks into a condition of hypochondriasis, devoting the whole of his thoughts to his own unhappy condition, and taking no interest in the ordinary affairs of life. He is languid and depressed in manner and devoid of all energy. His eye is dull, his countenance pale and anxious, his expression listless. There is often impairment of vision, accompanied by extreme sensibility to light, and buzzing or singing noises in the ears. He may thus gradually drift into a condition of melancholia, and entertain the firm conviction that he is incurable and is fast sinking into an early grave; or he may even sometimes develop suicidal tendencies. The late Mr. Gascoyen has well summed up the symptoms of spermatorrhœa, when he says that they are a mixture of 'sexual irritability, mental uneasiness, dyspepsia, and hypochondriasis.' This exactly expresses the whole state of the case. As a result of sexual excesses or self-abuse, or it may be from some of the other causes enumerated above, an irritability of the sexual organs is set up, which induces emissions without adequate cause. Conscious of his immoral habits, the patient regards this condition as of serious import, and hence falls into a state of mental uneasiness, which speedily produces derangement of the digestive organs, and, as a natural sequence, all the horrors of an advanced hypochondriacal state. The symptoms, therefore, can scarcely be said to be due to the emissions, though in the first instance induced by them, but rather to some over-sensitive condition of the nervous system. It is not a disease of the sexual organs, but a disorder of the nervous centres. *See* Hypochondriasis.

Diagnosis.—In the investigation of a case of spermatorrhœa, the first thing to do is to ascertain that the discharge is undoubtedly semen, and not the glairy fluid which sometimes exudes from the urethra, and which is either the natural secretion of its mucous membrane increased in quantity, or is derived from the prostate in cases of prostatorrhœa; and that it is not the discharge from a stricture or the remains of

an old-standing gleet. This point must be cleared up by the microscopical examination of the fluid, and the existence of true spermatorrhœa established by the presence of spermatozoa in it. Some care requires to be exercised in this, and it is well to examine the discharge on two or three occasions before coming to a definite opinion. The patient may recently have been attempting sexual intercourse or have been guilty of self-abuse, when spermatozoa would probably be found in the discharge, and this might lead to error. When the presence of spermatozoa has been definitely settled, the cause of the spermatorrhœa must be sought for. The condition of the external genitals must be examined; the presence or absence of balanitis, phimosis, or varicocele must be determined; the condition of the urethra must be investigated, and the existence of a stricture or tender spot on the mucous membrane ascertained, if it exists, by the passage of a bougie, of which the acorn-pointed one is the best suited for this exploration. The presence or absence of any rectal or intestinal irritation must be ascertained, and the general health of the patient, especially in regard to dyspepsia and constipation, inquired into. Finally, strict inquiries must be made as to the habits of the patient, whether he is still addicted to self-abuse, as unhappily is too often the case in the confirmed examples of spermatorrhœa.

Prognosis.—The issue of a case of spermatorrhœa depends, to a very great extent, upon whether the patient has entirely relinquished his evil habits or not. In many of these cases no persuasion, no fear, no threat will induce the patient to relinquish them. He appears to have entirely lost all power of self-control, and though he may promise and faithfully intend to keep his promise, he will relapse again and again. The outlook in such a case is gloomy. In some instances dementia is induced, in others active disease is set up as the result of the debilitated condition into which the patient has been reduced, and he falls a victim to his own folly. When, however, the evil habits are relinquished, the prognosis is hopeful, and the patient generally gets well under the influence of medical treatment and advice, and may be restored to perfect health and full vigour of mind and body, and become a useful member of society and a happy man.

Treatment.—The first point in conducting the treatment of a case of spermatorrhœa is to induce the patient to abstain, at once and for ever, from his habits of masturbation, if he be still addicted to them. Without this, no other treatment can be of any avail. Every effort should therefore be made by the surgeon to induce him to relinquish them, by laying before him the consequences of his folly, if he persists in it, and assuring him, on the other hand, that if they be given up a perfect recovery may be confidently anticipated. In order to carry this out with greater effect, the surgeon should strive by every means in his power to obtain the confidence of his patient. In many cases, the sensible man will believe what he is told and will abstain from all further vicious habits, and his cure will already be half-effected. Others, on the other hand, do not appear to possess sufficient moral self-control to abstain, and, in such cases, it is advisable to keep the penis constantly sore with some blistering fluid. A ring of blistering fluid is to be painted round the penis, and as soon as this is healed or nearly healed, a second ring is painted on some other part. This is generally effectual in breaking the habit, at all events for a time, and patients will sometimes ask that it may be done, of their own accord, since they have not confidence in their own power of self-control. *See* MASTURBATION.

After this, the main treatment must be directed to the patient's general condition, to improving his health and keeping the mind and body engaged. This will have a far more beneficial effect than any medicine. All sedentary habits, with mental overstrain and excessive reading, must be abandoned, and the patient actively engaged in some outdoor occupation or pursuit. Something congenial to the patient's tastes should be found, so that, while his body is actively engaged, his mind may become engrossed in the pursuit in which he is engaged, instead of brooding over his troubles. A change of air, especially to some bracing seaside place, is desirable, where he may engage in fishing, rowing, boating, or athletics of some kind, so that each night may find him healthily tired. He should rise early, as soon as he wakes, and take a cold or tepid bath, or, what is better, a plunge in the sea. His companions should be cheerful and amusing, and it should be their endeavour to keep his mind occupied with their various pursuits and pleasures. His diet should be nourishing and unstimulating, and all highly seasoned meats and condiments should be avoided, and he should

eat no supper or heavy meal before retiring to rest. He should sleep on a hard, horsehair mattress, without too much clothing, and it is a good plan to advise his getting into the habit of causing his bowels to act the last thing before he goes to bed, so that a loaded rectum may not press upon his vesiculæ seminales. He should also be cautioned against sleeping on his back, and may be prevented from doing so by having some hard body, as a cork, strapped over the sacrum when he retires to bed.

Dyspeptic symptoms must be corrected by appropriate medicinal treatment, and the state of the bowels carefully attended to. If sleeplessness exist, it must be combated by the bromides of potassium or ammonium; but it is better to avoid the exhibition of these remedies, if it can be done, and to trust to active outdoor exercise inducing the weariness which will produce natural sleep. These measures, if steadily persevered in, will be found more efficacious than any special medicines, though these have been recommended by some. Trousseau strongly advocates the use of belladonna, and states that its utility depends upon its undoubted influence upon the entire nervous system, particularly on the encephalon and spinal marrow. Digitalis and aconite have been given with the same view, and to nitrate of silver, used internally, favourable results have been attributed.

Any special cause which can be discovered for the disease must, of course, be at once removed; such as an elongated prepuce, a phimosis, a varicocele, or hæmorrhoids or a fissure of the anus, and thus all source of irritation be got rid of.

Of local remedies, the one most extolled is the application of nitrate of silver to the prostatic portion of the urethra, either in the form of solid caustic, as recommended by Lallemand, or in solution, by means of the syringe catheter. The utility of this treatment has been a good deal disputed, and though there can be no doubt of the advantages derived from its use in cases of simple prostatorrhœa, the evidence in favour of its employment in spermatorrhœa is by no means conclusive.

T. Pickering Pick.

SPHACELUS. *See* Gangrene.

SPHINCTER ANI, Spasm of. *See* Fissure of the Anus.

SPICA BANDAGE. *See* Bandages.

SPINA BIFIDA.—*Definition.*—The term, first applied by Tulpius at the commencement of the seventeenth century, is used to define certain congenital malformations of the spinal canal, with prolapse of some of its contents, in the form of a fluid tumour.

Pathological Anatomy.—Most commonly this malformation affects the posterior segments of the vertebræ, and the tumour appears on some part of the back; but in a few cases the bodies of the vertebræ are found cleft, and the tumour then projects into the thorax, abdomen, or pelvis, between the lateral halves of the bodies affected. The tumour, at birth, varies very much in size—from that of a hazel-nut to that of a fist, and it may become very much larger. In form it is more or less hemispherical, its exact shape being largely determined by the size of the spinal fissure through which it issues; sometimes, the tumour is distinctly bi-lobed in its vertical axis; it may have a broad base, or be attached by a narrow pedicle, which may be either long or short. The tumour is usually situated in the median line, sometimes, however, with a little inclination either to the right or the left side; it usually occurs as a single tumour, but cases are on record where more than one tumour has been present. In St. George's Hospital Museum there is a specimen which, on the surface, appears to be constricted about its middle, and this constriction corresponds with a horizontal septum within, which separates two independent cysts. The sac is not infrequently multilocular, and in University College Museum there is a remarkable specimen of such a cyst; but there are no instances of two distinct tumours in any of the London museums. An occasional combination of spina bifida with congenital sacral tumour has been recorded.

The spine may be affected in any one of its regions. Demme records 57 personal cases, divided as follows:—5 cervical, 2 cervico-dorsal, 15 dorsal (two of which were instances of double tumours) 17 lumbar, 11 lumbo-sacral, 7 sacral. The writer's own cases, 19 in number, have all been lumbar or lumbo-sacral, with one exception, and this was at the sacro-coccygeal junction. Wernitz gives 210 collected cases (the above not included), with the following analysis:—Cervical 12, cervico-dorsal 3, dorsal 6, dorso-lumbar 9, lumbo-sacral 127, sacral 53. An examination of 125 specimens in various pathological museums gave the following results:—1 affecting the whole column, 9 dorsal, 9 lumbar, 68 lumbo-sacral, 21 sacral,

1 sacro-coccygeal, 3 dorsi-lumbar, 7 dorsi-lumbo-sacral, and 6 which could not be defined. It will thus be evident how largely the malformation affects the lower part of the spine—a significant fact when taken in conjunction with the relatively late period at which its development is completed. The anatomy varies considerably; the tumour may be a simple dilatation and protrusion of the spinal meninges (meningocele), or it may contain more or less of the cord and its nerves (meningo-myelocele), or it may be a dilatation of the central canal of the cord with prolapse of its membranes (syringo-myelocele). An analysis of the 125 specimens just alluded to showed that 10 were meningoceles, 79 meningo-myeloceles, 2 syringo-myeloceles; 19 were macerated specimens, and 15 were undeterminable or not dissected.

All these points are of importance, chiefly in prognosis, and as affecting the probable results of treatment. The cleft in the spine may involve all the vertebræ, or may affect but a single bone; more commonly three or four vertebræ are at fault. On examination, the spinous processes are absent, and the laminæ, more or less ill-developed, are found separated by the protruding sac. The sac may, or may not, be covered with normal skin; in the majority of the recorded cases of pure meningocele the skin is normal; it may also be normal in cases where the cord is intimately involved in the deformity. In the latter cases, however, more usually the skin surrounds the base of the tumour, and extends on to its surface for about half to three-quarters of an inch, and then becomes lost in the membrane which completes the sac. In a few cases, the membranous part of the sac corresponds with the extent to which the altered cord is adherent to the sac-wall. In others no such limitation exists. There is strong presumptive evidence, however, that this membranous area represents the attenuated neural tissue of the spinal cord from which the nerves within the sac really take origin. In St. Thomas's Hospital Museum there is a specimen of spina bifida in the dorsal region, in which the spinal cord, after blending with the sac-wall, may be found normally constituted in the lowest part of the sac, and in the entire part of the vertebral canal below the sac. This membrane is often white and glistening, like distended dura mater; sometimes it is red and inflamed; it may be so thin as to burst shortly after the child's birth, or strong enough to withstand considerable ill-usage.

Inside the sac there is a closely-fitting lining of arachnoid, so that the cavity of the majority of these tumours corresponds to the subarachnoid space. The pure meningoceles are more usually dilatations of the arachnoid cavity. The extent to which the cord enters the sac varies within considerable limits. If the deformity affects the lowest part of the spinal column, the cord will be less manifest, because here, at all ages, it is smaller in size than in other regions; when the cleft occurs in the lumbar region, then the cord, being larger, is more obvious. It will be remembered that the cord extends through the whole length of the spinal canal at the early period when spina bifida commences, so that there is nothing extraordinary in finding the cord even in a sacral spina bifida; and, in a very large proportion of the specimens preserved in the London museums, the cord, to a greater or less extent, is adherent to the posterior wall of the sac. In many cases a longitudinal furrow can be seen, giving the tumour a bi-lobed appearance in its vertical axis; in a few cases, as first pointed out by Virchow, and figured by him, there is a distinct depression or umbilicus corresponding to the insertion of the tip of the cord. In the former class, the cord passes out of the vertebral canal, and follows the curve of the tumour. In the latter, it passes more or less through the centre of the tumour to reach its posterior surface. Thus, the longitudinal furrow or the central umbilicus is, in some measure, evidence of the extent to which the cord is adherent; and whenever treatment is contemplated, it suggests that this median vertical portion of the sac, at any rate, must not be interfered with.

The spinal nerves belonging to the prolapsed cord arise within the sac, and pass forwards to their respective foramina; their anterior and posterior roots can usually be distinctly traced. They are sometimes found separated by a structure continuous with the ligamentum denticulatum, but far exceeding its normal proportion, which then forms a prominent falciform fold on each side of the middle line, corresponding to the interval between the anterior and posterior nerve-roots of either side. In some cases of sacral spina bifida, the spinal nerves arising from the cord within the sac, and even those arising from it above its entrance into the sac, take an upward course in order to reach their proper intervertebral foramina; this upward direction of the nerves is most common for the lumbar nerves. In the cases where the distended

central canal of the cord forms the interior of the sac, the nerve-arrangement varies a little; the sac, of course, does not contain any nerves, and it might hence be concluded that the case was one of simple meningocele. Dissection, however, shows the nerve-roots lying in the loose subarachnoid tissue between the innermost membrane and the other component layers of the sac-wall; they pass thence round the sac-wall towards their respective foramina of exit. The central canal, however, is sometimes larger than normal throughout the cord above the sac, in cases of spina bifida, without appearing to be involved in, or essentially connected with, the deformity.

Causes.—Early classical authorities are about equally divided in opinion between a primary dropsy of the central nervous system, interfering with the normal development of the spinal canal, and a primary arrest of development in the laminæ of the vertebræ, allowing of prolapse of the nerve-centres and their membranes. There is little beyond conjecture in favour of the former hypothesis; and while it must be admitted that some arrest of development is found in most cases, there is at least one case in the College of Surgeons where no such arrest occurred. The association of other malformations—harelip, ectopia vesicæ, anencephalus, sacral tumour—doubtless speaks in favour of some congenital error in development as the most frequent cause, without, however, very clearly indicating in what the first step really consists. With regard to cases of pure meningocele, it seems not improbable that, owing to deficient development in the vertebral arches, and consequent lack of support, the spinal membranes prolapse in response to the increasing pressure of the cerebro-spinal fluid, or to its accumulation at the point of least resistance.

For the forms of spina bifida in which the cord and its nerves are attached to the sac, Cruveilhier advanced the opinion, previously foreshadowed by Morgagni, that the essential lesion is adhesion between the cord elements and the external skin. This opinion has since been independently put forward with much force by Ranke. Such an adhesion of the spinal cord with the skin cannot take place when the neural arches are once closed. The deformity, therefore, if this view be correct, must begin in the earliest period of fœtal development—at a time, indeed, when the arches are still wholly undeveloped; that is to say, before the spinal membranes, the intervening structures, and the skin have been differentiated. Hence, the error of development consists in the persistence of a fœtal condition—a non-differentiation of blastoderm—rather than an adhesion in the more usual acceptation of the term. The formation of the sac (which is not an essential part of the deformity) proceeds automatically from the pressure of the cerebro-spinal fluid and the absence of adequate resistance. The cord, which is adherent to its membranes, together with the nerves arising from it, is displaced from the canal by the enlarging sac; they thus effectually prevent union of the vertebral laminæ. The spinal nerves are necessarily elongated, and it is, perhaps, this condition which partly accounts for the varying degrees with which their functions are implicated.

Translucency of the sac is sometimes regarded as evidence of its purely fluid contents; but this is a very delusive diagnostic guide. In a case recently under the writer's care, the sac appeared quite translucent; but, after death, the cord was found within and adherent to the sac, and large nerves traversed it on their way towards their intervertebral foramina. Dr. Halliburton has favoured the writer with the following analysis of fluid taken from a recently treated case: Water, 989·75; solid matters, 10·25. These latter consisted of—extractives and soluble salts, 9·406; insoluble salts, ·218; proteids (almost exclusively *globulin*), ·842; sugar, ·002. The composition of the fluid, according to Ranke, is:—·061 per cent. albumen out of a total of 1·06 per cent. solids; these yield 82·17 per cent. of their bulk, ash. This ash contains six-and-a-half times more soda than potash.

Diagnosis and Symptoms.—The diagnosis of spina bifida is not difficult. Given a congenital cystic tumour on some part of the vertebral column, and situated in the median line, the probability is very great that we have to deal with a spina bifida. Other cystic tumours may, undoubtedly, occur near the spine; thus, situated deeply, broad-based collections of fluid are sometimes met with, which Virchow and other authorities regard as sacs which have been gradually shut off from the spinal canal. Especially frequent in the sacral region, and extending towards the perineum, large pendulous sacs ('false spina bifida'), which have no connection with the spinal canal, are sometimes found. In many cases of spina bifida, a communication between the sac and the brain can be appreciated by alternately compressing the one and the other, the proceeding not infrequently

giving rise to spasm of the limbs, or to other signs of nerve-irritation. The sac varies in its tension; in a few cases it can be emptied. When the child's head is placed low, the sac relaxes; when the head is raised, it becomes more distended: the distension is influenced also by respiration, and by crying or other effort. In a few cases there is a distinct respiratory rhythm, synchronous with the pulsation at the anterior fontanelle. A young woman, with a very large tumour, recently seen by the writer, distinctly felt the wave of fluid between her spina bifida and the head. Many children with this deformity are born marasmic, with the lower extremities cold and atrophic, and sometimes quite paralysed. The sphincters of the bladder and rectum are also affected in many cases. This is presumptive evidence that the cord is involved. A post-anal dimple is often found associated with this deformity. When the sac is not very tense, the commencement of the cleft in the vertebral arches can often be felt, and is then an important factor in diagnosis. The writer knows of no symptoms by which the three varieties of spina bifida can be differentiated *with certainty* during life. A tumour situated high up on the spine, with a covering of normal skin, translucent, and having a narrow pedicle, will in all probability prove to be a meningocele; while a tumour on the lower parts of the spine, with a broad base and a membranous ulcerated sac-wall, accompanied by paralysis of the sphincters or lower limbs, will almost as certainly prove to be a meningo-myelocele.

Treatment.—A cure has not infrequently followed on spontaneous rupture of the sac, but death more often takes place. This is due to draining away of the cerebro-spinal fluid and to meningitis of a septic character, which gradually extends to the brain. The same occurs, too, after puncture in many cases. In all cases alike, then, in attempting treatment, the greatest attention must be paid to cleanliness and to prevent draining of the fluid. If the surface of the sac is ulcerated, still more when it is semi-gangrenous, a dry, absorbent, antiseptic dressing should be applied; and over this a moulded gutta-percha covering which, while it holds the dressing in place, will protect the tumour from injury. One of the most appropriate dressings is iodoform or salicylic wool; or, the tumour being well sprinkled over with iodoform, a plain wool dressing may be laid on. If the wall of the sac is very thin, but not actually ruptured, it is well to paint it freely with collodion, in which a little iodoform has been dissolved; a thin layer of absorbent wool first laid on, and impregnated with the collodion, gives solidity and firmness to the sac-wall, and sometimes even suffices to cause the sac to shrivel up. This application should extend for some distance round the base of the sac. Such a protection frequently suffices to arrest the growth of the sac, if it does nothing else. Meanwhile, time is gained for the general health to improve, if it will. The frequency with which the spinal cord terminates in some part of the wall of the sac, and with which the spinal nerves pass through the sac, contra-indicates such methods of treatment as removal of the sac either with the knife or by means of a ligature around its base. Notwithstanding the fact that some cases treated successfully by these methods have been published, the remark holds good because of the impossibility of diagnosing cases in which the nerve-centres are not involved.

By far the most successful treatment is that proposed by Dr. Morton of Glasgow. He withdraws a portion of the fluid—'not more than half of the fluid contents'—and then injects a solution of iodine in glycerine (℞ Iodi gr. x., Potassii iodidi gr. xxx., Glycerini f℥j.). Of this 'from half a drachm to two drachms are injected, according to the size of the protrusion.' In the management of a case of spina bifida, among other points of importance Morton gives the following:—'The child should be in a thriving condition; the puncture should be carefully closed by collodion or otherwise, so as to prevent further escape of fluid; the parts must be gently handled and protected by the nurse; the injection is to be repeated if required.' Velpeau was the first to use iodine injections. He emptied the sac, and then injected some iodine solution, which was allowed to escape again after a short interval. A few successful cases, treated by other methods, may be found scattered through medical literature; but Morton's method is at present the most successful of any in vogue. In puncturing a spina bifida, always avoid the apex or membranous portion of the sac; puncture near the base, and select a spot where the skin is normal. The utmost that can be expected from treatment of such a serious malformation is a cure of the spinal protrusion. If paralysis exists, it will not be benefited by treatment; in a few cases, paralysis has come on subsequently; while very occasionally sudden death has followed interference. Hydrocephalus may

complicate the spina bifida, or appear as the cure of the spina bifida proceeds. Treatment should always be delayed for a few weeks – that is to say, until the infant's general health has had time to establish itself; palliative measures, such as the application of collodion, being meanwhile adopted to prevent the increase of the tumour. ROBERT WILLIAM PARKER.

SPINAL CORD. *See* BACK AND SPINE, Injuries of the.

SPINE, Diseases of the. *See* CARIES OF THE SPINE; LATERAL SPINAL CURVATURE; ANTERO-POSTERIOR SPINAL CURVATURE.

SPINE, Injuries of the. *See* BACK AND SPINE, Injuries of the.

SPIRILLUM.—A spiral thread-like organism, one of the SCHIZOMYCETES, the turns of which are arranged around a longitudinal axis. When the organism grows to a considerable extent, and secondary flexures are produced in its course, it has been termed Spirochæte. This form of spiral organism has received the specific name 'denticola,' and is found in the mouth and nose and in dental abscesses. The most important spirillum is the S. Obermeieri, which is found in the blood of patients suffering from relapsing fever. It appears in the blood in greater quantity when the attacks of fever recur, and disappears when they vanish. The symptoms of relapsing fever have been communicated, from man to the monkey, by inoculating the latter animal with human blood containing the organisms (Carter).

Other spirilla found in stagnant water are S. undulum and S. volutans, the latter being a very large organism and provided with a flagellum on each end.

VICTOR HORSLEY.

SPLEEN, Diseases of the.—Certain of the diseases to which the spleen is liable are of interest to the surgeon, because it is now a well-established fact that the whole organ may be removed from the human subject in suitable cases, not only with safety to life, but with actual improvement to health.

The spleen may be dislocated, and pain may be produced by the resulting drag upon its vessels and nerves; it has even been found in the pelvis. It may be malformed, simply fissured or lobulated, or multiple. In the latter case, a number of little spleens may be found, merely attached to one another by their nerves and blood-vessels.

Dislocation, if accompanied by severe pain, may give rise to the question of operative interference, and possible malformation must be borne in mind in cases of doubtful abdominal tumour occupying the region of the spleen. Dislocated or wandering spleens have been twice successfully removed—once by Péan and once by Martin. Injury, simple hypertrophy, leukæmic hypertrophy, malignant hypertrophy (sarcoma or carcinoma), abscess, hydatids, and cysts, are the conditions which may raise the question of possible cure by operation.

INJURIES.—These may arise from incised wound, gun-shot wound, or rupture from direct or indirect violence, and there can be no doubt that in any case in which a clear diagnosis of either of these conditions can be made, and in which the symptoms indicate danger to life, the surgeon is not only justified, but bound to open the abdomen, and either to deal with the injury on general surgical principles or, if this be impossible, to remove the organ.

SIMPLE HYPERTROPHY.—This condition may be accompanied by softening or hardening of the organ, or it may retain its normal consistence. Endocarditis, syphilis, long exposure to malarial influences, intermittent fever, and ague are the common causes; but the spleen may be found enormously hypertrophied without any obtainable history of previous illness.

In this, as in other enlargements, it may form a tumour almost filling the abdomen and extending into the pelvis, so as to be mistaken for an ovarian or uterine tumour. Its upper part will, however, be found in its proper situation, and this, together with the notch, which can usually be distinguished, should prevent a mistake in diagnosis. The fact that the intestines do not lie in front of it, may help to distinguish an enlarged spleen from a renal tumour.

Zaccarelli of Naples is credited with the successful removal of an hypertrophied spleen, so far back as 1549; and in more recent times Péan, Volney d'Orsay, and Franjolini have each added a successful case to the records of this procedure. But against these at least an equal number of fatal cases must be recorded, and it remains an open question whether the deliberate removal of a spleen, simply because it is greatly hypertrophied, is a justifiable operation, unless it can be clearly shown that the condition is causing immediate danger to the life of the patient.

LEUKÆMIC HYPERTROPHY.—The enlargement in this case is so clearly only a part of a general blood-disease, which also affects other vital organs, that operative interference would be contraindicated, even with-

out the terrible list of failures which the records of splenectomy furnish. The leukæmic spleen has been excised in sixteen cases, and all the patients have died.

Malignant Hypertrophy (Sarcoma or Carcinoma).—This is extremely rare as a primary disease, and is only of interest to the surgeon in so far as it is necessary to diagnose between the various forms of hypertrophy. The most ardent advocate for the operative treatment of cancer, would hardly include the spleen among the organs which it is advisable to extirpate for this disease.

Abscess.—This should be treated by incision and drainage, and in the event of the antecedent inflammation not having caused adhesion between the spleen and the parietal peritoneum, great care should be taken to avoid any fouling of the peritoneal surfaces with the pus. The edges of the opening in the spleen should be accurately and closely sutured to those of the opening in the abdominal parietes, and the cavity drained and, if necessary, washed out from time to time with antiseptic solutions.

Hydatids should be treated in exactly the same way as abscess; suture, drainage and washing-out being employed, after the thorough evacuation of the small cysts and loose membranes.

Cysts.—Cystic disease of the spleen, other than that arising from the presence of hydatids, is very rare; but both single and multilocular cysts have been met with, and the spleen has been successfully extirpated for cystic disease by Péan, Credé, and the writer.

Splenectomy.—If complete extirpation be decided upon, the incision outside the rectus, recommended by Langenbuch for extirpation of the kidney, should be employed. The preparation of the patient and general procedure should correspond with that described in detail for Ovariotomy. The pedicle should be transfixed and ligatured in two or more portions, great care being necessary to avoid including a portion of the pancreas in the ligatures, and also to avoid the slipping back of any small vessel between the layers of the omentum, an accident which happened to the writer when removing an hypertrophied spleen, and which led to the death of the patient. If the ligatures can be applied before the tumour is turned out of the abdominal cavity, and therefore before the pedicle is put upon the stretch, it will be much easier to tie the ligatures securely and avoid the above-named accident; but with very large tumours this may be impossible.

Increase in the number of white cells in the blood, enlargement of lymphatic glands, enlargement of the thyroid, and anæmia have been said to follow the successful extirpation of the spleen, but were not observed by the writer in his case of successful extirpation for cystic disease; the patient recovering more slowly than after ovariotomy, and with more symptoms of disturbance about the pedicle than are common after the latter operation, but now enjoying the most perfect health.

J. Knowsley Thornton.

SPLEEN, Rupture of the.—A less common injury than rupture of the liver, it is generally complicated with other injuries of the abdomen and chest. The degree of rupture varies.

Causes.—Blows, kicks, falls, wheels of vehicles passing over the organ; penetration by fractured ribs; gunshot injuries.

Symptoms.—The nature and position of the injury received must be borne in mind, as there are no distinctive symptoms. There will be marked general shock, anxious countenance, coldness of the trunk and extremities, feeble pulse, sighing respiration; abdominal pain, especially over the seat of injury, dulness on percussion over the splenic area due to extravasated blood.

Prognosis unfavourable, as, owing to the vascularity of the organ, the hæmorrhage is generally severe; more so than when the liver is similarly injured. If the parenchymatous tissue be not very extensively torn, recovery may take place. In the surgical history of the American war three cases of recovery are recorded, two being the result of gunshot injuries and the third a bayonet wound. If the shock and hæmorrhage do not lead to an immediately fatal result, peritonitis and abscess are the complications to be feared. *See* Gunshot Wounds.

Treatment. — Rest in the horizontal position; warmth to the general surface of the body; ice, or warm fomentations, over the region of the spleen; morphia subcutaneously or by the rectum, to relieve pain. Brandy or egg-flip in teaspoonful doses at frequent intervals.

Should symptoms of internal hæmorrhage continue, no external wound existing, abdominal section at the edge of the left rectus muscle is to be recommended. If laparatomy shows that the hæmorrhage will not cease by exposure or the application of the thermo-cautery, the splenic artery may be ligatured or the spleen itself removed, either directly or by means of a ligature. This last procedure has been successfully

accomplished. All blood must be cleared from the peritoneum, and the abdominal cavity be thoroughly washed out with warm antiseptic lotion, carefully sponged dry, and closed after the introduction of a glass drainage-tube. THOMAS F. CHAVASSE.

SPLENECTOMY. *See* SPLEEN, Diseases of the.

SPLINTS are surgical appliances used to maintain injured or diseased limbs at rest in accurate position, and to prevent or correct deformities. The materials used for splints are either rigid, such as wood or metal, or are capable of being moulded to the shape of the limb, such as leather, felt, or gutta-percha. Wooden splints are made of pine or deal boards cut to the required shapes and sizes. A very useful material for wooden splints is that known as Gooch's, or the 'kettle-holder' splint, which consists of strips of wood not quite separated from one another and glued on to oilcloth; it is flexible in one direction and perfectly rigid in the other, so that it is very useful when splints are required to surround a limb, as the thigh in fractures of the femur treated by extension. Metal splints are chiefly used for the lower limb: iron is the metal mainly used, and the splints, such as M'Intyre's and Arnold's, are made according to a fixed pattern and of various sizes, so that it is only necessary to select one of the proper size and pad it. Bars of malleable iron or telegraph wire make useful splints, either alone or in combination with wood or plaster of Paris.

If accurate adjustment to the shape of the limb is required, leather, poroplastic felt, gutta-percha, or house flannel soaked in plaster of Paris, must be used.

LEATHER SPLINTS.—A piece of stout sole-leather, of the required shape and size, should be steeped in a trough of cold water for about forty-eight hours, or until sufficiently softened; the addition of a small quantity of vinegar to the water used will shorten the time required for softening to four or five hours. The limb should be first bandaged with a flannel roller, and the softened leather applied and moulded to the limb and retained in position by a bandage for twenty-four hours, by which time the splint will have 'set' to the required shape; the splint must then be taken off, trimmed, lined, and fitted with eyelet-holes and laces.

POROPLASTIC FELT is made of two kinds —one, Hides', which is perforated with small holes, and the other, Cocking's, which is not. For most purposes the latter is preferable on account of its greater strength. It consists of felt saturated with resin; it is light and porous; it is easily softened either in boiling water or before the fire, and it rapidly sets on cooling—properties which in the main render it more generally useful for splints than leather. Splints, partially moulded to the leg and other regions, can be obtained from instrument-makers. In these splints the bony prominences are well allowed for, so that it is a very easy matter to finish the moulding to a particular limb. Felt is undoubtedly the best material for spinal supports; it is lighter, more comfortable, easier to remove than plaster of Paris, and is quite strong enough for the purpose.

GUTTA-PERCHA is not porous, and on that account is not so comfortable to wear as leather or felt. It is quite easy to mould, but this requires a little care and experience. The water should not be too hot, or the gutta-percha will rapidly lose its shape, particularly if lifted out of the water by one end; the water used should be about as hot as the hand can momentarily bear. When sufficiently softened, the gutta-percha should be lifted out on a towel and plunged for an instant into quite cold water, which will cool it enough to be bearable by the patient, and will cause it to set enough to be easily manipulated without stretching, though not so much as to interfere with exact moulding. When partially set, the splint may be removed to quite cold water, in which it will rapidly set and harden. When moulding the splint, the bandage which is used to fix it in position should be wet, or it will stick to the softened gutta-percha.

MILLBOARD is not often used as a permanent splint, but, in combination with starched bandages, it is useful. Strips about four or five inches wide should be thoroughly softened in boiling water, steeped in hot starch solution, and then placed lengthwise along the limb outside a flannel or layer of cotton-wool, and fixed in position by a starch bandage. It is well to tear the half-divided strips of millboard, and to rub down the edges so that they may lie more comfortably against the limb.

Starch, plaster of Paris, paraffin, &c., may be employed to form immovable splints. *See* IMMOVABLE BANDAGES.

In the antiseptic treatment of compound fractures and excisions of joints, two methods are possible:—(1) To place the splint outside the dressing, or (2) to place it next to the limb and enclose it within the dressing. In the first method the splint is obliged to be taken off at each dressing—a pro-

ceeding which involves more movement of the fragments and more pain to the patient than is desirable; in the latter method there is the liability that the splint will get soiled with the discharges, which may decompose and lead to the failure of the antiseptics. The good points of each method may be retained, and the bad ones avoided, by the use of interrupted or bracketed splints. These consist of wood or metal splints applied to the limb above and below the wound, and connected by bridges of iron wire, which, while they maintain the rigidity of the apparatus, allow of the efficient antiseptic treatment of the wound being carried out beneath them.

A combination of plaster of Paris and telegraph wire forms a most satisfactory splint for the treatment of compound fractures and excised joints; in the manner about to be described, it has been extensively employed by the writer and found to be extremely efficient. The following description applies to a case of compound fracture of the humerus, in which the wound is about the middle of the outer side of the upper arm. The bone being held in position, and the elbow flexed at a right angle, the wrist and forearm should be bandaged with a flannel roller, and over this two or three layers of plaster of Paris bandage applied; similar bandages should be applied to the arm above the fracture, and be carried well over the shoulder. Pieces of telegraph wire should be cut and bent so as to form three rectangular splints accurately adjusted to the limb—an inner one reaching from the axilla to the wrist, an anterior one reaching from the front of the shoulder to the wrist, and a posterior one passing from the top of the shoulder to the wrist. The fracture being properly reduced, the wire splints should be applied and fixed by a turn of strapping above and below it, and then immovably secured by three more layers of plaster of Paris bandage. The edges of the plaster case, which bound the interruption above and below, should be trimmed. The three wires alone pass over the seat of fracture, and they stand off from the limb sufficiently to allow of the deeper part of the dressing being applied beneath them. But the apparatus, if used as described so far, is liable to the following accidents:—The blood-stained serum, which oozes from the wound, may trickle beneath the plaster of Paris case and decompose there, and the moisture alighting from the carbolic spray may sodden the bandages and weaken the splint. These objections are met by taking some melted beeswax and paraffin (equal parts), soaking pieces of absorbent cotton-wool in it and carefully packing them between the limb and the borders of the plaster apparatus, and then painting these and the borders of the plaster apparatus—above and below the interruption, over a width of three or four inches—with the melted wax and paraffin mixture. The completed apparatus forms an immovable support, which allows of the strictest antiseptic precautions in the treatment of the wound.

The method described above was suggested by that employed by Mr. Howse in cases of excision of the knee. He employs a mixture of yellow wax and olive oil in such proportions as render the wax just soft enough to be applied cold without cracking; the mixture is warmed and bandages are passed through it, re-rolled, and allowed to cool. The limb is placed on the excision splint, and fixed by the waxed bandages; the intervals between the limb and the splint are next packed with pieces of absorbent wool soaked with the wax, and the whole apparatus is painted over with some of the hot wax mixture, so as to weld the bandages together.

Pads.—Splints should be well padded before they are applied. Pads may be made of tow or cotton-wool, packed together and wrapped up in soft cotton cloth, for which purpose old napkins or sheets serve very well. Cotton-wool alone is objectionable, as it tends to work into uncomfortable lumps, and, if used, it is well to sew through the pad here and there so as to prevent the wool shifting. A piece of tow wrapped up in a thin layer of cotton wool, and the whole covered by some soft cotton cloth, forms a good pad. Pads should be a little broader than the splint, so that the edges of the latter are well covered; and jointed splints should have separate pads for each piece, so that the angle of the splint may be changed without disturbing the pad. The pads should be fixed to the splint by stitches passing from one side of them to the other behind the splint, in the form of a lace-stitch. Sometimes, it is necessary to employ separate pads to relieve prominent points from pressure—e.g., when treating a broken leg on a back splint, a pad should be placed opposite the tendo Achillis, so as to relieve the point of the heel from pressure.

Bilton Pollard.

SPONDYLITIS — Inflammation of a Vertebra. *See* Caries of the Spine.

SPONGE-GRAFTING. *See* Grafting.

SPRAIN.—The textures liable to this injury are ligaments, muscles, and tendons. As ligaments are mostly situated round joints, we usually speak of the latter as the parts injured. Those joints least liable to dislocation are most liable to sprain, and *vice versâ*. The joints most commonly sprained (in order of frequency) are the ankle, wrist, and knee.

Pathology.—A sprain is something more than the name implies. There is always more or less of rupture of fibres, blood-vessels, and sometimes of nerves. A sprain may be defined as a wrench of a joint, causing rupture of ligamentous structure without dislocation of the bones.

Symptoms and Diagnosis.—In order to describe the symptoms, sprain of the ankle may be taken as an example. The patient, in running, walking, or jumping, slips his foot, or comes down on the outer edge of it, so that it is forcibly *inverted*. (This is the most common method of infliction of the injury, because *eversion* is liable to produce Pott's fracture of the fibula.) The patient feels a sudden pain on the outer side of the foot; he may be conscious of something giving way (which would probably be the external lateral ligament); he may become sick or faint, and will probably fall to the ground. The ankle will swell at once, and the foot will be incapable of bearing the weight of the body. A person under the influence of excitement, or with a slight sprain, may be able to walk some distance, but soon the foot will become too painful for progression. Swelling comes on very rapidly, and is due at first to effusion of the blood and serum into the cellular tissue round the joint. There may also be effusion into the joint itself in severe cases. After a few hours, discoloration begins to take place from the effused blood, and it is astonishing how quickly the ecchymosis appears in some cases.

Certain complications which may occur will affect these symptoms. If the synovial membrane of the joint is injured, there will be effusion of blood and serum into the joint, as already mentioned, and, perhaps, subsequently synovitis. A blood-vessel of some size may be torn, when there will be considerable effusion of blood throughout the cellular tissue; or a nerve may be injured, when there will be severe pain, or numbness and powerlessness, of the parts beyond. Rupture of a tendon or muscle will also aggravate the symptoms. If a bone is broken, there will be crepitus, &c., and the case will become one of fracture complicated with sprain. If there is dislocation of the joint, the deformity which results should be a sufficient guide in forming a diagnosis. In all cases of difficulty the position of the osseous prominences, and the presence or absence of deformity and crepitus, should be sufficient to decide by.

Treatment.—The writer has been in the habit of describing the treatment of sprains under four heads, viz: cold, heat, pressure, and massage.

1. Cold. If the case is seen early, cold water, or. better still, pounded ice in a waterproof bag, kept constantly applied, will prevent swelling and effusion, will favour the absorption of the blood already extravasated, will relieve pain, and will prevent inflammation. The secret of success in applying this method is to keep up the cold without any intermission. Two or three days of this treatment may be sufficient to let the patient get up and go about with a bandage on.

2. Heat. If considerable swelling has occurred, and some time elapsed before the patient is seen, then hot fomentations are very soothing. Absolute rest and warm applications having been maintained for some days, treatment by pressure or massage may be resorted to, in order to hasten the cure.

3. Pressure. This method may be employed at any stage of the treatment of a case of sprain. After some days of cold or hot applications, a firm bandage, wet or dry, or, better, carefully applied straps of adhesive plaster, will afford support to the weakened limb, and will promote the absorption of the effused blood and serum. But the way in which pressure is most beneficial is when applied at the very first. It then *prevents* swelling and effusion, and, if combined with some immovable apparatus, as lateral splints with starch bandaging, or plaster of Paris, the patient may be able to go about. The great point in employing this method is to apply the bandage *evenly*, with no undue pressure at any point. The following is a safe and comfortable apparatus:—Let two pieces of thick flannel be cut the shape of the foot and ankle (or wrist), large enough to meet behind and in front (they had better be double for the ankle). These should be soaked in a thin mixture of plaster of Paris, and firmly and evenly bandaged on. When they have set, which they will do in a few minutes, they may be removed, padded, if necessary, and re-applied.

4. Massage. This method consists, as is well known, of a combination of rubbing,

kneading, and movement of the part. *See* Massage. Such procedure is, of course, totally opposed to the principle of *rest*. The theory of its beneficial action is that it promotes absorption, and prevents adhesions and contractions. Massage is useful in two ways. It may be employed from the first in slight sprains, and in severer ones is very beneficial, if employed after a week or ten days, in restoring the injured parts to their natural appearance and functions.

After-treatment and Results. — It should never be forgotten that there is truth in the popular saying that a neglected sprain is worse than a broken bone. When one remembers what structures are torn, one easily sees how their non-union or improper union will leave a permanently weakened or disabled limb. It comes to be an important question, therefore, 'how long ought treatment of a sprain to be continued?' The writer would say that for a severe sprain three weeks of rest will be necessary. But the best guide, which will apply to all cases, is disappearance of all swelling, and capability of moving the joint freely without pain. If these indications are fulfilled, then there can be no difficulty in pronouncing the patient cured, and the limb fit for use. But, unfortunately, such a result is not always obtained; even after several weeks of treatment, the joint may be swollen and stiff, or painful and weak. This is usually the result of one of two things—either the joint has been kept too long stiff, or the patient has been using it too much. In either case, a course of massage is usually beneficial, combined with warm or salt-water bathing. But there are other more serious and permanent results that may follow a badly-treated sprain. A *ganglion* may appear, connected with a tendon-sheath or a joint, and associated with permanent weakness of the part. A more serious event is the occurrence of disease of the joint. The history of a scrofulous joint often commences with a severe sprain.

A. G. Miller.

STAFF. *See* Lithotomy; Boutonnière, the Operation of; Buchanan's Rectangular Staff.

STAPHYLOMA. *See* Cornea, Variations of Curvature of the.

STAPHYLORRHAPHY. *See* Cleft Palate, The Surgical Treatment of.

STASIS. *See* Inflammation.

STEATORRHŒA. *See* Seborrhœa.

STERILITY IN THE MALE.—An incapacity for procreation. It may be the result of absence of spermatozoa from the seminal fluid, or of absence of any seminal discharge during coition. The former is designated Azoospermism, the latter Aspermatism.

Temporary azoospermism is sometimes caused in persons of naturally feeble power by excessive indulgence in venery or by masturbation. Abstinence from all erotic excitement speedily restores the functional activity of the glands in these cases.

Idiopathic azoospermism is a very rare affection. It occurs in young and vigorous adults, in whom no physical defect can be discovered. They have all the external signs of virility, can copulate and have emissions with the normal pleasurable sensations, but the seminal fluid never contains spermatozoa. The writer has recently had under his care an instance of this affection. A gentleman aged 40, vigorous and healthy, had been married for several years but had no children. His sexual appetite was normal, and coition was always attended with an abundant ejaculation and normal sensations. His testicles were large, firm, and sensitive to pressure, and no abnormality could be discovered in the efferent passages. He had never had epididymitis. His semen, examined on three occasions, with an interval of some months between each examination, was always devoid of spermatozoa. It was perfectly normal in appearance, but microscopically disclosed many epithelial scales, molecular fat, and crystals of triple phosphates. No explanation of this condition has as yet been discovered.

Usually azoospermism is due to defect or disease of the testicles, or to obstruction of their efferent ducts. Atrophy of both glands, from accident, disease, or mal-nutrition, must produce this condition. Cryptorchism has generally the like result. Cases have been recorded of apparently successful procreation by the subjects of bilateral cryptorchism. But in the absence of microscopic demonstration of spermatozoa in the semen of such persons, or of dissection disclosing a normal condition of the glands, some doubt must be entertained, for the examination of such retained testicles has almost invariably revealed an absence of the ordinary glandular structure.

Obstruction of the efferent ducts will also cause azoospermism. This may be congenital, but is more usually the result

of gonorrhœal epididymitis or of tubercular deposits. Sometimes tumours of the prostate gland may cause obstruction of the vasa efferentia before their junction with the vesiculæ seminales. Aspermatism may be caused by some obstacle to the discharge of the seminal fluid, or may be of nervous origin. Very tight phimosis, or a very small urethral orifice, such as usually exists in intermediate cases of hypospadias, where the urethra opens on the under surface of the penis and a little behind the glans, may produce retention of the seminal fluid. Urethral strictures may have the like result, even when no difficulty in micturition has been experienced. If the stricture be situated anteriorly, the semen is retained in the urethra and voided after erection has subsided; but if the stricture be far back the semen usually passes into the bladder, and spermatozoa are found in the urine. But the obstacle may be in the ejaculatory ducts, when there will be either no discharge whatever during coition, or only the scanty secretion of the prostatic, Cowperian, and urethral glands. Cicatricial formations in the prostate, resulting from inflammation or suppuration or prostatic calculi, may produce this condition. Lateral lithotomy is said to sometimes have the same result.

But aspermatism may be of nervous origin. As ejaculation is a reflex act, so the afferent or efferent nerves or the nerve-centre may be the cause of failure. Thus, deficient sensibility in the glans penis, from cicatrices or induration, has sometimes caused it. Sometimes there is a history of incontinence of urine in childhood, which suggests the possibility of some atonic condition of the muscular apparatus for ejaculation. As physiology has not yet demonstrated the existence of a distinct ejaculatory centre, the pathological affections of it, if any such exist, are unknown.

But aspermatism may be of psychical origin. This form may be permanent or temporary, complete or partial. Some persons are said to have had sexual desire and erections, but never to have had ejaculations while they were awake, while during sleep they have had abundant emissions of normal semen. Such cases can only be explained by the assumption of some inhibiting psychical influence. Minor degrees of this have been described where the inability was limited to intercourse with one individual, or was only of temporary duration.

Treatment.—Azoospermism, unless as the temporary result of exhaustion of the glands from excessive venery, is practically incurable in the great majority of cases. Hence, acute inflammation of the testicles or epididymis, and syphilitic orchitis should be promptly and suitably treated, for speedy resolution of the inflammation and absorption of the syphilitic deposit afford the best chance of functional recovery of the glands and maintenance of permeability in the efferent ducts. Aspermatism due to phimosis or stricture may be cured by circumcision and dilatation. Obstruction of the ejaculatory ducts is not amenable to treatment, but nature sometimes bursts open the opposing barrier during coition. When the sensibility of the glans penis is deficient, blistering the part and galvanism have been of service in some cases, but have been ineffectual in others. In atonic aspermatism the extract of nux vomica or Easton's syrup is useful. The psychical variety of aspermatism occurs so rarely that little is known about it. Possibly the repeated application of the constant current to the lower part of the spine and neck of the bladder might prove useful. JEREMIAH M'CARTHY.

STERNUM, Fracture of the.—Fracture of this bone by itself is of exceedingly rare occurrence, but it is more common when associated with that of other bones, as of the ribs or spine, especially in accidents of a crushing or compressing nature. It is also said to be produced occasionally by muscular action, as in the straining of parturition, when the patients have arched their bodies strongly backwards in the act of delivery. Fracture of the bone may also be produced by bending the body, either backwards or forwards, over a projecting angle. In the former case, the fracture is produced by indirect violence; the parts of the sternum getting torn asunder by the strain put upon them. In the latter case, the injury may be either produced by the direct action of the projecting angle, or the sternum may get so doubled in on itself as to break.

Fractures of the sternum may be either transverse, oblique, or longitudinal. Of these, the two former are by far the most common. The so-called dislocations of the sternum may be most fitly considered here with the fractures of this bone,—the signs of the lesion, the symptoms following it, and the effects being similar in the two cases. The only dislocation of the sternum at all frequently seen is that between the manubrium and the gladiolus, and even this is not common.

The causes producing both fracture and dislocation are the same. There is generally considerable deformity, produced by the overlapping of one fragment upon the other.

The lower fragment is generally found to be the one most in front. Reduction of the deformity is most difficult, though it has been accomplished by manipulation in a few cases. If the surgeon should be successful in this, the attempt may be made to keep the fragments in position by pads, strapping, and bandages. It will, however, generally be found that the effort is futile, the deformity being reproduced on a change in the patient's position.

Other symptoms of these lesions will consist in pain at the seat of separation, increased by efforts at respiration, especially those of the forced kind, such as sneezing or coughing. These injuries to the sternum are frequently complicated by laceration of the pericardium or pleura. In such cases, the symptoms will be those of the more important injury, and will be found treated of in the articles PERICARDIUM, Wounds of the; LUNG, Wounds of the; HÆMOTHORAX, &c.

The prognosis in an uncomplicated case of fracture or dislocation of the sternum is very favourable. In complicated cases the mortality is high, and the prognosis will depend upon the organ injured.

H. G. HOWSE.

STINGS OF INSECTS. — In this country, the stings of bees and wasps, and in tropical countries, besides these, the bites of spiders, centipedes, and scorpions may be attended by unpleasant consequences.

BEES AND WASPS.—As a rule, nothing more than local swelling and pain follow the introduction of the poison, and the severity of these effects depends a good deal upon the general condition of the individual. The sting sometimes remains in the wound, and must be extracted. This and the local application of some cooling lotion or powder are usually all that is necessary. The sting of the bee will sometimes give rise to serious general symptoms, and even prove fatal; but it appears, from a study of several cases, that these unusual results are determined largely by a predisposition on the part of the individual. In two cases, of which one proved fatal, it is noted that the ordinary local swelling did not occur, and, as both patients had frequently been stung before with the usual local effects, it is suggested that the poison entered a vein directly. The poison, when it produces a general effect, does so within a few minutes, leading to faintness, vomiting, diarrhœa, dyspnœa, and unconsciousness. Recovery may take place in an hour, or the patient may remain feeble for days, or death may result from cardiac failure. When the sting is inflicted in the mouth or pharynx, there is danger from œdema of the glottis. Such a result, ending fatally four hours after the injury, is recorded as occurring in a man aged twenty-four.

SPIDERS. — The bite of the katipo or poison spider, of New Zealand, is the most serious in its effects. A local swelling of large size and of a white colour is produced; the patient in one case became faint and pulseless, cold and flaccid, but rallied after the free use of ammonia and brandy. The most peculiar effect of the poison appears to be the production of a low and feeble state of health, which may continue for six weeks or three months. The spider has a dark glossy body, with a marked red spot on its back. Another variety without the red spot is also described. The insects inhabit the sandy beaches, and shelter amongst the drift-wood and sedge.

CENTIPEDES AND SCORPIONS have special hooks for purposes of attack, connected in the former with the mandibles, and in the latter with the terminal abdominal segment. Only the bites of the larger centipedes are serious, and the effect seems to be purely local, so that probably no poison is introduced. The hooks of the scorpion are perforated and connected with poison-glands, and the symptoms resemble those described as occasionally following the stings of bees —viz. numbness, vertigo, vomiting, &c. Locally there is acute swelling, followed in many cases by suppuration, sloughing, and their consequences.

Treatment. — The local and general effects being much the same in all, the treatment also will be similar. Where possible, a ligature should be tightly applied above the wound, the puncture sucked or otherwise treated, and afterwards the ligature slowly relaxed, constitutional treatment being employed as symptoms develop. Locally, the application of cold at first, and, if inflammation occur, of warmth by means of poultices, &c. In the case of spiders, a crucial incision has been made with good effect, and afterwards a strong antiseptic might be applied. Free stimulation by means of ammonia and alcohol should immediately be resorted to in cases where there is any faintness, and their timely administration has no doubt saved many patients, for the effect of the poison, in the majority of instances, is of short duration.

CHARTERS J. SYMONDS.

STOMACH, Cancer of, and Treatment. *See* GASTROSTOMY; PYLORUS, Operations on the.

STOMATITIS. — The inflammatory lesions which may affect the mouth are as follows—(1) catarrhal; (2) follicular; (3) aphthous; (4) ulcerative; (5) gangrenous; (6) mercurial; (7) parasitic, and (8) syphilitic stomatitis.

1. Catarrhal Stomatitis.—*Causes.*—*a.* Dentition. The disease is most common during the period of eruption of the milk teeth, between the ages of six months and two years, but may also appear in connection with the second dentition, between the ages of six and thirteen years, or even in early adult life, at the time of the eruption of the wisdom teeth.

β. Local irritants. Improper food, abuse of alcohol or tobacco, carious teeth, accumulation of tartar, &c.

γ. Disturbances of the digestive tract, primary or in association with general disease. In this case the complaint seldom falls under the notice of the surgeon, unless the causative condition be masked by the local lesion.

Symptoms.—The onset is marked by a temporary diminution of the secretions of the mouth, while the mucous membrane becomes dry, hot, and tumid, and is beset with bright red patches which quickly spread, and by coalescence form a diffused blush over the whole of the cavity. The saliva is scanty and tenacious, the sense of taste is vitiated or lost, mastication and deglutition are painful, the breath becomes offensive owing to decomposition of the secretions, and the patient may be annoyed by subjective gustatory sensations of a more or less disagreeable nature. At the end of a few hours, the secretions are restored and soon become excessive; the mucous membrane becomes redder and more swollen, and presents deep indentations at the points of contact with the teeth; the epithelium becomes thickened and cloudy in places, and may here be detached, leaving superficial erosions; and finally, in severe cases the borders of the gums may ulcerate and the teeth become loosened. The course of the disease is usually mild, the symptoms passing away within a few days; but occasionally it may defy treatment for several months.

Treatment.—It is seldom necessary to adopt any special treatment for the milder forms of the disease, beyond attention to the probable cause and to the regulation of diet. In the more severe cases, the use of detergent washes (chlorate of potash, borax, &c.), ice to suck, and the administration of bark and other tonics, will hasten the progress of recovery. In the rare examples of chronicity, perchloride of iron in large doses (one to three drachms three or four times daily) may be found efficacious.

2. Follicular Stomatitis is marked by an eruption of red papules surrounded by inflammatory areolæ, and developing apparently in connection with the mucous glands of the lips and cheek. The points generally soften and burst, leaving small excoriations, which soon heal.

3. Aphthous Stomatitis is a disease that offers a certain resemblance to the parasitic stomatitis or 'thrush,' both in appearance and course, but is less superficial and does not present the same fungus on microscopical examination. It is characterised by the appearance of disseminated whitish or yellow patches of sub-epithelial exudation, which give place to superficial excoriations, and it may be associated with febrile disturbance, and in some cases with vomiting, diarrhœa, and other manifestations of digestive disorder. This and the last variety of stomatitis usually appear under the same circumstances as the ordinary catarrhal form, and are amenable to the same treatment.

4. Ulcerative Stomatitis.—This is a more specific and troublesome affection than the catarrhal form, and is marked by a fairly definite localisation of its principal lesions, and an almost absolute limitation to two eras of life.

Etiology.—The causes are twofold: on the one hand, *constitutional debility* mainly induced by impure air and improper or insufficient food; and on the other, *local irritation* in association with the eruption of the permanent teeth. It is, hence, almost peculiar to the children of the poor between the ages of six and twelve, or to young men between eighteen and twenty-five who are placed under unfavourable hygienic conditions, as in barracks, hospitals, &c. In either case it may assume an epidemic form, but there is no satisfactory proof that it spreads by contagion.

Symptoms.—The earliest sign is, usually, a fetor of the breath with a sense of heat and tenderness of the gums. The saliva is at first diminished in quantity, but soon becomes profuse, opaque, and offensive. The whole of the buccal membrane becomes red, swollen, and hyperæsthetic, the gums are exquisitely sensitive and bleed at the slightest touch, the teeth loosen, the submaxillary and sublingual glands become enlarged and slightly tender, and the movements of the jaw are so painful that mastication becomes intolerable. On examination of the mouth, the affection is found

in most cases to be unilateral (more frequently attacking the left side), the gums are dusky red or purple, swollen, ulcerated, especially where in contact with the molars, and covered with a greyish pultaceous material consisting of epithelial débris and altered secretion admixed with pus and blood, and containing countless bacilli. The mucous surface of the cheek, opposite to the ulcerated gums, usually presents a whitish oval patch of altered epithelium or an ulcer left by the detachment of the morbid tissue, and this lesion may become continuous with that of the gum by meeting it near the last molar tooth. The tongue, in like manner, may present a white patch or a superficial ulcer opposite to the same point; and, lastly, disseminated areas of a similar character may appear upon the palate, pillars of the fauces, and tonsils, where they may possibly be mistaken for mucous tubercles. It must be noted that the ulceration is not associated with inflammatory induration of the contiguous tissues, as in cancrum oris.

The course of the disease is usually favourable under treatment, but in very severe cases it may end as in *Mercurial Stomatitis*.

Treatment.—The essentials for recovery are pure air and good food. The diet should be in a fluid form, as nutritious and assimilable as possible, and may be carried to the back of the pharynx through a tube, if direct contact with the mouth induce much suffering. Pancreatic emulsion is a useful adjunct in many cases, and other articles of food may be artificially digested before administration. Nutrient enemata may be employed where the demand for support is urgent, and sufficient nourishment cannot be introduced by the ordinary channel; tonics in the form of the preparations of bark and iron are often valuable. Local applications of nitrate of silver or powdered alum to ulcerated surfaces, and the frequent use of stimulant washes (chlorate of potash, 20 grains to the ounce, &c.), may be recommended. The mouth should always be cleaned after food.

5. Gangrenous Stomatitis. *See* Cancrum Oris.

6. Mercurial Stomatitis.—This once common disease is now rarely seen in its more acute forms. It may occur, as heretofore, during the administration of mercurial preparations, especially where there is any natural or acquired susceptibility to the action of the drug; or in connection with industries involving frequent contact with the metal; but the exercise of more adequate precautions in the latter case, and the influence of therapeutic progress in the former, have almost transferred the complaint to the list of pathological curiosities.

Symptoms. — The onset of mercurial 'salivation' is usually announced by a dry burning sensation in the mouth, a nauseous metallic taste, tenderness of the gums, and fetor of the breath. The salivary secretion soon becomes increased, and may at length pour from the mouth in immense quantity, even to the amount of several pints in the course of twenty-four hours; the fluid is thin and offensive, and the presence of mercury may be detected in it by chemical tests. The gums swell, assume a purplish tint, and may ulcerate; the teeth become loose and tender, and coated with a greyish pultaceous material of repulsive odour; the whole buccal membrane becomes inflamed, and covered with whitish patches of proliferating epithelium. The salivary glands and the submaxillary and retromaxillary lymphatic glands enlarge, and the swollen tongue may protrude from the mouth. Extension to the Eustachian tube may induce deafness, and the implication of the arytæno-epiglottidean folds may give rise to suffocative symptoms. Finally, the inflammatory processes may assume a destructive character, leading to extensive gangrene of the mucous membrane; and at length the patient, worn out by suffering and imperfect nutrition, sinks into fatal adynamia.

The duration of the disease is very variable even under the most active treatment. In ordinary cases a cure may be effected within a few days, but occasionally the resources of the surgeon are baffled for weeks.

Treatment.—The general principles of treatment are the same as in ulcerative stomatitis. The most active remedy in the mercurial form is chlorate of potash, which often exerts an almost magical influence over the local lesions. It may be used in the form of lotion (20–30 grains to the ounce), and given internally in association with hydrochloric acid and bark. Sulphurous baths have been recommended, with a view to hasten the elimination of the poison from the system.

7. Parasitic Stomatitis or Thrush is a disease caused by the growth of a fungus, called the oïdium albicans, in the buccal epithelium. It seldom appears as an independent affection, but more often arises as a complication in the later stages of chronic exhaustive maladies.

It commences with the appearance of little whitish spots upon a reddened base

about the angles of the mouth; these enlarge and coalesce to form milk-white superficial patches of considerable extent, which may eventually spread over the whole buccal cavity and the passages communicating with it. If the complaint be a symptomatic development in the course of other diseases, no special changes are observed in the pre-existing constitutional symptoms; but where it arises *de novo* it is usually preceded by febrile disturbance, and may be accompanied by vomiting, diarrhœa, and other signs of disorder in the digestive tract.

The patches, on examination, are found to consist of epithelium permeated by the spores and filaments of the fungus.

The general *treatment* is directed to the improvement of health and the relief of any digestive disturbance that may be present. Nitric acid is of value as a tonic. As local applications, glycerine of borax, powdered alum, and chlorate of potash are the most serviceable medicaments.

8. Syphilitic Stomatitis.—The syphilitic lesions of the mouth are—(1) those of the early secondary period, a transient erythema, mucous tubercles, and superficial sores resulting from the latter; and (2) the gummatous infiltrations of the later stages, which tend to break down into ulcers. The affections may assume special characters in the Tongue and Palate.

An erythema of the mouth and throat is commonly associated with the earliest cutaneous eruption, but is generally of trifling severity and short duration, and calls for no special treatment.

Mucous tubercles show themselves in the early months of the disease. They appear as flat or slightly prominent opaque greyish patches, which by detachment of the affected epithelium may become converted into irregular excoriations. The angles of the mouth, the tongue, tonsils, and pillars of the fauces are the most frequent points of attack, but the lesion may involve any portion of the buccal membrane. *See* Mucous Patches.

This affection, so quickly amenable to treatment in most other situations, is apt to be excessively obstinate when established in the mouth, probably owing to the irritation kept up by the normal and abnormal secretions, by the passage of food, and by the constant movements of the affected part in speech, mastication, and deglutition. The best local measures of treatment are cleanliness, careful selection of diet, and the occasional application of nitrate of silver in stick or solution.

The gummatous infiltrations may be roughly divided into 'superficial' and 'deep;' the former confined to the mucous membrane, the latter extending into the subjacent tissues. In either case the lesion, as a rule, is primarily manifested by a tubercular prominence, but may sometimes assume a more diffused character, as in the 'sclerous glossitis' of Fournier. *See* Tongue, Diseases of the.

The gummata are always destructive in tendency, and may lead to deep ulceration in the soft parts, or to necrosis where the bony walls of the mouth are attacked, and leave permanent and often unsightly scars.

The *diagnosis* of syphilitic ulcers of the mouth is of more particular interest when the tongue is the seat of disease, but the distinction of the specific lesion from non-specific ulcerations and from epithelioma must be borne in mind, in the investigation of all parts of the cavity.

The characters of ulcerative stomatitis and tubercular sores have been dealt with elsewhere and should offer no difficulties of diagnosis, but it is sometimes by no means easy to arrive at the far more important decision between malignant and gummatous ulcers. As a rule, the tertiary ulcer is marked by the absence of glandular enlargement, the comparatively slight induration of its base and borders, relative freedom from pain, its frequent localisation in situations not exposed to direct irritation by carious teeth, &c., and by the age and history of the patient. But age, history, and locality in certain cases fail to afford any guiding indications. A syphilitic sore is occasionally painful and indurated, and there may be some irritative enlargement of the submaxillary glands; while, on the other hand, an epithelioma in its early stages may cause no suffering, and may be long unassociated with any perceptible glandular implication. In cases of doubt, the examination of a fragment taken from the surface of the ulcer, and the tentative administration of rapidly increasing doses of iodide of potassium, will often provide a solution to the problem; or the sore may be scraped with a curette, a plan that may enable the surgeon to arrive at a positive conclusion without prejudice to further treatment. It must, however, be remembered that a syphilitic lesion is a not infrequent nidus for the development of malignant disease, and that it is hence unadvisable to temporise too long with a suspicious ulcer that resists all the appropriate treatment for the milder affection.

The constitutional treatment of the later syphilitic diseases of the mouth is that of SYPHILIS in general. Locally, there is little to be done beyond the exercise of the precautions mentioned in connection with mucous tubercles.

WILLIAM ANDERSON.

STONE IN THE FEMALE BLADDER.—Stone is much less frequent in the female than in the male, the proportion in the Norwich Hospital being about 1 to 19. It is usually of phosphatic structure, and its nucleus is often formed by some foreign body, such as a hairpin, a portion of catheter, or of bone or vegetable substance. Sometimes it attains a very large size, and has been known to interfere seriously with parturition. When small, the calculus may escape unnoticed by the urethra, and sometimes it is discharged by vaginal ulceration. In the museum of the Norwich Hospital there is a collection of 3,000 calculi, which were passed by a lady during three years and a half. In the same collection there is also a stone weighing six ounces, which was spontaneously extruded from the female bladder.

The *symptoms* are similar to those of stone in the male bladder, and the diagnosis is seldom attended with any difficulty. Exploration should be made with a short and almost straight sound, or with an ordinary female catheter. In cases of difficulty, the finger should be placed in the vagina and, at the same time, pressure be made to bear upon the bladder above the pubes. The stone, if large, may often be thus detected.

The usual methods of treatment are dilatation of the urethra, lithotrity, and lithotomy.

DILATATION.—The female urethra may be readily dilated by Weiss's three-bladed dilator, or by gently introducing the little finger, or a large sound or bougie. Gradual dilatation of the canal may be effected by the use of a sponge-tent or a stem of laminaria, but it has been found that the rapid method is less liable to be followed by incontinence of urine. A suitable pair of forceps is then introduced, and the stone extracted. Dilatation may be assisted by incision of the mucous membrane of the urethra. Except in cases of very small stone, dilatation, with or without operation, cannot be considered a suitable operation, as it so often results in incurable incontinence, due either to over-distension of the urethral walls or of the sphincter of the bladder.

LITHOTRITY is the most satisfactory operation in cases of stone in the female bladder, since calculi may be crushed or removed at one sitting at least as readily as in the male subject, if not more so, and the convalescence, as a rule, is more steady, certain, and rapid. The objection to this operation that it is difficult to inject much fluid into the female bladder has, at the present day, lost much of its importance. By the use of a short and specially devised lithotrite, a stone of moderate size may be readily seized and crushed into small fragments, which can either be removed at once by forceps or by a suction apparatus, or be left for expulsion in the stream of urine, which is more free and forcible in the female than in the male.

LITHOTOMY.—The stone may be removed by making an incision through the floor of the urethra on a grooved staff (urethral lithotomy), or more directly through the anterior wall of the vagina (vaginal lithotomy), the edges of the wound in each case being brought together by fine metallic sutures, and a catheter being retained in the bladder. The chief risk of lithotomy in the female, whether urethral or vaginal, is failure of union between the edges of the wound and consequent formation of a fistula. The operation, though much less formidable than lithotomy in the male, is not indicated except in cases of large and hard stones that cannot be crushed.

If the stone be very large, so as to occupy most of the cavity of the bladder, the only method of operative treatment likely to prove successful would be supra-pubic lithotomy, the difficulties and dangers of which might be much diminished by attention to antiseptic details and by distension of the vagina. *See* LITHOTOMY. T. W. CROSSE.

STONE IN THE MALE BLADDER. The children of the poor, and elderly members of the well-to-do classes, are the chief sufferers from vesical calculus; it is seldom found in children of parents in comfortable circumstances, and rich men are more prone to the disease than poor men. Before discussing the special symptoms of stone, it may be remarked that it is very suggestive of the presence of a calculus in the bladder, if the patient who complains of painful and frequent micturition has previously passed a number of stones, and now congratulates himself that he cannot be suffering from a calculus, since he has passed none for some time.

Symptoms.—1. *Pain.*—This is usually the most prominent symptom. The patient

complains of pain in passing water. It is most severe at the close of micturition, when the bladder is empty, and is usually felt at the end of the penis, about an inch from the external meatus. The pain disappears as urine gradually collects again in the bladder, and separates the stone from the sensitive walls of that organ. It is described as a shooting, throbbing or aching pain, and is accompanied by much involuntary straining in which the rectum often participates, causing the evacuation of its fæcal contents, or the protrusion of piles if any exist. Pain is felt if the patient is jolted over a rough road, or shaken in any way. Riding on horseback often causes the first symptoms noticed, and brings the sufferer to the surgeon. Stooping is often found to cause pain.

2. *Blood in the Urine* is generally the next symptom which attracts notice. After exercise, especially, the urine is likely to be tinged with blood. Sometimes the urine is passed apparently free from blood to the naked eye, until the final part of the stream, which may be red; and at the very last a drop or two of pure blood may pass. The hæmaturia comes on gradually. Sudden and well-marked hæmaturia is not characteristic of stone. Rest generally causes bleeding due to stone to disappear.

3. *Frequency of Micturition.*—As a rule urine has to be passed oftener than usual. When moving about, the patient finds he has to make water more frequently than when sitting quietly in his easy-chair. When in bed at night, micturition is less frequent than in the day-time. If these facts are elicited, they will be strong evidence of the presence of stone in the bladder.

4. *Sudden stoppage in the flow of Urine.*—This symptom is mentioned in most books on stone, and is, therefore, referred to here, but it is in reality rarely observed. When it does occur, the stoppage is due to the stone getting into, or falling over, the vesical orifice of the urethra.

5. '*Attacks of the Stone.*'—The bladder may carry a large stone without producing many symptoms, because the calculus has made a nest for itself from which it rarely moves. When, however, it is disturbed, as after unusual exercise or shaking, severe symptoms may suddenly appear. There will be frequent desire to pass water, accompanied by straining and much pain, and the urine will contain blood and mucus. Such a condition is called 'an attack of the stone.' Rest and fomentations generally suffice to make these symptoms disappear for a time, only to return with increased vigour when fresh provocation is given.

6. *Condition of the Urine.*—The urine is usually cloudy from muco-pus; but perfectly clear urine is not incompatible with the presence of a large stone in the bladder.

In boys the symptoms are much as just described. Micturition is painful, and the child cries and tries to relieve his suffering by pulling at his foreskin, which is long and reddened from constant manipulation. The right thumb and forefinger may be found in a sodden condition from their frequent contact with urine. The bowel is constantly protruded, and genuine prolapse of the rectum is not uncommon.

Differential Diagnosis of Vesical Calculus.—The symptoms of stone in the bladder must be distinguished from those of many of the diseases of the urethra, prostate, bladder, and kidney. In stricture of the urethra, any pain there may be in passing water is during the act and not afterwards. In hypertrophy of the prostate, pain is felt before water is made. In tumours of the bladder, the bleeding is more profuse than when caused by stone. Portions of tumour-débris may also be detected by the microscope in the urine. Tubercle or calculus of the kidney can only be diagnosed by a process of exclusion, after an instrumental examination has been made. It may be accepted, as an axiom, that no surgeon can say, from a patient's symptoms, whether or not he has a stone in his bladder without sounding him; and it may be added, no patient should be sounded for stone unless he has at least some of the symptoms, or until the following simple physical examinations have been made.

Passage of a Catheter.—After the patient has made all the urine he can by his own efforts, a soft catheter is immediately introduced. The instrument will at once detect any stricture of the urethra or calculus in that canal. If atony or paralysis of the bladder exists, a large quantity of retained urine may be drawn off, while, if there is a stone in the bladder, the operator will often be able to form a shrewd suspicion of its presence by experiencing a grating sensation as the catheter leaves the bladder; and the probability of its presence will be much increased if there is a stain of blood at the meatus as the catheter comes away, and especially if the patient at that moment complains of pain.

Rectal Examination.—The introduction of the finger into the rectum will enable the surgeon to detect, at once, any abnormal

condition of the prostate. He will note the size of the organ, and, should it be enlarged, will determine the nature of the swelling. If the gland is acutely inflamed, it will be hot and exquisitely tender, and if abscess has formed, fluctuation will be sufficiently obvious. The finger in this position may also gather useful information as to the condition of the bladder; if that organ is full of habitually retained urine and no catheter has been passed, the distension will be readily felt. Any organic deposit in the wall of the bladder at its base will be also distinguished. During a rectal examination the vesiculæ seminales should always be defined; they are very likely to be enlarged from tubercular deposit if any other portion of the urinary tract is so affected. In boys, a vesical calculus is often easily felt by the finger in the rectum. Suprapubic pressure will aid a rectal examination.

Stone not infrequently exists in addition to one or more of all those complaints for which its symptoms may be mistaken, and sometimes stone is a direct consequence of certain of these diseases. *See* STRICTURE OF THE URETHRA; PROSTATIC HYPERTROPHY. But if a well-marked stricture is found, or an enlarged prostate, or atony, or paralysis of the bladder, the patient should be subjected to appropriate treatment, and sounding must be delayed, unless the symptoms of stone are very marked, in order to avoid aggravating these affections by instrumental disturbance. If treatment fails to relieve the symptoms, the case must be further investigated and the bladder sounded.

SOUNDING FOR STONE.— The operation consists in the surgeon introducing a metal rod into the bladder, and searching with it for the stone. He is not satisfied that a stone is there unless he feels it with the sound, and hears the characteristic 'click' made by the contact of his instrument. Sounding must never be hastily or lightly undertaken, for there are many instances on record of its having been followed by fatal results even in children, although they are much less susceptible to such interference than men. Sounding is, therefore, an operation which must be performed with every precaution and with extreme gentleness.

The sound consists of a cylinder of polished steel or of silver, about nine inches long, and in size equal to No. 7 of the English catheter scale. The final inch is curved at an angle of 120° to the shaft, forming a beak with its extremity smoothly rounded. The other end is fitted with a handle, preferably cylindrical. A child's sound is of the same shape, but of course much smaller. A couple of sounds, one equal to No. 1 and one to No. 3, will suffice for all cases of children. A sound is quite unlike a metal catheter, with which it has nothing in common. No patient should be sounded with a metal catheter or catheter-shaped sound.

Simple as the operation of sounding may appear to the inexperienced, there is no minor operation in surgery more important, or requiring more delicacy, skill, and experience, for the possibilities of error are numerous.

Sounding a Child. — An anæsthetic should always be administered if possible. A sound of appropriate size is selected and used with gentleness. The mistake most likely to occur is that of not finding a stone when it is really there; the opposite mistake is not of common occurrence in the child's bladder, although contact of the sound with the bony prominence of the ischial spine has been taken to be contact with a stone.

Sounding a Man. — A patient should rarely be sounded unless he is prepared to rest quietly in a warm room for twenty-four hours afterwards. A railway journey, for example, taken immediately after being sounded, has not infrequently been followed by alarming illness (urinary fever), and sometimes by death. A minor accident after sounding is an attack of retention of urine, for which the surgeon must be prepared. An anæsthetic is rarely necessary. The surgeon should so plan his examination that there is not more than an ounce or two of urine in the bladder, or he may empty the bladder by means of a soft catheter, and inject an ounce of tepid water into the organ. The patient lies on his back upon a couch, with the head on a low pillow, the buttocks raised upon a pillow higher than that under the head, the knees flexed, the soles of the feet on the couch, and the thighs rotated outwards. The surgeon frees his own wrist from any jingling jewellery and, standing on the patient's right side, introduces the sound, which has been made absolutely clean, and has been lubricated with a little carbolised oil. As the beak of the sound enters the prostatic urethra, the instrument is gently rotated from side to side upon its long axis, in order that the beak may be lateralised right and left directly it enters the neck of the bladder, for it is here that most stones are found. Having searched the sides of the bladder and the upper fundus, the handle of

the sound should be depressed so as to raise the beak in the bladder; the beak should then be turned downwards and brought forwards to the neck of the bladder, sweeping the floor from side to side. In this way many a stone, which otherwise would have escaped detection, will be found lying behind and below the enlarged middle lobe of the prostate. All these movements should be slow; the too eager operator, by his energetic movements produces currents in the urine, which move a small stone about in such a way that it eludes the sound.

Contact with the stone having been obtained, it is very desirable to form an opinion as to its nature, size, and also whether there is more than one stone present. It is not unusual for an experienced hand to fall into error concerning these particulars. The sound of the instrument striking the stone is characteristic of the three chief kinds of calculus: the sound of an oxalate calculus is like that of a piece of iron; a uric acid stone sounds like a piece of marble, and a phosphatic calculus sounds and feels like a piece of mortar. By passing the sound to the extremity of the stone, and then tapping as the instrument is withdrawn, a very fair idea of the size of the calculus may be formed. The sound may be the means of forming an opinion as to whether there is more than one stone; but the certain method is to introduce a lithotrite, seize the stone, hold it tightly in the lithotrite, and use it and the instrument as a sound in searching for more stones. The larger the stone the fuller the ring of the sound upon it. Small stones of all kinds produce only a tinkling sound; when they are very small the sound is a mere tick. It is difficult to mistake an acid stone when once the sound has touched it, but the phosphatic calculus is not infrequently passed over as a mere sabulous condition of the mucous membrane.

The sources of error in sounding will now be discussed. There are few mistakes in surgery more annoying than to miss a stone, although it is an accident which may occur to the best surgeon. (Cheselden, the distinguished lithotomist, missed a stone in a case which is historical.) There are also few mistakes more terrible than to find a stone when in reality none exists. We will first consider how a stone may be missed, putting aside, of course, the possibility of a careless or clumsy hand, or a dull ear.

Sources of Error in Sounding. — I. *How a Stone is missed.*—1. The sound may not have passed into the bladder. A capacious prostatic urethra, or a prostate hollowed by disease, may deceive the surgeon, and the actual cavity of the bladder may escape without examination.

2. A common mistake is to have too much urine in the bladder. A small stone in eight or ten ounces of urine is frequently difficult to catch.

3. Too much movement of the sound produces currents in the fluid contents of the bladder, which move the stone away from the instrument.

4. The sound is frequently allowed to pass the neck of the bladder without any rotation upon its long axis, so that the beak glides by and does not strike a stone lying close to the neck, the movements of the sound being confined to the superior fundus, where the stone is not likely to be. Of all mistakes, the writer believes this one to be the commonest.

5. The hypertrophied prostate may project like a hen's egg into the cavity of the bladder. There is of necessity below this projection a deep and narrow sulcus, in which a stone may lodge and defy detection by any ordinary examination. To find a stone so placed, the beak of the sound must be reversed directly it has entered the bladder, and the handle of the sound raised as much as possible. The forefinger passed into the rectum may facilitate the search.

6. A stone may have lodged in a sacculus or have become engaged between the fasciculi of an hypertrophied bladder, or it may be arrested at the opening of the ureter into the bladder, or may have become so covered by mucous membrane that a sound cannot easily reach it.

In the last case, it is perhaps generally more correct to say that the stone has been formed in a sacculus, which has only a minute aperture of communication with the bladder, so that for all practical purposes the calculus is covered by mucous membrane. Sacculated or semi-sacculated stones may therefore escape detection, until felt by the finger introduced by means of a perineal incision.

II. *How a non-existent Stone may apparently be found.*—1. Noises are produced by the patient's or surgeon's clothes and appendages, which may deceive the unwary; for instance, the ticking of a watch, the tinkling of jewellery, especially the surgeon's sleeve-links, the creaking of a boot, or the chink of money.

2. A well-oiled sound will often produce in the urethra a sucking noise, not unlike that of a small stone.

3. A vesical tumour may become covered with phosphates, and, especially if

pedunculated, will give a sensation very like that of a stone. In cases of real doubt the lithotrite will clear up the mystery.

4. A growth from the middle lobe of the prostate may practically form a vesical tumour, as under the last heading, and become coated with phosphates.

5. Vesical rugæ, if old and hard, may appear very like calculus; the sound may even elicit a dull note on striking them.

6. Phosphatic deposit may occur upon any portion of the vesical mucous membrane which is unhealthy.

7. Certain bony parts in the neighbourhood of the bladder, as, for example, the sacral promontory and the ischial spines, have, especially in the child, been mistaken for stone.

8. The bladder itself may beat upon the end of the sound, exactly as a bird's wing might be supposed to beat. This has been called 'the fluttering stroke of the bladder,' and is a well-recognised phenomenon. It can only deceive those who are unpractised in bladder-manipulations.

Many contrivances have been planned for intensifying the sound produced by the contact of an exploring sound with a vesical calculus. The microphone, sounding boards, and the lithophone, may be cited as examples. The lithophone consists simply of a rubber tube fixed into the operator's ear and attached at the other end to the sound; some may find such an instrument of assistance, but in reality a simple sound is the only instrument required in addition to a practised and sensitive hand and ear.

A stone having been found, the only question is which operation—lithotrity or lithotomy—shall be performed for its removal. All attempts at solution by medicines taken by the mouth or injections made into the bladder are useless, and generally worse than useless.

Choice of Operation. — Lithotrity or lithotomy?

In the Boy.—Up to the present time, boys suffering from vesical calculus, with very few exceptions, have been always subjected to lithotomy, and with excellent results. Lithotrity has not been considered a suitable operation, owing to the unfitness of the child's bladder for the residence of fragments of stone, and the urethra for the expulsion of sharp-edged pieces. Now, however, that lithotrity at one sitting—by which is meant the crushing and complete evacuation of the calculus at a single operation—is accepted as yielding in the adult far better results than the older or many-sitting method, it is not unlikely that the single-sitting operation may prove superior even to lithotomy in children; for, if efficiently carried out, lithotrity will no longer be open to the objections formerly urged against it. In this country, we have not at present evidence upon which to found a definite opinion upon the question; but, in India, lithotrity at one sitting has been performed with marked success upon a number of children. The surgeon may therefore choose for himself between lithotomy and lithotrity, if called upon to operate upon a boy; but, if inexperienced in lithotrity, he will perhaps do well to decide in favour of the former. *See* Lithotomy.

In the Man.—Here lithotrity is the rule, and lithotomy is becoming yearly more and more the exception. Lithotrity has always, *cæteris paribus*, been the safer proceeding, and now that the operation at a single sitting, with complete evacuation, has fully justified its claims to superiority over the older or many-sitting method, lithotrity for all practical purposes may be considered incomparably safer than lithotomy, and with rare exceptions it can always be performed. *See* Lithotrity.

There are four conditions in which lithotrity is contra-indicated: (1) *When the urethra is deformed*, owing to cicatrisation after abscess from stricture, or mechanical injury, or even old hip-joint disease. In such cases, the urethra is often bound down by old adhesions, and is irregular from the existence of urinary fistulæ. A staff can be introduced after suitable attention and even operation, and lithotomy performed, but lithotrity will be impracticable unless the stone is very small (under an inch in diameter). Ordinary stricture of the urethra is no hindrance to lithotrity in experienced hands. An internal urethrotomy may be performed, or the stricture can be dilated. The writer's plan yields good results. He dilates the stricture while the patient is under the influence of ether, by passing in immediate succession a series of highly polished conical steel dilators, up to 16 (Eng.) Lithotrity is then performed, and the necessary intruments pass without special difficulty, which is not always the case if an incision has been made into the urethra, as in internal urethrotomy.

(2) *When the stone is very large.*—All stones may be said, in general terms, to be mechanically crushable; but the injury inflicted upon the bladder in crushing a uric acid stone of, say, three ounces in weight or two and a quarter inches in diameter, or a phosphatic stone a little larger, will be so

great that it will nearly always be safer to perform lithotomy.

(3) *When the stone is very hard.*—An oxalate stone of over an ounce in weight, or even a very large round uric acid calculus, may prove uncrushable by any ordinary lithotrite, and an instrument sufficiently powerful to break them will be so injurious to the urethra and bladder, that lithotrity must be set aside in favour of lithotomy.

(4) *When the nucleus of the stone consists of a foreign body incapable of being crushed.*—If the history of the case be distinct, lithotomy must be the operation selected.

Prostatic hypertrophy, atony and paralysis of the bladder do not interfere with the proper performance of lithotrity.

When lithotrity has been attempted and abandoned on account of one or more of the four contra-indications, the patient's chances of recovery will be much enhanced if lithotomy be performed at once. The case must necessarily be a severe one, and the mechanical interference with the urinary organs may cause such constitutional disturbance from urinary fever and cystitis, that the patient may die in a few days, without giving the surgeon another opportunity of operating, or at any rate a serious illness may cause considerable delay. It is therefore wise, whenever unusual difficulty is expected in the operation of lithotrity, to make preparation for, and obtain the patient's consent to the immediate performance of lithotomy, should lithotrity prove impossible. If lithotomy has to be performed, the selection of the method of cutting for the stone must very much depend upon the particular operator. The median method can only be required now for the removal of foreign bodies from the bladder, or in cases where the stone is not large, and lithotrity is only put aside on account of urethral deformity with perineal cicatrisation, the consequences of old-standing neglected urethral stricture. In cases of large stones, the choice is between lateral and suprapubic lithotomy. Dr. Petersen's method of distending the rectum with an air-bag and so pushing up the bladder, has rendered suprapubic lithotomy easy of performance, and apparently well adapted for the removal of large calculi; but further experience is required of this operation before a decided opinion can be given, and a comparison made between it and lateral lithotomy. *See* Lithotomy.

Is a patient with stone in his bladder to be left unrelieved by operation under any circumstances? A patient known to have stone, but suffering little or no inconvenience from it, should never be advised or allowed to postpone operation beyond a very short period (a few weeks), because he can certainly never be in better health for operative procedure, and the stone, if retained, must gradually grow larger, and the operation for its removal become proportionally more formidable. There are, however, graver cases, where the patient is so worn by his sufferings, or by the presence of other disease, that the surgeon may well hesitate before subjecting him to an operation for stone. Are there *any* cases which should be left unrelieved by operation? This is a question which not infrequently has to be answered under circumstances of great anxiety, and the writer fully realises his responsibility in making the following remarks. From an extensive experience of many grave cases of stone in the bladder, he has no hesitation in saying that a patient with a stone in his bladder should almost invariably submit to an operation for its removal, however old or ill he may be. It is certain that if the stone is left it will destroy him, and not only that, but probably in the most agonizing manner. Death from stone in the bladder is generally preceded by prolonged torture, unless the patient is tolerant of, and susceptible to, opium, or unless uræmic coma mercifully comes to his aid. One of the exceptions to the rule here laid down must be the case where lithotrity is impossible, and the kidneys so extensively diseased that lithotomy may be expected to be immediately fatal. Cases, to all appearance most desperate, will often make astonishing recoveries if the stone is skilfully and entirely removed.

G. Buckston Browne.

STONE IN THE URETHRA may be classified under two heads—1st, the acute; 2nd, the chronic. In the former, a calculus is passed down from the bladder, and, lodging in the urethra, causes more or less complete obstruction in the flow of urine. It may lodge anywhere in the canal, but as the meatus is the narrowest point of the passage, the most frequent site of impaction is the fossa navicularis. The penile urethra is the favourite site, from its greater proportionate length, greater amount of muscular spasm, and its numerous lacunæ. A not uncommon locality also is the membranous portion, just behind the anterior triangular ligament.

The stone is generally globular in shape, and seldom larger than a pea; but if permanent lodgment occur, with only partial

obstruction to the flow of urine, it loses its original shape and becomes elongated, resembling a date-stone; it then causes a certain amount of dilatation of the urethra, generally confined to one wall, a sacculus being formed, and thus allowing a fairly free passage for the urine. The tendency is for a stone to pass outwards towards the meatus, unless prevented by organic stricture, being in marked contrast to the opposite tendency of foreign bodies introduced into the urethra. These stones most frequently become impacted in children, on account of the small calibre of the urethra.

In the second class of cases, the symptoms are referable almost entirely to the primary complaint—stricture. Dilatation always takes place behind a stricture, and so forms a convenient receptacle for stagnant urine, which is favourable to the formation of calculous material or, what is more likely, its deposit on small stones or crystals passed from the bladder, which in a healthy urethra would have made their escape unnoticed. These cases occur almost invariably in adults, and the symptoms to which they give rise are but slight. The calculi may be of any kind found in the bladder, and when impacted they increase in size by deposit of the same material.

Symptoms of Impacted Stone.—While micturating, the patient suddenly feels intense pain; the urine which has been flowing freely as usual completely stops; violent straining ensues, which may dislodge the stone at once, especially if it come down in the first gush and there is a good head of water in the bladder to flush it through. Frequently this force is insufficient, and nothing but blood is expelled, and this is more common when the calculus is of irregular shape. The straining then passes off for a while, though great pain is complained of at the site of impaction and in the glans penis. After a while, the want to micturate is again urgent and straining re-ensues, which may force a little urine by the side of the stone if the obstruction be incomplete, and the urethra then becomes slowly accustomed to the presence of the stone; though severe pain is felt for a long time, and there is always a prospectt of a complete block taking place if the stone be dislodged from its position.

Treatment.—Direct the patient to retain his water as long as possible, unless there be already complete retention; compress the glans penis between the finger and thumb, and tell him to try and micturate by straining as hard as possible; a small round stone may be then easily dislodged, as the force of urine expands the whole passage and flushes it through. If these simple means fail, a stone in the penile urethra can generally be safely extracted by means of a fenestrated earscoop. If the stone be merely retained in the fossa navicularis by a tight meatus, this may be safely incised downwards towards the frænum. The small incision readily heals. If, however, the stone lies in the bulbous or membranous urethra, and there is little prospect of speedy removal through the meatus, a long fenestrated scoop may be applied. One form of scoop is made to bend over behind the stone by an internal screw, so as to secure a better hold, and there are endless varieties of long narrow forceps with joint and spring action, of every conceivable shape, their very number being a fair index of their inutility; these may be gently passed down the urethra, and an attempt made to grasp the stone, but great care must be used not to lacerate the mucous membrane in passing them or in seizing the stone. This little operation is most conveniently performed under anæsthetics. During this manipulation, digital pressure must be applied either in the perineum, or, if necessary, in the rectum, to prevent the stone being pushed back into the bladder. If the stone cannot be extracted, two courses are open: to push back the stone into the bladder, or to cut down upon it and extract it.

Here, the choice of the operation is determined by the age of the patient. In a child, it is best to open the perineum in the median line, the operator being guided either by feeling the stone, or by a straight staff passed down the urethra, and made to project into the perineum. A stone in the bulbous urethra can then be pushed out backwards; the bulb should not be incised, if possible, on account of hæmorrhage. In an adult, if attempts at extraction fail, the better procedure is to push the stone back into the bladder, this being best effected with a hollow-ended catheter. When the stone is fairly in the bladder, the operator can break it up at his leisure, or by slowly screwing down the lithotrite can compress it rather than break it, and so extract it practically entire.

Results of neglected Urethral Stone.—If retention be complete these are very grave. The first attempt at micturition being unsuccessful, the bladder remains for a time quiescent; but the distension soon gives rise to great pain, and repeated straining ensues, until at length the urethra is rup-

tured and the urine is forced into the surrounding cellular tissue. This for a time greatly relieves the bladder, but intense pain in the perineum soon sets in, with all the symptoms of extravasation of urine, and, unless free incisions be made at once, the constitutional disturbance and sloughing set up by the irritant action of the urine soon carry off the patient. *See* Extravasation of Urine.

When the obstruction is slight, the stone may increase to an unlimited extent, forming for itself a pouch in the urethral wall, which gradually becomes absorbed by the irritation and inflammation set up. The stone thus gets to lie outside the urethra, and may slowly ulcerate its way out through the scrotum or perineum. This explains the curious fact that a catheter may be passed right into the bladder without feeling the stone, though it is known that a large one is present.

As an instance of the size which these stones may sometimes attain, it may be mentioned that the Norfolk and Norwich Hospital Museum contains a specimen of this class weighing eight ounces, which was removed from the scrotum. It consists of a central uric acid nucleus as large as a pea; around that some mixed urates and phosphates in an oval shape; the rest of the great mass of the stone is composed of dense white phosphates. T. W. Crosse.

STRABISMUS.—Convergent Strabismus (Hypermetropic).—A very large majority of all cases of convergent strabismus are due to hypermetropia. The hypermetrope, in order to see clearly at any given distance, must make a greater accommodative effort than is normal for that distance; but, since accommodation and convergence always go together, this excessive effort tells also on the ciliary muscles; consequently the hypermetrope tends to converge for a nearer point than that at which he desires to look. If he cannot avoid an excess of convergence, he instinctively turns both eyes slightly towards one side or the other, so as to bring one eye to bear on the object while the other takes the whole deviation, and, as it were, squints for both. The majority of hypermetropes, however, do not squint, for the relation between corresponding degrees of accommodation and convergence is not absolute. With a given accommodative effort, it is possible to vary the angle of convergence to some extent. This does not necessarily disprove an anatomical association of the two functions; it may be, that a given effort of the centre for convergence can be more or less neutralised by an opposing effort of the centre for divergence.

In slight degrees of hypermetropia, it is thus possible to preserve the required angle of convergence, in spite of the excess of accommodation, and there is no squint. In very high degrees also, there is usually no squint, for the strongest accommodative effort proves insufficient to bring the eye into focus, and is therefore instinctively abandoned. It is thus, in moderate degrees, that strabismus is most likely to arise. It commonly begins in childhood at the time when the eyes are first freely used on near objects; as in learning to read and write. At first the strabismus is often periodic, appearing and disappearing in accordance with the amount of accommodative effort made. After some weeks or months, it generally becomes confirmed in distant as well as in near vision. When the two eyes have equal degrees of hypermetropia and are equally sharp-sighted, the squint is likely to alternate between them according to the position of the object looked at; thus, in looking at an object to the right of the middle line the left eye will be used, while the right deviates inwards, and *vice versâ*. But, if either eye be at a disadvantage as regards the degree of the hypermetropia, the presence of astigmatism, opacity of the cornea, or any other defect, the patient will instinctively at all times fix with the better eye and squint with the worse. In a few cases, a squint remains periodic for many years, and in a few it continues for a long while to alternate, but in the large majority it becomes persistent and constant in the one eye.

Referring again to the simultaneous action of the convergent and the conjugate centres necessary to bring the one eye to bear upon the object, it will be seen that in the fixing eye the two impulses fall one on the internal, the other on the external rectus, while in the squinting eye both fall on the internal rectus. The persistent contraction of the latter leads to its permanent shortening, so that, even in the absence of all accommodative effort, parallelism of the eyes is not recovered. In the squinting eye, the picture is formed at some distance from the macula lutea—that is, at a less sensitive part of the retina than in the fixing eye—hence it is easily neglected or suppressed, and the eye becomes amblyopic from non-use. In many cases of long standing, the squinting eye loses all power of true fixation, and, even when the good eye is covered, is wrongly directed in its efforts

to look at the object. Double vision is uncommon in this form of strabismus; the absence of a faulty projection may be connected with the fact that the position of the deviating eye is not independent of and disproportionate to the impulse of the will, but is the normal result of an excessive impulse. *See* Ocular Muscles, Affections of the.

There are a good many cases of concomitant strabismus in which, though hypermetropia is probably the essential cause, the circumstances of the onset, the apparently capricious appearances and disappearances, and the variations in the amount of the deviation, demand some further explanation. Thus, a squint not infrequently begins during an attack of hooping-cough, measles, or some other childish disorder, or after a fright; it is distinctly aggravated by digestive or mental disturbance; it may even vary regularly from day to day, or at longer intervals, with remarkable periodicity. In such cases, it may be assumed that the convergent centre, always irritable and tending towards overaction by reason of the hypermetropia, is suddenly thrown into a state of spasm by other causes, or possibly that the controlling action of the opposing centre is weakened or lost. There are, moreover, cases of convergent strabismus in all respects resembling those now under consideration, except that there is no hypermetropia; these, however, form a very small minority.

Symptoms.— These have for the most part been described in the foregoing paragraph. The first step in making the clinical examination is to make sure that the squint is real and not simply apparent. In young children, the appearance of a convergent strabismus is sometimes simulated by the condition termed epicanthus, a redundant fold of skin between the eye and the nose, which overhangs the inner canthus and makes it appear that the cornea is too near to it. The appearance is at once removed by pinching up the skin at the root of the nose between the finger and thumb. Again, in nearly all eyes the axis of the cornea forms an angle with the axis of vision, or, in other words, the point at which the eye actually looks lies not exactly in a line with the anatomical axis of the globe, but a little to its inner side. In the normal eye the angle amounts to about 5°; if it be much less than this, as it often is in myopia, we have an apparent convergent strabismus, while if it be greater, as in some hypermetropic eyes, a divergent strabismus is simulated.

The presence of an actual deviation is easily proved. The patient being told to look at a distant object, we hold a hand or a card over each eye in turn; if either eye moves when the other is covered, in order to look full at the object, we know that it was previously directed wrongly; we thus learn which eye habitually fixes and which deviates. If no deviation manifests itself while both eyes are open, we note whether either eye deviates behind the hand covering it; and supposing no deviation to be discoverable, under any circumstances, in distant vision, we ascertain whether a squint is elicited by accommodation for a near point, as in reading small type held in the hand. A squint, which occurs only when the eye is excluded from participation in vision, is termed *latent*, while one which persists when both eyes are uncovered, is termed *manifest*. Each eye is then tested with regard to its ability to move freely inwards and outwards, in order to ascertain whether there is any decided limitation of movement, either through shortening of the one muscle or weakening of its antagonist.

It is well also to measure the amount of the deviation, although this is not essential for correct treatment. It may be done either by linear or by angular measurement. The good eye being fixed on a distant object straight in front of the face, the distance between the centre of its cornea and the inner canthus is measured on the lower lid by means of a small scale or strabismometer, and then, before any movement is made, a similar measurement is made in the squinting eye; the difference between the two measurements represents the amount of the deviation. A more precise, though rather more troublesome, method is to make an angular measurement with the perimeter. A distant object is placed in line with the axis of the instrument, and the arc is placed horizontally; the deviating eye is then placed in the usual way at the centre of the arc, and the patient is told to look at the distant object; this he does with the good eye. Taking a lighted candle in his hand, the observer passes it along the arc, keeping his own eye close to it, until the reflection of the flame appears in the centre of the cornea of the deviating eye; the position of the candle is then read off upon the arc. The angular distance between this point and the centre of the arc represents the angular deviation of the eye. More important than a precise measurement of the deviation is the estimation of the refraction in both eyes. With the help

of the shadow test (retinoscopy) this is very easily and quickly done, even in young children, and even though the squinting eye be highly amblyopic. If the patient is old enough, the acuity of vision should also be ascertained. The prospect of obtaining a complete cure varies in proportion as the acuity of the deviating eye is good or bad.

Treatment.—A periodic strabismus may usually be removed entirely, for the time being, by the free use of atropine to both eyes, for, so soon as the ciliary muscles are completely paralysed, accommodative efforts are abandoned, and the excessive convergence dependent on these efforts disappears; if any shortening of the internal rectus has already taken place, the atropine will not remove the deviation, though it will probably diminish it. The use of eserine may produce the same result in exactly the opposite way. By a moderate use of eserine, it is possible to increase the excitability of the ciliary muscles without keeping them in a state of spasm; so that to a given impulse they will respond more vigorously than in the normal state. With its help the hypermetrope may thus succeed in accommodating sufficiently without excessive effort, and, consequently, without excessive convergence. These remedies are, however, temporary in their effects. By some surgeons atropine is employed as a preliminary to other measures, in all cases. Eserine is less frequently used. The essential treatment of a convergent strabismus consists in the correction of the hypermetropia by glasses, and if this does not remove it, in tenotomy of one or both of the internal recti. Glasses should be given which correct the greater part of the hypermetropia discoverable by retinoscopy, which will usually be greater than the amount which is manifest on testing with types and lenses. These should be worn constantly. If the deviating eye be amblyopic from non-use, it should be used alone, while the other is covered, for a few minutes every day; by this means its acuity will probably be raised, and the prospect of restoring binocular vision greatly improved. At the end of from one to three months, the benefit obtainable by optical means will usually be manifest, and, if the strabismus persist, the case must be treated by tenotomy. Children should not, as a rule, be operated on until they are old enough to wear glasses —i.e. until about six years of age. If a strabismus appear much earlier than this, it may be combated for a while with atropine, and the acuity of the squinting eye may be kept intact by covering the other with a shade or a bandage for a certain time each day.

Tenotomy of the Internal Rectus. The tendon of the internal rectus is attached to the sclera at about 5 mm. from the corneal margin, and more loosely by connective tissue to the conjunctiva and to Tenon's capsule — the fibrous envelope which surrounds the globe and separates it from the other contents of the orbit. The operation of tenotomy consists in completely dividing the tendon close to the sclera, and separating it more or less from its other attachments; these latter prevent it from withdrawing itself completely from the globe, and retain it in a more or less retracted position, where it forms a fresh and firm adhesion with the sclera. The aim of the operation is to set back the insertion of the tendon sufficiently to neutralise the effect of its previous shortening, without abolishing its ability to rotate the eye inwards to the normal extent. When the deviation exceeds 5 mm. in extent—that is to say, in the majority of cases which come under notice—it is better to operate on both eyes, setting back the tendon to a moderate distance in each, than to attempt to obtain the whole correction in the one; symmetry of the attachments in the two eyes is thus retained, and the danger of displacing the one tendon to such an extent as to impair its efficiency is avoided. The connective-tissue attachments of the tendon should, however, be divided more freely in the eye which habitually squints than in its fellow, so that the effect may be greater on this side than on the other. An over-effect is guarded against most certainly by operating on one eye only at one time; but, in very many cases, an experienced operator may with confidence divide both inner recti at one time, especially if he adopt the subconjunctival method recommended below.

An anæsthetic—chloroform or ether—has, until lately, always been found necessary in children; in older subjects, with ordinary self-control, it may be dispensed with. Since the introduction of cocaine as a local anæsthetic, the practice in this, as in many other ophthalmic operations, is changed. Two or three applications of a two or a four per cent. solution, at intervals of two or three minutes, produce insensibility in the conjunctiva, and a few minims of the solution may then be injected beneath the conjunctiva, by means of a hypodermic syringe without causing pain. The whole of the operation is thus rendered almost, if not absolutely, painless. A

special advantage of this method is that the amount of effect produced by the tenotomy in the one eye can be better estimated at once, before the other eye is dealt with, than when the patient is under the influence of a general anæsthetic. The instruments required are the speculum, the fixing-forceps, a strabismus hook, one which is flattened sideways and not bulbous at the extremity being in the writer's opinion the most convenient, and a pair of blunt-pointed straight scissors; curved scissors are used by some operators, but have no evident advantage, and in unpractised hands are likely to be passed too far backwards along the surface of the sclera, a mistake which is followed by copious bleeding into the orbit and protrusion of the globe; a needle threaded with silk or gut is sometimes required as well.

The patient is placed in the recumbent position; the surgeon stands at the patient's right hand, in which position he is conveniently placed for operating on both eyes. He separates the lids widely with the speculum; with the fixing-forceps, held in the left hand, he seizes the conjunctiva below the insertion of the internal rectus—i.e. about midway between the canthus and the corneal margin, but an eighth of an inch or more below the horizontal meridian of the globe. With the scissors, in the right hand, he snips through the conjunctiva, and then, if it be not divided at the same time, picks up the subconjunctival fascia and divides that in like manner, the aperture being large enough easily to admit the scissors with closed blades, but not larger. The blades may then be introduced into the wound, and widely opened beneath the conjunctiva so as to stretch without cutting its connections with the outer surface of the tendon; or, if a considerable correction has to be effected, these attachments may be divided by a few snips towards the canthus, care being taken to keep the points well forwards beneath the conjunctiva, and not to cut deeply backwards along the curvature of the globe.

The scissors are then laid down, and while the forceps in the left hand still hold the conjunctiva close to the wound, the hook is taken in the right hand, and with its concavity turned away from the operator, and its point directed backwards as though it were to be carried towards the posterior pole of the eye, is passed deeply into the wound and swept round along the surface of the globe, so that its point passes upwards between the tendon and the sclera, and projects beneath the conjunctiva above the insertion of the tendon. If an attempt be now made to carry the hook forwards towards the cornea, it will be found to move the globe by its traction on the tendon beneath which it lies. The forceps are now laid aside and the hook is transferred to the left hand, and held parallel with the side of the nose and with some forward and outward traction upon the tendon; the scissors, held in the right hand, are passed with slightly opened blades between the hook and the eye, so that one blade passes on each side of the tendon, and then with one or two snips, the latter, which is felt as a firm resisting substance, is cut through as close to the sclera as possible. When the tendon is completely divided, the hook can be brought forward beneath the conjunctiva quite up to the margin of the cornea; it should be re-introduced in the same manner as before to make sure that the division is complete. If much blood be effused beneath the conjunctiva, a small aperture may be made with the scissors above the insertion of the tendon to favour its escape. The bleeding is likely to be more profuse when the subconjunctival fascia is freely divided with the scissors, than when it is simply stretched by widely opening the blades beneath the conjunctiva.

The after-treatment consists merely in keeping a fold of wet lint over the closed eyelids for a few hours, and avoiding exposure to wind, bright light, and other possible sources of irritation during the next few days. A little finely powdered iodoform, dusted upon the conjunctiva in the neighbourhood of the wound, is a good safeguard against septic inflammation of the tissues, a complication which is occasionally met with in badly nourished subjects, and which, in very rare instances, has been known to lead to orbital cellulitis and loss of the eye. The discoloration due to the extravasated blood, which may extend to the eyelids, usually disappears in from two to five weeks.

Disasters during the operation are seldom met with; if sharp-pointed scissors be used, or if the blades be introduced with much force, it is possible, however, to wound the tunics of the eye. If the globe is pushed forwards by a deep outpouring of blood into the orbit before the tendon is divided, cold compresses and a roller bandage should at once be applied, and the tenotomy postponed. If the immediate effect of the operation is manifestly insufficient, it may be increased by a further division of the subconjunctival tissue or by passing a silk suture underneath the conjunctiva, near to the external margin of the

cornea, so as to include about 6 mm. of it, and fastening the two ends to the skin of the temple with strapping, so as to draw the eye into a position of strong outward deviation; or the suture may be introduced close to the external margin of the cornea, and carried underneath the conjunctiva to the external canthus, and then tied over, so as to gather the conjunctiva into a fold which draws the eye outwards. The suture should remain for a day or two. Should the immediate effect be obviously too great, it may be diminished by a similar conjunctival suture at the inner side of the eye, or later, if it should prove necessary, by division of the external recti or advancement of the inner, one or both, or by a combination of these measures. The immediate effect should be that the eye cannot be turned so far inwards as before, the tendon now acting only through its connective-tissue attachments; during the following week the effect diminishes as the tendon forms a fresh and firm adhesion with the sclera; ultimately it again somewhat increases as the uniting tissue becomes stretched by use.

A simple subconjunctival tenotomy, with little cutting of the subconjunctival fascia, usually alters the position of the eye to the extent of 3 or 4 mm. If it is found, at the close of the operation, that the patient can converge for a point about six inches from his face, and can maintain this degree of convergence steadily, a perfect result is likely to be obtained; but if either eye deviates under this test, the effect of the tenotomy is likely to prove somewhat too great or too small, as the case may be. The continued use of spectacles after the operation is generally desirable, both as a safeguard against a return of the strabismus, and for the sake of good vision; if, however, the effect of the tenotomy tends to be too great, it is sometimes well to leave a part or the whole of the hypermetropia uncorrected, so as to call more or less of the extra accommodation into play, and thereby to increase the convergent effort. Several slightly different methods of performing tenotomy for strabismus are in use. The chief variation from the method described above consists in making the aperture directly over the insertion of the tendon instead of below it. By this proceeding the tendon is exposed to view as it lies upon the hook, and the principle of dividing it subconjunctivally is abandoned.

Tenotomy of the External Rectus is sometimes required to neutralise the effect of an excessive operation on its antagonist; it may conveniently be referred to here, although it does not usually form part of the treatment of convergent strabismus. The steps of the operation are essentially the same as those of the operation just described, but, it is to be noted that the insertion of the tendon is about 2 mm. further from the margin of the cornea than that of the internal rectus.

Advancement or Readjustment of the Internal Rectus is practised for the removal of the divergence which occasionally results from a too free division of the muscle in the treatment of convergent strabismus, and for divergence due to paralysis and other causes. It is a less simple and more painful operation than that of tenotomy. It consists in dividing the tendon at its point of attachment to the globe, and drawing it forward and detaining it in an advanced position, by means of sutures passing through it and the conjunctiva, until it forms a fresh attachment. The advancement of a tendon is usually combined with division of its antagonist, but this latter step is not always required, and may, sometimes, with advantage be postponed until the permanent result of the advancement can be estimated. The operation is performed in several slightly different ways. The following gives good results and is perhaps the simplest. In addition to the instruments used in an ordinary tenotomy, a silk or fine gut suture threaded into three curved needles is required; one needle is drawn along to the middle point of the thread, the others are placed at each end.

A vertical incision is made through the conjunctiva corresponding with the insertion of the tendon to be advanced, but not more than an eighth of an inch from the corneal margin. Its lip, together with the subconjunctival fascia, is dissected back a little way towards the canthus so as to expose the insertion of the tendon, but a separation of the conjunctiva from the tendon is, as far as possible, avoided. The tendon is divided on the hook in the usual way. One blade of the forceps is passed into the wound, and the divided tendon is firmly seized, together with the conjunctiva and fascia lying over it. The middle needle is then passed through these structures from within outwards, so as to pass as nearly as possible through the middle of the tendon behind the forceps, and the other two needles are, in like manner, passed beneath the conjunctiva in the opposite direction and brought out near to

the corneal margin above and below, at or even beyond the middle line. The middle needle being cut off, the two sutures thus formed are tied above and below, so as to draw the tendon forwards towards the corneal margin, and throw the included conjunctiva into folds. The further back in the tendon the sutures lie, the greater is the effect which can be attained. The immediate effect should be considerably greater than the permanent effect desired. Some pain is complained of during the first twelve hours, and there is sometimes a good deal of swelling of the lids, the patient should therefore be kept in bed a day or two, with cold compresses over the closed eyelids; and, as a safeguard against suppuration, a little finely powdered iodoform should be dusted on the conjunctiva twice daily. The sutures may be removed on the third or fourth day, or, if gut is used, may be left much longer without danger of their causing irritation.

Divergent Strabismus (Myopic).—In a large proportion of cases myopia underlies this condition, just as hypermetropia underlies the convergent form, and to a certain extent the one condition is pathologically the counterpart of the other. In looking at an object at any given distance, the myope needs to make a smaller accommodative effort than the normal-sighted person, and, if the object be at or beyond his farthest point of distinct vision, he sees best by avoiding accommodative effort altogether; but since accommodation is closely associated with convergence, he will at the same time be apt to make an insufficient effort of convergence—that is to say, one eye will be likely to deviate outwards, while the other is directed to the desired point. A *latent insufficiency of convergence*—that is, an insufficiency appearing only when one eye is covered—is common in all degrees of myopia, while a *manifest divergent strabismus* is met with chiefly in association with the higher degrees. The former may be accounted for almost entirely by the abnormal relations between accommodation and convergence; the latter is traceable to another cause as well. The elongated form of the highly myopic eye offers an obstacle to its rotation in any direction, while the very fact of the myopia obliges the patient to bring objects very near to his eyes, and, if he is to enjoy binocular vision, to maintain an excessive degree of convergence. The double difficulty is insurmountable. Binocular vision is abandoned in looking at very near objects, and, as a recompense for its loss, the patient is freed from the necessity of any convergent effort and from any associated accommodative action, which would of course only increase his difficulties. Any other imperfections of the eyes, which add to the difficulties of binocular vision or render it of little value, such as difference in the refraction of the two eyes, astigmatism, corneal opacities, or retinal changes, promote the deviation of the less useful eye. When once such a deviation in near vision has begun, it is likely to pass into a divergent strabismus for all distances.

Although myopia is, for the reasons stated, the commonest cause of this form of strabismus, any condition which renders the combined action of accommodation and convergence unnecessary, may lead to it; thus, an eye which from any cause has been long out of use, is liable to assume a position of outward deviation, especially if by reason of myopia, defective sight, or loss of accommodative power in the other eye, no habitual accommodative efforts are made. The slighter forms of latent divergent strabismus are frequently described under the name *insufficiency of the internal recti*; but there is no reason to suppose that the muscles are essentially defective in these cases, any more than in other forms of concomitant strabismus, and, indeed, these same muscles show no deficiency of power in conjugate movements; it is the impulse which is insufficient, either absolutely or relatively to the resistance to be overcome. Such insufficiency is induced artificially, when the accommodative effort habitually required for a given distance is diminished by optical means; thus, if a normal-sighted person attempt to read with convex glasses, he will find difficulty in maintaining the necessary degree of convergence, and if a myope, who habitually reads with concave glasses, tries to read without them, he will do the same.

In certain cases of high myopia, while there is an inability to converge sufficiently for very near objects, the eyes remain too convergent in distant vision, the abnormal form of the eye limiting its excursions in all directions.

The *diagnosis* of divergent strabismus is usually made with certainty by the tests already described; in the slighter latent forms it is made with greater precision by means of a prism. Both eyes being fixed upon an object, such as a flame in testing distant vision, or a vertical line on a sheet of paper in testing near vision, a prism of 8° or

10° is held base downwards before one eye. The image belonging to this eye appears to the patient to be displaced upwards, and fusion of the two under these circumstances is impossible. The eyes at once assume the particular degree of divergence or convergence which is most easy in connection with the given effort of accommodation; if the convergence be normal for the distance in question, the eye will remain stationary, and the two images will remain vertically placed the one above the other; if it be insufficient, the eye will move outwards and its corresponding image, the upper one, will appear to move in the opposite direction. The slightest deviation of the eye is thus revealed by the deviation of the image; it must be noted, however, that slight deviations obtained in this manner are often devoid of all practical importance. Subjectively, a latent divergent strabismus may cause much difficulty and pain in reading or other use of the eyes on near objects.

Treatment.—The insufficiency of convergent effort in near vision, which often accompanies the slighter degrees of myopia, may be remedied by giving concave glasses which correct a part or even the whole of the myopia, and thus induce a normal accommodative effort; in higher degrees, it may be neutralised by decentring the glasses—i.e. by setting them so that their centres are farther apart than the centres of the pupils, and thus giving them a prismatic effect, or by prescribing prisms for near work. *See* Myopia, *under* Refraction, Errors of. But it is to be remembered that, in high degrees of myopia, a divergent strabismus in near vision is to some extent a preservative change, tending, by abolition of the convergent strain, to save the eye from increase of structural mischief. The operative treatment of divergent strabismus consists in diminishing the effect of the external rectus by tenotomy, and sometimes by advancing the internal rectus in the manner already described. An operation cannot safely be undertaken unless the eyes are actually divergent, or unless they are found to be able to diverge to an extent sufficient to neutralise the effect of a prism of at least 10° held, base inwards, before one eye.

Priestley Smith.

STRANGURY.—A frequent, almost constant, and irrepressible desire to void urine, which is expelled in drops by acutely painful, spasmodic contraction of the bladder and perineal muscles.

Strangury is a symptom, not a disease, and may be called forth by irritating or inflammatory affections of any part of the urinary tract. In the kidney, frequent causes of strangury are nephritis and intense renal congestion, such as follows in some persons the absorption of turpentine or of essential oils allied to turpentine, or of cantharides. Another cause is some morbid condition of the calyces of the kidney, such as the presence of calculus, tubercle, or cancer. In the ureter, the passage of a calculus from the kidney to the bladder will excite severe strangury. Of the bladder, cystitis, stone, or tumour are very constant excitors of strangury. Of the prostate, acute congestion, especially in old men, when there is hypertrophy, is a very frequent source of strangury. The affections of the urethra which are apt to cause strangury are urethritis, especially gouty inflammation of the deeper portion, or gonorrhœal inflammation of the mucous membrane of the neck of the bladder, stricture, or lastly, preternatural narrowness of the meatus urinarius.

The course and terminations of strangury are those of the disease which excites it in great measure; but it is essentially a spasmodic affection, and therefore has intervals of quiet between the acutely painful attacks. Aggravation in severity of attacks of strangury is greatly promoted by locomotion, by exposure of the surface of the body to cold, by food generally, and especially by stimulants of all kinds.

The *treatment* of strangury consists in the removal of the cause, the cure of the disease exciting the irritation, or, if that be impossible, the soothing of its effects. To those persons who suffer strangury from cantharides, other vesicants should be applied, and turpentine, copaiba, or sandalwood oil be withheld from those in whom those drugs produce renal congestion. When the cause depends on inflammation of the kidney or bladder or urethra, rest in bed, warm hip-baths, leeches, and hot fomentations are useful. Internally, free saline purging and the administration of belladonna, combined with opium or not, are the main resources. It is customary to direct bland liquids such as barley water, effervescing waters, milk, &c., to be taken freely during the attack. The writer believes that thirst may be slaked by small quantities of iced drinks; the spasm is more quickly allayed when the secretion of urine is not encouraged by the imbibition of large quantities of watery fluid.

Berkeley Hill.

STRIÆ et MACULÆ ATROPHICÆ. *Definition.* — White scar-like streaks and spots on the skin, slightly depressed below the surface.

Etiology.—Both striæ and maculæ are seen in both sexes at all ages, and may be idiopathic or symptomatic. The idiopathic striæ are most frequent in adults, and much more frequent among women who have never had children than among men, and they are more frequent in tall than short men. They are supposed, in these cases, to be due to stretching of the skin during the expansion of the pelvis and growth of the limbs. Symptomatic striæ, more generally known as lineæ albicantes, are seen most frequently after pregnancy, and are due to stretching of the subcutaneous tissue by distension; they occur from any cause of similar distension, such as ascites, ovarian or other tumours, and even accumulation of fat if rapidly developed, and in the breasts from lactation. No satisfactory explanation of idiopathic maculæ can be offered, but a similar kind of lesion, though usually classed as scars, occurs from external pressure such as results from corns, favus crusts, &c.; and the depressions remaining after absorption of inflammatory or other infiltrations of the corium, such as result from syphilis, lupus, leprosy, lichen ruber, planus, &c., are of a similar nature.

Symptoms.—The idiopathic form occurs as streaks or spots; the streaks are from one to several inches long, and a quarter of an inch or more wide, lying in parallel lines at various angles to the long axis of the body, and are situated chiefly about the buttocks, the anterior border of the ilium, the trochanters and thighs, rarely on the trunk, neck, and arms. They are pearly or bluish-white, scar-like, irregular lines, slightly depressed below the surface of the skin, which is evidently thinned in the shallow sulci. The lineæ albicantes of pregnancy, &c., before alluded to, present ultimately the same physical characters as the so-called idiopathic striæ, but at first are bluish-red from hæmorrhage, and very itchy. Striæ tend to become less conspicuous ultimately, from their edges being drawn together by the natural elasticity of the skin, but they never go away entirely.

Maculæ or spots are less common than striæ; they vary from a large pin's head to half a crown in size, are white, slightly depressed, and are seen mostly on the trunk and neck; and there is reason to believe that they are only the sequel to a more acute condition. Liveing observed a case where the spots were in all stages: in the first, the spots were slightly red, raised above the surface, hard and fibrous; the characteristically white, sunken spots soon followed on the site of the raised spots; and finally the skin contracted, and the healthy tissues were drawn together and the spots nearly obliterated. Other observers mention antecedent hyperæmia as occurring in some cases, and, as they give rise to no inconvenience, probably the early stage is usually overlooked.

H. Radcliffe Crocker.

STRICTURE OF THE URETHRA: loss of the natural distensibility of this canal over a limited area, whereby the passage is narrowed at that part.

When at rest, the walls of the urethra are drawn closely together by its elastic and muscular contractility. They so remain until separated by a stream of urine or by a sound; further, as the flow of urine or sound pass outwards, the walls close again immediately behind them. This statement, though true for the greater part of the canal, is not quite so for the prostato-membranous portion; the complete evacuation of this part is achieved by certain muscles which are under voluntary control. The elastic tension of the urethra will yield readily before a sound of greater size than that to which the passage is ever expanded by the flow of urine, and the width of the urethra consequently depends, within certain limits, on the amount of distending force applied. Hence, the ordinary size of the urethra means the width to which the closed tube must be dilated, to give the urine an unimpeded escape when driven from the bladder. During the flow of urine, the contractile and elastic fibres maintain a tonic pressure on the stream, to ensure its forcible ejection from the body.

The natural expansibility of the urethra differs in different parts of its length; in the prostatic and membranous portions it is greatest, having there a diameter of at least 18–20 millimètres (about three-quarters of an inch), sometimes more; and thus it allows of the passage of a man's forefinger as far as the neck of the bladder. It may be mentioned that in speaking of the sizes of urethral instruments, the French scale, where the numbers advance by 1 millimètre added to the circumference, is always followed by the writer. As the urethra passes through the triangular ligament, it is often narrower than elsewhere, except at the meatus urinarius. At the bulbous portion it widens again considerably for about two inches of its

length, and then contracts slightly during the last three inches to the meatus, which is commonly the narrowest point of all. As the penis varies in circumference in different persons, so does the urethra in dilatability; the extremes of the latter being between about 20 millimètres and about 40 millimètres; the usual expansibility being 30 or 32 millimètres. At the meatus the expansibility varies very greatly, from a mere pinhole to 40 millimètres; the most common size being 25 millimètres, or almost exactly one inch. Otis, of New York, maintains that there is a constant relation between the circumference of the penis behind the glans and the dilatability of the urethra. Thus, an outside circumference of three inches is accompanied by a urethra of a capacity of 30 millimètres; one of three and a half inches by a urethral capacity of 34 millimètres, and so on. The writer has found this a usual condition but not an invariable one, and, consequently, places little reliance on the outside measurement when desiring to know the interior capacity.

To ascertain the expansibility of the urethra or the existence and position of unyielding parts, the following instruments are necessary:—A set of bullet-sounds, some with narrow stiff stems, some with flexible ones, carrying bullets shaped like a turkey's egg, varying in circumference at the widest part from 8 to 40 millimètres. Besides these, an Otis's urethrometer is useful, which can be enlarged from 12 millimètres (about No. 6 of the English catheter scale) to 44 millimètres. The meter is useful to measure the urethra in cases of narrow meatus, or where a thin bridle of membrane, near to the meatus, prevents the condition of the urethra behind such a constriction from being explored by a sound of greater width than that of the contracted point. But it cannot be readily introduced beyond the triangular ligament, and therefore is most useful as a gauge of the penile portion of the canal. The bullet-bougies with wire stems can be bent to suitable curves, and with a little management passed to the bladder without giving pain.

The *causes* of stricture are several, but of them, two are by far more frequent than the rest. (1) The great majority of strictures are the consequences of long-continued inflammation, with or without shallow ulceration of the mucous membrane, set up by gonorrhœa; hence gleets should never be neglected, as they are frequently the only indication of the existence of a patch of inflammation in some part of the urethra, which is slowly changing the mucous membrane there into undilatable fibrous tissue. (2) The next most frequent cause is laceration of the urethra by kicks or blows, which heal by a contracting scar. These are most commonly situated in the perineum, but may be produced at any part of the urethra. (3) Intra-urethral chancre, always near the meatus, caustic applications, lacerations caused by a calculus or by the disintegration of tubercle, are also causes, but rare ones, of stricture by the scars they leave behind them.

Age.—Stricture may be met with at any age. When before puberty, it may be caused by the injury done by an impacted calculus, or by the development of a scar after the healing of tubercle in the urethra. A case of tubercular stricture came under the writer's notice a few years ago; in which instance the cause of the stricture was ascertained *post mortem*. But as gonorrhœa is the greatly preponderating cause of stricture, and as the most common age for that disease is eighteen to twenty years, and as, moreover, stricture generally needs three years or more for its development, the decade in which strictures usually become troublesome is between thirty and forty.

The abnormal narrowings of the urethra are classified as—(1) *inflammatory*, (2) *spasmodic*, (3) *organic*. The organic stricture is the only contraction to which the term 'stricture' is applied by some surgeons; but as the other conditions not infrequently cause impediment to the flow of urine, and a narrowing of the urethra which is very easily measured, they may also be fairly termed strictures though the contraction be only transient.

Inflammatory Stricture is a temporary local congestion and swelling of a part of the urethra, which is generally, not always, the site of some permanent induration; in other words, a stricture of wide calibre contracted by temporary swelling.

It is usually sudden in its onset, and of short duration if appropriately treated. It is met with in persons of gouty habit of body, who indulge freely in the pleasures of the table or in venery, or who, having some permanent stricture, after exposure to damp and chill get congestion of the urethra at the strictured part. The small inconvenience of this permanent stricture is suddenly and seriously aggravated into more or less complete closure of the urethra for purposes of micturition. The leading symptom is inability to pass, or great difficulty in making, urine. To this are added dull pain in the perineum, some fever, considerable anxiety

and distress, slight redness and swelling of the meatus urinarius, with thin purulent discharge. The affection is distinguished from prostatic congestion by the absence of tenderness and swelling of that organ.

The immediate treatment consists in relieving the retention with a soft, flexible catheter, No. 8 or 14 French (4 to 7 English scale), soothing the irritation by a smart purge, followed by rest in bed and salines, with opium and belladonna in small frequent doses. In one or two days the trouble ceases, and a régime must then be adapted to exclude the causes which brought on the attack. Any small organic stricture must be widened when the inflammation has subsided. This affection is very apt to recur again and again, whenever the causes already mentioned come into operation.

Spasmodic Stricture is a narrowing of the calibre of the urethra by contraction of the muscular fibres of the canal. It is always met with in the deeper portion, where the muscular bands are most numerous. It may accompany the inflammatory swelling just described. In such cases, of course, the amount of the contraction due to swelling and of that due to spasm cannot be apportioned accurately to the two causes. But spasmodic stricture is also met with without inflammation—e.g. when reflex irritation is set up in the perineal muscles by the presence of a fibrous stricture at or near the meatus. Such a contraction is easily detected by the bullet-sound behind the bulbous portion, and often causes difficulty and even pain in micturition. If the anterior fibrous stricture be enlarged, the contraction and impediment in the deeper portion at once disappear. Such a condition is often mistaken for organic stricture near the bulbous portion, if by imperfect examination of the urethra the surgeon has overlooked a small amount of stricture near the meatus, and discovers only the spasmodic contraction behind the bulb, which may let pass only No. 12 or 13 (No. 6 of the English scale). Of course such spasmodic strictures disappear at once under anæsthetics.

Spasm is very apt to increase the contraction of an irritated or inflamed organic stricture, and is readily assuaged by the remedies which have been prescribed for the treatment of inflammatory stricture, especially by sufficient widening of organic contraction, if that be present.

Organic Stricture is due to the formation of a new product of a slowly contracting nature. This permanent contraction is often increased, as already said, by temporary inflammatory swelling and muscular spasm.

The new material is produced in various ways. Its earliest stage is inflammatory congestion of limited areas of the mucous and submucous tissue, from which the new growth may extend deeply into the erectile spongy tissue beyond those limits. It may, on the contrary, be limited to a few short bands stretched across the urethra or surrounding it. These narrow bands are termed bridle strictures. They are found in the ante-scrotal portion. Besides almost exclusively originating in inflammatory patches without ulceration, the spreading fibrous tissue may begin at the roots of warts, or in the floor of healing ulcers of the mucous membrane.

The indurated areas may take the form of hard knots or projections of the mucous membrane, which divert the canal with sudden twists; or, instead of forming circumscribed masses, the induration sometimes surrounds the canal, converting it for some distance into an unyielding tube of uneven surface. Hence, the stricture may vary from a thread-like band to a gristly mass invading the whole corpus spongiosum except the glans, where it never completely replaces the erectile tissue, and it may pass beyond the perineum, rendering the whole of that region hard and leathery.

The organic stricture also varies in the position of the new product and in behaviour. First, the *localities* of strictures. Strictures are found in any part of the canal as far back as the triangular ligament; and, by slow extension backwards, the fibrous induration may spread to the membranous portion, and even to the neighbouring part of the perineum. Taking all forms of fibrous stricture together, contraction is most frequent near the meatus, in the last half-inch of the urethra. Beyond the last inch, passing towards the bladder, strictures are less and less frequently met with, until the bulbous part is reached, when they again become frequent, though less so than at the outlet of the passage. In the bulbous portion, the narrowest, thickest, and toughest strictures are more commonly found, on account of the depth to which the new formation penetrates into the erectile tissue, and the mass of it which is thus produced at this situation. But very tight and massive strictures may be developed near the meatus, without any contraction existing at the bulb.

Strictures seldom extend far into the membranous part, and probably never begin there. The prostatic portion is involved

only where very extensive injury has reached the perineum. Such cases the writer has met with in miners, whose pelves have been crushed by falls of earth or the like accidents. The pubic portion of the pelvic bones has been broken and the urethra beneath them destroyed, so that, when the wounds have healed, the perineum is transformed into a mass of cicatricial tissue, through which the urine reaches the surface by one or more fistulæ.

Strictures are more often multiple than single. There are usually two or more contractions near the meatus, with an additional one in the bulbous portion. But a solitary stricture may exist at any part of the canal.

Produced in these several forms, it may be readily understood that the *behaviour* of strictures varies greatly. Some are rigid and cannot be dilated nearly to the natural expansibility of the urethra. After giving way in some degree to the introduction of the expanding bougie, the urethra yields no more. Further attempts to pass larger instruments excite inflammatory complications in the urethra itself or in the kidney, bladder, or testicle, with more or less constitutional disturbance attending them. Other strictures yield easily to dilatation and slowly contract; such have usually scanty development and a recent origin. A third set of strictures yield easily before the dilating force, but quickly shrink back to their former narrowness (india-rubber strictures).

Besides the changes in the urethra at the situation of the strictures, others take place in consequence of the irritation or injury to which the canal is subjected by the straining efforts of the bladder and perineal muscles to expel the urine, or by the treatment employed to relieve the difficult micturition. Between the meatus and the narrowest stricture, the passage, sometimes quite healthy, is more often marked with excoriations and ulcers. Just in front of the main stricture, there are sometimes perforations of the urethra into the cellular tissue, occasionally passing into the urethra again behind the stricture or into the rectum. These are termed 'false passages.' At the stricture itself, the surface is dull and roughened, and the canal somewhat tortuous; behind it, the walls are dilated, pouched, and the pouches lined with ragged ulcerated tissue. Through such pouches also fistulæ and urinary extravasations break away, from the strain to which their weakened walls are put by the impediment in front.

In cases of long continuance, the bladder is affected with chronic catarrh. If examined *post mortem*, its mucous membrane is rigid, thickened, and of an ashy-grey colour; here and there are often patches of crimson or purple colour from irritation excited shortly before death. The capacity of the bladder is generally diminished, though in old men it is sometimes dilated. The muscular coat is thickened so as to cause marked fasciculation of the inner surface. Between these ridges, pouches or sacculi are common.

The changes in the kidneys are those of chronic over-distension, either with or without acute inflammation. The ureters and the pelves of the kidneys are widened through the obstruction of the orifices of the ureters by the swelling of the mucous membrane of the bladder and the hypertrophy of its muscular fibres, and are also tortuous or pouched. Their interiors, like that of the bladder when attacked by inflammation shortly before death, are marked by red patches, but generally the surface is dense, white in colour, here and there ulcerated; the ulcers being often covered by a sheath of thick mucus. The urine in these diseased ureters and pelves is ammoniacal and horribly fetid. The changes in the kidney consist in those caused by simple pressure of the urine dammed up in the bladder, ureters, and pelves. The organ is softened, greatly enlarged, the calyces dilated, the pyramids flattened, and the cortical substance spread in a thinner layer than in the healthy organ; the capsule is toughened. The interior may be so far expanded, in extreme cases, as to convert the pyramids into funnel-shaped pouches, the cortical substance being almost wholly atrophied. In addition to this simple expansion, the kidney is commonly altered by repeated attacks of interstitial inflammation, with or without the formation of circumscribed abscesses. *See* Pyelonephritis.

The *symptoms* of organic stricture depend much on the degree to which the disease has developed. Those which usually first attract the patient's attention, are caused by considerable diminution of the calibre of the urethra.

In the early stages, when the disorder is easily managed and probably capable of complete cure, the symptoms are obscure. The most constant symptom is a scanty, muco-purulent discharge, not exceeding a small drop of whitish fluid collected at the meatus on rising from bed in the morning; or even not more than a few shreds of inspissated mucus floating in the

urine, which have been washed from the surface of the patches of chronic inflammation left by gonorrhœa long after the end of the acute stage. Gleet is seldom absent from any case of stricture, either of recent origin or of long duration. It is, of course, not confined to stricture, being present in other urethral affections.

The next symptom very often present in the early cases is a little soreness or itching in some part of the canal, felt sometimes after micturition, but also as frequently quite independently of micturition. The pain and itching are not severe, and are never put forward by the patient, however much his attention may be fixed on his gleet, as a matter of consequence. Indeed, inquiry is usually needful to learn the presence of these sensations. But, as these symptoms do not point solely to stricture, the urethra of a patient should always be examined if he has had gonorrhœa at least once, generally twice or thrice, in the last three or four years, and recollects that the discharge continued as a gleet for some time after each acute attack. Very commonly, there will be found, along the tract from the meatus to the bulb, contractions at certain places, which resist the passage of a bullet-sound three or four numbers smaller than the natural expansibility of the canal; if a smaller sound slip past these places, pain is felt by the patient, and perhaps a drop of blood is brushed from the congested or excoriated patch as the sound is withdrawn.

When the stricture has advanced so far that its narrowness obviously delays the outflow of urine, the following symptoms are usually present. In such cases, an interval of from three to eight years has generally taken place between the first gonorrhœa and the patient's application for relief.

The ordinary symptoms are several: among the most usual are diminished size and force of the stream, straining to expel the urine, and increased frequency of micturition. Of the two former symptoms many patients are quite unaware, even when they are well-marked; but, if questioned, they usually acknowledge that the habit has grown on them of passing urine once or twice during the night, between going to bed and rising in the morning. Pain in passing urine is sometimes severe in cases of narrow stricture, but there may be considerable stricture without pain; while pain is a symptom of many affections of the urethra from which stricture is absent. If pain in cases of narrow stricture is felt, it is generally described as of a 'cutting' character. Occasionally, aching pain in the perineum, a sense of weakness and fatigue or aching in the groins, buttocks, and thighs, are complained of by stricture patients. 'Twisting' or 'forking' of the stream is often present; being caused by the irregularity of the passage, and by the contracted part preventing the impulse of the bladder from driving the urine forcibly through the meatus. But an irregular or slightly narrowed meatus will make the same alteration in the stream, when no contraction is present elsewhere. Hence, 'twisting' or 'forking' is not a very important indication of stricture. A pretty constant symptom is trickling of a few drops of urine from the urethra, after the act of micturition has ceased. Thus, the patient notices that his dress is disagreeably wetted after passing water. This imperfect clearance of the urethra is due to the impediment the stricture causes to the onward flow given to the stream by the perineal muscles, when the bladder is emptied. This symptom is often absent or not noticed by many patients.

In the history of the period between the original cause of the stricture (acute gonorrhœa or wound of the urethra) there often will be found accounts of attacks of retention of urine, complete or partial, which have been overcome by medicine or by instruments. Attacks of feverish disturbance are not infrequent in some persons. These are shown by frequent calls to pass urine; increase of the pain felt while the stream flows; shivering fits, single or repeated, and accompanied by a rise of temperature to 103° F. or higher. On the other hand, none of these symptoms may be so pressing as to attract attention, and the first intimation to the patient of any disorder in his urethra may be a sudden attack of retention of urine, brought on by a fit of debauchery, by exposure to cold, or by excessive fatigue.

The consequences of so serious a disturbance of the working of the urinary apparatus may be readily conceived. As degeneration of the secreting tissue of the kidney advances, so does the nutrition of the body become seriously impaired, and liability to inflammatory affections of a low type greatly increased, among which may be mentioned pneumonia and other consequences of Bright's disease, by which the duration of life is much shortened. Even before these serious affections arise, others less hazardous, but very harassing, attack the patient. He is beset with more

frequent calls to micturate than before, and has always trouble in voiding urine, which varies between a little twinge of pain and severe suffering; while, at any time, a trifling accident may cause swelling of the stricture and jeopardy to the patient's life. If the urethra do not give way behind the stricture, and thus cause urinary abscess, extravasation, or fistula, other less active affections may develop when the kidneys have become greatly deteriorated by long interference with their function, such as cystitis or urethral fever.

The *diagnosis* of stricture, when the condition is advanced, is rendered highly probable by the diminished stream, by its altered shape, by pain or effort in voiding urine, by the trickling away of a few drops of urine after the patient has buttoned up, and by the history of previous attacks of retention. In such plainly marked cases, the question is not then of the existence of a stricture, but of the amount and situation of the contraction.

In cases where the stricture has had only a short duration, and where one slight contraction has taken place, the symptoms being limited to a gleet and occasional itching, the diagnosis cannot be made without exploration of the passage with instruments.

The *prognosis* depends somewhat on the temperament of the patient. A man of nervous, irritable nature is more quickly worn down by stricture than one of placid, easy temper. A far more important condition than the temperament of the patient, is the extent to which the kidneys have suffered. Some evidence of this can be learned by careful examination of the urine, noting the quantity secreted, the amount of urea, the presence or absence of albumen. A third condition of weight is the narrowness of the stricture; another is its situation. Strictures, which involve the bulbous and membranous portions of the canal, are less safely treated than others which are seated in the penile portion of the urethra. If untreated, the consequences of stricture gradually develop and increase in severity, until death is caused by one of the several accidents already mentioned—rupture of the urethra and extravasation of urine, exhaustion by urethral fever, degeneration and acute inflammation of the kidneys, septicæmia, pneumonia, or cardiac disease.

On the other hand, if treated, stricture need not shorten life, and by removing the impediment to micturition, it is possible to arrest the development of the several consequences of that disordered function.

Treatment.—For treating organic stricture there are five methods available—viz. gradual interrupted dilatation, gradual continuous dilatation, forcible rupture or divulsion, internal urethrotomy, and external urethrotomy. In addition to these established methods there are others, such as destruction of the stricture with caustic, which has become obsolete, or by electrolysis, which is not yet of proved practical value.

In all methods of treatment, a permanent cure cannot be achieved unless the stricture be of very recent formation, and the conversion of the inflammatory thickening into contractile material not yet complete.

In the rare cases in which no contraction returns after expansion, the whole of the new product is probably absorbed, and the natural elasticity of the urethra is restored. But when the transformation from inflammatory plastic exudation into fibrous tissue has taken place, the stricture, however completely it may be widened to or beyond the natural dilatability of the urethra, must be expected to shrink again, either slowly or speedily, according to the individual or to the method adopted for its dilatation. Hence, the aim in treating stricture is to expand it to the natural width of the urethra, and to maintain it near to that size by the occasional passage of a sound or bougie.

1. *Gradual interrupted dilatation*—by passing instruments of increasing sizes at short intervals, is the mode applicable to the majority of cases. This method excites the least irritation; it is a simple plan and need not interfere with the patient's ordinary pursuits, while it gives some relief even when that relief is only imperfect and temporary.

The classes of cases to which the interrupted gradual dilatation is most suited are, early semi-inflammatory strictures, and strictures in the bulbous portion, where the kidneys are greatly diseased. In the latter, sufficient increase to the width of a stricture may be given by the passage of bougies to render life very endurable; but, at best, any plan of treatment is unsatisfactory in such cases. After this method of dilatation, whenever the stricture is caused by well-organised fibrous tissue, long intervals between the passage of an expanding instrument are not to be expected. Nevertheless, if he pass his bougie regularly, the patient may enjoy fair health and comfort for the remainder of his life. As a rule, gradual dilatation is useless for bridle strictures, for contraction of the meatus, and

for very dense perineal strictures. These latter obstructions resist dilatation by this method; any attempt to widen them beyond a very insufficient degree will cause great constitutional disturbance, pain, rigors, and high fever, with subsequent prostration. Again, certain strictures shrink back so fast, after dilatation by the interrupted passage of instruments, that no progress is achieved. For all these varieties, incision through them by the knife is to be preferred, since it gives an almost complete cure for the bridle stricture, greatly retards the rate of contraction of the elastic strictures, and, if practised with proper precautions, is less frequently followed by febrile reaction than is any other plan of treatment.

For the interrupted dilatation of strictures three forms of instruments are employed. They are rigid or flexible. The best rigid sounds are made of steel, as steel can be more highly polished than any other material. Silver and plated metal, especially pewter, grow rough or scratched in use. All metallic instruments should be immersed in hot water immediately after use and then wiped dry while hot. Heating them before use often greatly facilitates their passage. Steel sounds should be kept in a wash-leather case. The most useful shape of rigid sounds for dilating strictures is that which, for about eight inches from the handle, is perfectly straight and cylindrical; beyond that the sound should have a curve occupying a quarter of a circle of two and one-third inches in diameter—that is, the curve is one inch and seven-eighths long. The curve should be maintained to the very tip of the sound; and the latter should not be prolonged in a straight run after the curve is passed. A sound of this shape most easily passes through a stricture, and avoids catching against the neck of the bladder before entering it. The sound has a broad flat handle, that the fingers may control the instrument and easily direct the point. The upper surface of the handle, being parallel with the shaft, is at right angles with the tip or 'beak.' This disposition enables the operator to be constantly aware of the direction of the beak when using the instrument. The sound should be of the same thickness from beak to handle, and simply rounded at the point. It is true sounds are used of conical shape—i.e. at the curved portion the calibre increases slowly from the neck till the straight part is reached, the remaining straight portion having the same diameter along its length.

Conical sounds are supposed by those who use them to wedge the stricture asunder more readily than a succession of sounds of cylindrical shape; but they have the serious disadvantage of not letting the operator feel the progress of the point of the sound, as the resistance of the stricture to the widening part at the curve masks any impediment that is caused by catching of the beak. For this reason conical sounds are dangerous instruments in not very practised hands. 'Bellied' sounds, like conical ones, are brought into use and fall out again from time to time. Their enlargement is confined to the curved part, and the straight part of the stem is slender, in order that, when several strictures have to be traversed, the resistance may be occasioned only by that stricture through which the belly of the sound is actually passing. As rigid sounds are less safe to use and more likely to cause pain and febrile disturbance than are flexible bougies, it is usual to confine their employment to strictures of only moderate contraction, attacking very fine or tortuous ones with pliant instruments.

Flexible bougies of various thicknesses are used for treating strictures by interrupted dilatation. They range between 1 millimètre in circumference and 25 or 30 millimètres. The smallest bougies are made of plaited silk, silkworm gut, catgut, or whalebone. The former materials are the most flexible, and do not fray or get rough, as do catgut and whalebone. Whalebone, which is a good deal stiffer than gut or silk, can be made temporarily supple by soaking it in boiling water for a quarter of an hour. Still, the rigidity and sharpness of its point render the whalebone bougie very apt to catch in a follicle or pocket of the urethra, and come to a dead stop. The best lubricator to prevent the instrument from rubbing or hitching as it enters the canal, and also to prevent the introduction of infectious matter, is 'Lund's oil' (so named after the surgeon who first used it); a mixture of almond oil f℥jss., castor oil f℥ss., and pure phenol (crystallised carbolic acid) ℥j.

To prepare the patient for treatment, every source of irritation should be removed. Violent exercise, especially long walks on the days the bougies are to be passed, must be avoided. The digestion should be good, diet plain, and free, or almost so, from alcoholic drinks. The urine should be acid, quite free from blood, and almost so from albumen. If the kidneys or bladder are irritated by the stricture, they must be relieved by rest in bed, warm baths, saline purges, &c. When there is

chronic retention or cystitis, the bladder must be regularly drained by small catheters until the urine is acid and nearly free from pus. Acute urethritis must also be subdued before the dilatation of the stricture is begun. The preliminaries being got over, and the calibre and situation of the strictures ascertained, the urethra is gradually accustomed to the passage of instruments. Not more than two or three sizes should be passed at the same sitting, and, at first, none large enough to be tightly grasped by the stricture. Usually two days should intervene between each sitting. As instruments are most easily passed in the morning, before the patient rises from bed, in difficult cases the operation should be performed at that time. Indeed, if much spasm attend the passages of the instrument, the patient had better keep his bed wholly during the early stages of dilatation. In most cases, it suffices that the patient have the instrument passed immediately after breakfast, before he begins his day's work. The best position for the patient is to lie flat on the back: the risk of fall from sudden fainting is thus prevented, and the muscles and fasciæ are more thoroughly relaxed. If the patient stand up, he should lean against a suitable object, with his legs about one foot apart.

In passing an instrument, there are three localities in the healthy urethra where its point is apt to catch. First, the navicular fossa just within the meatus, to be avoided by directing the point along the floor for the first inch of the urethra; the next is in the bulb, as the instrument approaches the triangular ligament; and the last is in the prostatic portion, before the bladder is reached.

When using sounds, to prevent a hitch at these places, the operator stands on the patient's left, holding the sound steadily but lightly with the thumb and two first fingers of the right hand across the patient's left groin, with the beak pointing downwards; while the penile portion of the urethra is drawn on to it with the fingers of the left hand, lightly holding the penis between them. By this means the point of the sound is gently pushed to the bulb, whence it then has to traverse the curved ascending portion of the urethra. If the right hand, holding the handle of the sound, be carried to the middle line of the patient and gently raised as the sound is pushed along the urethra, until the handle is vertically over the symphysis pubis, and then, in continuation of its curve, depressed till the handle is between the patient's thighs, the beak will be kept in contact with the roof of the passage all along the urethra. By this precaution, the sound will not depress the urethra at the orifice in the triangular ligament, nor get fixed in the urethra below that orifice, until the handle is depressed between the patient's thighs sufficiently to tilt the point up, to enter the triangular ligament with a jerk and a cry of pain from the patient. This hitch strains the urethra, and may even tear it, by the long leverage which the sound exerts over the parts in which its point is entangled, as the handle is passing through an arc of a considerable circle. Again, in approaching the neck of the bladder, no resistance is felt if the beak be kept from the floor, otherwise the beak catches in the prostate, and, pushing that organ onward, slips into the bladder with another painful, sudden jerk.

These impediments are natural, and being known can be avoided, but the entry to a stricture is not known until discovered by exploration. It has been pointed out that the irregular growth of the fibrous tissue which forms the stricture often diverts the track to one or other side, thus throwing the beginning or 'mouth' of a stricture athwart the proper direction. If the point of the sound catch in this obstruction, it is stopped in its progress; and if force be used with a fine instrument, the wall of the urethra may be penetrated, and the instrument pass between that canal and the rectum, or into the rectum itself. The 'false passage' so made, remains a pitfall for future embarrassment; the immediate result being for the patient great pain and free bleeding, with not infrequently a sharp attack of fever and abscess, and for the surgeon, failure to reach the bladder. When made by the surgeon, false passages usually start from the floor or from the left side; when by the patient operating on himself, on the right side or in the floor. Recollection of this fact will usually enable the surgeon to avoid the wrong route, by keeping the beak of his sound steadily away from the opening, as he approaches the stricture. In difficult cases, by passing the finger into the rectum the position of the catheter in a false passage can be ascertained, and the beak can often be guided along the urethra. Something may be gained by watching the position of the handle of the sound; if the upper surface is directed to one or other side of the middle line, the beak of the instrument is turned from the course of the urethra against or through its wall.

Even when no false passage exists, the position of the entry to the stricture should be sought for methodically, and, when discovered, carefully noted for future guidance. To do this, the beak should be carried along the roof in the first instance, then along the left side, and then along the right side; leaving the floor to the last, as that is the least likely part at which to effect an entrance. If there be spasm which contracts the stricture closely, a hot sound, passed lightly but swiftly down the urethra, will often surprise the stricture and slip through it without being held. Of course, this resource is only available with strictures of fair width, No. 14 or 16 French, as fine sounds are too apt to pierce the wall of the urethra and do serious mischief, if carried swiftly along the urethra. Indeed, so easily is damage done by using fine rigid instruments in the treatment of strictures, that it is best to reserve their use for cases where flexible ones have been tried in vain. The special and important advantage of rigid instruments, is the power which they give to the surgeon of directing the point in any way he chooses. But, as already mentioned, the sound, some ten or twelve inches in length, is a powerful lever, and sufficiently strong to tear the urethra at the perineal fascia, if forcibly raised and depressed when it is not gliding steadily along the urethra. Much practice and delicacy of touch are needed to safely handle fine silver catheters and sounds.

To pass flexible bougies, the steps of the method are at first the same as those for sounds, directing the point against the floor till the fossa navicularis is passed, then pushing it straight onwards. If it catch at any part —usually the floor of the bulb—the bougie should be withdrawn a little, and, while rotated between the fingers and thumbs, again pushed onwards. If the bougie persistently catch at one point, it must be withdrawn and the point given a little twist or bend. On a second introduction the point will not travel precisely as before, and will probably fail to catch where it was checked at the first attempt. It is well to have bougies with points somewhat bent or twisted spirally, in order that, by rotating the stem, the point may be carried beyond the pocket or round the face of the stricture, and so avoid resistance to its onward passage. Also, when bougies with tapering ends fail, those of equal thickness throughout will often pass, especially if a slight curve be given to the bougie by softening it in hot water, then bending it with the fingers, and, while thus held, stiffening the curve by plunging the bougie into cold water. If the arrest is caused by the bougie being too thick to pass the stricture, and not by its point being stopped at an obstruction, a different sense of resistance is felt. In the former the point enters the stricture, and is so grasped that force is required to extract it. If the point is stopped, the bougie comes away at once or is even partially ejected by the urethra, which, having been pushed towards the bladder, recovers its natural position.

When the bougie or sound has fairly passed the stricture—i.e. its thickest part is introduced into the narrowest portion of the canal—it should be withdrawn at once. No benefit follows the retention of the instrument, unless it remains in the urethra for the rest of the day, when enlargement of the stricture is attained by another process—that which is set in action by tying in the catheter continuously, to be presently described. On the contrary, spasm and pain are often excited by the bougie being left for a few minutes in the urethra. At the next sitting, the process of dilatation is continued by first passing the largest bougie of the previous sitting, and following it up by one or two of greater thickness, according to the readiness with which the urethra yields to the expanding force. This process of interrupted dilatation is carried on until the No. 24 or 25 can be introduced easily. The patient should then be trained to pass one of these sizes for himself, and, when perfect in his lesson, dismissed with the injunction to repeat the operation once a month, once in two months, every quarter of a year—in short, just so often as he finds needful to prevent shrinkage of his widened stricture.

During the course of expansion it may happen that, while the deeper and narrower strictures continue to yield, one near the meatus, or the meatus itself, refuses to expand before the enlarging bougie. The gradual dilatation thus comes to a standstill. This difficulty is got over by cutting these bands till the meatus, or contraction near the meatus, allows a bougie of the size of the unaltered portions of the canal —No. 28 or 29—to pass it. The further dilatation of the deep stricture can then be proceeded with, and the incised obstructions kept open by passing through them a sound of the size mentioned, until the cuts have healed. Again, strictures, where there is copious formation of cicatricial tissue, often yield up to a certain width, too narrow for safety; but any attempt to stretch them beyond this extent causes violent febrile

disturbance, rigors, vomiting, and other signs of renal irritation and congestion. Such strictures must be cut by some of the methods described under URETHROTOMY. Experience shows that in these cases of irritation from bougie-stretching, the speedy division of the stricture by the knife is seldom followed by more than slight rise of temperature, and hardly ever by rigors and high fever, if proper precautions be taken in the after-treatment.

When dealing with strictures of extreme narrowness, through which the urine escapes only by drops, it very rarely happens that an instrument cannot be introduced into the bladder, if sufficient perseverance be exercised. To succeed, it is needful to have a good supply of fine bougies, varying in shape and material, but all of great tenuity down to No. 1 or less of the millimetrical scale, made of the materials, and with points varying in shape, in the manner already described. The more pliable the bougie is near the point, the more likely is it to insinuate itself into the devious path of the stricture. Various manœuvres are also useful. One is to inject a teaspoonful of oil into the passage before the stricture is attacked by the bougie; the oil distends the anterior part of the urethra and percolates along the stricture. In doing this it often opens the little granulation that overlies the mouth of many strictures, and allows the bougie to slip past. In other cases, the bougie will sometimes run in during the act of micturition.

When spasm is readily excited by instrumentation, chloroform should be employed to annul it. But chloroform has the disadvantage of rendering the patient unconscious of the surgeon's proceedings, when his warnings are often of service to the latter in avoiding false passages.

It is useful to pass a silver tube of the size of No. 14 or No. 12 down the urethra as far as the stricture, and push through it the filiform bougie to the stricture. The point of the bougie is thus prevented from catching in pockets or irregularities, before it arrives at the stricture itself.

A still better plan in very narrow strictures, after repeated failures with the fine bougie, is to pass an endoscope-tube down to the stricture, dilating the anterior portion of the urethra as a preliminary if necessary, and so illuminate the face of the stricture. The mouth is generally readily seen, and the filiform bougie, directed by the eye, enters the stricture with surprising facility. *See* ENDOSCOPE.

Directed by the fact that the mouth of a stricture is generally placed at the side of the urethra, not near the middle of the passage, an American surgeon has invented an instrument called the 'pathfinder.' This consists of a straight tube of the size of No. 20, the further end of which is closed by a disk, that can be made to revolve round the axis of the tube by a screw at the handle. In this disk, away from the centre, is a hole large enough to allow a filiform bougie to pass through it. In use, the straight tube is passed along the urethra until it arrives at the stricture; the disk is then made to revolve slowly, while a long fine bougie is kept continually peeping from the little orifice. As the disk revolves, it carries the end of the bougie slowly round the face of the stricture; and, being thus brought against several parts of the stricture, the fine bougie probably enters the mouth, and can be pushed on through the stricture, when the pathfinder can be withdrawn over it from the urethra. The drawback to this ingenious instrument is that strictures are seldom single. The large tube is checked in its passage to the fine stricture by a less narrow one placed nearer the mouth of the urethra. This of course can be widened by gradual dilatation or incision, and the narrow one got at, but, in practice, cases of such extreme difficulty as to need the aid of the pathfinder are extremely rare.

When the resources of flexible instruments have been exhausted, silver catheters of great fineness may be used. They can be made three or two, or even only one millimètre in circumference. They should be supplied with a well-fitting stylet that runs closely to the end of the catheter, lest its interior be filled with clot or mucus, and the outflow of urine prevented when the stricture has been penetrated and the bladder reached. The outer end of the catheter may be fitted with a mouthpiece, to which a little syringe can be attached. By this syringe a few drops of urine can be sucked from the bladder, and the interior of the tube cleared of obstruction. As these instruments are as sharp as knitting-needles, they must be used with a very light hand, and never *driven* along the urethra. A very moderate force suffices to push the point through the urethra and cause serious damage.

When, by any means, an instrument reaches the bladder through a very narrow stricture, it should be tied in the urethra until it is loose; then it should be replaced by a somewhat larger one, or the dilatation

be continued by the interrupted method. Even if the instrument be only a bougie, not a catheter, the urine finds its way by the side of the instrument more and more freely the longer the bougie remains.

2. *Gradual Continuous Dilatation.*—This plan consists in tying a flexible instrument in the stricture, and replacing it with a larger one every two or three days, until the natural calibre of the urethra is restored. The change of catheter is needed lest it slip out when very loose in the stricture, and also for purposes of cleanliness. This method occupies about ten or twelve days, and is easy, rapid, and generally safe. It requires a few precautions—(*a*) the catheter should always be a loose fit; that is, two or three numbers smaller than the stricture; if a tight fit is employed, the patient suffers much from pain and irritation, often sufficient to compel the interruption of the treatment; (*b*) the patient should be confined to his room, and for most of his time to his bed; (*c*) the catheter, as it lies in the stricture, should leave the neck of the bladder free. Of course, the catheter must be pushed into the bladder when it is desired to draw off urine, and withdrawn when the bladder is emptied, and its mouth stopped by a little spigot.

The process by which this dilatation is obtained is, probably, similar to that which goes on in parts where a seton or other foreign body has been placed. The fibrous tissue becomes swollen and juicy; its cells enlarge, and the intercellular spaces are charged with leucocytes. The further disintegration of the fibrous tissue into pus quickly widens the contraction, and causes a purulent discharge from the urethra.

The drawbacks to this rapid and easy dilatation prevent reliance on it alone for the whole course of treatment; though for the first stage of widening a very tight stricture it is very appropriate. These disadvantages are—(*a*) the rapidity with which a stricture enlarged by continuous tying in shrinks back when the process is over; usually so rapidly that the patient cannot keep himself free from danger and discomfort; (*b*) a few patients cannot support the presence of a catheter in the urethra for more than two or three consecutive days. In such persons, *malaise*, pain at the neck of the bladder, or general febrile reaction, which may be very severe, compels the removal of the catheter and, when subsidence of the irritation allows the treatment to be resumed, the adoption of some other method. Notwithstanding these disadvantages, tying in is useful when rapid dilatation is needful to drain a bladder attacked with cystitis after long retention, or where the large amount of renal disease renders urethrotomy hazardous.

3. *Forcible dilatation* is a method which seeks to widen the stricture by stretching the fibrous tissue sufficiently at one sitting to restore the calibre of the canal. As fibrous tissue is quite inelastic, 'stretching' really means tearing the bonds asunder slowly instead of ripping them apart instantaneously as in 'divulsion.' To effect 'forcible dilatation' a split sound is used, the halves of which, when lying close together, equal No. 12, but can be separated, for about three inches of their length, by a lever worked by a screw until the width equals No. 26 or more. In use, the sound is passed in its contracted condition far enough for the expanding part to lie in the stricture. The blades are then slowly separated, until in the course of ten or fifteen minutes the strictured part is stretched to the natural expansibility of the urethra.

4. *Divulsion*: the instantaneous ripping asunder of the narrowed part, is effected by a variety of instruments working on the same principle—viz. forcibly separating the halves of a small split sound by thrusting a wedge rapidly between them.

Both forcible dilatation and divulsion have the great disadvantage of being followed by rapid re-contraction, and divulsion is very liable to the untoward consequences which occasionally attend the gentlest instrumentation of the urethra. Indeed, rigors and suppression of urine, with fatal result, are more frequent sequelæ of divulsion than of any other method of treating stricture.

For treating strictures by cutting operations, the reader is referred to the article on internal and external URETHROTOMY.

In reference to the numerous list of complications which may follow any method of widening strictures, it must be recollected that the urethra is of extremely delicate, highly nervous structure, easily damaged or irritated, and that no method is quite free from risk of painful or dangerous consequences. Of the less serious complications are slight hæmorrhage, soreness and pain in passing urine, fainting or syncope, spasm of the perineal muscles, causing more or less difficulty in voiding urine for some hours or days after the passage of an instrument. These symptoms usually subside spontaneously in a few hours without further mischief; but the hæmorrhage, if

the erectile tissue at the bulb be injured, may be so abundant as to greatly exhaust the patient and even endanger his life. The syncope may be attended by more serious nervous disturbance, such as violent vomiting, great prostration, great anxiety and depression of spirits, and copious clammy sweats. The difficulty in micturition from spasm of the deep perineal muscles may amount to total retention of urine. The shock, which sometimes follows even the passage of a bougie over the bulbo-membranous portion of the urethra, may cause reactionary pyrexia, showing itself as Urethral Fever or as Suppression of Urine. The latter varies from a small diminution in quantity of the renal secretion to the complete arrest of the renal secretion and a speedily fatal termination. The presence of albumen or blood in microscopic quantity in the urine passed during the next few hours, indicates the renal congestion of moderate amount which follows the diminished secretion of urine even when that is but slight. The local troubles are not few nor of light importance. They include inflammation of the testicle, abscess in and around the prostate or perineum, with, it may be, septicæmia as their final termination. Berkeley Hill.

STRICTURE-DILATORS. — Under this name are included instruments which act upon strictures in very different ways; some of them are true dilators, but others, of which Holt's instrument for the urethra is best known, really act by rupturing the stricture.

The instruments employed for the rapid dilatation of strictures of the urethra are —conical metal sounds, Wakley's tubes, Thompson's expander, and Holt's and Berkeley Hill's dilators.

Lister's conical sounds are solid instruments made of plated steel; their curve is accurately adapted to the urethra, and their weight and the smoothness of their surface greatly facilitate their introduction; they cause very little irritation, and patients upon whom they have been used often prefer them to soft instruments. The sounds have bulbous ends with narrow necks, beyond which they increase gradually in size until about the opposite end of the curve, where they are three sizes of the English scale larger than at the points. Two, and sometimes three, instruments may be passed successively at one sitting. By this method, which is one of true dilatation, the stricture may, in suitable cases, be rapidly and safely brought up to the full size.

Wakley's dilator consists of a small silver catheter which serves as a guide, and ofa series of tubes of gradually increasing sizes. The guide is first passed through the stricture, and then a steel rod is screwed on to its proximal end. Over this, one of the tubes is passed onwards through the stricture, and, when in place, it serves as the conductor over which another and larger tube may be passed, and so on through the whole series until the stricture is sufficiently dilated. It is possible to use this instrument in two ways. One or two tubes only may be passed at one time, and then the effect would probably be one of true rapid dilatation; but if the whole series are successively introduced at one sitting, it is difficult to conceive that the urethra will escape laceration.

Thompson claims for his instrument that it acts by over-distending the stricture —that is, by stretching it to four or five sizes beyond what is natural to the urethra at the part affected, without causing unnatural dilatation of other parts whose normal calibre is less. This instrument is composed of two blades, which can be separated most widely at the desired spot by means of a lever, which is itself worked by turning the handle. It should only be used for strictures situated in the bulbous portion of the urethra, and the blades of the instrument should be slowly separated so that their action may be, as much as possible, one of dilatation, though, undoubtedly, some laceration of the urethra at the seat of the stricture must be caused.

Holt's instrument consists of two blades joined at the extremity, and, lying between them, of a wire, which serves as a guide, along which a tube (No. 12 English scale) may be passed in such a way that the blades of the instrument are rapidly wedged asunder. The two-bladed instrument is first passed through the stricture, and then the wedge is forcibly thrust home, and any resisting bands are ruptured.

Berkeley Hill's dilator consists of a split sound, the halves of which can be separated by passing between them a wedge which is fixed on the extremity of a steel rod. The wedge is dovetailed to the blades of the sound, and seeing that friction only occurs at these points instead of all along the instrument, as in Holt's dilator, the force required to use it is comparatively slight.

Sir H. Thompson and Mr. Berkeley Hill have both abandoned rapid dilatation in the treatment of stricture of the urethra, and there is a widespread belief that rapid dilatation, or, more correctly, rupture of stric-

tures, has in many cases been followed by disastrous consequences. Rupture of a urethral stricture is often followed by intense shock; in many cases suppression of urine has resulted from it; and in others pyæmia has followed it. But in addition to the dangers attending forcible rupture of a stricture, the degree and permanence of relief afforded by it has been less than that gained by other methods of treatment. In fact, the only recommendation of forcible dilatation is the ease and rapidity with which it may be accomplished.

Fibrous strictures of the rectum are commonly treated mechanically by the introduction of bougies of gradually increasing sizes, in combination with, or independently of, notching of the constricting band in a few places; but there is an instrument known as Todd's dilator which is adapted to produce more rapid dilatation. It consists of two blades, which are joined together by four crossbars in such a way that a parallel motion and separation of the blades may be effected by turning a screw in the handle. Before introducing this instrument into the stricture, its blades should be closed and covered with an india-rubber sheath, so as to protect the mucous membrane against being caught between the blades of the dilator.

BILTON POLLARD.

STROMEYER'S CUSHION is used, as a support for the upper limb, in the treatment of compound fractures of the humerus and the elbow-joint. It is a triangular cushion with two of its angles rounded off, and stuffed with horsehair. One of the rounded off angles is placed in the axilla, and the upper limb, flexed to a right angle at the elbow, is laid on the cushion. The cushion is maintained in position by two tapes, which pass from its axillary angle over the opposite shoulder; and by other tapes, which pass round the body from the two lower angles of the cushion. The whole apparatus is supported in a sling.

STRUMA. *See* SCROFULA.

STUMPS, Affections of.—A stump is said to be a good one when the soft parts are freely movable over the end of the bone, without any redundancy of tissue, when pressure can be borne directly on the face of the stump, and when the cicatrix is not over the end of the bone.

After the lapse of a year or two, a stump will be found to have undergone considerable change. The muscles and soft parts atrophy, and the cut ends of muscles and tendons have taken up new attachments either to the bone, or to the fibro-cellular tissue of the end of the stump. The bone becomes rounded and the medullary canal closed by a layer of compact tissue, and from disuse it often undergoes fatty atrophy. The ends of the nerves are thickened and more or less bulbous, the swollen ends consisting of fibrous tissue, with nerve-fibres intermixed. The vessels also diminish in size, and their ligatured ends dwindle, until at last they are represented only by fibrous cords as far as their nearest branches. The stumps that undergo least change are those which are formed of skin-flaps only, or those which are obtained by union between a natural bone-covering and the sawn section of a long bone, as in a Pirogoff or in Gritti's amputation at the knee.

Treatment of a Recent Stump.—The dressings should be of some antiseptic form, and great cleanliness exercised in changing them. Rest for the stump is essential, and muscular spasm is best controlled by the application of suitable splints. Efficient drainage must be provided, but the tubes should not be kept too long a time in a stump. In ordinary cases, when the flaps are well approximated, and there is no constitutional disturbance, they may be shortened or dispensed with at an early dressing. When, however, there is a cavity in the stump, as in a Syme's amputation, or in an amputation through the knee-joint, the drainage must be continued for a longer time. Through carelessness, or from not properly securing the ends of the drainage-tubes, a piece may be left forgotten in a stump and give rise to troublesome suppuration.

Hæmorrhage that occurs a few hours after an amputation is best treated by removal of the dressings, elevation, and exposure of the stump to the air. If the oozing seems general, then firm compression may be applied; but if there be reason to suppose that a vessel has escaped ligature, the flaps must be opened, and search made for the bleeding point. This is especially necessary if there be great distension by clot; the removal of all clot, provided proper precautions are taken to maintain an antiseptic condition of the wound, will greatly expedite the reparative process. *See* HÆMORRHAGE.

Secondary hæmorrhage, at an interval of several days after operation, necessitates careful watching, and often prompt action on the part of the surgeon. If it be small in quantity, the expectant treatment is

indicated, but a renewal of the bleeding, or any excess indicating lesion of a large vessel must be dealt with by careful search for the bleeding point. However unhealthy the condition of the stump, the bleeding vessel can generally be found, and by a little dissection secured. The thorough cleansing and drainage obtained by opening the flaps is often followed by rapid healing. *See* Arteries, Wounds of.

If hæmorrhage occur at a later period when the stump is nearly healed, then an incision may be made in the course of the vessel and a ligature placed at a slightly higher point, or the artery may be ligatured at some convenient position as near the stump as possible.

Necrosis of Stump.—From the irritation of the saw, or when the periosteum has been stripped from the bone above the point of section, a limited necrosis of the end of the bone may occur, and delay take place in the healing of the stump until the dead bone has separated. A limited necrosis may also result from the projection of the end of the bone through the anterior flap, secondary to ulceration of the coverings from pressure; occasionally an extensive central necrosis ensues, attended with much constitutional disturbance and profuse offensive suppuration. A considerable time will then elapse before the sequestrum can be extracted, but still eventually a good stump will result. The thickening of the bone by periosteal deposit, and the tenderness elicited by pressure over it, the retraction of the soft parts, the necrotic appearance of the end of the bone, and the escape of pus from the medullary cavity, will make the diagnosis clear. In certain of these cases, but fortunately now of rare occurrence, acute necrosis after amputation is attended with such severe constitutional disturbance and evidence of septic absorption, as to necessitate a higher amputation, and an amputation if possible at the joint above the bone affected. Such a procedure is, however, only justifiable when life is endangered by the septic process, or by the exhaustion produced by prolonged suppuration. *See* Osteomyelitis.

An *adherent cicatrix* may be the result of undue prominence of the end of the bone, or be caused by any of the conditions giving rise to conical stump. Such a cicatrix is often tender to the touch, prone to ulceration, and entirely prevents any direct pressure being borne on the end of the stump. When much inconvenience is occasioned, removal of the cicatrix, if the parts are redundant and permit of it, will be requisite. In many cases, it will be desirable to take away a sufficient portion of bone with the cicatrix.

Eczema of stump may be induced by the irritation of the dressings, and is apt to take on a chronic course, especially in persons predisposed to it, or when there is an ulcerated condition of cicatrix keeping up continued irritation.

When eczema occurs in consequence of the dressings, boracic lotion should be substituted for any stronger antiseptic that may have been in use.

Painful Stump.—A recent stump may be excessively painful from inflammatory exudation. When acute necrosis occurs, then pressure on the end of the bone, or manipulation during the dressings will occasion the most intense suffering. For the first few days after an amputation through a muscular part like the thigh, the involuntary movements caused by spasm of the muscles are often very distressing to the patient, but can be controlled by the application of splints. The possibility of pain and spasm, due to the inclusion of a nerve in a ligature, must also be remembered.

A stump may become painful, and remain so long after it has healed, and yet nothing be found to explain the condition. The patient is generally a young or middle-aged female of hysterical temperament. Careful search should be made for any point of local tenderness, especially in the cicatrix, since the implication of some nerve-twig in the cicatricial tissue might be the cause of the condition, and relief be afforded by the excision of the portion of cicatrix involved. In conical, and sometimes in well-shaped stumps, the nerve-ends may become greatly enlarged and painful, so that pressure on them gives rise to a peculiar electric form of pain. The bulbous nerve-ends often constitute a true form of neuroma, and contain numerous nerve-fibres as well as fibrous tissue. Free excision of the tuberous swelling or swellings would then be necessary.

Malignant disease of a stump may be a local recurrence after amputation for malignant disease in the immediate neighbourhood, or epithelioma may attack the cicatrix of a stump that has been the seat of chronic irritation. Re-amputation when possible will, of course, be advisable.

The time at which an artificial limb can be adapted to a stump, will vary according to the particular case and the amount of direct pressure to be borne.

An interval of three months after complete cicatrisation is advisable, and no expensive instrument should be ordered for at least a year. The stump will then have shrunk to something like its permanent dimensions. Amputations at the ankle-joint, and at or through the knee-joint generally, give a stump capable of bearing the whole or nearly the whole weight of the body; but in an amputation through the leg or thigh, no matter how the flaps have been fashioned, the bearing points of an artificial leg must be distributed carefully on the bony points above, and little if any pressure be allowed on the end of the stump. *See* Artificial Limbs.

Conical Stump.—After amputations through the shaft of a single bone, such as the humerus or femur, the stump generally becomes a little conical in time, owing to the atrophy of the soft parts. In young subjects, with active growth of the bone going on, this condition of stump is sometimes extreme, the end of the bone, covered by stretched skin or thin cicatricial tissue, projecting very much like the stick of a half-opened umbrella; and this may take place in a stump that was originally well-formed.

A stump may become conical owing to the shortness of the flaps, or from the bone not being sawn through at a sufficiently high level, from bad after-treatment, or from the recession of the soft parts during the healing process, especially when this is prolonged, and when the amputation has been performed through parts previously inflamed, or when the patient is in an exhausted, unhealthy condition.

Treatment.—By proper attention to the dressing of a stump, much may be done to prevent its becoming conical. By injudicious bandaging, strapping, or over-manipulation during the dressings, almost any slowly healing stump may be made conical. To correct such a tendency, the limb should be carefully bandaged from above downwards, and in some cases extension by means of strapping may be made on the flaps. Subsequently, if it be found that the bone is very prominent, and especially if there be a troublesome cicatrix adherent to the bone, a sufficient portion of the bone must be removed. This may best be effected by making a dependent incision along the side of the bone away from the chief vessels, separating the periosteum with the soft structures by careful use of an elevator, and sawing through the bone at the desired level; care being taken to protect the soft parts from injury by the saw. When the conical condition is caused by increasing growth of the bone, it is best to defer operation as long as possible, since the deformity is likely to recur, and further interference is then rendered necessary.

Bernard Pitts.

STY. *See* Eyelids, Diseases of the.

STYPTICS are astringents which are applied, either in the solid form or in solution, to the surfaces of wounds with the object of arresting bleeding; or are taken internally in the belief that they increase the coagulability of the blood, and so are beneficial in cases of hæmorrhage from internal organs.

Styptics act locally in two ways—(1) by stimulating the walls of the blood-vessels and causing them to contract; (2) by combining with the albumin of the blood and forming a coagulum in the mouths of the vessels. It is only the bleeding from small vessels and capillaries that can be checked by means of styptics, and to act efficiently on those vessels the styptic must be carefully applied. The clots should be removed from the wound and the cut surfaces should be mopped dry, and then the styptic should be rapidly applied so that it may come into contact with the blood in the mouths of the vessels—the object being to form a plug of coagulum within them. If the surface of the wound be not mopped dry, the blood will coagulate upon it as a film, beneath which the bleeding will continue.

Styptics can only be recommended as a means of arresting hæmorrhage in quite exceptional cases, since they act injuriously upon the wound. They act as weak caustics on the tissues, and hence tend to produce superficial sloughing; the clots formed in the vessels are not fibrinous, but consist of a combination of the styptic with the albumin of the blood, and in consequence they cannot be such a good medium for the formation of reparative tissues as a healthy clot would be. However carefully, too, the styptic be applied, it is difficult to prevent the formation, on the surface of the wound, of a coagulum which will act there as a foreign body. All these conditions are fatal to union by the first intention, which is, of course, the surgeon's aim in the treatment of wounds. Styptics should, therefore, never be applied to a wound till other less objectionable methods have been tried and have failed. There are, however, certain regions in which it is

impossible to apply other means of arresting hæmorrhage efficiently, and then styptics are of value.

In cases of vesical hæmorrhage dependent on new growths, it may be impossible to arrest the bleeding by other means, and then an injection composed of a drachm of the solution of perchloride of iron to an ounce of water is of much use. In post-partum hæmorrhage from the uterus, if the uterine contractions cannot be provoked, and an injection of an antiseptic solution at a temperature of 105° to 110° Fahr. has failed, an intra-uterine injection of perchloride of iron (one part of the solution of perchloride of iron to three of water) should be tried. Its use is not, however, unattended with risks. In obstinate bleeding after extraction of teeth, when careful packing of the tooth-sockets has failed to check the flow of blood, a plug of cotton-wool soaked in a solution of perchloride of iron often arrests it at once. Hazeline, the active principle of *Hamamelis Virginica*, is a good styptic, and may be employed instead of iron for the last-named purpose. The writer has found hazeline most successful in arresting bleeding in a patient, the subject of hæmophilia, who had, on a previous occasion, a bleeding of such severity and persistence that he had to remain in hospital for some months. In bleeding from leech-bites, in situations where pressure cannot be effectually applied, the hæmorrhage can often be quickly stopped by touching the bleeding points with the solid stick of nitrate of silver. Powdered matico-leaves, tannin, gallic acid, alum, and spirits of turpentine may be enumerated as styptics, and the last-named has many times proved successful in controlling hæmorrhage which has resisted other means of treatment.

Wherever it is possible, styptics should be applied on cotton-wool, which should be fixed in position with firm pressure; but if the bleeding be from an internal cavity, such as the bladder, a soluble styptic must be injected into it. With regard to internal styptics, it is only necessary to state that they are useless in the treatment of such cases of bleeding as are met with in surgical practice.

BILTON POLLARD.

SUBCLAVIAN ANEURISM. — In this class of aneurism are included only those cases in which the innominate artery is not involved; that is to say, it excludes all cases of aneurismal dilatation commencing in the arch of the aorta or the innominate artery, and extending into the subclavian. It also excludes all those cases in which the dilatation begins below the level of the lower border of the first rib. It is necessary to be somewhat precise in thus limiting the lower level of the subclavian artery, as very different anatomical points are adopted as the seat of its termination, especially by continental writers. Thus Kocher, in his elaborate essay on subclavian aneurisms, makes the artery terminate at the lower border of the pectoralis minor, and therefore includes many cases of what would be ordinarily termed axillary aneurisms. It frequently happens, however, that an aneurism commencing in the subclavian extends downwards into the axillary artery, and to these the term subclavio-axillary aneurism has been applied.

Subclavian aneurism is of fairly frequent occurrence, and is said to occupy, in order of frequency, an intermediate place between carotid and innominate aneurism. Considering the strains to which the subclavian artery must be subjected in the varied movements of the upper extremity, it seems surprising that more cases, the direct result of violence, are not met with. The aneurism may be seated in any part of the artery on the *right* side of the body, or it may occupy the whole course of the vessel from its origin to its termination. On the *left* side it is stated that aneurism only occurs in that part of the artery which is external to the thorax, and that the intra-thoracic portion is never the seat of aneurismal dilatation, except as a secondary result of primary dilatation of the arch of the aorta. The most common situation, however, for aneurism of the subclavian on both sides is in the third part of its course, external to the outer border of the scalenus anticus muscle. The aneurisms are usually of the fusiform variety, and are often of comparatively small size.

Causes.—Aneurisms of the subclavian artery are generally connected with extensive disease of its coats, and also of those of the arteries on the proximal side of the swelling, and to this pre-existing morbid condition of the vessel most of these cases are due. Thus of 121 cases tabulated by Poland, in 33 there were distinct proofs of atheroma, in 14 there was aneurismal dilatation of the aorta, and in 25 the aneurism was stated to be spontaneous and without any history of an injury, and therefore was presumably due to disease of the coats of the vessel. Of 43 cases out of the 121 in which the disease was ascribed to traumatic causes, in 13 atheroma was discovered, in 3 aneurismal dilatation elsewhere, in 23 there was no evidence as to

the presence or absence of atheroma, and in only 4 were the vessels declared to be healthy. It has been stated by some that the much greater frequency with which subclavian aneurism occurs on the right side (in the proportion, it is said, of three to one) is evidence that the disease results in a great measure from traumatic causes, from prolonged or repeated exertion of the right arm, or violent strains of this extremity. But the greater frequency of aneurism on the right side of the body may be explained in another way. The mechanical strain to which the arteries are subjected on the right side of the body is greater than on the left, on account of the larger amount of use to which the right upper extremity is put; and this may be the cause of a more extensive amount of atheromatous degeneration in the coats of the arteries on this side, which renders the vessels more inelastic, and predisposes them to a more frequent occurrence of aneurism on the right than the left side of the body.

The greater frequency of subclavian, as well as of other aneurisms, in the male than the female may be explained in the same way—that is to say, the greater strain to which the arterial system is subjected in the male, on account of the laborious occupations in which he is engaged, renders the arteries more liable to become the seat of atheromatous change.

Symptoms.—An aneurism of the subclavian artery is characterised by a swelling, generally ovoid or fusiform in shape, and usually situated in the subclavian triangle, just above the clavicle, and between the posterior border of the sterno-mastoid and the anterior border of the trapezius. It is often of small size, but may vary from that of a bean to an orange; after becoming diffused, it has been said to attain the size of a football or a child's head. When small, it may disappear behind the clavicle when the shoulder is raised; but generally, when the patient is standing erect in a position of ease, it presents itself as a prominent swelling above the clavicle, and can be distinctly seen to expand at each impulse of the heart. It presents the ordinary symptoms of aneurisms in general, consisting of a circumscribed, compressible swelling, with a distensile pulsation, and having the other characters which are described under Aneurism. Its pressure effects depend on the part of the vessel implicated. When the disease is confined to the third part of the artery, the brachial plexus and its branches may be pressed upon, producing numbness and sometimes pain down the arm and in the fingers, with weakness and loss of motion in these parts. There may be also pressure on the subclavian vein, and œdema of the hand and arm may be present. The external jugular vein is also commonly involved and becomes distended and varicose. When the aneurism is seated on the first portion of the vessel, the internal jugular and vertebral veins are pressed upon, giving rise to œdema and lividity of the head and face, and congestion of the brain, producing sometimes a semi-comatose state. It may irritate the phrenic nerve, causing a spasmodic action of the diaphragm; or, on the right side, the recurrent laryngeal nerve may be involved, causing a paralysis of the vocal cord on that side. It may likewise interfere with the trachea or œsophagus, producing stridulous breathing or dyspnœa and difficulty in swallowing, and finally it may press on the clavicle or first rib, causing erosion of these structures.

Diagnosis.—Two points have to be considered in the diagnosis of subclavian aneurism — 1st, its diagnosis from other tumours, and 2nd, its exact situation and diagnosis from aneurism in other vessels. The most common swelling for which subclavian aneurism may be mistaken is enlarged glands, which are often found in this situation. The character of the pulsation and the fact that, as a rule, the enlarged glands can be lifted off the vessel, when all pulsation ceases, is generally sufficient to establish the diagnosis. Chronic abscess may also be mistaken for aneurism, and aneurism for chronic abscess; but, by attention to the history of the case and careful manipulation, the true nature of the tumour can be made out. Mayo relates a case, in which an exostosis on the first rib pushed forwards and flattened the subclavian artery, and caused a prominent and pulsating swelling above the clavicle much simulating subclavian aneurism. A subclavian aneurism may be mistaken for a carotid or innominate aneurism, or even for one of the aorta itself, and it is often a matter of great difficulty to ascertain from which of these vessels the tumour springs. A sign of importance, in diagnosing between carotid and subclavian aneurism, is the character of the distal pulse. If the radial pulse is weaker on the affected side than on the other, the aneurism is probably subclavian; whereas, if there is a marked difference in the temporal pulses of the two sides of the body, it is probably carotid.

Prognosis.—At first small, a subclavian aneurism may for some time remain almost

stationary, or only increase very slowly. After a time, however, it augments rapidly, and has a tendency in many cases to become diffused. In the earlier stages, and sometimes even after it has been increasing rapidly, a spontaneous cure may take place. In some of these cases, pulsation suddenly ceases, as if the distal vessel had become blocked, and the swelling subsides; in other cases, there is a gradual diminution in the pulsation and an abatement in the severity of the symptoms, and the aneurism becomes solid and compact. When a subclavian aneurism becomes diffused, it loses its defined shape, contracts adhesions to surrounding parts, and approaches nearer and nearer to the surface. It may burst externally, or into the pleural cavity, bronchi, or trachea. It may cause death from pressure on the windpipe and suffocation, or from irritative fever and exhaustion.

Treatment.—Probably there is no class of external aneurisms in which the surgical treatment is so unsatisfactory and the outlook so gloomy as in subclavian aneurism. All the various means of treating external aneurism have been resorted to, with a very small amount of success and with repeated failures, and it becomes a question whether it is not more expedient to abandon these measures, and to treat the cases on the ordinary principles of internal aneurism, by rest, attention to diet, and medicine. At all events, in the majority of cases the surgeon will best fulfil his duty to his patient by endeavouring, in the first instance, to bring about this condition of so-called spontaneous cure by these means. But should they fail, or should the disease be spreading so rapidly as to preclude any attempt to cure the aneurism in this way, the question of surgical treatment will have to be considered. All the various plans of treating external aneurism have been adopted in these cases: pressure, either direct or indirect, both on the cardiac and distal side of the aneurism; proximal or distal ligature; injection of ergotin into the neighbourhood of the sac; manipulation; galvano-puncture and amputation at the shoulder-joint, have all been resorted to, though with a very scanty amount of success.

1. *Direct pressure*, where the aneurism implicates the third portion of the vessel, has been said to succeed in some cases, and its employment holds out a certain prospect of success. At all events, it can do no harm, and ought always to be tried in the first instance, either alone or as an accessory to proximal or distal pressure. It may be applied either by means of a weight, such as a bag of shot, or by a leaden cap. It is, however, difficult to apply satisfactorily, and in some of the cases in which a cure has been said to have been effected by these means, there is considerable doubt whether the recovery was not to be attributed to other causes.

2. *Pressure on the Cardiac Side of the Aneurism.*—On account of the position of the artery, compression can rarely be applied in this situation, and it is only in exceptional cases that the artery rises so high as to permit of pressure on its cardiac side. Poland records a case in which it was entirely successful, but this success was mainly due to the 'probable existence of a supernumerary cervical rib, and the unusually lengthened and abnormal course of the subclavian artery.' Acupressure, or direct compression of the exposed innominate artery, has been adopted in two instances by Porter and Bickersteth. In Porter's case the pressure was made after the artery had been exposed, by an instrument resembling a small lithotrite. The patient died on the tenth day from secondary hæmorrhage. In Bickersteth's case the pressure was made by a leaden wire passed round the vessel, and this, by means of a series of india-rubber springs, was made to compress the vessel so as to control the circulation. On the second day the wire broke, and the innominate artery was then ligatured. Death took place on the sixth day afterwards from hæmorrhage.

3. *Distal compression* by itself can hardly be expected to succeed, but may be useful as an adjunct to cardiac or direct pressure. Porter records a case in which the size and pulsation of the tumour was temporarily reduced by compression of the axillary artery, by means of a probe passed under the vessel, after it had been exposed and bridged over by a loop of wire. The benefit was only temporary, and the tumour recommenced growing.

4. *Proximal ligature* is the treatment which has been tried most extensively, but with almost uniformly bad results. Four different operations have been performed —viz. (*a*) ligature of the innominate; (*b*) ligature of the first part of the subclavian; (*c*) ligature of both subclavian and carotid, just beyond their origins; (*d*) ligature of subclavian, carotid, and vertebral, just after their commencement. To these T. T. Sabine proposes to add a fifth—viz. ligature of the carotid, the subclavian, and all the branches of the latter, except the superior intercostal. The innominate has been

ligatured in sixteen cases, and in every instance but one with a fatal result, and in that the common carotid was also tied, simultaneously, an inch above the bifurcation, and the vertebral artery on the fifty-fourth day, to control secondary hæmorrhage.

Ligature of the first portion of the subclavian has been uniformly fatal in all cases but two, from secondary hæmorrhage. It seems right, therefore, to banish this operation from our means of cure, until some form of ligature can be adopted which will be successful in preventing secondary hæmorrhage.

Ligature of the carotid and subclavian, just beyond the bifurcation of the innominate, has been advocated by some as a means of cure in subclavian aneurism. The object in tying the carotid is to render more certain the formation of a proximal clot in the innominate artery. Probably this end is achieved, but, the branches of the subclavian remaining pervious, so much blood is returned into this vessel as to prevent the formation of a distal clot, and secondary hæmorrhage therefore results. In three cases in which this plan was adopted, the treatment was unsuccessful.

In cases of subclavio-axillary aneurism, or aneurism low down on the subclavian artery, ligature of the second portion of the vessel by dividing the outer half or two-thirds of the scalenus anticus muscle is practicable, and has been followed by good results. Poland records twenty-one cases, of which nine recovered.

5. *Distal ligature* has been resorted to in a few cases, with uniformly bad results, and indeed it seems scarcely possible that any good can be expected from this plan of treatment, which would apparently have the result of increasing rather than diminishing the aneurism. For, between the sac and the ligature are the numerous large branches of the axillary, which would continue to be supplied by blood passing through the aneurism in such quantities as to preclude the chance of any consolidation taking place.

6. *Injection of Ergotin* into the tissues in the immediate neighbourhood of the sac has been employed, and in three cases by Langenbeck has been said to be successful. More extended observation requires to be made before it can be proved that any decided beneficial results are to be obtained from this plan of treatment. It is possible in those cases where recovery has been said to follow this operation, that the cure was spontaneous.

7. *Manipulation* was first recommended by Sir William Fergusson for the cure of subclavian aneurism. It has been adopted in some few cases, and in one case (Littré's) with the most satisfactory results. The treatment in most of the other cases, even if it has not been beneficial, at all events has done no harm, and it would therefore appear that it undoubtedly deserves a further trial. The cases in which this treatment is most applicable are those where there is a thick sac-wall, pointing to the probability of fibrine having been deposited in its interior, and where the aneurism is easily accessible.

8. *Galvano-puncture* has been tried in these cases, in one instance with success. The result of the same treatment in aneurisms elsewhere is not such, however, as to encourage us to hope for any but the most temporary relief from this measure; though at the same time it must always be regarded as a possible means of cure in cases which cannot be treated in any other manner. *See* Electrolysis; Acupuncture.

9. *Amputation at the Shoulder-joint.*—This formidable measure was first suggested by Sir William Fergusson, as a mode of treatment in cases of subclavian aneurism which are inaccessible to any other plan of treatment, and in which the aneurism is rapidly increasing and evidently must soon terminate the existence of the patient. It must be confessed that this is a desperate measure, since it involves the loss of a most important member (in very many instances the *right* arm), and ought to be reserved for those cases in which it is quite evident that the aneurism is rapidly increasing, and that other means are of no avail; or, in those cases where the limb is gangrenous, or threatens to become so. Certainly, it seems preferable to adopt this measure rather than to resort to any of the formidable operations of ligature of the arteries on the cardiac side, to which allusion has been made, and which have almost invariably terminated fatally.

To sum up. It would appear that in cases of subclavian aneurism an attempt should first be made by rest, careful dietary, and medicinal treatment, to bring about the so-called spontaneous cure. Failing this, if the aneurism is situated in the third part of the artery, direct pressure, and then manipulation, should be fairly tried, since these measures hold out the best prospect of success. If the disease is in the first portion they cannot, however, be adopted; and it may be right to perform the distal operation by tying the third portion of the subclavian, as a preliminary to amputation

at the shoulder-joint. If these various plans have been thoroughly tried, and in spite of all treatment the aneurism is increasing, amputation at the shoulder-joint holds out a better hope of preserving the patient's life and curing his aneurism than any form of proximal ligature, and ought certainly to be adopted.

T. Pickering Pick.

SUBCLAVIAN ARTERY, The.—This vessel carries blood to the upper extremity, to the side of the neck, and to the brain. The right vessel starts from the bifurcation of the innominate, the left from the aortic arch beyond the left common carotid. Each artery is divided into three stages by the anterior scalene muscle. The relations of the first stage differ on the right and left sides, but the second and third stages on the two sides are similar.

I. The first stage of the right subclavian passes from the innominate to the inner border of the anterior scalene muscle. It extends forwards, upwards, and outwards from the right sterno-clavicular articulation.

In *front* are the cutaneous structures and the muscles attached to the inner end of the clavicle; but immediately on it are the internal jugular and vertebral veins, the pneumogastric nerve, and sympathetic cardiac nerves. *Behind*, the longus colli muscle, the sympathetic cord, and the recurrent laryngeal nerve. *Internally*, the common carotid artery and the trachea. *Externally* and below, the pleura and the recurrent laryngeal nerve.

The first stage of the *left subclavian* passes from the aortic arch to the inner border of the left anterior scalene muscle; its length is three and a half inches. In *front* are the left lung and pleura; *behind*, the longus colli, the œsophagus, and the thoracic duct; to the *outer* side is the pleura; on the *inner* side is the trachea, œsophagus, thoracic duct, recurrent laryngeal nerve, and the left carotid artery. The pneumogastric and phrenic nerves, and the internal jugular and subclavian veins, converging to form the left innominate, are on a plane anterior to the vessel.

Ligation.—On the right side the artery is exposed by the same operation as that described for the Innominate. On the left side the vessel is exposed as follows:—Place the patient in the recumbent position; depress the shoulder; make an incision from the sternal notch upward along the inner edge of the sterno-mastoid for a distance of three inches; another, a horizontal incision, is commenced one inch above the lower end of the former, and carried outwards for a distance of two inches, half an inch above the clavicle. Reflect the flap, with the sterno-mastoid detached from its origin; avoid or tie the anterior jugular vein; divide and raise the sterno-hyoid and -thyroid muscles; with the forefinger feel for the inner edge of the anterior scalene muscle; pull inwards the internal jugular vein. Pass the needle from before backwards—i.e. below upwards—avoid the phrenic, and keep close to the vessel to avoid the pleura.

II. The second stage of the artery is that behind the anterior scalene muscle; in length it is about three-fourths of an inch.

In *front* is the anterior scalene muscle, and on the muscle lie the phrenic nerve, and the transversales colli and humeri arteries. *Behind*, the cord of the brachial plexus formed by the eighth cervical and first dorsal. *Below*, the pleura, and *above*, the brachial plexus.

Ligation of the second stage is performed by steps almost identical with those for ligation of the third, until the outer edge of the scalene muscle is reached. It is then necessary to cut the muscle for some distance. To do this, feel for the scalene tubercle, pass a director behind the muscle, and nick, or cut it to the extent of half an inch or even two-thirds of its breadth; the danger of cutting too far lies in wounding the phrenic nerve. The lower down the muscle is cut the safer is the nerve.

III. The third stage of the subclavian passes from the outer border of the anterior scalene muscle to the outer border of the first rib. The length is about two inches.

In *front*, are: the skin; superficial fascia with clavicular branches of the superficial cervical plexus of nerves; platysma; deep fascia. The clavicle, the subclavius muscle, the supra-scapular artery, and the subclavian vein run nearly parallel courses in front of the artery. The external jugular vein and the nerve to the subclavius cross it. *Behind* is the middle scalene muscle, separated by the lowest cord of the brachial plexus. *Below*, the first rib and the first serration of the serratus magnus, and *above*, the cords of the brachial plexus.

Ligation.—Place the patient in the position of repose, with the shoulder depressed. The operator takes his stand between the abducted upper limb and the trunk. Pull the skin down over the centre of the clavicle; cut for a distance of three inches along the centre of the clavicle, severing the cutaneous structures and the platysma. Allow the skin to retract; avoid the transversalis colli

and humeri veins if possible, and open the deep fascia. With a director or knife clear the tissues between the posterior belly of the omo-hyoid and the clavicle. Draw the muscle mentioned upwards; feel for the scalene tubercle and the arterial pulsations, and clearing the front of the artery and opening its sheath, pass the needle, with the left forefinger on the scalene tubercle, from behind forwards to avoid the brachial plexus. It is best to pass the needle obliquely. Difficulties and dangers: (1) Wounding the external jugular vein by cutting too far forwards. (2) Wounding an abnormal cephalic by cutting too far out. (3) Venous bleeding to a great extent from the transversalis colli and humeri veins. Veins, when bleeding, are to be compressed or tied. (4) Finding the omo-hyoid bound down, or attached, to the clavicle. (5) The sterno-mastoid muscle or the trapezius, or both, may require cutting, owing to their wide attachments to the clavicle. (6) Picking up the lowest brachial cord. (7) Wounding the subclavian vein. (8) Difficulty in seeing the needle-end when it is passed, owing to a deeply-placed artery in a short, fat neck, with a high clavicle.

JAMES CANTLIE.

SUBCONJUNCTIVAL ECCHYMOSIS (Hyposphagma).—The rupture of a small vessel under the bulbar conjunctiva is a frequent occurrence. It suddenly gives to 'the white of the eye' a more or less extensive purple hue, which causes the patient much concern. It is common in old people, but may occur in the young, and even in children, from severe straining, as in hooping cough, vomiting, or raising heavy weights. It is of not the slightest importance, doing no damage to the eye.

Treatment.— If no measures be taken, the extravasated blood gradually becomes absorbed. The process may be hastened by the application of a tight bandage.

H. R. SWANZY.

SUBCUTANEOUS INJECTION. *See* HYPODERMIC INJECTION.

SUBPERIOSTEAL RESECTION.— Since the beautiful experiments of Ollier, there has always been a fascination for subperiosteal operations, partly on account of the regeneration of bone, and partly on account of the intimate relation which the tendons have with the new bone obtained by this method. But opinion has changed very much as to the desirability of subperiosteal resection in the treatment of joints. There is no mechanical difficulty in the operation when it is done for disease, for the periosteum, being thick and vascular, peels off very readily from the bone. But, in the case of primary excision for injury, the periosteum is with difficulty preserved uninjured, being in no way distinguishable from a loose connective tissue. In such cases, the amount of bruising and laceration, to which it is necessarily exposed by the use of the raspatory and elevator, defeats the object with which it has been so carefully preserved, and as a consequence the periosteum frequently dies.

First, then, as to *joints*, the advantages of this particular method of excision, even when successfully accomplished, are very doubtful, for the amount of bone that may be and often is thrown out around the new joint will, if excessive, increase the difficulties of obtaining a movable joint. In the knee, where complete osseous ankylosis is desired, there is very little periosteum to preserve, so that, in the only joint in which such new bone would be an advantage, there are no means of doing a subperiosteal resection. *See* JOINTS, Excision of.

Another very serious objection to this method in the case of diseased joints and carious bones is that, in preserving the periosteum, some risk is run of a return of the disease when the new bone is produced.

Consequently, as far as joints are concerned, this method of operating is not in such general favour as it was some years ago, when first suggested by M. Ollier. And the experience of most surgeons is that the older operation, in which the periosteum is not so carefully preserved, yields as good if not better results than the more tedious and prolonged operation of subperiosteal resection.

In some cases of excision of a joint, a considerable portion of the shaft of a bone may require removal. Under such circumstances, the periosteum should be carefully preserved, to prevent the shortening of the limb that might otherwise occur; but the instances in which this is necessary are very few in number, and do not invalidate the argument that has been previously given as to the objection against the general adoption of subperiosteal resection of joints.

For *caries of bone* this method of removing the disease may be of service, as, for instance, in excision of the os calcis; but there is some danger of a return of the disease, as has been already pointed out. *See* CARIES, Causes of. But there is not much evidence forthcoming as to this possible result, so that the objection may after

all be a fanciful one. The periosteum is very easily lifted from the bone, and should, as far as possible, be left connected with the tendo Achillis, this connection with the new bone being one of the main objects of the operation.

In *acute necrosis*, this operation will be found of undoubted value. Where the whole or greater part of the diaphysis of a long bone has suddenly become necrosed in acute diffuse PERIOSTITIS (as has been pointed out in the article on that subject), the dead part may be exposed and quickly removed in the earliest stage of the disease before any new bone has been formed by the inflamed periosteum. The long and tedious course of the disease is thereby considerably shortened, and instead of waiting till the periosteum has formed an invaginating sheath, which is the representative of the new shaft, as was formerly the practice, the dead bone is at once removed, and the suppuration thereby reduced to a minimum. A very natural fear has always been entertained that the new shaft would not be of the same length as the old one, even if its thickness and strength were equally good. When two bones exist side by side and only one is affected, as in the case of the tibia and fibula or the radius and ulna, this fear would appear to be groundless; and the experience of many surgeons has proved that, in these instances, the healthy bone maintains the length of the limb while the periosteum of the other is forming new bone. In single bones, such as the femur and humerus, a very large portion of the shaft has been successfully removed before the periosteum has formed its invaginating sheath, and no shortening has been observed. But the writer is not aware that any surgeon has successfully performed subperiosteal resection in the manner above indicated of the *whole* shaft of either the humerus or the femur without a very considerable shortening of the limb.

Transplantation of bone was thoughtfully designed for a case of this kind by Dr. William Macewen of Glasgow, and successfully carried out in 1879 and 1880. The whole shaft of the humerus had been removed from the upper and lower epiphyses by subperiosteal resection, and doubts were at that time entertained as to the integrity of the periosteum. The wounds healed completely in a few months, but bone was only reproduced for about an inch and three quarters from the head of the humerus. From this point down to the condyles it was completely absent, leaving a deficiency of over two-thirds of the humeral shaft. The arm was therefore to a great extent useless, for there was no fixed point from which the elbow could act. The condition was the same a year afterwards, when the first operation of transplantation of bone was successfully accomplished. Wedges of bone, with the periosteum which covered them, were removed from some cases of deformed tibiæ which were at that time under the care of Dr. Macewen, and utilised for the purpose. These were cut into small fragments and inserted in a groove that had been previously made between the muscles of the arm, immediately adjoining the upper extremity of the humerus.

'The former presence of bone was nowhere indicated, and the sole guide as to the correct position into which the transplant was to be placed was an anatomical one.' This operation was performed three times, when the gap was completely filled up. The ultimate result at the end of a year and four months was a most brilliant success, for the bone was firmly united throughout its whole length, and only half an inch shorter than its fellow. See *Bone-Grafting* under GRAFTING.

If transplantation in this way proves on further experience to be as successful as it was shown to be in this case, then there will no longer be the same objection to removal of the whole shaft of a long bone as there appears to be at the present time.

In *amputation* through the shaft of a long bone, periosteal flaps may be advantageously made, a method which is distinctly derived from the other subperiosteal operations. It diminishes the chance of subsequent necrosis of the sawn surface of the bone, covers over any little irregularity of the section, and, by the rapid formation of new bone at the end of the stump, produces a rounded end to the bone more quickly than is obtained by the older method of amputation. After making a circular sweep round the bone, the periosteum may be pushed back with the elevator, and the saw applied. If done in this way there is very little delay, and the operation is not materially lengthened. H. H. CLUTTON.

SUBUNGUAL EXOSTOSIS.—This almost always occurs on the great toe, arising with a sessile base from the last phalanx. It is common in early life, and more frequent in girls. Its structure is that of spongy, cancellous bone, tipped with a layer of cartilage. Its size is usually that of a small currant. As it occasions, if allowed to persist, much inconvenience in

walking, it should be removed early, and completely as well, otherwise recurrence and sarcomatous changes are very likely to occur. Ether being given, and as much of the nail removed as will thoroughly expose the exostosis and its base of origin, a deep groove is to be cut round the exostosis with a small, strong-backed scalpel, and removal completely effected with fine-cutting bone-forceps. The foot should be kept quiet for a few days on a back splint, and one of the following dressings made use of: iced lead-lotion, carbolic oil (1 in 40), or a saturated solution of boracic acid applied by means of two thicknesses of lint, the deeper one of which is only removed once in twelve hours, the other being resoaked and re-applied every two or three hours.

W. H. A. Jacobson.

SUPPOSITORIES are preparations of drugs, which are moulded in the shape of small cones suitable for administration by the rectum.

The Pharmacopœia authorises suppositories containing morphia, lead and opium, tannic acid, mercury, carbolic acid and iodoform; but many other drugs may be advantageously administered, in the form of suppositories or pessaries, which differ from suppositories only in their larger size, and in being used in the vagina instead of in the rectum.

Cocoa butter is very frequently used as the menstruum for suppositories; it melts quickly, and so the full effect of the drug which it carries will be quickly obtained. Curd soap is ordered in the Pharmacopœia for tannic acid and carbolic acid suppositories. Morphia suppositories are directed to be made either with cocoa butter or curd soap. Curd soap dissolves slowly, and so the local effects of drugs mixed with it will be more prolonged. Suppositories may also be made of gelatine and glycerine, in the proportion of one part of the former to four of the latter.

Nutrient suppositories may be efficiently and easily made in either of the following ways:—1. Take equal weights of concentrated peptonised milk and cocoa butter; warm the cocoa butter in a mortar and mix the peptonised milk with it; then divide and mould the mixture into suppositories weighing a drachm and a half. Each suppository will be equivalent to about an ounce and a half of milk. 2. Take equal parts of Koch's meat peptone and cocoa butter; warm the latter and mix the peptone with it, and mould the mixture to the required shape.

Rectal medication is useful when, from any cause, medicine is rejected by the stomach, or when the local effects of the drugs are required.

Suppositories may be either anodyne, purgative, astringent, disinfectant, or nutritive. Morphia (gr. ½) and belladonna (gr. ½ to 2) are the most useful anodynes; but if their employment be objectionable, iodoform suppositories (gr. v.) will often be found useful. After operations on the rectum, anus, urethra or bladder, the introduction of a half-grain morphia suppository into the rectum is followed by great relief from both pain and spasm. A similar suppository is very valuable for allaying the pain consequent on disease of the surrounding organs—e.g. in acute cystitis with strangury and in painful chordee.

The introduction of a piece of soap into the rectum is a well-known popular remedy for constipation. Suppositories containing aloine (gr. j.), elaterium (gr. ¼), gamboge (gr. v.), or podophyllin (gr. j.), may, in suitable cases, be employed as rectal purgatives.

Astringent suppositories may be employed for catarrh or simple ulceration of the rectum or vagina, and disinfectant ones may be serviceable in malignant ulceration of the rectum or uterus, &c.

Nutrient suppositories offer no advantages over nutrient enemata, except the ease with which they may be administered. In introducing a suppository into the rectum, it should be oiled and pushed well beyond the internal sphincter; a little support should be maintained for a few seconds until any reflex contraction of the rectum has subsided. When the sphincter ani has been divided, as in the operation for fistula, the suppository must be passed well up into the rectum, and the anus must be supported by a pad and bandage.

Bilton Pollard.

SUPPRESSION OF URINE, or the failure of the kidney to secrete—also spoken of sometimes as anuria—is produced in several ways. It may be due to chronic organic disease of the glandular portion of the kidney or to disturbance of its innervation or vascular supply, or, finally, to sudden obstruction of the ureter, leading to complete arrest of its functions. The first of these causes is easy to understand: the organ has more or less gradually undergone fibroid change, as the result usually of one or other form of interstitial or catarrhal nephritis; but of the other two it is not easy to speak definitely. This much, however, may be said, that whether we speak of disturbances of

vascular supply or of innervation, the immediate cause of the suppression of urine has been found to be, in many cases verified by necropsy, an intense congestion of the kidney; in other rarer cases it is probably anæmia of the organ. Thus, in the acute fevers, such as scarlatina, where anuria has proved a fatal symptom, renal congestion has been observed, probably in this case due to the direct action of the morbid matter of the disease upon the renal capillaries; this seems the more likely when we remember that the same effect is produced by overdoses of turpentine, acetate of lead, or the mineral acids. In all these instances the deeply congested organ is unable to excrete more than perhaps a few drachms of dark, highly concentrated and blood-stained urine as long as the hyperæmia lasts. But, in suppression from severe shock to the system after injuries, the matter is not so clear, and requires further study; possibly in these cases anæmia of the organ is the cause. The difficulty surrounding these questions is much enhanced by the fact that the amount of blood found in the kidney *post mortem* seems to vary considerably within the range of health, the organ sometimes looking very pale or turgid where we have no grounds to suspect morbid change.

One form of disturbance of innervation producing suppression, not infrequently met with, gives us, perhaps, a clue to the whole question, and this is the effect upon the kidney of violence to the urethra. Every surgeon is familiar with the fact that after operations upon the urethra ranging from the simple passing of a catheter to bursting of a stricture, or internal urethrotomy, more or less complete suppression of urine is seen from time to time, and this in the healthiest individuals. In these cases the patient may not secrete more than a few drachms of high-coloured blood-stained urine for many hours after the operation, and may exhibit much constitutional disturbance; he may even die unrelieved. If this be so, we find nothing but intense congestion of the kidneys to account for the anuria. Nothing appears to account for these phenomena so fully as the theory of reflex vaso-motor disturbance of the organ; but the exact mechanism of the change requires further study.

In the case of suppression from *sudden* blocking of the ureter by a stone or fragment of growth, the effect upon the kidneys appears to be practically the same. Only a few drachms of urine are found in the ureter and pelvis; but this urine is usually clear, pale, without albumen, deficient in urea, and of low specific gravity. The kidney in some of these cases is found enlarged and deeply congested, in other cases anæmic and mottled, and not larger than usual. It is somewhat hard to reconcile these differences, but it may be that both the congestion and anæmia are merely the result of different stages of the same reflex disturbance of nervous balance in the kidney, due to stretching of the urethral walls from sudden impaction of stone, just as in the case of violence to the urethra.

The *symptoms* of suppression of urine are usually very trifling until several days have elapsed. Gastric disturbance, loss of muscular vigour, and insomnia are often seen early; but the characteristic evidences of uræmia are often delayed until perhaps a week has elapsed. When they once appear they become intensified, and death takes place in a few days, usually from the ninth to the eleventh. The characteristic signs of uræmia are muscular twitchings, contraction of the pupils, loss of muscular power, and, as a consequence, laborious breathing. Insomnia is usually very distressing, but coma and convulsions are exceptional; diarrhœa and vomiting are rare unless produced artificially; anorexia is only a very late symptom. The skin often acts profusely, and there is no dropsy or ammoniacal odour from the surface of the body or breath; the pulse has a tendency to rise, and the temperature to fall, as also the respirations (Roberts).

The *prognosis* where suppression is extreme is very bad. Cases are known to have recovered where it has lasted for seven or even fifteen days, but death takes place in the majority of cases before the eleventh day.

The *treatment* of suppression of urine depends of course upon the cause. It resolves itself into local and general. If due to chronic interstitial change, but little can be done locally beyond protecting the loins from sudden changes of temperature. The general treatment will embrace warm baths or vapour baths, the use of pilocarpine and all other measures promoting excretion from the skin; laxatives may also be cautiously employed, but not diuretics as a rule. The diet should be light, consisting chiefly of milk; stimulants should be very cautiously used. Where we have reason to suppose that anuria is produced by renal congestion, wet cupping over the loins, or bleeding from the arm in strong individuals, and dry cupping in the anæmic are most valuable. These measures should be followed up by hot belladonna fomentations over the loins

and abdomen and the general treatment recommended above. The use of instruments should be avoided as far as possible. Where suppression follows upon the impaction of a stone in the ureter, the treatment is directed in the first place to efforts to relax the contraction of the ureter by antispasmodics—as belladonna, chloroform, or even opium used cautiously, together with hot baths of one kind or another. In the second place an attempt should be made to dislodge the calculus by mechanical means, i.e. by placing the patient's body in various positions while kneading over the track of the ureter is practised with the hand: the patient may also be encouraged to active exercise. If these measures fail and the evidence of the presence of a stone is clear, it may be justifiable to cut down upon it from the loin, and either extract the stone or establish a urinary fistula in the flank, if the former be impracticable.

ARTHUR E. BARKER.

SUPPURATION. — Inflammation is said to terminate in suppuration when the exudation is sufficiently corpuscular to form a yellowish fluid—pus. This may escape from a mucous or cutaneous surface, or an open wound; or it may accumulate within an organ or natural cavity—e.g. a joint—in the form of an abscess.

In the case of interstitial inflammation, it is generally conceded that the whole or greater part of the pus is composed of migrated leucocytes and liquor sanguinis; that, in fact, the connective-tissue corpuscles, instead of responding to the irritation by proliferating, remain perfectly passive throughout the entire process. On the other hand, it seems clear that, in catarrhal inflammation of the skin and mucous membranes, the epithelial cells—which, by the way, are physiologically subject to perpetual growth and multiplication—furnish a by no means inconsiderable number of the cellular elements of pus.

There are several circumstances, one or more of which determine suppuration, and favour its continuance when established.

(1) *The degree of injury* to the vessels must be such as to entail exudation of plasma and leucocytes, too copious for the lymphatics to carry off the surplus beyond what can be accommodated by the tissues, consistently with the maintenance of their vitality. If the irritation be too great, stasis rapidly supervenes; the blood coagulates in the vessels, and acute interruption of the exudation ensues. The tendency then is to gangrene.

(2) *Continuation of the irritation.*—A tissue, especially if previously healthy, may be able to withstand a severe injury, and quickly recover from the effects of it, provided the cause be at once removed. On the other hand, if it be allowed to act indefinitely, the power of resistance becomes less and less; the walls of the vessels are so damaged, and the circulation hampered by the pressure of the exudation, that resolution of the inflammation may be impossible.

(3) *The entrance of air* into a wound is a very important factor, as the records of clinical surgery abundantly prove. This is nowhere better exemplified than in fracture of the bones. Even comminuted *simple* fractures habitually unite without the occurrence of suppuration; whereas pus-formation is the rule in compound fractures, and a certainty if the wound is allowed to remain open and unprotected by antiseptic dressings. It is not merely the entrance of air, as that in itself is not harmful, but the admission of organisms contained in the atmosphere, organisms which possess the property of setting up fermentative changes in the products of inflammation. There is thus added to the mechanical injury the irritation by decomposed organic matter. Conversely, the inflammation may be reduced, and, it may be, entirely subdued, by arresting these putrefactive changes.

(4) *Tension* exerts a potent influence on the course of suppuration. It is well known that, so long as an acute abscess remains closed, the signs of inflammation continue unabated. When it bursts or is opened, they subside with surprising quickness. The improvement is not confined to the local lesion, for the constitutional disturbance—the fever—shows at the same time a corresponding decline in intensity. The higher the tension the greater the febrile symptoms and the pain; hence, the importance of the early evacuation of abscesses situated beneath resisting structures like the periosteum, dense fasciæ, &c.

(5) *Friction* is another cause of retarded healing of suppurating wounds. Ulcers of the leg, e.g., continue to secrete pus whilst the dress is permitted to fret the granulating surface. The obstinacy with which sinuses remain open for want of rest and apposition of their walls is proverbial.

(6) *The constitutional condition* of the patient and the *state of local nutrition* must not be neglected here. The result of any injury to a person in good health, and one reduced by acute disease or the subject

of profound cachexia, will be widely different. Depressed vitality, general and local, is at once the cause and consequence of continued suppuration; hectic fever, e.g., whilst it indicates prolonged discharge of pus, tells against the chances of repair of tissues. The cicatricial formation in the wall of a chronic abscess, by diminishing the vascularity, offers an effectual bar to the growth of vigorous granulations.

Scrofulosis greatly increases the pyogenic tendency, and thus underlies the development of suppurative fever.

In *diffuse interstitial suppuration*, the lymph or granulation-tissue melts away so rapidly that there is no chance for limitation of the action of the irritating products; whereas the walls of an acute local abscess, although being continually changed into pus (Billroth), offer a greater resistance to the absorption of irritant matter.

In the so-called pyogenic membrane, or suppurating zone of an acute abscess, the granulation-tissue contains only the remains of the old vessels. So long as suppuration is going on, there is only destruction. New-formed vessels are evidence of repair.

Pus, the anatomical product of suppuration, varies in composition according to the rate at which it is secreted, and the tissue in which it is formed, and whether or not it has been exposed to the air. Healthy, laudable pus, e.g., from an acute abscess, is a creamy, yellowish, somewhat viscid fluid; specific gravity 1,030 to 1,033. It contains about 88 per cent. of water, and a little over 8 per cent. of albumen. The latter fact should be borne in mind when considering the existence or extent of albuminuria in cases of 'pus in the urine.' Traces of leucin, tyrosin, and other products of the dissolution of proteid matter are present. It is rich in chloride of sodium, and is alkaline in reaction. Liquor potassæ forms with it a gelatinous mass. If allowed to stand, it divides into two strata, the upper a clear fluid—*liquor puris*—the lower a yellow sediment. On microscopical examination, it is seen that the deposit consists mainly of opaque corpuscles $\frac{1}{2500}$ to $\frac{1}{3500}$ inch in diameter. They are granular from the presence of fatty and albuminoid particles. Acetic acid clears up the latter and brings into view the nuclei, two or three in number. Some of the corpuscles contain only one nucleus, and resemble leucocytes in every way, their nuclei being visible, as a rule, without the aid of reagents. The fat-granules can be dissolved from pus-cells by ether or liquor potassæ. The corpuscles of Gluge are merely inflammatory cells swollen and crowded with granular fat. Cornil and Ranvier refer the multiplication of the nucleus to a vital process; others look upon it merely as the result of disintegration after the death of the corpuscle. Pus-cells are devoid of a capsule.

The pus from a closed acute abscess contains *micrococci*, which are incapable of setting up putrefaction. Rod-shaped *bacteria* are found in abundance in pus that has been exposed to the atmosphere; they are the active agents of septic decomposition. In some cases of infective septicæmia, longer rods, *bacilli*, are met with.

Pus-corpuscles may be pigmented by the colouring matter of the blood, when hæmorrhage has taken place into an abscess or wound. *Blue pus* owes its peculiarity to the presence of *micrococcus cyaneus*, a fungus not found in the contents of a closed abscess. The pus from cerebral abscesses is usually of a greenish tint.

Fluids resembling Pus.—(1) *Disintegrated, liquefied, decolorised blood-clot.* This was mistaken as the proof of suppurative endophlebitis, until Goodsir exposed the fallacy. (2) *Atheromatous matter*, which consists largely of the fatty débris of degenerated cells and cholesterine plates. (3) *Turbid serum*, which in reality is serum charged with pus-corpuscles, endothelial cells, and, it may be, films of fibrin. It is furnished by the serous membranes, pleuræ, &c. (4) The secretion obtained *post mortem* from the Fallopian tubes and renal papillæ. The creamy appearance is due to fatty epithelial cells. (5) Inspissated milk, like that composing a galactocele.

Pus from a Chronic Abscess has often the unpleasant odour of the fatty acids. It varies in consistence from serum to firm cheesy matter; when thin, the fluid portion holds in suspension flocculi of fibrin, fat-granules, very few cells, crystals of cholesterine, and it may be of hæmatoidin and stearic acid. There may be shreds of necrosed tissue. When the suppuration is connected with bone, lime-salts are in excess, and minute sequestra are sufficiently common. Finally, inspissated pus may undergo calcareous infiltration. Microscopical organisms are absent.

The pus from a *gouty abscess* is gritty, being laden with needle-shaped crystals of *urate of soda*. Augustus J. Pepper.

SUPPURATIVE FEVER.—Fever is not an essential concomitant of suppuration, for it is usually absent during the formation of a chronic abscess, and there is

no pyrexia associated with the discharge of pus from a healthy granulating wound.

Primary Suppurative Fever, such as occurs in the course of an ordinary acute abscess, is not infective; nor is it due to absorption of the products of putrefaction. The pyrogenous matter taken up from the seat of suppuration is incapable of multiplication in the system.

The body temperature rises to about 103° F., but there are no steep fever curves, the morning remission being usually 1°. It remains at its height until the matter is discharged, when it suddenly falls, and soon reaches the normal, if there be ample drainage and the cavity be protected from infection. The relief from the high tension checks absorption. If the fever be high and the abscess large, the patient may experience chills or even severe rigors.

Secondary Suppurative Fever.—*Hectic fever* is septic, but not infective. The proximate cause is absorption of decomposing—not necessarily putrefying—pus, charged with bacteria. Exceptionally, it follows close in the wake of primary traumatic or primary suppurative fever, but far more frequently it is the consequence of long-continued absorption of septic matter in small doses. It is seen to perfection in the disintegration of the walls of large open abscesses, especially where drainage and disinfection of the discharges are difficult: hence its connection with bone-disease—e.g. caries of the spine, and suppuration in the joints. Constitutional debility is largely concerned in its incidence and progress. Hectic fever is absent so long as a chronic abscess, however large, remains closed. *See* Hectic Fever.

Symptoms.—The fever is remittent in type. The temperature, which in the evening is 103° F., or even higher, may fall to the normal in the morning. There is a tendency to regularity in the diurnal variation, so that the register is a series of steep curves. The general symptoms, which are more marked in the evening, are those of exhaustion. The want of tone in the vasomotor system is evinced by the flushed cheek, profuse sweatings, and soft rapid pulse. Lithates are deposited in the urine. The patient's strength is further depleted by colliquative diarrhœa. There is great muscular weakness and rapid emaciation. The pupils are dilated and the eyes glistening. In fatal cases death takes place from asthenia.

The *prognosis* is always grave. It is worse in scrofulous subjects, and in all cases where it is impossible to remove the cause of the suppuration.

Treatment.—The indications are (1) to secure free escape for the pus; (2) to render the pus aseptic; (3) to check excessive secretion from the skin and bowels; (4) to support the strength by nutritious, easily digestible food, tonics—of which quinine is the best—and alcoholic stimulants in quantity proportionate to the degree of exhaustion; (5) to prevent the formation of bedsores. For the profuse sweating belladonna is the appropriate remedy. When the temperature is high, tepid sponging affords decided relief. But chief reliance must be placed in quinine given in 5- to 10-grain doses.

Augustus J. Pepper.

SURGICAL FEVER.—The various forms of pyrexia, which occur in 'surgical' disorders, are sometimes grouped together under the title of Surgical Fever. The employment of this term, however, is obviously disadvantageous, as unwarrantably involving the assumption that there is a difference of kind in the pathology of pyrexia met with in 'surgical' cases, from that which characterises most 'medical' ailments.

The following are the varieties of pyrexia which are met with in practical surgery:—

1. Simple Traumatic Fever. *See* Traumatic Fever.

2. Aseptic Fever. *See* Antiseptic Surgery.

3. Septic Fever (q.v.)—(*a*) *Sapræmic Fever, see* Sapræmia; (*b*) *Septicæmic Fever, see* Septicæmia; (*c*) *Pyæmic Fever, see* Pyæmia.

4. Neurotic Fever, including Urethral Fever.

Pathology.—Considering the want of exact information on the subject of heat-production in the body, and considering how little is known of heat-regulation under *pathological* conditions, it would be out of place here to review the various theories, of more or less problematical value, which have been devised to explain the well-known process of fever. In view, however, of the paramount importance of the subject as essentially a practical one, the general notions on the subject, which prevail at the present time, will be here enumerated.

The process of fever presents the following phenomena:—

(1) There is increased tissue-destruction (oxidation or combustion).

(2) As a result of this there are the following changes:—

Physico-chemical.—(*a*) Increased production of heat; (*b*) increased production

of waste products; (*c*) degenerative changes in tissues.

Functional.—(*d*) Acceleration of heart-rate; (*e*) acceleration of breathing rate; (*f*) vaso-motor contraction and relaxation of arterioles, formation of rash, &c.; (*g*) increased secretion; (*h*) diminution of assimilative power; (*i*) clonic spasm (*see* RIGOR); (*j*) diminution of mental power and production of delirium.

The above familiar facts require no explanation or amplification, and it only remains to notice, in addition, the condition known as *hyperpyrexia*. This state, which to outward appearances is simply an exaggeration of ordinary physico-chemical change, shows itself symptomatically by a rapid rise in the temperature, and leads, unless adequately treated, to a fatal issue. Its causation is more obscure than that of simple fever, since it occurs under circumstances where, apparently, no change has been observed in the condition of the patient.

Etiology.—Little can be said of the etiology of the febrile process in general, seeing that it necessarily differs according to the exciting cause in each instance; but, as far as individual peculiarities go, it appears that age plays an important part in determining the intensity of the process to some extent. As might have been expected, the tendency to perversion of the balance between the production and regulation of heat is greatest at the time when the metabolic processes are most active; for this reason it gradually diminishes with age. It is uncertain whether sex and other conditions really influence the febrile process; but race does seem to cause a predisposition to it, especially where the causation can clearly be traced to changes in the nervous system.

Causation.—Fever may be caused by—(1) Lesions of the nervous system. *See* NEUROTIC FEVER. (2) Absorption of specific poisons called contagia. (3) Absorption of certain chemical substances.

At the present time (having regard to the alterations in the bodily functions produced by fever), it is generally believed that the above causes of fever act by influencing the central nervous system, so (*a*) increasing heat-production directly, or (*b*) removing inhibitory action over the degree of tissue-metabolism. This belief, which practically assumes the existence of heat-centres governing the production of heat by regulating both tissue-change and vascular capacity, is supported by many facts of clinical experience which need not be detailed here.

Symptomatology. — For any special points not enumerated in the list of symptoms of fever sketched above, the various articles on each variety of fever must be referred to.

Treatment and Prognosis.—The details of both treatment and prognosis of fever, as seen in surgical cases, will be found under the headings enumerated at the beginning of this article. VICTOR HORSLEY.

SURGICAL KIDNEY. *See* PYELONEPHRITIS.

SUSPENDED ANIMATION may be defined as a condition in which all the coarser manifestations of life are in abeyance; in which the patient is motionless and senseless, with arrested respiration, and scarcely any recognisable evidence of the heart's action.

An exhaustive treatise on the subject should include a discussion on the hybernation of animals, and those other conditions in which the arrest of animation consists mainly in the stoppage of the mental faculties, as is seen in coma, sleep, the mesmeric trance, and some forms of melancholia; but, in a practical work like the present, it is necessary to confine our attention to those forms of suspended animation which the surgeon is called upon to treat.

These are *two* in number—viz. *syncope* and *asphyxia*.

SYNCOPE, or fainting, is brought about by failure of the blood-supply to the brain. Such failure may be due to causes situate in the heart itself, as anæmia, or fatty degeneration of the cardiac muscle, or valvular disease; or the heart may fail from faulty or perverted innervation, brought about by causes acting through the mind (such as fear or the sight of blood), or through the body, such as an overcharged stomach or a sudden injury. These are examples of reflex action in which a peripheral irritation, whether bodily or psychical, causes inhibition of the vagus by acting through the centre of origin of that nerve.

Again, the causes of syncope may be, as it were, mechanical, and the blood may fail to reach the brain because its course has been diverted, either by hæmorrhage, whether external or internal, or by the dilatation of the abdominal vessels, as occurs in conditions of shock, and especially in sudden injuries to the abdomen. Usually the conditions which produce syncope are mixed.

The *symptoms* of syncope are giddiness and pallor; the face becomes pale, the fore-

head often beads with perspiration, and the patient, who is usually warned by a feeling of faintness, giddiness, or nausea, falls insensible. The pupils are often dilated, the pulse can scarcely be felt, or may for a few seconds be quite imperceptible, and the sounds of the heart are exceedingly weak. Recovery usually commences immediately, and as soon as the patient is laid horizontal there is a slow gasping inspiration, followed by a return of consciousness. When syncope proceeds to a fatal issue, the respiratory acts become very laboured, and death is usually preceded by a fit of convulsions.

The *treatment* of a fainting fit consists in keeping the patient horizontal, so as to favour the circulation through the brain and tax the strength of the heart in the least possible degree. Take care that the circulation and respiration are not impeded by any constricting bands round the neck or waist, and, if necessary, loosen the clothing at the neck and undo the stays. Admit fresh air in abundance, but, at the same time, take care that the patient is not chilled. Let him be covered with wraps and keep the feet warm. The respiration may be encouraged (and the circulation indirectly) by dashing cold water on the face and upper part of the chest, but the greatest care must be taken that the patient is not made unnecessarily wet, and that the damp clothing is dried as soon as possible. These measures are all that is required in an ordinary fainting fit, and, if the patient be left undisturbed for half an hour, recovery will be complete. It may be advisable to give some stimulant, and a small quantity of brandy or sal volatile mixed with water (hot water is best) will increase the vigour of the heart's action. If the faint be prolonged and the signs of recovery delayed, and if the patient cannot swallow, no time must be lost in giving a stimulating enema of an ounce of brandy, or in injecting ammonia hypodermically (twenty to thirty drops of Sp. Ammoniæ Co.).

Asphyxia is a state of suspended animation, which is primarily due to a failure of the respiratory functions—i.e. the oxygenation of the hæmoglobin of the blood. This may be caused—

1. By the non-admission of a sufficient supply of oxygen to the lungs, or by the inhalation of a gas incapable of oxidising the hæmoglobin, such as carbonic acid, carbonic oxide, or sulphuretted hydrogen. This accident is usually brought about by the closure of the air-passages, as in strangling or throttling; or by the impaction of foreign bodies in the larynx or trachea, or the compression of the trachea by foreign bodies in the œsophagus. The inhalation of gases unfit for respiration is an accident which happens to well-sinkers, brewers, sewer-men, night-men, and occurs in one form of suicide—viz. by the inhalation of charcoal fumes.

2. Asphyxia may be brought about by a failure of the respiratory apparatus. In fractures of the spine above the origin of the phrenic, the immediate cause of death is asphyxia. In poisoning with curara or strychnia, the respiratory muscles are rendered useless by paralysis or spasm, and asphyxia results. During the inhalation of chloroform, asphyxia is one of the dangers, caused apparently by the failure of the dilators of the glottis (the crico-arytænoidei postici) to contract in unison with the descent of the diaphragm. If both pleural cavities be opened, then the respiratory machine fails to work, and asphyxia results. Again, compression of the chest, as in crowds, or when persons are covered with falling earth, may lead to asphyxia.

3. The most common cause of asphyxia is drowning, in which water takes the place of air in the higher respiratory passages, and effectively prevents the oxygenation of the blood.

The term *asphyxia*, which literally means pulselessness, has been cavilled at as inappropriate, and the word *apnœa*, or breathlessness, has been proposed for the condition of suspended animation from respiratory failure. The latter term has, however, been used by physiologists to denote a condition of arrested respiration from the excess of oxygen in the blood, and has, therefore, been discarded in favour of its older rival.

The *symptoms* of the asphyxial condition may be shortly stated. At first there is great anxiety, and the want of oxygen in the blood and tissues causes great efforts to breathe, and, the respiratory centre in the medulla being over-stimulated by the venous blood, the extraordinary muscles of respiration come into play. Insensibility quickly supervenes and the skin becomes livid. The lips and finger-tips get distinctly blue, the conjunctivæ are injected. The eyes are bright and protruding, and the pupils usually large. Sometimes there are general convulsions. The pulse is at first quickened, and then fails.

The rationale of the asphyxial condition is said to be as follows:—The blood not receiving its supply of oxygen, and being unfitted for the needs of the tissues of the

body, the arterioles contract and prevent its circulation. The left cavities of the heart, the lungs, and the right cavities of the heart, are in turn and in the above order distended with blood, and ultimately the blood is, as it were, dammed back in the veins, while the arteries are empty, or nearly so.

It is usual, *post mortem*, to find the right cavities of the heart as well as the veins distended with dark blood, while the left cavities of the heart are empty. The explanation offered by physiologists of this fact is that the left cavities, originally distended, are emptied after death by rigor mortis.

The *treatment* of suspended animation from asphyxia consists—(1) in the removal of the cause; (2) in the stimulation of respiration, and (3) in the stimulation of the circulation. It seems needless to insist that the first measure is to pull the drowning man from the water, or to cut down the man found hanging. These necessary preliminaries having been accomplished, the first thing is to see that *the air-passages are free for the admission of air.* If any articles of clothing are constricting the neck or chest, these should be at once loosened and removed.

Next look to the mouth: pull forward the tongue with one hand, and pass the fingers of the other hand completely into the pharynx, so as to remove any foreign body which may have got there by accident or have been intentionally placed there, such as mud and weeds, a lump of food, false teeth, or possibly some kind of plug intentionally thrust into the pharynx by a determined suicide.

While this is being done the head should be turned to one side, so that fluid may flow out easily. Next, we have to empty the trachea and bronchi of fluid (in cases of drowning), and also to give an opportunity to any fluid which may have been swallowed to be ejected from the stomach. To this end, turn the body on its face, taking care that the trunk is higher than the mouth, and that the mouth is kept open and the tongue pulled well forward; and at the same time exert steady, firm pressure round the margin of the thorax and upper part of the abdomen, so as to assist in the mechanical expulsion of fluid from the lungs and stomach.

This should be done thoroughly and quickly, and the patient should then be turned upon his back, lying on the ground, or better, on a table of convenient height, if one be at hand. The head should be raised on a small bolster, or a roll of clothing, or anything of suitable size and shape which may be available; the neck should be extended and the chin raised.

Artificial respiration should then be commenced by Silvester's method, which is performed as follows:—

The patient lying as above described, stand directly behind his head, seize the arms at the elbows and press them firmly and gently against the sides of the thorax. By this manœuvre some of the air in the lungs is expelled, and it is always well to begin with an expiratory movement. Next, pull the arms, gently but firmly, above the head as far as they will go; the removal of the pressure from the elastic thorax and the traction of the humero-thoracic, clavicular-thoracic, and scapulo-thoracic muscles on the ribs cause these latter to be raised and the capacity of the thorax to be increased, and, if the air-passages be free, air *must* flow into the lungs. It is usually easy to tell if the artificial respiration is efficient, for, with or without the aid of a stethoscope, the passage of air through the larynx and trachea can be heard.

It is important to bear in mind that artificial respiration is a purely mechanical act, and that, if efficiently performed, air must enter the lungs, even of a corpse which is hopelessly dead. It is not less important to remember that the efficient entry of air is no sign *per se* of returning vitality. Artificial respiration must not be performed too quickly or too violently. From twelve to sixteen respiratory actions per minute is sufficient. The pressure exerted by the patient's arms and elbows against the sides of the thorax must be firm, and the traction on the ribs effected by the arms, when pulled above the head, must be certain and steady.

Howard proposed another method of performing artificial respiration. The body is first laid prone with the head lower than the trunk, and with a roll of clothing placed beneath the stomach. Firm pressure is then made upon the spine, and in this way fluid is squeezed out of the stomach and lungs. The body is then laid supine, with a roll of clothing in the hollow of the back. An assistant holds the arms drawn above the head, and at the same time keeps the tongue pulled forward. The operator then kneels astride the body, placing the palms of the hands over the short ribs. He then, by alternately throwing the weight of his body on to the palms of his hands and then letting go, produces contraction and enlargement of the thoracic cavity. In this way, air effects an entry and exit from the

lungs, but the method is not so efficient as Silvester's. It is very important to take care not to break the patient's ribs, an accident which has followed excessive and unwise zeal on the part of the operator.

Of all methods of resuscitation, artificial respiration is the most important, and it must not be delayed or relaxed under any consideration. At the same time, it must be remembered that the circulation must be encouraged, and, while the operator is performing artificial respiration, he must give directions to the bystanders to proceed with other measures.

The wet clothing must be removed as best it may, and no hesitation must be thought of in the use of scissors or knife, as an aid to this process. The body must be rubbed dry, and with *warm* towels if possible. Warmth must be encouraged by hot blankets and bottles of hot water to the feet, between the thighs, and to the flanks. Steady friction of the limbs towards the trunk is also of service as an aid to circulation and as a help in restoring the animal heat, of which the patient has, mayhap, been deprived by long immersion.

Stimulants must also be administered. An ounce of brandy, with an equal amount of hot water, should be injected into the bowel, and stimulants should be administered by the mouth if the patient can swallow. The application of ammonia to the nose may be of service, as may also the hypodermic injection of half a drachm of the compound spirit of ammonia.

An electric battery may be of use, and if one is at hand it may be brought. The faradising or induced current must be used, and the object of its use is to cause a vigorous contraction of the diaphragm, and thus aid in respiration. This is not easy to bring about. The best way to proceed is to place one rheophore (well wetted with hot salt and water) on the side of the neck, over the phrenic, in the angle formed by the external border of the sterno-mastoid with the line of the omo-hyoid muscle. Make firm pressure with this rheophore, and when the arms are being raised above the head take the opportunity to place the second rheophore (which should be of large surface and well wetted with hot salt and water) over the sixth interspace in the right axillary line. If, in this way, a vigorous contraction of the diaphragm can be brought about, a far larger volume of air will enter the lungs than when Silvester's method is used alone.

Duchenne advises that in these cases faradisation should be employed for its reflex effects, and he recommends that the precordial region and also the back of the chest should be faradised with a wire brush, and he asserts that in this way he has restored circulation and respiration in those apparently dead from suffocation.

If the operator is satisfied that by the methods already recommended air is made to flow into and out of the lungs, well and good; but if he be not satisfied on this head, then, as a last resource, he may have recourse to tracheotomy. Possibly the opening of a jugular vein might allow of the escape of some blood, and thus relieve the over-distension of the right ventricle and encourage it to contract. These two last measures are not recommended as a matter of routine.

From whatever cause the asphyxia may have been produced, the efforts at resuscitation must be continued methodically and thoroughly for at least half an hour, and if the patient be revived, he must be carefully watched for some hours, as it is characteristic of some forms of asphyxia (especially from charcoal fumes) that the sufferer is liable to relapses, and may need the help of artificial respiration a second and even a third time.

In the case of new-born children who have never breathed, the chances of inducing vitality are far greater than in the case of patients whose respiratory functions have been suspended by asphyxia. In the case of the drowned, it is said that recovery is not possible after two minutes' complete immersion; but as the time of immersion can never be certainly ascertained, efforts at resuscitation should not be hastily abandoned.

G. V. Poore.

SUSPENSION.— Mechanical convenience and therapeutic benefit may be derived from the appropriate use of means to suspend the whole body, or parts of it. Having to remove (1862) at the hip-joint a lower limb weighing 99 lbs.—nearly two-thirds of the weight of the whole body—and measuring 48 inches in circumference, the writer suspended the limb. Two long towels passed round the enlargement, and joined in the middle line above, were attached, by a hook and double pulley, to a beam in the roof of the operating theatre. An assistant holding the pulley-rope, while standing well out of the way, was thus enabled to raise and lower the huge limb accurately and easily, greatly facilitating the whole operative procedure, which resulted in the patient's surviving for sixteen years.

Professor Annandale has since advocated, as an aid to surgical demonstrations and practice, the principle of suspension, which has been largely utilised by Professor Sayre in his treatment of spinal disease, by the suspending tripod and the plaster jacket. In arresting hæmorrhage, and treating injured and swollen parts, suspension is of great use and comfort. It is so especially when combined with immobility and equable pressure, by checking the inward and favouring the return blood-flow, relieving pain and promoting absorption and drainage, in direct proportion to its efficiency in lessening vascular and nerve tension. Swellings of the breast, scrotum, and limbs supply many illustrations in point.

Swings, whether with anterior or posterior splints or rods, are very useful; but it is important to bear in mind that suspension in a swing, to be effective, should be elevation and something more. A limb suspended to a bed-cradle by two or three loops of bandage, or leather straps, is certainly raised on an inclined plane, but not swung on the hammock principle. The suspending medium should be as movable as possible, so as to exhaust in its undulations the motive power communicated to the limb. In the case of a limb encased in an accurately fitting mould, and properly swung, undulation of the suspending medium conduces to immobility of the suspended part. In the absence of special instruments, an upper or a lower limb may be suspended, comfortably and efficiently, by very simple contrivances—e.g. fix the limb with a handkerchief, a towel, or a few turns of bandage, on a padded board, or in a wooden or wire frame; then swing this by cords attached to the angles, and gathered into one and suspended by a hook from the bed-head or the ceiling. The effect is harmonious co-operation of apparently very dissimilar mechanical agencies, fixity and mobility in securing perfect rest, preventing irritation, congestion, and their sequelæ, and, in direct measure, favouring physiological repair. *See* Immobility; Position; Pressure; Rest. Sampson Gamgee.

SUSPENSORY BANDAGES are employed to support the scrotum and testicles in cases of varicocele, hydrocele, epididymitis and orchitis, and to support irreducible scrotal herniæ.

Special bandages, of which there are many varieties, may be obtained for these purposes from instrument-makers, but very efficient ones may be devised by the surgeon with handkerchiefs or a piece of strapping. The handkerchief should be folded into a band and tied round the pelvis; another should be folded three-corner ways, so as to make a triangular bandage. The middle of the base of the second should then be placed behind the scrotum, and the two ends should be looped over the pelvic girdle from before backwards; the apex of the bandage should be turned up and looped over the pelvic band in front, from behind forwards, and pinned to it. The two ends should be finally brought round and tied in front of the pubes. If the patient be confined to bed, the scrotum may be supported on a band of strapping, which is fixed to the front of the two thighs, so as to form a shelf across the interval between them.

Of the special bandages, the simplest consists of a bag made of silk or cotton netting, suspended from a pelvic band; there is a large opening at the posterior part of the bag, through which the scrotum can be introduced into it, and there is a smaller opening in front for the penis. In some of the suspenders, the size of the bag may be lessened and its base raised, by tightening a running tape placed in the margin of the hole for the penis. In others the bag is buttoned to the front of the pelvic girdle, and can be raised up or lowered, as desired, by fastening it to a higher or lower button on the pelvic band. When the bag is well braced up so as to form an efficient support, the scrotum is pulled forwards and a visible protrusion beneath the trowsers results, and the scrotum is liable to slip out of the bag. To prevent this, two perineal straps may be attached to the posterior margin of the suspender, carried backwards between the legs, and fixed to the pelvic band behind the body.

Keetley's suspensory bandage differs from that above described, in having no aperture for the penis, in the tape round the margin of the suspender being replaced by an india-rubber ring, and in having a median perineal band provided with an india-rubber ring opposite the anus; the ring is intended to prevent chafing of the anus and soiling of the perineal band.

Morgan's suspensory bandage for varicocele consists of a piece of webbing about 4½ inches long, 6 inches broad at one end, and 3½ inches broad at the other; a piece of leaden wire is fixed in the hem at the smaller end, and the long borders are perforated with a series of holes. To apply the apparatus, the piece of webbing should be wrapped round the scrotum and the

affected testicle, the piece of wire being bent so as to form a ring above the testicle; the long borders of the webbing should be laced together so as to envelop the testicle within it. By means of two straps, which are attached to the apparatus, the testicle may be raised up and suspended from a pelvic band; when raised up, the border of the apparatus which contains the leaden ring will be lowest, and upon it the testicle will chiefly rest.

Williams's suspender consists of a triangular piece of netting; one corner of it should be fixed between the legs by a perineal strap, and the base should be raised upwards and fixed to a pelvic band. The effect of this apparatus is to support the genitalia against the lower part of the abdomen.

To support irreducible scrotal herniæ, a strong bag made of jean, and lined with washleather, is used; it may be suspended entirely from the shoulders, or part of the weight may be borne by a pelvic band.

BILTON POLLARD.

SUTURES or stitches are employed to hold the cut surfaces of wounds in accurate apposition during the process of healing. The materials in common use for sutures are silver wire, silver-plated copper wire, soft iron wire, dentist's silk, silkworm-gut, catgut, and horsehair. The metal sutures, silkworm-gut, and horsehair are non-absorbent, and one or other of them should be chosen when means are not taken to prevent putrefaction of the discharges from the wound; an absorbent substance, like silk, would become saturated by the chemical products of putrefaction, and cause irritation, and probably suppuration, along its track. If, however, some form of antiseptic treatment of the wound be adopted, any of the above-mentioned substances may be used for sutures. Silk which has been well soaked for twenty-four hours in a solution of carbolic acid (1 in 20) is as good as any for general use. Catgut has the advantage that, in suitable cases, the deep part of the suture is absorbed and the superficial part is left free in the dressing; carbolised catgut is usually absorbed in four or five days, but the chromicised gut resists absorption for a much longer time. Horsehair makes a very good suture for wounds in which very little strain is thrown upon the stitches.

The soft sutures, such as silk, catgut, or horsehair, may be introduced by any form of needle either straight or curved, but the needle in common use, which is flattened transversely towards the point, is open to the objection that it makes an incision parallel to the direction of the wound; so that, when the suture is tied, the needle-puncture is drawn into a triangular wound, which does not always heal by first intention. Hagedorn's needle, which is flattened in the opposite direction, makes an incision at right angles to the direction of the wound, and consequently in the line of traction of the suture. For the introduction of wire sutures, some special modification of the eye is needed, so that the loop by which the wire is linked to the needle be not too bulky to be drawn through the needle-puncture. Price's two-eyed needle is one of the best for this purpose, though it is open to the objections above alluded to. *See* NEEDLES.

Sutures may be introduced in many ways: the more important of these will now be considered.

The *interrupted suture* is the simplest. It consists of separate stitches, passed obliquely from without inwards through one side of the wound, and made to emerge in a similar manner from within outwards on the other; each stitch should be tied in a reef knot, and the knot should be drawn to one side of the wound. The sutures should be drawn just sufficiently tightly to bring the edges of the wound into accurate apposition, without constricting the tissues included in the loop. In tying horse-hair or silkworm-gut sutures, the surgeon's knot, in which the first half-knot consists of a double loop, is preferable to the reef knot, because the smooth surface and resiliency of these sutures allows very slight tension to loosen the first half-knot of the reef knot, before it can be fixed by the second.

To close a longitudinal wound, the first suture should be placed in the middle, the second and third on either side of this, between it and the end of the wound, and so on until the wound is sufficiently closed. In angular wounds, or wounds of still more complicated shapes, the retracted angles of skin should be, first of all, fixed in position. Wire sutures may be fastened either by twisting the ends together, or by linking them together as in a half-knot and then turning the ends sharply upwards, so as to prevent the link slipping. The latter method is preferable for stout wires, as the process of twisting them is liable to displace the edges of the wound, which have been previously adjusted.

When a large surface of skin has been removed, as frequently happens in the excision of malignant tumours, the tension of the flaps on the sutures is liable to cause

irritation and inflammation at the margins of the wound, and in that way interfere with their union. In order to obviate this, deep sutures of stout wire or silk may be introduced about an inch from the margin of the wound, and drawn sufficiently tightly to allow of the skin coming together without any strain on the superficial or adjusting sutures. The deep sutures here referred to are often spoken of as *sutures of relaxation*. They should be removed on the second or third day.

In removing sutures, care must be taken that the union of the wound is not disturbed thereby. Silk or other soft sutures should be raised with a pair of forceps and snipped on one side close to the skin, and withdrawn by pulling the knot gently towards the side on which the suture was divided, so that the tendency of the traction is to bring the edges of the wound together rather than otherwise. A wire suture should be divided on one side of the twist or link, and straightened out as much as possible with two pairs of forceps before it is withdrawn.

Continuous Suture.—Under this name two different forms of suture are often included: one is the stitch of the seamstress, in which the thread passes from without inwards through one lip of the wound, and from within outwards through the other; the other is the glover's stitch or the herring-bone stitch, in which the thread passes from within outwards through both lips of the wound. The former is the true continuous suture, and the one usually meant by the term. It is recommended for cases where very accurate apposition of the edges of the wound is desired. It used, at one time, to be almost the only suture employed for stitching up wounds of the intestines, and it has latterly been recommended for that purpose. It is not a very safe suture, because, if one loop cuts out, the others are liable to become slackened.

The *fold suture*, or suture of Bertrandi, is another form of continuous suture. It is recommended in cases where the skin is very thin, and where, in consequence, the margin is liable to become inverted. It is commenced as an interrupted suture, but, instead of the thread being cut, the needle is passed back again through the lips of the wound, in a similar manner, a little farther on, and so on alternately; so that the loops do not lie across the wound, but alternately on one side and the other, as in the darning stitch of the seamstress. The result of this is that adjacent parts of the deep surface of the skin are brought into apposition, and the tendency to inversion is overcome.

In removing a continuous suture, the surgeon should never attempt to draw the whole thread out together, for in doing that there would be much risk of tearing the wound open, or of tightening up some of the loops, instead of withdrawing the suture; each loop should be divided and removed like an interrupted suture.

The *figure-of-eight* or *twisted* suture is frequently used in plastic operations about the face, and especially in cases of hare-lip. In applying the suture to a wound passing completely through the lip, a long needle should be entered about three quarters of an inch from the margin of the wound and made to emerge on the cut surface close to the mucous membrane, without, however, perforating the latter; it should then be made to perforate the other lip of the wound in a similar manner, though of course in the opposite direction. A piece of silk should then be twisted in figure-of-eight loops round the needle, so as to draw the margins of the wound into apposition without causing much compression of them. If a second needle is required, it should be placed in position before the silk is applied to the first. The points of the needles should be cut off, and a piece of plaster placed beneath the ends so as to protect the skin. The needles should be withdrawn by a gentle rotatory movement in from thirty-six to forty-eight hours, but the pad of silk should not be disturbed until it gets loose. Interrupted sutures should be inserted here and there, to bring the skin and mucous margins into apposition.

The *button suture* is a suture of relaxation, which is very useful when much skin has been removed and a widely gaping wound has to be closed. The buttons are oval pieces of sheet-lead, measuring from three-quarters of an inch to an inch and a half in the long axis, having a small hole in the centre and a wing projecting from each long side of the oval. The free end of a stout piece of silver wire, threaded on a needle, is passed through the hole in the button and secured by twisting it round the projecting wings. In applying the suture, the needle, carrying the wire with the button attached, is entered an inch or more from the cut edge, and brought out at a similar distance from it on the other side. The needle is next passed through the hole in a second button, and the latter is pressed firmly up to the skin until the edges of the wound are brought sufficiently close together; the wire is then twisted round the wings of the second button so as to secure

the suture in position. It is the best suture of relaxation, for the strain is widely distributed by the buttons, and so there is less likelihood of the wire cutting out quickly. Fine interrupted sutures will be required as well, but the greater part of the strain will be borne by the button sutures. Button sutures should, as a rule, be removed by the third day. Their removal is easily managed by cutting the wire between the skin and one button, and pulling gently on the other.

The *quilled suture* is used to bring the deep parts of a wound into apposition, as well as to take off the strain from the superficial sutures. It is most used for plastic operations on the female perineum. For its application, a needle with an eye at one extremity should be threaded with a loop of wire, entered about an inch from the margin of the wound, carried deeply down, and finally made to emerge in a similar manner and at a corresponding point on the other side. The needle must next be withdrawn, and the wire left *in situ*. As many sutures as are required should be passed in the same way. There will then be a loop projecting from each needle-puncture in one lip of the wound, and two strands of wire through each puncture in the other. A quill or piece of bougie should next be passed through each loop, and the quill and loops should then be pulled firmly against the skin. Another quill should be placed on the other side of the wound, parallel with the first, in such a manner that one of the wires of each suture lies over it and the other beneath it, and then the corresponding wires should be twisted together over the second quill with sufficient firmness to bring the lips of the wound into apposition. Superficial adjusting sutures should also be employed.

Various special sutures are employed for *enterorraphy*—that is, the closure of wounds of the intestines, or the union of two ends of gut after a resection operation has been practised. They all aim at bringing the serous surfaces of the gut into accurate apposition, for the very rapid adhesion which takes place between them entirely prevents extravasation of the intestinal contents; some aim at bringing the mucous surfaces into apposition as well.

Lembert's suture brings the serous surfaces together without perforating the mucous lining of the gut. The needle is entered on the serous surface, about a quarter of an inch from the margin of the wound, and dipped through the muscular and submucous coats, being made to emerge on the same side of the wound about one-sixth of an inch from the margin, without perforating the mucous membrane. The needle is next passed in a similar manner through the tissues on the other side of the wound, entering the gut on the serous surface about one-sixth of an inch from the margin, and emerging about one-quarter of an inch from it. As many sutures as are needed are inserted about one line apart, and then they are tightened up, one after the other, and tied in reef knots. It has been urged against this suture that its hold on the intestinal walls is so slight that it is liable to give way, and that, owing to its not perforating the mucous coat, its detachment into the lumen of the gut will be impeded. The latter objection would be met by the use of catgut sutures.

The *Czerny-Lembert suture* differs from the last in the addition of a second row of sutures, which are made to unite the mucous membrane only, just at the cut margins. The advantages claimed for it are that it affords greater security, and also prevents leakage of intestinal contents between the serous surfaces which are adjusted by Lembert's suture.

Gussenbauer's suture is intended to accomplish the same objects as the last with one stitch, which is commenced, like Lembert's, on one side of the wound, but, before it is finished on the other, it is made to pick up the mucous membrane first on one side and then on the other side of the wound, so that, when the suture is tightened up, the deep surfaces of the mucous coat are brought into contact as well as the serous surfaces of the gut.

Jobert's suture. — In the stomach, where the coats are thicker, Lembert's suture may be easily applied, but in the small intestine there is more difficulty on account of the thinness of the muscular coat, and, in order to obtain a more secure hold on the intestinal walls, Jobert recommends that the suture should not avoid the mucous membrane, but should be carried through the whole thickness of the gut. In other respects this resembles Lembert's suture. In cases of complete transverse division of the gut, Jobert recommends the following method of suture: The surgeon first passes a suture, armed with a needle at each end, through the upper extremity of the divided intestine, at about two-thirds of an inch from its margin. The lips of the lower portion of the divided gut are then inverted, so that the serous lining of the reflected portion looks towards the lumen of the gut. This inverted portion is

held in position between the finger and thumb of the left hand, whilst with the right the needles attached to the suture, already inserted in the upper portion, are passed through the double thickness of gut from within outwards; the outer needle is first passed close to the folded border, and the inner one about two-thirds of an inch lower down. A similar suture is passed at the other side of the gut, and then, by pulling at the four ends of the sutures, the upper portion of gut is drawn within the inverted lower portion, so that two serous surfaces are brought into apposition. The two ends of each suture are then tied together. Additional security may be obtained, by inserting a series of Lembert's sutures in the angle where the serous surfaces of the two segments of gut come together.

Gély's suture is recommended by its inventor either for closing linear wounds, or for uniting the gut after complete transverse division. It is a continuous suture. The thread is armed with a needle at each end. One of the needles is entered just behind the wound and about one-sixth of an inch from its margin, and, after traversing the lumen of the gut parallel to the direction of the wound. it is brought out about one-sixth of an inch from its point of entry. A similar stitch is made on the opposite side of the wound with the other needle. The sutures are next crossed over one another and over the wound, and each needle is entered at the puncture from which its fellow has just emerged, and is ready to repeat the stitch. When as many stitches have been introduced as is necessary to unite the wound, the thread is tightened up by pulling on the successive transverse loops, and the ends of the suture on either side of the wound are tied together. This method causes inversion of the edges of the wound, and brings the serous surfaces into accurate apposition.

Emmert's Suture.—The needle is entered on the serous surface of the intestine about one-third of an inch from the margin of the wound, dipped through the serous and muscular coats of the gut transversely to its axis, and brought out about one-sixth of an inch from the margin. The needle is next carried parallel to the direction of the wound, and entered on the serous surface of the gut about one-third of an inch beyond its last puncture, and made to traverse the walls of the gut at right angles to the direction of the wound and emerge about one-third of an inch from its margin. A fellow-stitch should be placed in the other lip of the wound, and as many couples should follow as are required to close the wound. The corresponding threads on opposite sides of the wound should be tied together, and the serous surfaces inverted and brought into apposition thereby.

Stanmore Bishop has recently described a suture for enterorraphy (*Medical Chronicle*, September 1885) which, though it is an interrupted suture, has the advantages of a continuous one; the knots are all within the lumen of the gut, and the loops are so placed that, when loose, they also may readily drop into it. Bishop has found by experiments on animals that, after the employment of this suture, 'no sign of ridge or suture, but a plain mucous surface, with no trace of the previous division,' may result. He uses a small round straight needle, threaded with fine Chinese twist or silk. The needle is placed exactly in the centre of the thread, which, when double, should be about 80 cms. (32 in.) long. 'The edges of the two pieces of divided intestine being approximated, a portion of both is seized by the forceps and turned inwards towards the lumen of the gut, in such a way that the serous surfaces of both are placed opposite and parallel to one another; and near the retiring angle, at the base of the fold thus formed, a needle carrying a double thread is thrust, from the mucous surface of the right side, through what has not retracted of the muscular coat, and through the serous coat of that side, and then through the serous, muscular, and mucous coats of the other side; the double thread is then drawn through until 6 cms. remain on the right side. One of the threads on the left side is to be cut 6 cms. long; the needle is then passed from left to right through the same fold, at a distance of 20 mm. from the first puncture. Two free ends and a loop remain on the left side, and two ends free and two connected with the needle on the right. By gently drawing upon the loop (on the left side), one of each of the two last pairs is seen to move; these are then drawn up so as to bury the loop in the mucous membrane on the left side and are reef-knotted on the right; the two ends are then cut off close to the knot. The free thread left in the first puncture is now drawn under the free extremities of the upper bars of the clamp, so as to be out of the way, and is reserved for the latter part of the operation. The needle is now carried back again from right to left through the base of the fold, and a similar loop is thus formed, this time on the right, and knotted on the left. In this way, as the suture progresses, a series of loops con-

sisting each of a single thread tied alternately on the right and left sides is formed, the threads of each loop passing through the same punctures as those of its neighbours on each side. When half the circumference of the bowel is united, and having finished the floor, so to speak,' Mr. Bishop prefers 'to take a fresh needle and thread; and tying one end to one of the free ends of the first thread, which it will be remembered was left behind, to commence again from the mesenteric border, and begin the roof from that point.' Thus the operator works towards himself whilst stitching both the floor and roof. 'In drawing up the loop which is thus formed, care must be taken to bring the knot in its centre directly opposite the middle of the portion of wall included.'

'On finishing the floor, too, a free thread will always be left; this is taken advantage of in finishing the entire suture, for the last loop is made by tying the two free ends on one side together; the loop thus formed is then drawn up on the other side, folding in the serous coats of both sides, and, the knot being made, the two threads are cut off close, the bowel becoming absolutely closed.'

BILTON POLLARD.

SWEATING FEET.—This offensive affection is not uncommon in young persons of both sexes, especially in those employed in in-door service, the subjects of it being often incapacitated from retaining their situations. The general health is usually not good, the circulation feeble, and the appetite often disordered.

Treatment.—The feet should be well bathed in salt and water two or three times a day, rubbed and dried most thoroughly, especially between the toes, and these parts well dusted with zinc and starch powder, to which a little iodoform powder has been added. Boots or shoes, socks or stockings, should be changed frequently; anything in the nature of patent leather is to be forbidden, and shoes preferred to boots, as admitting of better ventilation and more frequent changing. Belladonna liniment, as recommended by Dr. Ringer (the liniment being made up with eau de cologne, if preferred), may be employed; or the treatment recommended by Professor Hebra made use of. Here, an ointment made of equal parts of lead ointment and linseed oil, spread on linen, is wrapped round the feet, the application being renewed every third day for nine days. The practitioner, in using the above, must be prepared for its causing irritation in some cases, and even the outbreak of a papular eruption.

Improvement of the general health is nearly always required, it being needful to insist on sufficient open-air exercise, bathing, and attention to the appetite and bowels. *See* BROMIDROSIS.

W. H. A. JACOBSON.

SYCOSIS.—*Synon.* Sycosis non-parasitica, Mentagra.

Definition.—A chronic inflammatory disease affecting the hairy parts of the body (chiefly the face in the male sex), and characterised by the development of pustules pierced by hairs.

Cause.—This has not yet been ascertained; various diathetic conditions were formerly thought to give rise to it, e.g. rheumatism, gout, struma. According to later investigations, it is probably due to the irritation of the growing stiff hair on the walls of the follicle, in an individual out of health, or on a part predisposed to inflammation by the presence of some superficial dermatitis (eczema). Shaving, especially with irritating soap, and exposure to heat or cold, are also thought to be instrumental in causing the disease.

Pathology.—The affection is primarily a peri-folliculitis, the fibrous sheath of the hair-follicle being first invaded by inflammatory products (serum and pus). Soon the root-sheaths become involved, and the base of the follicle, the papilla resisting to the last; the hair-coverings (root-sheaths) as well as the soft structure of the hair itself, undergo destructive change, the hair falls out and is not reproduced if the papilla has been destroyed; not infrequently the neighbouring structures, the sebaceous and sweat glands, and even some portion of the skin itself, are involved in the destructive process, leading to loss of substance and scarring.

Symptoms.—In a simple uncomplicated case, at the commencement of the disease, there are seen a few papules pierced by hairs, accompanied by some temporary heat and swelling of the part affected, usually the chin. The papules may be isolated, but they tend rather to be aggregated together in groups. Soon each papule becomes surmounted by a minute collection of pus, the papule becomes converted into a pustule, if the lesions are close together the infiltrations surrounding each join up and become confluent, so that the affected patch takes the form of one large dusky-red infiltration dotted over with points of pus, pierced by hairs; it was probably this appearance which was likened to the inside of a fig and suggested

the name Sycosis (*συκον*, a fig). The pustules may dry up into little round crusts, or, as happens more frequently, they discharge and lead to the formation of thick yellowish-brown crusts of dried inspissated pus. The hairs over the affected surface are either matted down, or stick up through the crusts. On removing the latter, those hairs which are loose in their follicles come away; a few remain behind in the dilated funnel-shaped mouths of the follicles. Occasionally, on removing the crusts from an infiltrated patch, the surface is seen beneath denuded of epidermis, granular, and bathed with pus (*caro luxurians*) calling to mind the appearances of condyloma. More deeply seated and extensive suppuration may occur, leading to the formation of small subcutaneous abscesses. The disease progresses by separate outbreaks such as has been described. Chronic cases are liable to be complicated by (*a*) the occurrence of a permanent, diffuse, erythemato-squamous, superficial dermatitis, affecting perhaps the entire beard or whisker region, the result of previous attacks; or by (*b*) more or less scarring and alopecia from former destructive suppuration.

Diagnosis.—This lies between sycosis parasitica, eczema impetiginodes, lupus, and syphilis.

Sycosis parasitica.—The early, red, itchy patches frequently round and multiple (tinea circinata), the continuous outbreak of pustules, the gnawed stubbly look of the hairs, their opaque white appearance and rottenness, the history of contagion and rapid development of the disease—finally, the presence of fungus as seen under the microscope, are the points determining the diagnosis.

In eczema the eruption is not limited to the hairy parts, but it must be remembered that eczema may be present with sycosis, having either preceded it, in which case it may be looked upon as having caused the sycosis, or it may have supervened, as explained above.

In eczema impetiginodes, its rapid development, appearance elsewhere, the abundant discharge, the large flat pustules *not* pierced by hairs, the non-occurrence of alopecia or scarring, will help the diagnosis.

Lupus vulgaris generally occurs before puberty, and is very chronic, the tubercles are not pierced by hairs, the nose or its neighbourhood has probably been previously attacked; loss of substance and scarring invariably accompany lupus.

In syphilis the papules or tubercles (copper-coloured), tend to be arranged in rings or segments of circles, they are painless and not pierced by hairs; concomitant symptoms are usually present—scars, gummata, &c.

Treatment.—This is mainly local. The hair should be cut short with scissors to within one-third of an inch of the affected surface. All crusts must be removed before any remedies are applied. This may be done by saturating them with warm oil or some simple ointment, then poulticing with linseed meal; if they are still matted down by the hair, they should be slightly raised and the hairs snipped beneath them, the part should then be bathed clean with warm water.

As long as irritation is present (heat, swelling, &c.) only soothing applications should be used, e.g. :—

℞ Pulv. zinci oxidi . . . . ʒvj.
Liq. plumbi diacet. dil. . fʒvj.
ft. lot.

or Linimentum calcis. These remedies should be frequently and thoroughly applied to the affected parts.

Pus must be removed as soon as possible; small abscesses should be opened, and, above all, the hairs must be pulled out from the pustules. Each hair is to be grasped with epilation-forceps, and steady traction made in the direction in which it is growing; the hairs protruding from pustules will generally be found loose in their follicles, coming away without pain. By this procedure the pus is provided with an outlet, and the best chance afforded of avoiding destruction of the papilla. Some desiccant, soothing ointment should now be used night and morning, applied on linen and bound to the part. Hebra's ung. diachyli, ung. zinci benzoati, or ung. plumbi carb., are suitable ointments. If there is much infiltration the occasional use, once in two or three days, of some mercurial preparation will be necessary, such, for instance, as hydrarg. oleat. 5 p.c., or ung. hyd. ammon., mitigated by the addition of an equal quantity of ung. zinci. Opinions are divided as to the advisability of shaving the part; but the disease may be cured without resorting to this painful procedure of doubtful benefit. The patient should abstain from anything which may promote the disease—exposure to dust, heat, &c. Finally, constitutional treatment must not be neglected. The diet should be enquired into and regulated as to the quantity and quality of both food and drink. Dyspepsia, if present, must be treated, as well as any diathetic condition

(especially struma), on general principles. It is probable that nearly all cases will benefit by judicious regular purgation.

Sycosis Parasitica.— Synon. : Tinea barbæ, ringworm of the beard.—An inflammation of the hairy parts of the face and neck, set up by the presence of the fungus of ringworm (*trichophyton tonsurans*).

Symptoms. — The disease generally shows itself at first as a small, sharply defined, round red patch, not raised above the surface. Not infrequently several such patches are present — the eruption soon becomes marginate, or exhibits signs of papulation and desquamation. Considerable infiltration with suppuration may early disclose itself, or indeed be present from the commencement, so that the disease puts on a scattered, pustular appearance, the surface being studded with crusted elevations pierced with stumps of hairs. Itching is complained of. The disease advances steadily, not by successive outbreaks. Changes in the hairs of the part affected are soon noticeable; if the beard or whisker is grown, there is partial baldness, the hairs have a gnawed, stubbly look, some are reduced to mere stumps, and have a peculiar, opaque, whitish appearance, like the stumps seen in tinea tonsurans. By pulling them slightly with the epilation-forceps, they break off close to the mouth of the follicle. On placing such stumps, or any other affected hairs, on a slide with a little liquor potassæ, and examining under the microscope with a high power ($\frac{1}{4}$ inch), the hairs are seen to be infiltrated with fungus-spores arranged together in chains, for the most part lying in the direction of the hair-fibres. These hair changes are of course most noticeable in cases where the beard or whisker is worn, but even when the patient has shaved, the white stumps may be recognised with a magnifying glass, just protruding from the follicles; they may be collected by scraping with a knife which has been dipped in liquor potassæ, and submitted to microscopical examination.

Diagnosis.—The disease may be confounded with—1. True sycosis (sycosis non-parasitica); 2. Eczema; 3. Syphilis. In all doubtful cases the microscope should be appealed to; if the fungus is found, it at once settles the question. The following peculiarities belong to tinea.

1. Early round or ringed patches; 2. Continuous and comparatively rapid development; 3. Absence of scarring or other signs of previous attack; 4. History of contagion (barber's razors, &c.); 5. Probable existence of patches of ringworm on other parts of the body; 6. Partial baldness with stubbly appearance of hair, whitish brittle stumps, &c.

Treatment. — All pus-crusts must be removed, and if much irritation is present, this must be allayed before antiparasitic remedies are used (*see* Sycosis non-parasitica, treatment). The antiparasitic measures include all those which are adopted for the treatment of ringworm of the scalp. Of all the mercurial and tar preparations, perhaps the best are oleate of mercury and carbolic acid; the former should be used of the strength 5 p.c., at least at first; it should be freely rubbed in once every twenty-four hours, or more frequently if the skin can tolerate it. Should much irritation occur, the remedy should be discontinued for a day or two until the part recovers itself.

The glycerine of carbolic acid may be used in a similar way. The pharmacopœial Ung. hyd. nit., or Ung. sulph., are also useful remedies. Such applications necessarily set up a certain amount of inflammation, but they are especially liable to do so in cases where the disease has displayed a marked inflammatory type from the commencement. Success depends on the persistent use of efficient parasiticides, short of producing unmanageable inflammation. Epilation should be adopted, but it cannot be relied on to cure the disease.

Alfred Sangster.

SYMBLEPHARON. *See* Eyelids, Diseases of the.

SYME'S AMPUTATION OF THE FOOT. *See* Ankle-Joint, Amputation at the.

SYME'S OPERATION. *See* Tongue, Operations for Removal of the.

SYMPATHETIC OPHTHALMITIS is a plastic inflammation of one eye, excited by some special irritation in the other. There are two forms of this disease: the first form, being the slighter, is called Sympathetic Irritation; the second is the severe affection now so well known as Sympathetic Ophthalmia.

1. Sympathetic Irritation is probably only the early stage of sympathetic ophthalmia, as it will develop into it and is excited by the same causes. Sympathetic irritation is secondary to some excitant in the other eye, which is usually of an inflammatory character. The attacks are difficult to arrest, and they are very recurrent so long as the excitant in the other eye continues.

The points in which sympathetic irritation differs from sympathetic ophthalmia are:—1. Although the eye may be liable to frequent recurrences of the irritation, yet no fibrinous effusions nor disorganising changes take place in the tissues of the eye. 2. The excision of the injured or the diseased eye will, as a rule, at once arrest the irritation; whereas, in sympathetic ophthalmia, the excision of the other eye will but rarely exert any marked influence in controlling the disease.

The symptoms of sympathetic irritation are attacks of irritability of the sound eye, whenever the lost or injured eye becomes inflamed or painful; and, in some cases, whenever the sound eye attempts any prolonged effort of accommodation, without any change of appearance or altered sensation in the injured eye, and this is especially noticeable in eyes in which a foreign body is lodged. The symptoms are very variable: in some patients a slight indistinctness of vision is complained of, an inability to define clearly, and reading tires the eye. The patient may be able to read No. 1 of Jaeger's test types and to see distant objects rightly, but he cannot do so for any length of time, as the effort of accommodation fails, and the eye becomes fagged. In others, the eye becomes reddened and irritable whenever an attempt is made to use it, and occasionally it is painful; the seat of pain being sometimes referred to a position in the sound eye corresponding to the seat of injury in the other eye. Occasionally, there are neuralgic shooting pains in the sound eye, and this may be the symptom which gives the patient the greatest concern. Another symptom of which patients have frequently complained is that 'things dazzle in front of the sound eye, like heat over a stove.' There is frequently also some slight intolerance of light; the patient feels that the bright light of a clear day or bright artificial light is unpleasant. The symptoms of irritation are not always constant. In some cases there are attacks of irritation, which come on only when the lost or injured eye becomes inflamed, and subside when the inflammation has passed away; whilst in others the sense of there being something wrong with the sound eye, from the occurrence of some of the symptoms described, is ever present.

The *treatment* of sympathetic irritation undoubtedly is to excise the lost or injured eye, the source of the irritation, as with our present knowledge we cannot say when sympathetic irritation will drift into sympathetic ophthalmia. If the injured or diseased eye be excised when there are symptoms only of irritation, and before the spotty deposits on the inner surface of the cornea have been developed, then we generally succeed in arresting the disease. The writer has known cases in which the attacks of irritation have continued to recur, at short intervals, for over twelve months, and yet, after the diseased or injured eye has been removed, the irritation has been completely arrested.

The palliative treatment consists in giving rest to the eyes by abstaining from work, by excluding the eyes from strong light by means of dark glasses, and by keeping the light in the living room subdued by dark blinds. As a local application, a weak solution of atropine, about gr. j. to the ounce of water, and internally small doses of the extract of belladonna, from gr. $\frac{1}{10}$ to gr. $\frac{1}{8}$ combined with quinine, are the most useful medicine.

2. Sympathetic Ophthalmia differs from all other inflammations of the eye, both in the cause which produces it and in the character and course of the inflammation.

a. It is always due to some exciting cause in the other eye, and these may be thus briefly classed:—

Wounds of the eye, and especially those which involve the ciliary region; and wounds in and near the margin of the cornea, in which there is an entanglement of iris.

The lodgment of foreign bodies within the globe.

The irritation excited by degenerative changes taking place in eyes already lost either by injury or disease.

There are other causes which also give rise to sympathetic ophthalmia, but which may be regarded as exceptional. The operation for the extraction of cataract undoubtedly produces a certain percentage of sympathetic ophthalmia, but these unfortunate cases are, probably, far less numerous now than they were ten or fifteen years ago. About that date, it was the custom with many to carry the section through the sclerotic a little behind the corneo-sclerotic junction, and as the result to get frequently an entanglement of the iris in the edges of the wound. Experience has since proved that, by keeping the section corneal, we have less tendency to involvement of iris in the wound, and consequently many fewer cases of sympathetic ophthalmia following our cataract operations.

In the *Royal London Ophthalmic Hospital Reports*, vol. vi., Mr. Hulke has

recorded the case of a cyst of the iris which followed a penetrating wound with a fork. There was a serous iritis in the eye which had the cyst, and in the other there was sympathetic irritation. It was on account of the irritation in the uninjured eye that the mother brought the boy from Faversham to the hospital. Mr. Hulke removed the cyst through an opening at the margin of the cornea. The report states: 'The wound healed directly, and the iritis and sympathetic irritation of the other eye disappeared.'

It is a noteworthy fact that sympathetic ophthalmia is seldom, if ever, produced by a suppurative inflammation of the other eye. This fact was noticed by the late Von Graefe, and the writer's experience accords with it. If, however, there is a foreign body within the globe, suppuration of the eye does not diminish the danger which its presence in the stump may keep up.

β. *The character of sympathetic inflammation of the eye* is peculiar. It is essentially an adhesive or fibrinous inflammation. The tendency of the inflammation is to rapid, plastic effusions, which soon become organised and incapable of absorption, blending the tissues together and destroying their functions. As a rule, the eye is attacked without having pain as a warning. Children are frequently brought with the disease advanced into its second stage, and with the sight greatly impaired, because the absence of pain made the parents regard the affection lightly.

When once started, sympathetic ophthalmia is very difficult to arrest, and if, under treatment, it is subdued, it is generally only for a time, for the disease is very recurrent. The peculiar tendency of sympathetic inflammation to cause rapid effusion of lymph is manifested from the very commencement of the disease. In the earliest stage, there are usually spotty deposits of lymph on the inner surface of the cornea; then follows a plastic inflammation of the iris, which binds the pupil by adhesions to the anterior capsule of the lens, and rapidly extends to the ciliary processes, the choroid, and the vitreous. The lymph is not deposited on the surface in nodules, as in syphilitic iritis, but it occurs as an infiltration invading the very texture of the iris, ciliary processes, and choroid. In the synechiæ which are formed, it is not simply the pupillary margin, but the whole posterior surface of the iris which contracts adhesions to the capsule of the lens; so that if, at a future period, an attempt be made to form an artificial pupil by tearing away a portion of the iris, the exposed part of the lens will be found covered with uvea, indicating exactly the extent of the adhesions which had existed between it and the posterior surface of the iris. Early in the disease, when the iris is saturated with lymph, it is soft and rotten; but at a later date, when all the acute symptoms have passed away, the iris has become completely changed in its texture; it is excessively tough, it has lost all its elasticity, and is converted into a dense fibrous membrane. *The age of the patient* has an influence in sympathetic ophthalmia. The young are more liable to it than the old, and it runs its course more rapidly in the child or young adult than it does in the middle-aged or the old.

The Period at which Sympathetic Ophthalmia may come on after Injury.—It is impossible to assign any date at which sympathetic ophthalmia may be expected, or after which the sound eye may be considered as safe. It is seldom seen earlier than two or three weeks after the injury, and generally much later. So long as the irritation primarily excited by the injury continues, the sound eye may sympathise. The risk cannot be said to have passed away until the injured eye has quite recovered; the sclerotic must have regained its normal whiteness and all photophobia and lacrymation have ceased. It is the knowledge of these facts that has often induced the writer to urge upon a patient to have the injured eye removed, when it has drifted into a state of subacute irritability with no tendency to yield to remedies, and when there was no reasonable prospect of the eye regaining useful sight. In such cases, it is better to make a partial sacrifice for the sake of securing the safety of the uninjured eye.

Symptoms.—For the convenience of description, the symptoms of sympathetic ophthalmia may be divided into three stages, a division which, although arbitrary, serves to impress the progress of the disease upon the memory of the surgeon. It must, however, be remembered that, in many cases, the symptoms succeed so rapidly on each other that it is difficult to recognise the division into stages. In some cases, the disease has passed well into the second stage before it is even recognised that the uninjured eye is affected; and this is especially the case in children, from the absence of pain in the early stage of the affection.

In the *first* stage of the attack, the eye is irritable and abnormally sensitive to

light; there is some lacrymation, and the conjunctiva is a little injected; there are usually spotty deposits of lymph on the inner surface of the cornea (corneitis punctata), sometimes only to be detected by looking at the cornea with a lens, and the pupil is sluggish in its action; the power of focussing the eye for near objects is diminished, and the patient is unable to maintain a prolonged accommodative effort. Reading quickly induces fatigue, the words become confused, blurred, and at last indistinguishable; after a few minutes' rest the eye may resume its work, but the same symptoms shortly reappear and oblige it to desist. At this stage of the disease there is generally *no pain*—not even sufficient to draw proper attention to the eye.

In the *second* stage of the disease, fibrinous exudations take place within the eye, and lymph is effused, as an infiltration, into the different tissues involved in the inflammation; the pupillary area of the capsule of the lens is covered, and the iris almost soaked with it. This exudation rapidly becomes organised, and contracts firm adhesions between the whole posterior surface of the iris and the lens-capsule. If atropine be dropped into the eye, the pupil is either not affected by it or it dilates only slowly, irregularly, and partially. The aqueous becomes serous, and the striation of the iris, at first indistinct, is afterwards completely lost.

The *third* stage of the disease is characterised by increased tension of the globe, and this condition is *generally associated with pain*, oftentimes very severe, and sufficient to make the patient willing to submit to any means suggested for his relief. The increase of tension may come on at any time after the inflammatory exudations within the eye have commenced, and may continue during many months, or even last beyond a year. If the disease runs on, the vitreous atrophies, loses its consistence and diminishes in bulk, and the eye gradually becomes softer than normal and sinks to $-T\,2$ or 3. As the atrophy of the vitreous proceeds, the retina is deprived of its normal support, and, falling forwards, becomes partly or completely detached.

The increased tension of the eye, combined with the inflammatory changes in the ciliary region, sometimes leads to a thinning of the sclerotic around the cornea, and to ciliary staphyloma.

Treatment.— Sympathetic ophthalmia is certainly one of the most intractable of all the affections of the eye. Many cases go on from bad to worse until the eye is lost, and this in spite of what appears to have been judicious and careful treatment from the very commencement of the disease. Still, we occasionally meet with bright results, although these are comparatively few.

The *treatment* will be considered under three headings:—1. How to arrest the progress of the disease. 2. How to proceed when the injured eye still retains some useful sight. 3. The general constitutional and local treatment in each of the three stages of the affection.

1. *How to Arrest the Progress of the Disease.*—If the sympathetic inflammation of one eye is dependent on injury to the other, and it is clear that the wounded eye is irreparably blind; or if the exciting cause of the mischief proceeds from a previously lost eye becoming inflamed, then there cannot be a moment's hesitation about the propriety of at once extirpating the injured or the diseased eye. The importance of removing at an early period an eye which has been so injured as to be useless, and which is exciting, or is likely to excite, irritation in the other, or the inflamed remnant of a lost eye which is acting as an irritant, cannot be exaggerated. For, though, in the *very early stage* of sympathetic ophthalmia, the removal of the cause of irritation will frequently cause its subsidence, yet, when the disease has thoroughly taken hold of the sound eye, even the removal of the lost one will rarely arrest its progress. The writer's experience leads him to believe that if an injured eye be excised before symptoms of irritation occur in the other eye, then the sound eye is safe from sympathetic ophthalmia. There may be exceptions to this rule, but they are probably very few.

Division of the optic nerve has been suggested to take the place of excision of the injured eye. Experience, however, has shown that optic neurotomy of the injured eye does not succeed in warding off sympathetic ophthalmia. Pagenstecher published a case in Knapp's *Archiv f. Ophthal.* viii., where the optic nerve had been torn off, and yet sympathetic ophthalmia occurred in the other eye. Cases of sympathetic ophthalmia have also come on in the other eye after the optic nerve in the injured one had been divided. We may therefore consider that the division of the optic nerve of the injured eye fails to arrest the disease. From the experience we possess of the power nerves possess of reuniting, it is difficult to understand how the division of the optic nerve could arrest the develop-

ment of sympathetic ophthalmia, as, supposing that the transmission of the *materies morbi* is through the lymphatic spaces of the optic nerve, these spaces would have again become continuous after union of the nerve had been effected.

2. *How to proceed if the Injured Eye still retains some Sight.*—On several occasions the sound eye has been destroyed by sympathetic ophthalmia, while the injured eye has ultimately so recovered that useful sight has been restored to it, and the patient has been able to get about without assistance. As the removal of the injured eye will probably not arrest the sympathetic ophthalmia, and especially if plastic exudations have commenced, the conclusion at which the writer has arrived is, that if sympathetic ophthalmia be established, the injured eye should not be removed if it retains any useful sight.

3. *General Constitutional and Local Treatment.*—In the early stage of the disease, absolute rest to the eyes is imperatively demanded; all reading, writing, or fine work of any kind must be forbidden. When at home, the rooms should be darkened, and when out, very dark neutral-tinted glass goggles should be worn. It is impossible to overrate the importance of keeping the patient for a long period in a very subdued light; it affords the best hope of success, and places the eyes in a position to receive most favourably the influence of any other treatment which may be adopted. However well the patient may progress, the order to rest the eyes and abstain from work should not be rescinded for at least from six to eight months. The disease is very recurrent in its nature, and the too early exposure of the eyes to the stimulus of strong light will increase the chances of relapse.

During this stage, mercurial inunction into the temple with unguent. hydrarg. or the hydrarg. oleat. five per cent. cum morphiâ, may be tried and continued for two or three months, care being taken to avoid salivation by diminishing or omitting the rubbing in for a few days, as required. The patient should be well fed, as the disease is very depressing, and quinine in 1- or 2-grain doses, according to the age of the patient, combined with small doses of the extract of belladonna, or bark with the succus belladonnæ, may be given. From the use of iodide of potassium and perchloride of mercury—both of them favourite medicines in the treatment of irido-choroiditis—the writer has never known the slightest benefit.

Local Applications.—A weak solution of atropine, gr. j. to the ounce of distilled water, may be dropped into the eye three or four times a day; or a belladonna lotion may be frequently used. In the later stages of the disease, when the whole posterior surface of the iris is adherent to the capsule of the lens, all mydriatics do harm by stimulating the dilating fibres of the iris to contract when, from the adhesion of the iris to the lens-capsule, they cannot act. Mydriatics also favour the development of the state of increased tension which usually comes on at a later period of the disease.

In the *second stage* of the disease, when the union between the iris and lens-capsule has been effected, but after the acute symptoms have subsided and the eye is quiet, it is a question whether an operation may be attempted to improve the sight. The writer's opinion is, that if the sight is sufficient for immediate requirements, and will enable the patient to walk about without assistance, the eye should be left alone. It is the only eye; and operations on eyes sympathetically inflamed are so unfavourable, that it is better to let the patient enjoy the sight he has rather than to risk the loss of it with the prospect only of a slight improvement. If, however, the sight is so defective as to be almost useless, and there is a fair field of vision, then an attempt should be made to improve it by an operation; but no operation should be performed whilst the eye is inflamed. The objects to be attained are the formation of a new pupil and the extraction of the lens. There are very few eyes which have suffered from sympathetic ophthalmia, in which an artificial pupil can be satisfactorily made without, at the same time, removing the lens. The iris has become so changed in structure, and so adherent to the lens-capsule, that it is difficult and often impossible to perform an iridectomy; and even when this can be accomplished, it usually fails to benefit the sight from the exposed capsule of the lens being coated with adherent uvea. It is, therefore, generally advisable to endeavour to remove a portion of the iris and to extract the lens in the one operation. First, make a section of the cornea with a fine Graefe's cataract-knife; then, if possible, remove a portion of iris; but, failing to accomplish this, tear open the pupil and through the capsule of the lens with a cystotome; or, if this be insufficient, remove a portion of the iris and the adherent lens-capsule with a pair of iris-scissors; and, lastly, with a little pressure on the globe with the back of the

curette, cause the escape of the lens through the corneal wound. This operation may generally be accomplished without the loss of any vitreous, and the eye will usually recover from its effects well; but the pupil will probably again become closed. Another operation will afterwards be required for the formation of a new pupil. The extraction of the lens seems to exert a beneficial influence on the eye, as, after it has recovered from the effects of the operation, it is much less disposed than it was before to a recurrence of the inflammation.

In the *third stage* of the disease, when there is an increased tension of the eye, active treatment is necessary. If the state of tension be long continued, the little sight that is left soon vanishes, and relief also is required for the pain which so frequently accompanies the tension. An attempt to do an iridectomy the writer has always found unsuccessful. In these cases sclerotomy is a useful operation. A narrow Graefe's cataract-knife is to be made to pierce the sclerotic just external to the corneo-sclerotic junction, and to be directed across the front of the iris to a corresponding point on the opposite side. After slight cutting, so as to make the section a little broader than the breadth of the blade, the knife is to be withdrawn, leaving a wide bridge between the sections. Sclerotomy may be performed, in sympathetic ophthalmia, where there has been great pain associated with increased tension, and in cases where there have been pain, tension, and ciliary staphyloma, and with very good results.

Of the *pathology* of sympathetic ophthalmia we know but little. There is, however, one remarkable fact with reference to its exciting cause, which is, the important part the iris, or some part of its continuation, the ciliary processes or choroid, plays in originating the disease in the other eye. Looking over all the causes which induce sympathetic ophthalmia, we find that either the iris, ciliary processes, or choroid are invariably involved. In injuries of the eye, it is the wounds in the ciliary region; in corneal wounds, it is the entanglement of iris; after cataract or other operations, it is the prolapse of the iris which gives rise to sympathetic ophthalmia.

In the lodgment of foreign bodies within the eye, the danger is when the foreign body is embedded in the iris or the ciliary processes, or when it has gone still deeper and is buried in the choroid, or from lying on the retina it presses on the choroid. Sympathetic ophthalmia may arise from a chip of metal which has penetrated the cornea without wounding the iris, and lodged itself in the lens. So long as it remains in the lens the other eye is safe; the danger is that, with the absorption of the lenticular matter, it may become detached from the lens, and fall to the deeper parts of the eye. Again, a fragment of a gun-cap has been seen in the vitreous, and there it remained for a long period without producing any irritation; the danger was that it might become detached from its bed in the vitreous, and then produce irritation in the other eye.

Detachments of the retina, even from violence, fail to produce sympathetic ophthalmia. There may be hæmorrhage from the choroid detaching a large portion of the retina—accidents which are of frequent occurrence; and yet no sympathetic ophthalmia. The extensive detachments of the retina from other causes, which lead to blindness of the eye, do not produce sympathetic ophthalmia; in such cases, it is the degenerative changes in the choroid which take place at a long period after the detachment of the retina, which cause the other eye to suffer. So, also, in eyes which have been long lost from any cause, it is the degenerative changes in the choroid which excite sympathetic irritation and ophthalmia in the sound eye. In cases of displacement of the lens from blows on the eye, no matter whether the dislocation be partial or complete, the danger lies in the pressure which the displaced or swinging lens exercises on either the iris, ciliary processes, or choroid.

It is very difficult to say through what channels the inflammation of the injured eye is transmitted to the sound one—whether the sympathetic ophthalmia is due to reflected nerve-action, or whether the inflammation is propagated by simple extension along some special track. The pathology of the disease is still under investigation, and, until we know more of it, it is useless to harass the mind of the surgeon with mere hypotheses.

GEORGE LAWSON.

SYMPHYSIOTOMY (SIGAULT'S OPERATION).—This operation was originally proposed by a Parisian medical student named Jean René Sigault, in 1769, and was first performed by him in 1777, with a successful result.

The pubic symphysis is divided in cases in which contraction of the pelvis prevents natural delivery; the pubic bones are thus allowed to separate, the sacro-iliac synchon-

droses acting as hinges. The child is then born by the natural process.

The early operations were chiefly performed in France, with some few in Germany, Belgium, Holland, and Spain, and one only in England, which terminated fatally to both mother and child. The operation then found favour in Italy, and was extensively performed in Naples, but died out in 1858.

Dr. Harris, of Philadelphia, U.S., has tabulated 70 cases, with the loss of 26 mothers and 47 children. In 1866 it was revived in Naples, and from that time to the end of 1880, 50 cases were operated upon; 40 mothers recovered and 41 children.

The operation being chiefly in the interest of the child, the large infantile mortality told against its adoption. As regards the maternal mortality, however, it compares very favourably with the results of Cæsarean section; and if the complete results of embryulcia could be collected, symphysiotomy would probably hold its own in comparison with these operations.

Operation.—In Naples the symphysis is divided subcutaneously with a probe-pointed and sickle-shaped knife. An opening is first made in the skin above the pubic arch, then the knife is passed carefully behind it, and the section is made by cutting from below upwards. With careful antiseptic precautions this should not be a dangerous procedure. In about one case in four the forceps are applied to aid the birth of the child. The pubic bones are fixed by an immovable apparatus as soon as possible after the operation. Asymmetry of the pelvis may make it difficult to exactly hit the cartilage in performing the section, and a corner of one bone may be sliced off; but this would be of no consequence in a thoroughly aseptic case.

Metroperitonitis was the cause of death in the majority of the fatal cases in the recent Neapolitan revival; and though only one of these is specified as septic, it is probable that sepsis was the chief agent in the production of the fatal inflammation.

J. Knowsley Thornton.

SYNOVIAL MEMBRANE, Pulpy Degeneration of.—This term is applied to a condition of the synovial membrane resulting from chronic inflammation, in which the delicate membrane of health is replaced by a thick, semi-opaque, gelatinous mass of tissue, of low organisation and degenerative tendency.

This growth usually affects uniformly the whole synovial membrane of the joint; it may attain the thickness of a quarter or half an inch; it is of a dull yellow colour, varied here and there with spots and streaks of whiter hue, and the red lines of a few small blood-vessels; its consistency varies from a gelatinous softness to a considerable degree of toughness. In advanced cases numerous points of fatty softening and of suppuration are seen; and its free surface may be covered with a layer of pus-secreting granulation-tissue. It adheres to the cartilages, and bulges into all the less resistant parts of the joint.

Sections of this material exhibit, under the microscope, a delicate fibrillated stroma, containing in its meshes free nuclei and nucleated cells of varying size and shape, but mostly of somewhat oval outline.

These changes in the synovial membrane are accompanied by symptoms of chronic joint-disease. At first, there is but slight swelling and heat, with a little tenderness, often of limited area; but, as the disease progresses and the synovial membrane becomes more thickened and pulpy, the bony outlines of the joint are concealed by a general elastic swelling, giving to the touch a deceptive sense of fluctuation. The ligaments soften, the cartilages ulcerate, the bone-surfaces become displaced, and the functions of the joint are slowly but surely lost. Eventually, suppuration usually occurs in some part of the thickened tissue, and matter makes its way either to the surface or the interior of the joint.

The *treatment* of this disease consists in long-continued rest and counter-irritation, together with such constitutional measures as tend to improve the general nutrition of the patient. But, in its advanced stages, the changes are irremediable, and the best that can be hoped for is a permanently crippled joint. The alternatives, therefore, are—(1) To apply a splint, restrict movement, and avoid the use of the joint, leaving it lamed but painless and quiescent; (2) to open the joint and remove the diseased tissue by scraping or solution; (3) excision, whereby the articular surfaces, together with the altered synovial membrane, are removed, and an ankylosed limb or a false joint results. *See* Joints, Diseases of.

J. Warrington Haward.

SYNOVITIS.—Acute Synovitis.—The synovial membrane is, of all the joint-structures, the most commonly inflamed. It is exceedingly sensitive to injury and to the presence of any septic material, whether introduced by a wound or circulating in the blood. Thus, the majority of cases of acute

synovitis are of traumatic, septic, or rheumatic origin; and most acute joint-diseases commence as inflammation of the synovial membrane.

The *symptoms* of acute synovitis are pain, heat, and swelling of the affected joint, in addition to which there is pyrexia, of a degree proportionate to the size of the joint and the activity of the process. The pain is increased by movement; if the joint be superficial, its increased temperature can be easily felt by the hand; the swelling is limited by the synovial reflexions, it is elastic and fluctuant, and conceals the outlines of the articular ends of the bones.

If a joint be examined in the early stages of acute synovitis, the membrane is seen to be swollen and of bright red colour, and the cavity of the joint contains a quantity of synovial fluid of varying turbidity. The microscope shows the redness of the membrane to be due to dilatation of its vessels and increased vascularity, and the turbidity of the fluid to be owing to the presence of leucocytes and shreds of fibrinous lymph. As the inflammation advances, the synovial fluid becomes more turbid, the cellular elements increase, and eventually pus is formed. When this stage is reached, however, the process has usually spread to the other joint-structures; the cartilages undergo ulceration, the ligaments soften, and the bones are exposed. On the other hand, the inflammation may subside, and either assume the chronic form or undergo complete resolution and recovery.

Acute suppurative synovitis is usually of septic origin, and is accompanied by grave constitutional disturbance. Rigors (especially if repeated); increased pyrexia, with dry tongue; and œdema of the soft parts round the joint, may generally be taken as indications that suppuration has occurred. *See* Pyæmia.

Traumatic synovitis in a healthy person will probably subside, under proper treatment, without suppuration, if there be no wound of the joint. If there be a wound, suppuration is more frequent, and its occurrence will depend chiefly upon whether septic material obtains access to the joint or not. *See* Joints, Wounds of.

Rheumatic synovitis tends rather to adhesion than suppuration.

Treatment.—If the synovitis be of traumatic origin in a healthy person, the treatment should be antiphlogistic and decided. The joint being secured in a position of rest, leeches or cold should be applied. If, in spite of this, the tension remains great, the fluid should be withdrawn from the synovial cavity by antiseptic aspiration. Subsequently, elastic pressure must be maintained over the joint, and, if fluid remains, blisters will be needed.

In septic synovitis quinine is indicated; and in the rheumatic form, alkalies, the salicylates, and opium.

When suppuration has occurred, and the presence of pus within the joint has been ascertained by tentative puncture, one or more incisions must be made in such a position as will ensure the free drainage of the joint; the cavity must be washed out with antiseptic solution, a drainage-tube inserted, and antiseptic dressings applied. Recovery with a movable joint may ensue, but ankylosis is the more common result.

Subacute Synovitis is closely allied to the acute form both in causation and symptoms, but the process is one of much less activity and virulence, with correspondingly mild constitutional disturbance. Gonorrhœal synovitis, which is a mild form of septic inflammation, comes into this division; and similar forms of articular disease occur in connection with vaginitis, scarlatina, typhoid fever, and other sources of blood-poisoning. *See* Gonorrhœal Rheumatism.

Here, the *treatment* must be directed to the cure of the source of infection, at the same time that the joint-inflammation is combated by rest, blisters, and pressure. In these cases there is a great tendency to the formation of adhesions, which must be subsequently treated by rupture and passive movement. Some cases of subacute synovitis lead to a persistent, passive effusion into the joint, which resists the ordinary methods of treatment, and is called 'hydrops articuli.' For this, aspiration of the joint, followed by elastic pressure, must be used, and if this fail, the joint may be injected with weak antiseptic solutions, as that of carbolic acid (1 per cent.) or of iodine (1 or tincture of iodine to 10 or 20 of water).

Chronic Synovitis may result from the subsidence of the acute forms or from neglect of treatment, but is more often due to some constitutional condition which predisposes to chronic joint-disease.

The *symptoms* are a slowly progressive, indolent swelling of the joint, due partly to fluid in its cavity, but chiefly to thickening of the synovial membrane; slight pain, tenderness, and increase of temperature, and some restriction of movement. As the disease advances, the synovial membrane undergoes pulpy or gelatinous degeneration, and, bulging into all the less resistant

parts of the joint, gives rise to a deceptive sense of fluctuation. At the same time the functions of the joint become increasingly impeded, and the limb correspondingly lame. Eventually, suppuration occurs within the substance or upon the surface of the diseased membrane, and the joint becomes slowly destroyed.

Treatment.— In the earlier stages of chronic synovitis, the treatment will consist in keeping the joint at rest and the use of counter-irritation; while at the same time the health and reparative powers are by all possible means improved. Counter-irritation, as by blisters or the actual cautery, may be followed by pressure in the form of india-rubber bandages or strapping over mercurial ointment. Subsequently friction, shampooing, and passive movement may be used.

But if the stage of pulpy degeneration has been reached, nothing but the removal of the diseased membrane will avail; and this may be done, either by excision of the joint, or by incision combined with scraping or solution, with strict antiseptic precautions. For scraping away the diseased tissue a Volkmann's spoon is the most convenient instrument; for its solution the best method is to introduce into the joint, through lateral incisions, strips of lint soaked in a solution of sulphuric acid in two parts of water.

When suppuration has occurred, the same measures may be used for cleansing the joint; but if the health be much deteriorated and the reparative powers impaired, amputation will be indicated.

J. Warrington Haward.

SYPHILIS.—It is important to recognise that syphilis is by no means necessarily a venereal disease. Its various phenomena result from the introduction into the patient's system of a specific poison; and this poison, in all probability, consists of particulate or formed elements. It can be conveyed from one person to another only by direct contact of surfaces. The thinner and more delicate the tissues exposed to this contagion, the more easy is the implantation of the virus. It does not matter in the least upon what part of the body the contagion is effected, for syphilis is always one and the same disease, and is modified in its course only by the inherent peculiarities of the person acquiring it, and the antidotal drugs which are used against it. It is obvious that the venereal act affords peculiar facilities for the transference of a virus of this kind. Hence the fact that syphilis in the vast majority of cases is communicated in this way, and hence its popular synonym. We meet, however, in practice, with numerous cases in which the contagion takes place upon parts distant from the genitals. *See* Finger-chancre; Lips, Diseases of the.

The early stages of syphilis are probably very uniform in their duration; quite as much so as those of the exanthemata. We may conveniently specify these stages as: (1) the period which intervenes between the day of contagion and the first evidence of local change; (2) that which occurs before the full development of local peculiarities; and (3) that which precedes the appearance of constitutional symptoms. Syphilis, like the exanthems just alluded to, is followed in due course, after the poison has had time to breed in the blood, by constitutional symptoms. Those symptoms are febrile disturbance, sometimes acute, sometimes almost absent, an eruption on the skin and mucous surfaces, and transitory congestions or inflammations of the most various organs and tissues. It is customary to speak of the local phenomena resulting directly from the contagion as *primary* symptoms, and of those which follow when the whole blood is poisoned, as *secondary* or constitutional; whilst the terms *tertiary* and *remote* are reserved for a different class of phenomena, which may appear at very various periods after the primary and secondary have long cleared away.

Although, as has just been asserted, the stages of syphilis are, probably, when not influenced by antidotal treatment, very uniform, yet it must be clearly recognised that its severity varies very much in different individuals. This remark applies to all its stages and the whole series of its very varied phenomena. Without any reference to the health of the individual, to his age, to the part inoculated, or to the source of the virus, we may witness, both in the primary and the secondary symptoms, the widest possible differences as regards severity. The secondary stage may be almost fatal in one case and scarcely recognisable in another; the tertiary phenomena never happen at all in a vast number of persons who have suffered very severely in the secondary period, whilst they may affect with great pertinacity, in exceptional instances, those who have suffered very little in the early stages. Differences in treatment no doubt account, to some extent, for these apparent discrepancies, but certainly not for the whole. There remains much which can be explained only by the idio-

syncrasy of the individual. A similar remark is equally true of the specific fevers known as the exanthems.

The study of the first stage of syphilis has been rendered much more difficult, than would otherwise have been the case, by the fact that its contagion is rarely effected by a pure fluid. In a majority of cases, not only is the particulate virus of syphilis implanted, but with it the contagious products of peculiar forms of inflammatory action. In this way the local or primary symptoms are often complicated, and we witness on the same spot the results of the implantation of inflammatory material and of the true virus. Further, it may and often does happen, that either a contagion from the inflammatory material alone takes place, or that the effects of this entirely overpower and destroy the specific virus which was mixed with it.

The Primary Sore.—If the virus of syphilis in a pure form be inoculated, it rarely produces any irritation at first. A period of from three to five weeks will elapse before anything is observed. At the end of that time, a little red spot will be noticed, which itches more or less, and which, extending from day to day, soon becomes a papule, and by the end of a week or ten days is probably a little indurated disc or button. The induration is usually very marked, and its margins definite. There is not much surrounding inflammation, and the surface of the ulcer usually secretes but little. In some cases, indeed, there may be no ulceration whatever, and not the slightest secretion. At the end of five or six weeks, from the date of contagion, the induration will be probably marked. It will continue for a longer or shorter period (usually in relation to treatment pursued), but it never, even when wholly let alone, persists indefinitely, and frequently it vanishes after a very short duration. Occasionally it may last for months. The number of these indurated spots, or chancres, will depend upon the number of different places which were inoculated in the first instance, just as is the case with vaccination vesicles. It is not very often that more than one is seen, and if there be two, three, or more, they are always at the same stage of progress at the same time. No new ones are ever produced subsequently to the full development of the first. If, for the sake of experiment, it were attempted by direct inoculation to produce others, the attempt would fail, just as we should fail to revaccinate an infant, on the eighth day, from his own spots. *See* Chancre.

Simultaneously with the development of local induration, there is usually an enlargement and hardening of the nearest lymphatic glands. If the sore be on the finger, the glands in the armpit will enlarge; if on the lip, those under the jaw; if on the genitals, those in the groin. The character of the enlargement of the glands will be similar to that of the primary sore; that is, there will be great hardening and very little tendency to diffuse inflammation. The glands will remain separate from one another, and more or less movable. The degree of induration will often be such as to justify the term 'bullet bubo.' This term, however, is much more frequently applicable to enlarged glands in the groin than elsewhere. In the armpit and under the jaw the buboes often consist of glands as large as walnuts, and by no means very hard. Suppuration is, however, even less frequent in these regions than in the groin. *See* Bubo.

The conditions which result from the implantation of inflammatory, or from mixed, products are different. It would appear that some of the inflammations resulting from syphilis, but not attended by the actual presence of the virus, may produce a peculiarly irritating and very contagious secretion. This secretion, if inoculated, promptly produces inflammation. Sores form within a day or two of its contact, which are attended by ulceration, and by the secretion of pus which is capable, in its turn, of inoculating other parts. Hence, these sores may not only be multiple in the beginning, but they may become multiple afterwards. If the experiment of artificial inoculation on some other part of the patient's person be tried, it may easily be proved that he is in no sense protected, since sores of a precisely similar character will be produced. Inasmuch as sores of this kind never show definite induration, they are often spoken of as 'soft'; but it must be clearly remembered that it is quite possible that one or more of them may, at the end of the four weeks' incubation-period, take on induration. It must also be most clearly understood that, although the infecting sore in its typical condition is usually hard, it does not by any means always assume that character. The popular division of sores into 'soft' and 'hard' is productive of very numerous mistakes, since many infecting sores are never hard, and many which are without any trace of hardness at one stage may assume it at another.

The characters of these non-indurated, pus-secreting sores are very various; but

their most usual features are those of an abruptly margined ulcer, having cut or punched-out edges, with a grey, unhealthy surface, and with much surrounding inflammation. It is a remarkable fact, that the non-indurated sore is almost never recognised excepting on the genitals. We must explain this, probably, by the suggestion that the vitality of the pus-elements is much lower than that of the true virus of syphilis. Thus, should they come in contact with the lip or the finger, or even with an abrasion or a wound, they would probably be easily washed off and got rid of. The mucous folds on the genital organs, however, afford the pus a protection, and thus favour the success of its contagion. It may be, also, that non-specific sores on other parts are seldom diagnosed as such, since they present no features which are characteristic beyond dispute. The non-indurated sore, like the hard one, is very prone to cause enlargement of the lymphatic glands, and, as in the former case, this enlargement is of the same type as that of the sore which produced it. It is attended by excess of inflammation. The affected glands swell greatly, and, the intervening tissue being involved, they become glued together in one mass. Suppuration both within and around the glands, instead of being the exception, is the rule.

It is quite possible for a patient to suffer from non-indurated sores and suppurating bubo, without having subsequently any constitutional phenomena. Many such cases occur. It is probable, however, that they are far less common than is generally believed, and that, in a majority of cases, sores which are at first and remain throughout their course diagnosed 'soft,' prove to be infecting. The surgeon must be most cautiously on his guard in giving opinions on this point; for, if the patient has never had syphilis before, whatever may be the characters of any primary sore which he may exhibit, the chances are two to one that the sequel will prove that it contained the germs of true syphilis. The terms infecting and non-infecting, or true chancre and false chancre, might perhaps conveniently displace the adjectives 'soft' and 'hard.' Whatever terms we use, however, we must clearly understand that softness very often precedes induration, that the infecting is not always hard, or, to state it in other words, that the soft may often prove to be infecting. So also with the bubo; an infecting sore may often cause suppuration of the glands, and a non-infecting sore may be attended by a quite moderate degree of enlargement of glands, which never show any tendency to suppurate. Such being the facts, it is absurd to attempt the formation of sharply-defined rules in the diagnosis of chancre. The general precepts in use are, however, safe enough if we are content to apply them lightly, and careful to remember that they have many exceptions.

It is desirable, at this point, to say a few words as to the relation of the very peculiar disease known as *herpes* to true syphilis. Herpetic vesicles may occur on the genitals of either sex quite independently of any venereal cause, and if they have occurred once they are very prone to occur again. They are seldom or never seen before puberty, and, in those liable to them, they often appear to follow directly on nocturnal emissions or sexual intercourse.

Herpetic vesicles are recognised by their coming out in a group, consisting of at least three or four, by their developing simultaneously and suddenly, and, if time be permitted, by their spontaneous disappearance. Their relationship to syphilis is very peculiar, and often very puzzling. It would appear that they are liable to follow on both kinds of local sore, the non-infecting as well as the infecting one. And although it is to be admitted that those who have never suffered from syphilis may be liable to recurrent herpes on the genitals, yet it is certain that those who have done so are infinitely more prone to it. In syphilitic subjects, further, herpes is often much more severe than in others. Its sores may last longer and become much larger than they would in others, or some of the vesicles may heal and others may persist, and thus it may become by no means easy to distinguish an herpetic sore from a non-indurated chancre. Since herpes very frequently follows intercourse, the patient will often give a misleading history. There is yet another fallacy which occasionally occurs, for in the careless the existence of almost healed herpes may facilitate the introduction of the syphilitic virus, and thus a true chancre or a group of chancres may follow what was in the first instance herpes.

It is necessary, next, to say a few words about a peculiar type of the inflammatory process which is liable to attack both forms of sore—namely, *phagedæna.*

When an ulcer steadily extends in depth and in area, and when its edge presents little irregularities, as if it had been eaten away by a mouse, it is said to be phagedænic. Very often the edge presents, on careful examination, minute points of slough not bigger than pins' heads, whilst

in more exceptional cases there may be sloughing of large and conspicuous portions, and the spreading will be very rapid. To this latter condition the term *sloughing phagedæna* is given.

Sores which are phagedænic are nearly always painful, and the pain is proportional to the extent and rapidity of the process; they are also very liable to bleed, for it would appear that the arteries adjacent to them often fail to get plugged before they are opened by it. If the ulceration extends deeply, and involves vessels of any considerable size, the hæmorrhage may be very profuse.

A certain degree of power to cause the phagedænic type of inflammation appears to attach itself to several specific animal poisons. Thus, the affections called cancrum oris and noma, which are forms of sloughing phagedæna, usually occur in fairly healthy children as the sequelæ of measles or scarlet fever. The syphilitic virus, however, stands pre-eminent in power in this direction, and probably nineteen out of twenty of all forms of phagedænic action, which we encounter in practice, are due either directly or indirectly to its influence. *See* PHAGEDÆNA.

The disease known as hospital phagedæna, which may spread through a hospital, attacking all operation and other wounds, is, not improbably, almost always set going by the admission of a case of syphilitic phagedæna into the wards. The secretions of a phagedænic wound are unquestionably contagious, and they are so not only as regards other individuals, but also in reference to the patient himself. It is in large measure by the contagion of its own secretions that a phagedænic wound continues to spread. Remove those secretions and clean the wound, and the disease will be, in most instances, arrested. In a few cases, however, the constitutional tendency, under which the disease was initiated, is sufficiently strong to begin it again and again, in spite of the most efficient treatment. In these latter cases the use of internal specifics becomes equally important with that of local remedies. *See* HOSPITAL GANGRENE.

Syphilitic inflammations of all kinds and at all stages, whether primary, secondary, or tertiary, are liable to take on phagedænic action. Its most frequent examples, however, occur in connection with primary chancres. Although it is admitted that it may attack the non-infecting as well as the infecting, the writer cannot quote, from his own experience, any example of a well-characterised, primary, phagedænic sore which did not prove to be infecting. In this statement reference is made only to chancres occurring in those who have not previously suffered from syphilis, for exceptions occur in those who have done so.

Phagedænic action in primary sores may vary much in different cases, being sometimes slight and easily arrested, at others persistent and extensively destructive. In some cases, it may destroy the whole of the penis; and in a few cases, chiefly in young prostitutes, it may end fatally. It appears to be more apt to occur in sores which are concealed under a long prepuce, by which the secretions are retained. But it may attack sores in any position. Whenever a concealed sore becomes painful or liable to bleed, the foreskin should be slit up and free access obtained.

Treatment.—As regards indurated primary sores, if the hardness be such as to justify a positive diagnosis, and if, in further corroboration, there be also the bullet bubo, there can be no question as to the treatment. Mercury should at once be given and applied locally, and under its influence there will ensue, in the most definite manner, softening of the indurated patch and healing of the ulcer. If the mercury be stopped, the induration will recur, and if it be again given, it will again melt away. The excision of an indurated sore, or its destruction by an escharotic, can seldom do any harm, but will rarely be productive of good. The virus has already passed into the lymphatic system, if not into the blood, and the occurrence of induration, for the most part, denotes a stage of development too far advanced for any hope of cure by local treatment. The treatment of non-indurated sores will vary according to the stage at which they are seen. If a patient who has never suffered from syphilis before, and who can give his dates correctly, comes under observation at any period within a fortnight of the contagion, with a single sore, it will certainly be wise to destroy it utterly. For this purpose fuming nitric acid may be used, or, still better, the actual cautery; and if the part affected admit of it, free excision by the cautery had better be done. The shorter the period, the greater will obviously be the chance of success. However short the period, success is not certain, as is proved by well-known facts.

The facts alluded to, however, are not of such a nature as to relieve the surgeon of the duty of giving to those patients

who seek his aid early in the case, such chance of escape as the freest possible local treatment affords. If instead of a single one there be many sores, and much surrounding inflammation, there is then no encouragement to commence an abortive local treatment. In these cases, and in all which come under care late, the local treatment will consist in very free washing of the sores and the application of iodoform. This latter drug has superseded all others for the cure of non-indurated or suppurating sores. It should be dusted into the sore after liberal irrigation, and should be applied also as an ointment, one drachm of iodoform to one ounce of vaseline. Perhaps in nine cases out of ten this application will cause the non-indurated sore to take on healthy action and to heal. There are cases, however, which unexpectedly resist it. For such, mercurial applications are next to be tried; and, should they fail, cauterisations with the acid nitrate of mercury may become needful.

Before the introduction of iodoform, a host of remedies were in much repute, but were all of them frequently disappointing. Amongst these may be mentioned the sulphate or chloride of zinc, the sulphate of copper, borax, and various preparations of opium. There are a few cases in which sores, which are not in the least indurated, will yield to nothing but the internal administration of mercury. These are, however, very exceptional; and it may be asserted that, for the most part, the introduction of iodoform has rendered the treatment of non-indurated sores a very easy matter. The same remark applies to the suppurating stage of true chancres.

Several different measures are of the utmost value in the treatment of phagedæna; and, whilst invariably aggressive if left to itself, it is as almost invariably cured by one or another, or all of them combined. In the first place, we have local measures which have for their object the removal of the secretion or its destruction. Amongst these the application of nitric acid, and the use of the continuous bath, are chief. In most cases one or two free applications of nitric acid will stop phagedæna. It is, however, a painful measure, and, in most cases, equally good results may be obtained by keeping the part immersed in warm water. In a bad case, the patient should remain day and night in a sitz bath; but in less severe ones, he may get into his bed for five or six hours at night. When he leaves the bath, the sore should be dressed with iodoform. Since the occurrence of phagedæna is almost invariably a concomitant of the infecting sore, mercury ought always to be given unless it definitely disagrees. With the mercury should be combined full doses of iron and opium. If it be unquestionable that mercury does disagree, iodide of potassium should be substituted.

Finally, there are certain cases in which a phagedænic sore, although much benefited by the measures enumerated, may yet decline to heal under any or all of them. In these, healthy processes will almost always result if the patient be sent to the seaside. When once phagedænic action is completely stopped it scarcely ever recurs, a fact which speaks strongly in support of the belief that it is, to a large extent, a local process only.

Having thus far considered the peculiarities of primary sores, we may here dismiss entirely the non-infecting or abortive ones, since they are not productive of any constitutional phenomena, and, though associated with it, are not in any true sense syphilis. We may now proceed to the investigation of the very remarkable train of symptoms which follows the infecting chancre.

The Stage of Constitutional Infection (Secondary).—The chancre and the bubo make up together the primary or local group of syphilitic symptoms. We shall be very near the mark if we say that definite induration in the chancre is rarely present till five weeks have elapsed from the date of contagion, and that secondary phenomena seldom follow till from two to four weeks later still. There is thus a period of from two to four weeks after it has been possible to recognise the infecting sore for a certainty, before the time at which constitutional symptoms will show themselves. If this period has been well employed, if, in other words, mercury has been freely and adequately given, it is probably quite the exception for any secondary symptoms to occur at all. At any rate, if they do, they are but slightly and very feebly marked. The earlier the mercury is resorted to, the greater the probability that they will be wholly prevented. Even when not permanently prevented, they will usually be much delayed.

It must, unfortunately, be admitted that in a certain number of cases, often apparently the most successful, the sequel will prove that delay only has been accomplished. After even a six months' treatment with mercury, and absolute prevention

during the whole of that time, an outbreak may occur when it is suspended. It is this remarkable power of mercury, as an antidote to syphilis, which has led to such different opinions as to the laws of the natural evolution of the malady. If mercury were never given, we should soon see that syphilis is much more regular in its course and stages than is generally supposed. The order of events in cases not interfered with would be probably somewhat as follows: At the end of about six weeks from the date of contagion, the patient would begin to experience slight malaise and feverishness, and his temperature would rise a little every evening. During the next fortnight, if the skin of his chest and abdomen were carefully inspected, it would be found to be mottled by evanescent patchy congestion, not unlike measles, but more dusky and not so conspicuous. To this term syphilitic roseola is appropriate. It is often very evanescent, present at one part of the day and gone at another, or may last only a few days and then disappear. Simultaneously with it, a little later or a little sooner, symmetrical superficial ulcerations on the tonsils occur, and these, too, may be very transitory, and cause so little annoyance that the patient may be scarcely aware that his throat is sore. As the roseola fades, or it may be before it fades, other types of eruption will follow; and a rash composed of little smooth-topped or slightly scaly papules is the most common. The eruption may, however, vary within very wide limits. It may be a lichen, or it may be pustular; or it may take the impetigo or acne type; or it may be vesicular or bullous; or it may assume the rupia type; or it may be corymbiform (the lichen ruber type); or, lastly, it may be indistinguishable from true variola.

We know respecting syphilis that during its early stages the blood and all products of inflammation may prove the vehicles of the contagion. How long this condition persists we do not know. That the blood may still be contagious, after all external phenomena have vanished, we know from the facts of vaccination-syphilis, and from many instances of accidental inoculation. A vast amount of negative evidence favours the belief that the normal secretions, the saliva, the milk, the sweat, the semen, are not usually, perhaps never, vehicles of contagion. If they were so, syphilis would be far more common than it is. The rarity of the lip-chancre is an almost conclusive fact against the contagion of the saliva. So also, as regards the semen, is the fact that syphilitic husbands do not usually communicate the disease unless pregnancy ensues. Yet, it is unquestionable that the virus exists in the semen in a manner which permits of spermatic infection of the embryo. It is possible, however, that this may be a very different thing from the infection of a wound.

A very large amount of negative evidence supports the belief that the virus ceases to exist, in a form efficient for contagion, long before the subject of the disease is free from the risk of relapses. Almost all the examples of accidental contagion occur within short periods from its origin. It is seldom that more than two years can be proved under such circumstances. The primary and all secondary lesions are certainly contagious, and during their persistence the blood is virulent, but after they have ceased, whether from treatment or without, there is reason to believe that the virus does not long remain potent for contagion. No instances of contagion from a tertiary lesion, or from one produced more than five years after the primary disease, are, as far as the writer's knowledge extends, on record. Perhaps the period might be shortened to three years. Yet, long after such periods, the patient continues to be himself liable to various forms of local inflammation consequent on his taint.

The older writers inferred that a man might have syphilis over and over again. Five-and-twenty years ago it was taught, almost universally, that one attack secured immunity from others. We are now again coming back to the old belief. At any rate, we know for certain that second attacks are not very infrequent. The writer has himself had not a few opportunities for observing the course of second attacks, in patients whom he had himself seen during the first. The doctrine that immunity is conferred is, however, to some extent, well founded. Second attacks are exceptional, and when they do occur the disease is almost always modified. Second chancres do not run the usual course. Their induration is often developed quickly, and very quickly passes away, to be followed by nothing definite. For the most part, second contagions result only in non-indurated or abortive sores. Yet, in spite of this being the usual course of events, it is, beyond doubt, quite possible for a man to have complete syphilis twice. Perhaps it is as infrequent as in the case of variola, and to be explained, as in the latter instance, by the idiosyncrasy of the patient. It curiously happened, in the first instance in which the

writer observed a second attack of syphilis, that the patient had experienced two attacks of variola also.

One of the occasional manifestations of secondary syphilis is the production of papillary warts. The fact that we encounter not only the most various modifications of the inflammatory processes, but also conditions which are in the main produced by structural overgrowth, is so remarkable that the writer must refer to it in some detail. The warts which we see in the middle of the dorsum of the tongue are the most simple and definite example of this structural enlargement. They are often unattended by inflammatory infiltration of adjacent parts, and consist simply of hypertrophied papillæ. They wither when mercury is given. Now and then similar warts, directly due to syphilis, are seen on the genitals, and sometimes (but very rarely) the whole skin-eruption assumes a papillary type. The condyloma is, however, much more common than the ordinary wart. It is indeed a variety of wart, and between it and the typical *verruca mollis* we observe all gradations. In the condyloma there is great hypertrophy of papillæ, but these are concealed by the extensive cell-infiltration into the intervening layers. The great thickening of the intima, which occurs as the first stage of syphilitic arteritis, is also, in many instances, a condition of hypertrophy rather than of inflammation. The same remark applies to some of the cases of hypertrophic cirrhosis which we meet with in syphilis, in which there is much diffuse fibrous overgrowth. This fibrous overgrowth may vary much in the amount of its cell-infiltration. The term 'mucous patch,' often used as synonymous with condyloma, should be superseded by mucous wart or papilloma. Many, indeed by far the greater number of true mucous patches, are not attended by any papillary growth. *See* Mucous Patches.

Thus, it may be said that the syphilitic virus often causes sclerosis or sclerotic hypertrophy in the first instance, and inflammation, more or less marked, in the second. Sometimes no inflammation occurs, and the chancre may run its course without pain or irritation, without ulceration, and without discharge. Such were probably the conditions, as regards the chancre, in some of the cases in which intelligent and truthful patients, affected by unquestionable syphilis, assure us that they have never had any local sore.

The indurated chancre does not present any features peculiar to itself when examined by the microscope. It is simply an example of cell-infiltration without giving way of the cellular-tissue fibres amongst which the cells are effused. Hence, perhaps, the explanation of its hardness. Inflammatory action is almost absent, and the process resembles that of a new growth. The hardest chancres are always those which are least inflamed.

In the false chancre, on the contrary, the pus-elements which effect the contagion produce inflammation from the beginning. Even if the specific virus be present also, it is very possible under such conditions that it may be unable to effect any noticeable degree of sclerosis, and thus, as already observed, the sore may rank as soft or suppurating, although it may prove infecting.

At the same time that the skin is affected in constitutional syphilis, the eye, the periosteum of the bones, the bones themselves, the joints, the nervous system, indeed all the tissues of the body, are liable to suffer. Whatever part is attacked, however, the inflammation, although persistent for a certain time, will usually prove transitory in character. Very often, the duration of the phenomena at this stage is exceedingly brief. Just as the patient may have a roseola which lasts only a few weeks, or even only a few days, so it is with periosteal pains, with affections of the eye, and with those of the nervous system. What happens may be a merely temporary congestion, and by no means a definite inflammation. In this, we note a strongly marked difference between all the occurrences in the secondary stage of syphilis and those which are tertiary. The latter, unless cured by treatment, invariably persist, and tend to spread locally. The former, although often for a time very severe, as invariably show a tendency to subside spontaneously.

Other important distinctions between secondary and tertiary syphilis must be insisted upon. The phenomena of the secondary stage are caused by poisoning of the blood, and of the tissues generally through the blood; they are therefore almost always symmetrical, and are developed with accurate sameness of appearance on the two halves of the body. In the tertiary stage it is highly probable that the virus has ceased to exist in the blood, and, in an active form, even in the tissues themselves. Thus, in this stage the phenomena are due to peculiarities, which have been stamped upon the tissues by what occurred during the more or less remote period of blood-poisoning. Local influences have

much to do with the bringing out of these inflammations, but when once produced they are always self-infective, and tend not only to persist, but to advance in adjacent tissues by 'contagion of continuity.' As an example of this may be adduced the well-known horse-shoe sore, a form of syphilitic lupoid affection of the skin, always tertiary, and always tending, unless stopped by treatment, to spread at its edge. To this quality of edge-spreading the term serpiginous is applicable, and the serpiginous tendency is one of the most important features of difference between the tertiary phenomena of syphilis and those which are secondary. One which is perhaps still more important is, that the tertiary symptoms are, as a rule, not developed with symmetry. They depend far more upon local causes than do the secondary. Thus, there is no reason why they should be symmetrical, and, in fact, they are only exceptionally so. Even when an accidental symmetry is observed, we never witness with it the general distribution, which is another marked feature of the secondary symptoms. As a rule, we may note, also, that the inflammations which occur in the secondary stage do not spread at their edges, are not serpiginous—a feature in which they resemble those of the other exanthemata. The only exception to this occurs in the case of phagedænic ulcerations, and in these, as has been already explained, the phagedæna is not in a strict sense part of the syphilis, but is due rather to certain peculiar forms of inflammatory secretion which have been produced by it. Thus, if phagedænic action should occur in the secondary stage, it never shows any tendency to symmetry of arrangement.

It is desirable now to attempt a more detailed description of the symptoms which we meet with in the secondary period.

The Eruptions on the Skin in the Secondary Stage present so many features of difference that it would be tedious to attempt their separate description. It is a most interesting and remarkable feature, respecting the skin-diseases of syphilis, that they do not, as do the other exanthemata, keep to one form. There is, in fact, no single skin-disease of constitutional origin which may not be imitated very closely by an eruption which is due to syphilis. Certain general features of distinction may, however, be noted. First, the imitation is rarely absolutely correct. However close at first sight, the careful observer will almost always note some distinctions, and thus will usually know what name to apply. Next, there is very frequently a mixing of the types of two or more in the same case. Thus, as is well known, syphilitic eruptions are very commonly polymorphous. We see mixed in the same case, and often in close juxtaposition, papules of psoriasis and of lichen, or the rash may be in part lichenoid and in part pustular. There is a popular belief that the eruptions of secondary syphilis are always of a peculiar colour—a coppery tint, or the colour of the lean of ham, is supposed to constantly characterise them. No doubt this peculiar feature is very often observed, but it is far from invariable, and it is often exceedingly well marked in eruptions which have no relation to syphilis. Those who trust to it, therefore, will be in constant danger of making mistakes. In judging of the colour of syphilitic eruptions, allowance must be made for the temperament of the individual and for the part of the body on which the eruption shows itself. So far as the tint shows itself in pigmentation, we may say that the darker the complexion of the patient the more likely will his eruption be to show a deep copper tint. On the lower extremities, where the venous circulation is at a disadvantage, patches of syphilitic eruption will always be much more dusky, owing to venous congestion, than on other parts.

Next to colour, symmetry, and polymorphism, we have to mention the position on which the spots appear, as aiding us in the diagnosis of secondary syphilitic rashes. The earliest forms of eruption, roseola, &c., unquestionably occur on the front of the abdomen, and throughout the whole course of this stage the front of the trunk is very rarely exempt. Very probably the wearing of clothes, especially of woollen, and the warmth of the surface thus preserved, have much to do with this peculiarity of location. We seldom see the early secondary rashes on the face or hands, and if they do occur here it is only in cases of exceptional severity. Next in importance to the abdomen and front of the chest, we have the front surface of the arms; indeed, no region of the body is more constantly affected by secondary syphilis than these parts. The back and sides of the neck are very frequently affected. Although we may, without hesitation, draw a strong line between common psoriasis and syphilitic psoriasis, by saying that the latter usually affects the fronts of the upper extremities and the backs of the lower ones, while it is the reverse in the common form, yet the rule is liable to many exceptions.

Whenever we find psoriasis patches definitely located on the tips of the elbows and fronts of the knees, we may be confident that it is non-specific, but we shall meet with constant exceptions to all other rules as to diagnosis by location.

Next in frequency to the roseolous or blotchy eruption so common in the very earliest stage of secondary symptoms, we must place the papular rash, to which the name psoriasis is usually given. It differs from non-syphilitic psoriasis not only, as just observed, in the localities affected, but also in its general characters. It seldom, like common psoriasis, affects large areas, but is usually seen in small spots (from a pea to a sixpence in size), and it is never conspicuously scaly. The white silvery scale-crust usually present in the non-syphilitic form is seldom seen in the specific one. Not infrequently the papule, upon which the scales are scantily placed, shows so much thickening that the term tubercle might become appropriate. From these features, and from the fact that the various spots often differ a good deal from one another in the same individual, it is not often difficult to make the diagnosis, even without help from the history of the case. Amongst the less common of the syphilitic rashes we have the following:—

In *lichen* we meet with little red or dusky pimples scattered over the whole surface. They are often very thickly placed, but show little or no tendency to arrangement in groups, and seldom become confluent, or form patches. There is, however, a form of syphilitic lichen in which the spots are arranged in long, corymbose groups, or in streaks, exactly resembling those seen in lichen ruber, and sometimes these become flat-topped and polished as in lichen planus. The exact imitation of these peculiar forms of skin-eruption by syphilitic rashes is very remarkable, and the diagnosis is often exceedingly difficult. The mistake most usual is taking the non-syphilitic eruption for a specific one, and rejection of the patient's denial that he has ever run the risk of acquiring the latter. Lichen ruber and lichen planus are often dusky or copper-tinted, and present all the features which, to those of limited experience, suggest a confident diagnosis of syphilis.

Although a syphilitic eruption, looking closely like *small-pox*, is very rare, yet the knowledge of its possible occurrence is of extreme importance. The imitation, when it does occur, is very perfect. The papules are elevated, shotty to the finger, have depressed centres, affect the same regions as variola, and resemble it so absolutely that nothing but the history of the case can help the surgeon to a correct opinion. In proof of this statement, it may be stated that it is not at all unknown for patients presenting this type of syphilitic eruption to be sent to the small-pox hospitals, and there to obtain admission and prolonged treatment. This simulation of the variolous eruption by syphilis is the most marked example of 'syphilitic imitation' which can be adduced, but it is only one of many. By far the easiest clue to the recognition of the syphilitic skin-diseases is the acceptance of this general law: *Syphilis may imitate all known forms of skin-disease, but it can produce no originals.* All the known names for skin-diseases (excluding those of merely local origin) may in turn receive the adjective *syphilitic* before them. When they do so, that adjective becomes, of course, all important, and wholly swamps the designation to which it is appended. Of the exanthemata, not only variola but varicella, rubeola, and scarlatina may be thus imitated. The rash caused by copaiba is often exactly like a syphilide, or, what amounts to the same thing, syphilitic rashes are like it. Forms of inflammation, exactly like those called lupus, are very common as the results of syphilis, and it is the same with alopecia, leucoderma, true leprosy, and many others. We see here the importance of a correct appreciation of the patient's history. When any one of the evanescent eruptions is simulated by syphilis, the mere lapse of time clears up the diagnosis, though unfortunately often not early enough to save the surgeon's reputation. The supposed variola or copaiba rash does not fade at the proper time, but persists for weeks together, and thus proves itself a syphilide.

The eruption known as *rupia* is an important and peculiar one. The term *rupia prominens* was formerly in use, as applicable to the conical, limpet-shell-like crusts which characterise this eruption. Rupia prominens is of all others the most easy skin-disease to represent in a portrait, and good pictures of it occur in all atlases. It can scarcely occur excepting when the treatment has been neglected. Rupia is rarely the original form of eruption, but usually results from the ulceration of papules. This ulceration, gradually extending at its base, and producing a secretion, which is not very abundant but which quickly dries, causes the crust to enlarge in circumference and increase in height. Sometimes, and in the most typical cases, a bulla precedes

the formation of a crust. Rupia invariably leaves scars, and they are almost always round. There has been much misapprehension as to whether rupia should rank as a secondary or a tertiary form of eruption. In conformity with the old error that all forms of ulceration should rank as tertiary, it was commonly classed as such. We now know, however, that this feature will not help us. Many secondary lesions, both of skin and mucous membranes, ulcerate, and the chief distinction between secondary and tertiary is as to time of occurrence. Bearing this in mind, we may admit that rupia never occurs very early amongst the secondary phenomena, and that it is almost always preceded by some other form of skin-eruption (roseola, psoriasis, &c.), nor, on the other hand, is it ever seen amongst the late and well-characterised tertiary phenomena. Its usual place is from six to twelve months after the chancre, and in patients who have failed in health under treatment. Sometimes it will persist for long, but, even when it does so, it usually continues to be general and symmetrical.

Whenever an eruption displays these features, and occurs within two years of the chancre, it must rank as secondary, and such is the usual position of rupia. The scars left by it often help us much in the positive recognition of syphilis in patients who have reached the tertiary stage. Such patients do not, however, with the very rarest exceptions, show any rupia patches still extant. If we are careful to diagnose between rupia and certain forms of lupus which somewhat resemble it, we shall be obliged to admit that it belongs almost exclusively to the position assigned to it, and is simply a suppurating modification of a secondary rash. The explanation of the tendency to suppurate is to be sought in some peculiarity in the patient's health, and his susceptibilities to the influence of mercury and iodides. Each of these drugs may in turn appear to aggravate it; and not infrequently it has been developed during their use. The indication is always for the combination of tonics, steel, quinine, or opium, and, above all, for resort to sea air. It is a great mistake to assume, as was formerly done, that mercury is to be avoided when syphilitic sores ulcerate. On the contrary, when used in the associations suggested it will almost always prove the means of cure.

No other conjecture can be given, in explanation of the differences in the eruption which attends syphilis, than that they depend upon the idiosyncrasy of the patient. They certainly have nothing to do with differences in the poison, for, so far as we know, none such exist. The different types of syphilitic eruption never prevail epidemically, but, as it were, quite by accident. The rare ones are equally rare, and the common ones equally common, at all times and in all places. Nor do differences in health suffice to explain them, for the most severely ulcerating forms sometimes happen to patients who, both before and after their occurrence, appear to enjoy robust health. On the other hand, delicate persons often suffer very lightly from syphilis.

Of the Affections of the Eye in the Secondary Stage, *iritis* is by far the most common. It usually occurs from three to six months after the chancre, and is thus distinctly secondary. It seldom attacks the two eyes simultaneously, but the second usually suffers after a short interval, and often in spite of successful treatment of the first. The symptoms are, ciliary congestion, a muddy iris, an irregular pupil, and a variable degree of pain and photophobia. Of these, in slight cases, the demonstration of iritic adhesions by the use of atropine is by far the most important. Sometimes, the case never passes the stage of a slight ciliary congestion, which may be gone in a few days. In others, the attack may be attended by severe pain, great congestion, a thickened iris, nodules of rust-coloured effusion in its structure, and a blocked pupil. The result, even in severe cases, is usually restoration of almost perfect sight, but in many instances the eye is damaged, and in some it is destroyed. There is usually but little tendency to relapse when once the cure is well in progress, and it is but very seldom that the disease lapses into a chronic form. In severe cases the vitreous may be affected, and in a few the choroid and the retina are inflamed at the same time. More usually, however, these structures suffer at a somewhat later period, and when the iris is not itself inflamed.

The diagnosis of syphilitic from other forms of iritis must depend to a large extent upon the patient's history, and concomitant symptoms. There is nothing in the symptoms distinctive from those which occur in the arthritic form. The little gummata or nodules in the iris are, when they occur, pathognomonic symptoms, but they are seen but rarely. Arthritic iritis is, as a rule, attended by much more pain and intolerance of light than is the syphilitic form, whilst the iris is usually less swollen and less muddy. Effusion into the aqueous humour and dotted deposits in the back of

the cornea may occur in both. The history of repeated recurrences (once or twice, perhaps, every year) is very common in the arthritic form, and never occurs in the other. The first aim of treatment in syphilitic iritis is to secure dilatation of the pupil, and for this object atropine drops, four grains to the ounce, must be used every two hours the first day, and less frequently afterwards. The constitutional treatment must be, as for other secondary symptoms, the use of mercury. Iodide of potassium in full and increasing doses will often effect a rapid cure, but it is less certain than mercury. For a patient who was not previously under the influence of either, one grain of the grey powder in pill every three hours, until the gums are touched, will be an efficient treatment. In the meantime the patient should keep his room, live abstemiously, and, if the pain be severe, have leeches to the temple. If it is desirable to combine opium with the mercury, care must be taken that constipation is not induced. On the other hand, diarrhœa is to be avoided. The safety of the eye depends, however, mainly upon the promptitude and efficiency with which atropine is employed. *See* Iris, Diseases of the.

At a later period (rarely till a year from the date of contagion) the eye may be attacked by *neuro-retinitis* or diffuse retinitis, or by patchy choroiditis (choroiditis disseminata). These affections may occur after iritis has passed off and all treatment been put aside, or in cases in which iritis has never happened. They are both of them rare, and in each case the objective diagnosis must be made by the ophthalmoscope. In both, the subjective symptoms are simply more or less failure of sight with muscæ, but without much evidence of congestion, and with little or no intolerance of light. In both, the prompt use of mercury to ptyalism is urgently demanded. This will in most cases effect a cure, often with but very little damage to sight, and with little or no risk of relapse. These forms of retinitis are frequently attended by some opacity of the vitreous. *See* Choroid, Diseases of the; Retina, Affections of the.

We have to observe respecting *the mouth and mucous membranes generally*, as in the case of the skin, that various stages of different symptoms are observed in secondary syphilis. The earliest, and usually the very first of all secondary phenomena, are ulcers in the tonsils. These occur symmetrically, and are often very superficial, and almost painless. They are often present without the patient knowing that he has sore-throat, and often pass away very quickly. The condition is usually a kidney-shaped ulcer, with grey-white borders, like 'snail tracks.' Their presence often helps the diagnosis of constitutional syphilis in its earliest stage. They are usually coincident with the erythematous or roseolous rashes, and, like them, soon pass away. It is not, however, in all cases that they pass off so easily, and when they do so they are often followed by other and more troublesome forms of inflammation of the mouth and throat. It is a very remarkable fact that the syphilitic poison, when freely developed in the blood, can cause not only local inflammations and ulceration, but local growth. These differing processes may often be seen, side by side, in the mouth of the same patient. Patches may form on various parts of the lining of the cheeks and lips, on the gums, and on the tongue, which are simply attended by congestion, slight swelling, and abrasion. These are known under the name of the mucous patch. Upon them we sometimes witness the destruction of the proper papillæ of the tongue, causing the 'bald patch,' whilst in other cases the papillæ are hypertrophied. This hypertrophy may produce either warts or condylomata. Between these the chief difference is that in the latter the overgrown papillæ are fused together by swelling of the intervening tissues, and a flat-topped, elevated area is thus produced, whilst in warts the papillæ are free. There is one particular part of the tongue in which warts are specially prone to grow during syphilis. This is the central region, a little in front of the circumvallate papillæ, which, when the tongue is at rest in the closed mouth, is least in contact with other parts. It is not possible, excepting by the history, to distinguish warts due to syphilis from those in connection with other causes. In the case of the condyloma the diagnosis is usually easy, for nothing resembling it is ever produced, excepting in syphilis.

At the same time that the mouth suffers, the other mucous orifices are very likely to be affected. On the vulva in women, around the anus in both sexes, and under the prepuce in men, mucous patches, condylomata, and warts are very frequently seen. The same remedy which causes the abrasion to heal, and covers the bald patch with freshly-grown papillæ, will also cause the hypertrophies present in warts and condylomata to undergo shrivelling. Thus we may feel sure that both the atrophy and the hypertrophy were the real

results of the syphilitic poison. The development and persistence of syphilitic lesions in the mouth will be much influenced by local conditions. They are far more frequent in smokers than in others, and are also more severe and more lasting. Broken teeth will also often locate syphilitic sores on the tongue or cheeks, and cause them to persist when they would otherwise have healed.

The *tongue* in smokers, and occasionally in those who do not smoke, is apt to pass into a condition of chronic disease. This may assume various forms, being sometimes attended by much general swelling, causing bossy projections, with deep sulci between them, whilst in others it is a superficial change, leading to permanent baldness and sclerosis. The leucomata, or persisting, smooth, white patches, so often seen, must be regarded as the joint result of syphilitic glossitis, and the constantly-recurring irritation of hot tobacco-smoke. In a majority of cases the latter probably takes the larger share. *See* Psoriasis Buccalis; Tongue, Diseases of the.

The *periostitis* which occurs in the secondary stage of syphilis differs from that of later periods in that it is usually slight in degree and transitory. Definite nodes are very rare. It is common enough, however, for patients in this stage to experience pains in various bones, attended by tenderness on pressure, and sometimes slight swelling—osteocopic pains as they are sometimes called. Rheumatoid pains are also common, and in some cases very severe. Under specific treatment, however, or even without it, these bone and joint affections pass completely away and leave no permanent results. The bones usually affected are precisely those most prone to suffer later on—those of the skull, the tibiæ, and the clavicles. When rheumatism is severe in the secondary stage of syphilis, it occurs probably to those in whom there is an inherited tendency to arthritic diseases.

Loss of hair, a general thinning over the whole scalp, sometimes with a tendency to fall in patches, is a very frequent symptom of the secondary stage. It is sometimes attended by affections of the nails. It is usually arrested by the use of mercury, and the hair grows again as well as before.

Not a few patients during the secondary stage of syphilis become a little *deaf*, sometimes in one ear, sometimes in both. In most cases the condition is merely temporary, often lasting only a few days. In exceptional instances, however, absolute deafness is rapidly produced, and is permanent. Nothing but the rapid and vigorous use of mercury can save the function in these cases. When severe, both ears are almost always affected. Few, if any, opportunities have occurred for dissecting the ears of those who have become deaf in the manner described, and we have, consequently, no conclusive evidence as to the precise nature of the malady. It may be assumed that it is an affection of the internal ear, and that it is the same as that in the form of deafness which we meet with much more commonly in inherited syphilis. It usually occurs within a year of the primary disease. We do not know of any form of deafness due to syphilis which occurs in the tertiary stage of the acquired form. In the inherited disease, symmetrical keratitis and symmetrical deafness are both of them very common at or about the period of puberty. Although occurring so many years after birth, yet their constant symmetry seems to prove that they belong really to the secondary group. *See* Congenital Syphilis. Keratitis and deafness in the acquired disease are almost infinitely rare, but when they do occur it is in the secondary period, and they are symmetrical.

Menière's disease is now and then closely simulated, or perhaps we ought to say produced, by syphilitic affections of the ear. *See* Ear, Internal, Diseases of the.

A large number of those who suffer from constitutional syphilis pass through the secondary stage with very little disturbance of general health. They scarcely know that they are ill. With a minority, however, it is otherwise. Severe pains in the bones and joints occur, there is loss of appetite and failure of strength, and, above all, very marked rise of temperature every evening. These indications of constitutional disturbance are, sometimes, quite out of proportion to the skin-eruption and the other local conditions. It sometimes happens that a patient is confined to bed, and supposed to be the subject of some obscure 'blood-poisoning' with high temperature for weeks together, before the development of a characteristic rash reveals the real nature of the disease. Dr. Duffin, of King's College Hospital, was, probably, one of the first to study systematically the occurrence of febrile temperatures in association with syphilis. A very remarkable example of temperature ranging from 99·8° F. to 105° F. for several weeks was recently brought before the Clinical Society by Dr. Burney Yeo, of the same hospital. Probably, in almost all cases in the early part

of the secondary stage, if the thermometer were regularly used, we should find some tendency to evening exacerbation. Although the fever is sometimes disproportionate to the eruption, it is to be admitted that they are more usually in ratio with each other. The variola-like eruption in particular is almost always attended by much fever, and, indeed, wherever the eruption is unusually free, whatever may be its type, there is commonly more than usual fever. This occurrence of high temperature, simultaneously with the exanthem, is another of the numerous facts which support the belief that syphilis ought to be classed with the specific fevers.

Intermediate Symptoms.—All the usual phenomena of the secondary stage pass away, in most cases completely, under treatment. In a very large majority, at the end of six months from the date of contagion the patient is again in good health, and apparently quite rid of his disease. Unfortunately, however, in a large number relapses occur, and the patient becomes liable to what have been well designated 'reminders.' These symptoms are of a kind far less severe and aggressive than most of those known as tertiary, and they often in some features ally themselves with those of the secondary stage. Thus they often display themselves symmetrically on the two halves of the body and on the limbs. They seldom, however, resemble the secondary symptoms closely: thus nothing is less common than to see a patient, who has been cured of syphilitic psoriasis or lichen, display the same again in its original characters. The 'reminders,' to which reference is made, usually consist of peeling patches in the palms, sores on the tongue, patches on the scrotum, or it may be a scanty papular eruption over the whole surface. Sometimes sarcocele or gumma of the testis occurs in this association, but more commonly it is later. A very curious liability to a slight and short-lived eruption of erythematous rings is not infrequently noticed. These rings occur on the arms and trunk, and are especially visible after exposure of the surface to either heat or cold. They are noticed just after getting out of bed in the morning or just after a bath, whether hot or cold. The eruption rarely remains out more than an hour, often only a few minutes, but it returns over and over again. The syphilitic nature of this curious eruption is often proved by the entire disappearance of the liability to it after a short course of mercury.

Psoriasis Palmaris.—Peeling patches in the palms often occur during the secondary rash, but more usually they are seen somewhat later. The earlier they happen in the course of the disease the more likely they are to be symmetrical, and the more easily will they be influenced by mercury. On the other hand, the longer the interval the greater is probably the share of local causes, and the more difficult the cure. There is a form of palmar psoriasis which is distinctly tertiary, almost always one-sided, and in which the patches show a tendency to spread serpiginously. It is to some extent a mistake to call the palmar patches by the name of psoriasis. They seldom if ever show any tendency to scale-accumulation, but rather to peeling and destruction of tissue. In the secondary stage, however, numerous separate patches are seen, and although there is never any scale-crust, yet their co-existence with psoriasis on the trunk and limbs seems to denote sameness of type with that eruption.

The form of syphilitic psoriasis which occurs late in the disease, which affects only one hand, is attended by a dusky thickened edge, and which spreads out at its border, assuming the horse-shoe form, is more nearly of the lupus type. It is distinctly tertiary. It may be here remarked that it is a great mistake to suppose that all forms of palmar psoriasis are syphilitic. In a majority of cases peeling patches in the palm have nothing to do with syphilitic taint, but are in connection either with the dartrous state, with senility, or with purely local influences. *See* Psoriasis.

Sarcocele from gumma of the testis is an affection which occurs under much the same conditions as palmar psoriasis. If both testes are affected, the interval since the primary disease will usually be found to have been but short; but if only one, it may have been of several years. Syphilitic affections of the testis are seldom seen either in the early secondary, or later tertiary. They belong distinctly to the intermediate group. In this affection we sometimes meet with distinct masses of deposit in the epididymis. The most common condition, however, is a general enlargement of the whole gland with a smooth rounded exterior. The size attained may be very considerable, possibly as big as a small fist. The enlargement is slow in development, and usually painless. Abscesses may occur if no treatment is resorted to, and these may lead to fungus testis. The syphilitic testis may often be known by its large size, peculiarly rounded outline, and

light specific gravity. A gumma feels decidedly lighter in the hand than either hydrocele or malignant growth. However large the swollen gland may be, and however long the disease may have persisted, the surgeon should never despair of the cure by specifics; mercury and iodide of potassium are both useful, and under their influence the largest and most threatening forms of sarcocele will melt away. The same remark must be extended to cases in which abscess has occurred and been followed by fungus testis. It is never necessary in such cases to excise the gland, however hopeless the condition may look, for under the influence of treatment a cure, so far as a cure is possible, can almost invariably be brought about. *See* TESTIS, Diseases of the.

It is during this intermediate period that *choroiditis*, if it occur at all, is likely to happen. It is, however, a very rare affection. Sometimes distinct gummata in the choroid may be demonstrated by the ophthalmoscope. These, under specific treatment, may be observed to disappear rapidly, leaving more or less conspicuous scars and patches of atrophy. In other forms, thinning and absorption of the choroid occur without any evidence of previous gummata. With the choroiditis there may be inflammation of the retina or optic nerve, or these latter may occur alone.

Inflammation of the *arteries* in syphilis may occur either as an affection chiefly of the intima or of the adventitia. The middle coat, as a rule, escapes. When the inner coat suffers it becomes thickened, either in plates, or over long tracts, much as in the early stages of non-specific sclerosis. There are no special characters by which the syphilitic form may be distinguished, if we except the general fact that the cell-effusion is usually excessive in syphilis. The changes may advance so as to almost close the artery, or they may lead to ulceration, the detachment of emboli, and the formation of thrombus at the seat of disease. These processes have been chiefly studied in connection with the arteries of the brain, but they may occur in any part. As a primary and independent affection, disease of the intima is probably far more common than that of the external coat. If, however, the arteries be affected secondarily (that is, are involved in association with disease of the tissues in which they pass), then, usually, the adventitious coat suffers first and most severely. It also is the most likely to suffer if arterial disease should occur late in the course of the malady.

Cerebral disease, consequent on disease of the walls of the vessels, is a very distinct affection from the other brain and nerve disorders which occur from syphilis. It almost always assumes somewhat of the nature of a 'fit.' The arterial condition is one of thrombosis, not of laceration. From this fact it follows that the paralysis (usually hemiplegic) comes on, not suddenly as in hæmorrhage, but somewhat gradually. As the vessels become more and more nearly occluded, the patient experiences tingling, or twitching, or numbness in the limbs about to be affected, and this may last some hours before all power is lost. Now and then, however, the seizure is very sudden. A certain amount of recovery may be confidently expected from this form of paralysis; but it will seldom be quite complete. It not infrequently happens that the patient experiences no relapse, but remains through after-life with a weakened or possibly contracted arm.

It is probable that all the *viscera* are liable to suffer during the latter part of the secondary stage, or even sometimes in its earlier part. They suffer, however, in a manner very different from that which occurs in the tertiary stage. No large nodose gummata are formed, nor are any of the conditions produced at this stage, as a rule, permanent. The process is one of diffuse infiltration, with general congestion, rather than of local growth. The congestion, swelling, and ulceration of the tonsils is the first and commonest evidence of tendency to visceral affection. A little later, there may be engorgement and tenderness of the liver and spleen, and a remarkable failure in the blood-making process. Slight and transitory albuminuria may occur, or there may be symptoms of impending lung-mischief. All these conditions are rapidly and easily remedied by the administration of mercury. After they have passed away, the patient may remain well for several years before the gummata which characterises the tertiary stage begin to appear.

It was formerly thought that all syphilitic affections of the *nervous system* came late in the disease, and were distinctly of the tertiary class. We now know that this is to a large extent an error, and that it is not at all infrequent for patients to suffer from implication of the cerebro-spinal system in comparatively early stages. Alfred Fournier has described a very peculiar form of general analgesia, which is not uncommon coincidently with the eruption, and the ophthal-

moscope has demonstrated the existence of retinitis in many instances soon after or even before the end of the first year.

Tertiary Symptoms—The division of syphilis into stages is to some extent arbitrary, but for the most part it accords fairly well with clinical observations, and no one can doubt that it is practically convenient. The specification of the primary symptoms is easy, and all will admit that they, at any rate, do not (with rare exceptions) recur after disappearance, or mix themselves up with the later stages. So also of the secondary symptoms. Every one recognises a copious, symmetrical, copper-tinted eruption, and symmetrical superficial ulcers in the tonsils, as characteristic of an early period, and, as a rule, not in the least likely ever to re-appear in the same form if once they have completely disappeared. If a good interval of immunity has occurred, they will certainly not re-appear, but early recurrences are not so infrequent as in the instance of the primary symptoms. Although, in the present day, with the all but universal employment of mercury, we but seldom have the opportunity of witnessing spontaneous disappearance, yet we may feel certain that, like the primary stage, the secondary one has its limits of duration, and vanishes after a time spontaneously. In the stage which we are now about to consider, no such tendency to spontaneous cure is observed, and unless the physician intervenes with his remedies, the morbid processes, once initiated, continue to progress. Certainly, we have here a very important and quite natural feature of difference between the secondary and tertiary forms of disease. When we add that the tertiary are, as a rule, ranged without symmetry when multiple, that they are often few in number, or even single, and that we frequently observe them after an interval of immunity extending over many years, it will be yet more clear that they constitute a separate group. We make no distinction as to the tissues affected, asserting that all the tissues, or any single tissue, may suffer in either of the stages. It is not a question of the tissue attacked, but of the peculiar types assumed by the morbid process, which constitutes the difference.

As regards the stage which the writer has ventured to name intermediate, it is far less easy to separate it on the one hand from the secondary, and on the other from the tertiary. As its name implies, it stands between the two, and it partakes of the nature of both. Its phenomena are sometimes symmetrical, at other times not so, some of them disappear without specific treatment, though most of them, probably, do not. This stage may begin before the secondary is well over, and may be prolonged until that which is definitely tertiary begins. If it were practicable to use inoculation experiments as a test of stage, we might, perhaps, be able to distinguish definitely. In the primary stage, the local lesion is alone capable of conveying the contagion to another person; in the secondary stage, the blood and all fluid tissue-elements contain the virus, whilst, in the tertiary stage, contagion is probably not possible. The precise date at which the blood ceases to be the vehicle of contagion might be claimed as the end of the secondary stage. In most persons, probably, it occurs between the end of the first year and the second. In some it may be much later. Thus, then, we have clear rational data for the division of the stages. In the primary stage, syphilis is for a short time a local disease; then, in the secondary, it is a universal, or blood and tissue malady; and finally, in the tertiary, it is a disease of tissues but not of blood, and its manifestations are irregular, in most cases absent; and when they occur they are—in a strong, if not an absolute, sense of the words—local only.

We must again, and always, be on our guard against observations possibly made erroneous by the fact that we study syphilis as modified by mercury, not in its spontaneous development.

The conditions just mentioned as some of those which are most frequent in the intermediate stage, are obviously, some of them, the same in name as those which we witness in the secondary period, whilst others are those which might have been expected later on. They are, however, usually different in certain features from their homologues in the other stages. The erythematous ringed eruption, for instance, is never exactly repeated in any other period. The peeling patches in the palms are more superficial, much fewer in number, and slower in development than the psoriasis which sometimes, in the secondary stage, affects the same parts. Everything in this stage is feebler in type, less acute than in the secondary, whilst there is much greater proneness to wide diffusion or multiplicity than in the tertiary.

A few words must here be said respecting certain cases, in which the secondary and tertiary stages are reputed to run into one another, or in which the disease de-

velops itself so rapidly that they are not to be distinguished. Rightly classified, these are, probably, simply cases in which the specific is not successful, and the secondary stage is, therefore, persistent and severe. The disease remains throughout generalised, never assuming the more distinctive local peculiarities of the tertiary stage. We must not count severity of local processes, that is, tendency to suppurate or to ulcerate deeply, as being a peculiarity of any one stage. It may occur at any period if the treatment fails to cure the malady. The treatment, which is almost always successful in these cases, confirms this view as to their nature. If we enable the patient to bear mercury, by sending him to the country or to the seaside, we usually succeed in curing the disease, but the liability to true tertiary symptoms after a long interval will come just as in other cases.

The true tertiary symptoms are those to which a syphilitic patient may become liable five to ten, or even twenty years after his disease, and after, it may be, a long period of good health. We shall find that they are mostly of the nature of gummata, and that they all possess the peculiar feature of tendency to local spreading to which, when it shows itself in the skin, the term serpiginous is given. All of them, when they recede, leave a state of sclerotic atrophy, or, in a few instances, of hypertrophy, of the part involved. In almost all we see good reason to believe that, in addition to the syphilitic taint, some localising influence takes an important share in evoking the local changes. If we attempt to enumerate some of the chief, they are the following:—

Chronic and relapsing periostitis, leading to osseous nodes or sclerotic hypertrophy, but if neglected to suppuration and necrosis.

Muscular nodes, or gummata in the substance of muscles, which often, by their absence of inflammation and comparatively slow growth, simulate tumours.

Gummata in viscera, liver, testis, lung, &c., slow in progress, as just noted in the case of muscles.

Gummata in fibrous structures, and in cellular tissues. The meninges of the brain and spinal cord, the capsules of joints, and the subcutaneous cellular tissue generally, are the parts most likely to be affected.

Diseases of the skin of a lupoid type, gummatous or tubercular in commencement, serpiginous, and leaving scars.

Diseases of the tongue of a gummatous or simply inflammatory form; in either case leading to sclerosis.

These affections are so much influenced by the habit of smoking, that it is often quite impossible to say how much is due to the one and how much to the other cause. Superficial sclerotic hypertrophy is a not infrequent result; but as regards this condition and several others formerly supposed to be due to syphilis only, it is unquestionable that precisely similar ones may result from smoking only.

Aggressive structural disorders of the ganglionic, conductive, or central parts of the nervous system, leading to such affections as—

Ataxy and its complications.
Ophthalmoplegia externa.
Ophthalmoplegia interna.
General paralysis of the insane.

Amaurosis from optic atrophy, with various complications.

Paralysis of special nerves (the fifth, the facial, &c.).

In most of these there is not, at any stage, evidence of active inflammation, nor is there any proof of deposit or growth which might deserve the name of gumma. No doubt, a very chronic and slightly effusive form of inflammation is at first present, but it gives place quickly to atrophic changes. There is every reason to believe that the initial disease is serpiginous or locally infectious, for we find it slowly spreading to adjacent parts unless arrested by treatment. Excepting in their early stages, these affections are not usually much influenced by specific treatment.

Conditions implying general tendency to tissue-degeneration, such as amyloid disease.

Chronic inflammations of mucous membranes in certain regions, attended by thickening and ulceration. These occur especially in the rectum and pharynx, mouth, and female genitals (esthiomène).

The influence of specifics in the treatment of tertiary affections is variable and uncertain. Sometimes, as in the case of large gummata of the tongue or of muscle, the influence is shown very quickly, and a cure is easy. This, however, is by no means the case in many of the other tertiary affections. Some of them progress steadily in spite of treatment, or relapse very speedily when it is suspended. In many a distinctly beneficial influence is secured, but nothing like a cure can be obtained. Especially is the last statement true concerning many of the affections of the nervous system, which are remotely connected with syphilitic taint. Thus, the

non-success of treatment can by no means be accepted as conclusive in regard to diagnosis.

Many disorders are in association with a distant taint of syphilis, which yet do not respond definitely either to iodide of potassium or mercury. In nearly all cases, however, these remedies do some good, and it may easily be the fact that they are often laid aside just when decided benefit was about to accrue. A careful study of the therapeutics of lupoid affections of the skin, due to syphilis, will probably much help our conceptions of what takes place in parts which are hidden from our view. Syphilitic lupus very often does not get well under iodide of potassium, but vanishes at once when mercury is pushed. Very often, indeed, it gets almost well under one or the other of these drugs, and the patient, satisfied with the result, leaves off treatment before the cure is absolute. If the least portion of lupus-structure be left, from it the process will again spread. On the other hand, if the patch be quite well, and nothing but healthy scar left, then it is very rare to witness any relapse. In proof of the resistance of this malady to specifics, the fact may be adduced that many cases, in spite of treatment under different surgeons, last half a patient's lifetime. We have but to apply this experience of the power of resistance of syphilitic cell-growths in the skin, to the nervous system, and we shall understand why such maladies as ataxy and ophthalmoplegia often prove intractable. Iodide of potassium, given in sufficient doses, is usually very efficient in the cure of tertiary affections of all kinds. In some respects and in some cases it seems even more useful than mercury. In many instances, however, it depresses so much that its use must be abandoned, and in all such mercury usually succeeds. Whenever a case resists the iodide, and whenever it is important to obtain a rapid result, the two should be combined.

The prognosis of tertiary disease depends wholly upon the success or otherwise of our treatment. In their own nature, all affections of this class are progressive, and show no tendency to spontaneous amelioration. Even when much helped by specifics, there is a great risk of relapse. In many cases, however, when once a complete local cure is obtained, no relapse whatever occurs, and the patient will remain well for many years. In former times, before the introduction of the iodide of potassium, and when we knew less as regards the best methods of using mercury, many cases of tertiary disease ended fatally.

It will be understood, from what has been advanced, that the diagnosis of tertiary syphilis is beset with difficulties. In many cases it is very easy, and in many the sources of fallacy are such that they cannot be wholly avoided. As in the earlier stages, we still find the disease playing the part of an imitator. The form of ataxy which occurs to the syphilitic, and which is in part at least due to their former syphilis, is usually closely similar to ataxy when due to other causes. Many cases of syphilitic lupus are exactly like common lupus, and so of most of the other affections. Without here going into any detail as regards the diagnosis of special affections, it may be said in general that suspicion should be aroused whenever a malady is irregular in its development and course. The syphilitic simulations are seldom quite perfect, and they often develop in a more rapid manner than do their prototypes. In all such cases the history must be carefully inquired into, and upon it the diagnosis must in many cases rest.

Treatment.—Many questions of treatment have already been discussed in the preceding pages, but the subject is so important that, at the risk of repetition, it may be well to recapitulate and enlarge upon it. The treatment of syphilis has in recent years almost narrowed itself down to the judicious use of two specifics. When we have constructed sound rules for the administration of the iodide of potassium and of mercury, our task is almost done. In former times, various vegetable specifics enjoyed a certain amount of repute. The discovery of the iodide of potassium, and the assignment of its place as the adjuvant of mercury, has, however, so fully reinforced the latter drug that we now but seldom hear mention of any other remedies. It is, precisely, in the cases in which mercury either fails to cure or definitely disagrees that the iodide is efficient, and few indeed are those which the judicious use of one or the other, or of a combination, will not conduct to a satisfactory conclusion.

Some general rules may be offered for guidance in the employment of these important drugs.

In the early stages of syphilis the iodide of potassium is comparatively powerless, and mercury should be used. Thus, the induration of a primary sore will resist the influence of the former, but melts away at once when mercury is given. So also of the secondary phenomena, all of which, excepting perhaps sore-throat and sores in the

mouth, are best treated by mercury. The later the manifestation, the longer the period since the primary symptoms, the greater the probability that the iodides will prove efficient. Thus, against all forms of tertiary gummata, whether in muscles, in cellular tissue, or in glands, the influence of the iodide is usually shown in the most rapid and definite manner. A lump in the tongue, in the testis, or in a muscle, will often be absorbed under the iodide with a speed not less remarkable than the disappearance of a large primary induration under mercury. Nor does the precise stage of the gumma appear to make much difference, for the specific power of the drug is shown just as clearly against an open ulcer as against a deeply placed infiltration. From this assertion of the efficiency of the iodide against all tertiary symptoms, it must not be assumed that mercury is not useful in them, nor even that, in many such cases, it is not the better of the two. With some, however, it certainly does not agree; a fact which was abundantly proved by the frequent intractability of tertiary syphilis, in the times before the iodide was known.

In forming a comparative estimate of the value of these two drugs, attention must be given not only to the stage of the disease, but to the dose of the remedy and the idiosyncrasy of the patient. The iodide has certainly during the last ten years lost some of the repute which it enjoyed, and mercury has correspondingly gained. This gradual change of opinion has been coincident with the employment of mercury in much smaller doses than formerly, and its combination with tonics. In a great number of patients mercury, if the dose be but small enough, seems itself to act as a tonic, and careful observations have proved that not only does it favour depuration by the glandular system, but that it actually increases the number of red corpuscles in the blood. Everything depends upon the dose. Instances of idiosyncrasy are not very common in the case of mercury; but we do occasionally meet with patients in whom the smallest doses disagree, and, conversely, with others who take very large doses for long periods with but little appreciable effect. With regard to the iodide, idiosyncrasy plays a much more important part. Many persons cannot take ordinary doses without poisonous effects; many more, who can take them, yet experience under their curative influence, as regards the malady, a degree of depression of nerve-tone which causes real distress. Whilst, in the case of mercury, tolerance is seldom much increased by habit, the reverse is the fact as to the iodide. With the latter, in almost all persons, without regard to idiosyncrasy in the first instance, it is possible, by gradual additions, to obtain at length tolerance for large doses. It is one of those drugs respecting which the curious statement is true, that the dose does not much matter. We often get as good effects from small doses as from large, and the most severe examples of poisoning have usually been from very small ones. The writer has known patients cured in the most definite manner by doses of less than a single grain, and, on the other hand, a patient has taken, on his own prescription, more than an ounce and a half in the day. If a patient has become tolerant and his symptoms do not yield, it is often wise to increase the dose freely; but, as a rule, it may be doubted whether the very largest ones, now or recently in fashion, do anything more than might be effected by much more moderate quantities.

The fear of causing absorption of the mammæ or testes by the prolonged use of iodides exercises but little influence on the minds of modern prescribers. Although, however, these results are very infrequent, yet it must be fully recognised that the iodide does often depress the sexual function very definitely whilst it is in use, and possibly in some instances does permanent injury to it. Many persons become low-spirited and miserable whenever they take it.

With many prescribers, and especially in France, the iodides of mercury enjoy much favour. There can be no doubt that they are exceedingly efficient, but they are for the most part more irregular in their action, more liable to gripe and purge or even to salivate unexpectedly, than are most of the uncombined preparations of either of their components. It may also be doubted whether their combined salts are in the least more efficient than the simpler preparations, which have the advantage of less variability in effect. Those who aim at simplicity of prescription may therefore, without any risk of loss to their patients, well be content to learn the details of the use of mercury and the iodide of potassium severally or together, and may venture to pass by their combined salts. It would be most tedious to attempt to describe the modes of use of the latter; and, as their doses, &c., may be found in all prescribers' manuals, further reference to them will be omitted.

Mercury may be used in many different ways, and so efficient is it in all that each

one has its warm advocates. All that is needful is that it shall be got into the blood and brought into contact with the tissues; and any method, which does this without material interference with the patient's health or disturbance of his digestive functions, is satisfactory. Perhaps we ought, in these respects, to give the palm to those methods—inunction and fumigation—which introduce the drug by absorption through the skin. They are certainly less liable to be followed by purging than when it is given by the mouth. Here, however, their advantages probably end. It may well be doubted whether the claim put forward by their respective advocates, that they are more definitely curative, is borne out by facts. On the other hand, it is very easy to give mercury by the mouth in such a manner that it shall not in the least interfere with the stomach, and this method of treatment is in most instances much less inconvenient to the patient. The writer may confess that, after plentiful opportunities for the observation of different methods, he has adopted the practice of keeping the skin methods in reserve for exceptional cases, and under all ordinary circumstances administers the remedy by the mouth. One simple rule appears to be the key to success. It is to give small doses frequently repeated, and never large ones.

Hydrargyrum cum cretâ is, perhaps, the most constant and least variable of all preparations. It may be made into pills of one grain, in combination with one grain of Dover's powder if necessary, and of these the patient may take one every six, four, three, or even two hours, according to circumstances. Usually, one pill four times a day will suffice to clear away a chancre or a secondary eruption as rapidly and as completely as can be wished. In some cases, it may be more convenient to double the dose than to increase the frequency of administration, but the latter, if the patient is willing, is the better plan. If ptyalism should occur with such doses, it will certainly be mild and easily controlled. As a rule, however, all the symptoms of syphilis may be got rid of without any affection of the gums. If such affection should occur, it usually implies the full physiological influence of the drug, and a very rapid subsidence of symptoms may be simultaneously expected.

During a mercurial course, fruit, green vegetables, coffee, all aperients, and for the most part all stimulants, should be forbidden. The patient should carefully wash his teeth and gums twice in the day, and it will be better that he should not smoke. All irritation of the mouth by smoking increases the risk of mucous patches, and tends to make sores in the throat more difficult to cure. The reason for abstinence from coffee, fruit, &c., is the risk of their causing diarrhœa. A patient, taking the remedy in the form and doses just indicated, may go to business as usual, and is in no particular risk of taking cold. If he is much out in the fresh air, he must expect some delay in the influence of the specific, and be prepared to require larger doses. In like manner, all tonics—quinine, iron, &c.—enable the system to resist mercury, and should be used only when really necessary. If a patient be kept in bed and on rather low diet, he will yield much more quickly to mercurial influence, and ptyalism may be induced, under such conditions, with half the doses required in one who is about in the fresh air.

As regards the production of ptyalism in the treatment of syphilis, we may say that, although often the most rapid disappearance of symptoms takes place when it occurs, it is certainly to be avoided. If it is profuse, and necessitates the suspension of the remedy, the latter should be used again in smaller quantities as soon as the mouth has recovered. Some of the most severe outbreaks that we ever witness occur to those who have been rapidly cured by a short ptyalism in an early stage, and have then left off the remedy. It is especially under such conditions that rupia is prone to occur.

If mercury be given for an indurated chancre in the manner indicated, it may probably require about a month to get rid of all hardness, but the period varies much in different persons, and perhaps also in relation with the stage at which it is commenced. If it is begun before any secondary symptoms have shown themselves, it is very common for them not to appear at all, or, at most, only in the very slightest form. Sores in the throat are the phenomena least frequently omitted. It is, probably, quite the rule for the skin to escape. If, however, at any period within six months the mercury be suspended, then, within a few weeks of the suspension, a rash may show itself. Such rashes, when they occur, however, are always mild, and their mildness seems proportional to the length of time during which the mercury has been administered.

As yet no statistics have been collected which would enable us to speak, with any confidence, as to the relative efficiency of

different methods of treatment in preventing relapses. We do not know, with any certainty, whether those who have been freely salivated are less prone to relapse than those who have taken such small doses that they have never felt their effects in any other way than the disappearance of symptoms. This remark as to relapses of secondary phenomena applies also to tertiary symptoms. We believe, and probably on good grounds, that those who have taken mercury freely and for long periods, in the early stages of the disease, are less liable than others to the subsequent development of tertiary symptoms; but it must be admitted that proof is wanting. With the prevailing unanimity of opinion in reference to mercury, it is very difficult to get cases for observation in which it has been omitted. Syphilis is in its nature so variable, that it is unsafe to assume that what a few cases appear to teach is really the fact. There can be no doubt that very often we meet with severe tertiary symptoms in those who, from the history given, appear to have had very short or irregular treatment in the first instance. Unfortunately, however, there are some cases on the other side which show persistently recurring reminders, and even severe tertiaries, after specific treatment of the most careful and prolonged kind. As a general rule, mercurial cures in the secondary stage stand good, and a large majority of our patients know nothing more of their disease. But there are exceptions, and these probably occur after all the various modes of administration.

If we are allowed to estimate relative efficiency by the rate of disappearance of the phenomena, then it is probably true that the internal use of grey powder in small doses, frequently repeated, is just as useful as either inunction or fumigation.

To the credit of the method by small doses frequently given, it is to be clearly and strongly stated that patients usually improve in health under them. If purgation be avoided, the patient will often enjoy improved appetite and digestion, and may gain in weight and colour. At the end of a six or nine months' course, he may allege that he never was in better health. Those who have before suffered from constipation and liability to headache, may get quite rid of these troubles and may continue permanently free. In women who have suffered from painful menstruation, the mercurial course may prove a complete cure. These clinical facts, which are matters of frequent observation to specialists in syphilis, are so definite that they are well worthy the attention of the general physician. It is well known that many distinguished therapeutists have become enamoured of mercury for various chronic ailments, such as scrofula and some forms of dyspepsia, as well as for those in which the liver is more especially concerned. Experience in respect to syphilis would go to show that the drug may be used without any fear of loss to general health, if employed in the way suggested. On the other hand, there is no doubt that severe forms of cachexia and debility may be induced by the irregular and excessive administration of this potent drug.

As regards its mode of influence in syphilis, we may reasonably suppose that it is requisite that it should be brought into contact with the cell-elements concerned in the morbid process. Wherever its local application is practicable, we know that it is usually very efficient. Administration through the blood is necessary only when the disease is generalised, as in the secondary stage, or when its manifestations occur in parts which are not accessible. In a general way, it is well to combine local with internal use. For the primary sore, an efficient dressing with the black wash unquestionably expedites the healing and the disappearance of induration, and so also of the secondary eruption, the removal of which is materially helped by the inunction of a mercurial ointment. For this latter purpose, the ammonio-chloride, in the proportion of fifteen grains to the ounce of lard, is very convenient. Its use is especially desirable when the eruption affects the face and hands, and its early removal becomes a matter strongly desired.

The remarks, just made, may fitly introduce more detailed statements as to the efficiency of local treatment, in all cases in which the disease has passed the secondary stage. Very remarkable instances of this are not infrequently seen. Cases, in which the internal use of specifics has been long continued with only very partial benefit, may be cured very quickly by local measures. Not only may they be cured, but the cure may be a permanent one, and thus a very strong argument is afforded in favour of the essentially local character of such phenomena. Respecting all forms of syphilitic phagedæna in the tertiary stage this is well known. Although the administration of the iodides, or even of mercury, is usually very useful, yet by iodoform, or by cauterisation with the acid nitrate of mercury, the cure may be accomplished in a fifth of the time. So also, syphilitic palmar psoriasis

and syphilitic serpiginous diseases of lupoid type are best treated locally. An ointment, containing one drachm of iodoform to the ounce of lard, if liberally used, will often effect an unaided and rapid cure in such cases. To many it is unquestionably more efficient than any of its competitors. In all syphilitic skin-diseases in the tertiary stage, whether ulcers or new-growths, its use, if the patient will permit it, should never be omitted. That it is not necessary to use a specific is, however, fully proved by the efficiency of caustic applications for the same purpose. A single free application of the acid nitrate of mercury may be sufficient to permanently cure a patch of syphilitic lupus, which had resisted much internal treatment. It would appear that the cell-organisms of such growths possess but feeble vitality, although persistently infectious, and are thus easily killed by any caustic. The point is to destroy every portion, for, if the smallest particle be left behind, it will suffice to reproduce the malady. From what we see of the efficiency of specific applications and internal treatment, in the case of serpiginous affections of the skin, it is probably fair to infer as to their power in diseases of internal parts and especially of the nervous system. If in the former we stop short of a complete cure, the morbid process will be relighted, and a relapse will follow; but if the local cure be perfect, then it will probably be permanent. In this way may probably be explained the frequent disappointments in reference to disease in hidden parts. We do not push the treatment far enough.

After what has been just said, it is clearly impossible to lay down any rules as to the duration of an antisyphilitic treatment. It will depend upon the method employed and the effects produced. If the case be one of primary or early secondary syphilis, and the treatment adopted be that by small doses of mercury without ptyalism, a six months' course will probably be sufficient. During the last four of this period, the patient may probably have been quite free from symptoms. Even after this long course, we must be prepared, in a certain number of cases, to see a symmetrical eruption produced within a few weeks after the suspension of the drug. This rash will probably be an erythema of a very mild kind, and will disappear promptly when the remedy is resumed. Unless some symptoms should show themselves, there is probably no good reason for again resorting to specifics. If the patient be married or intending to marry, it may be wise to continue mercury for a much longer period, with or without brief omissions. Some good authorities advocate short intermittent periods of administration, and no doubt excellent results may be so obtained. On the small dose system, however, there seems but little reason for ever suspending it until it seems wise to wholly desist.

It may be convenient to introduce here a few details as to the different methods of using mercury for the cure of syphilis. The inunction method is one of old repute and still largely used on the Continent. It gives to Aix-la-Chapelle the reputation which brings to it crowds of patients. At this place, where the details are so well understood, it is customary to have the ointment rubbed in by trained attendants. These men occupy from twenty minutes to half an hour at each friction, and use about half a drachm of the strong mercurial ointment. Everything that is done at Aix can be done equally well at the patient's home. All that is necessary is, that he should give himself up to the treatment and observe proper precautions. The ointment should be rubbed into different places on successive days, so as to avoid the production of eczematous irritation. Generally, it is best borne on the sides of the chest and abdomen, but the inner sides of the arms and thighs are also convenient positions. After the rubbing, the patient should put on a flannel gown and go to bed without washing. In the morning a warm bath may be taken. At Aix, a course of rubbing lasts usually one month, the quantity used and the frequency being modified according to the effects produced. It is usual to advise patients to return after a few months for another course, in order to complete the cure. Excellent results are usually obtained in this way, and not infrequently patients are cured, whose symptoms had been very difficult to deal with under other methods. The explanation of these is, however, usually this, that the other methods had never had a fair chance, owing either to the patient's irregularity in their use, or inattention to diet and exposure to cold. It may be alleged for the inunction plan that it is less likely to disagree, by causing colic or purging, than the internal administration, and that it is very certain in its effects. It may, with good reason, be doubted whether it has any other recommendations, and more especially whether the claim put forward that its cures are more permanent than others is well founded.

At several Continental watering-places of repute for the treatment of syphilis,

popular attention is fixed upon the use of warm sulphur baths quite as much as upon the mercurial rubbing. There is no reason, however, to believe that these exercise any share in the cure. *See* INUNCTION OF MERCURY.

Another endermic method of administration is by the fumigation bath. This plan was perfected by the late Mr. Langston Parker of Birmingham, and has been very successfully employed by Mr. Henry Lee and others. Calomel is the form of mercury now usually employed. It should be specially prepared and of great purity. The patient is made to sit over a lamp upon which the calomel, in quantity of from a scruple to half a drachm, has been placed. The calomel is sublimed by heat in company with watery vapour, and is deposited on the patient's skin. When the process is completed, the patient is made to wrap himself in a flannel gown, and without any washing or drying to go at once to bed.

This method has the same advantages as that by inunction, and is exceedingly efficient. The two share in the disadvantage of being much more troublesome than administration by the mouth, and although less liable to purge, they are at least equally prone to cause unexpected salivation.

Hypodermic injection has come but little into employment in English practice, nor does it appear to increase in favour with those Continental surgeons who at one time thought highly of it. Mr. Astley Bloxam, at the Lock Hospital, employs it largely, and considers it, on the whole, the most efficient and least troublesome of all methods. Inasmuch as the surgeon administers the dose himself, he has the fullest control over its employment. Mr. Bloxam has, in verbal communication with the writer, insisted on the following precautions :—

In order to prevent irritation and abscess, the injection should be made into muscle and not into cellular tissue. The needle should always be washed after the syringe has been charged, so that none of the fluid may touch the skin during introduction. It is sufficient to inject a third of a grain of the bichloride of mercury dissolved in twenty drops of water, once a week. Three such injections, made on consecutive days, will usually salivate freely, thus proving the efficiency of the method. The gluteus maximus is the most convenient muscle for the purpose. The solution should always be freshly made when wanted.

Some important memoranda may be offered as to the use of the iodide of potassium and other iodides.

In some cases the iodide of sodium depresses less than the potassium salt, and acts as efficiently. It is a very good practice to combine the three iodides—sodium, potassium, and ammonium—in the same prescription. Whether given singly or in combination, some free ammonia, preferably sal volatile, should always be added. It always increases the efficiency of the iodide salt. It is never well to begin with a large dose of an iodide. Small ones are, in the first instance, just as efficient as larger ones, and it is often a great point to go on increasing them. Doses of two or three grains will often, at first, do as much as those of ten or more. Every week, if the cure is not progressing rapidly, two grains should be added to the dose.

Coryza is the commonest of all symptoms due to the iodide when it disagrees. It may be very profuse at first, but usually lasts only for a short time. In other cases, the patient may suffer from a chronic cold in the head so long as he continues the drug. When this is the case, there is generally definite depression of tone as well, and the surgeon will do wisely to try whether he cannot effect the cure better by small doses of mercury.

The skin-eruptions which may be produced by the iodide are very various in their characters. They are certainly due to idiosyncrasy, and have little or no relation to the dose employed. They usually develop very quickly, and sometimes with great severity after two or three doses. When once an eruption is produced, we seldom witness any tendency to disappearance, so long as the drug is continued. Usually, the eruption becomes aggravated both in amount and character. A form of acne is the commonest type of iodide-eruption, but hæmorrhages, erythemata, and vesicular and bullous eruptions may occur Now and then we witness the formation of large bossy wheals, which may develop to a very great size. Some of these eruptions may closely resemble, to the inexperienced eye, syphilitic eruptions, and thus the remedy may be further pushed in the hope of curing that which it is itself producing. In such cases, occasionally a fatal event by exhaustion may be brought about. When eruptions occur, either reduction of dose or disuse of the drug is usually definitely indicated.

Most patients bear the iodides best when in vigorous health, and, in the stage in which they are needed (the tertiary), it is generally wise to employ tonics and fresh air freely. Arsenic has repute as tending

to prevent eruptions, and many persons will bear full doses when enjoying the advantage of sea air, who are much depressed by them under other conditions.

An extempore combination of the bichloride of mercury with the iodide of potassium enjoys a high repute in English practice. In doses of one drachm of the Pharmacopœia solution of the bichloride ($= \frac{1}{16}$th of a grain), with four or five grains of the iodide, and half a drachm of sal volatile, a very efficient compound is obtained, which seldom disagrees.

It may be well to mention, in relation to special measures of treatment, certain peculiar symptoms and conditions which may need special rules.

Ulcers in the Throat and Sores in the Mouth in the Secondary stage.—Give mercury, use black wash as a gargle, or dust the sores with iodoform. If they prove intractable, touch them lightly with the acid nitrate of mercury or some other caustic. If very painful, it is necessary to consider whether they may not be aggravated by mercury, especially if the latter has been long used. If this appears probable, mercury must be disused, and the iodide of potassium given. Smoking must always be prohibited.

Ulcers in the Throat in the Intermediate or Tertiary stages.—These are often phagedænic. Iodide of potassium must be freely given, and iodoform applied by insufflation, or by means of a camel's-hair pencil. If, in exceptional cases, the condition persists, the sore must be freely touched with the acid nitrate of mercury. It is a rapidly destructive condition, and the treatment must be efficient. There is usually no objection to small doses of mercury, but the iodide will generally suffice.

Iritis, Retinitis, Neuritis, &c., in Secondary stage.—Push mercury rapidly to slight ptyalism, and in iritis use atropine very freely. Large doses of iodide of potassium will usually suffice for these affections, but mercury is better.

Ulcerating Secondary Eruptions of the Rupial type.—These usually occur after mercury has been given in too large doses, has disagreed, and been wholly laid aside for some time. Mercury, in combination with the iodide of potassium, is indicated, or mercury may be given alone. The iodide alone is rarely sufficient. Ptyalism is to be carefully avoided, and, if success is not soon obtained by other methods, inunction or fumigation should be resorted to. Sea air is often very valuable. When once the cure sets in, it usually progresses well, and is in the end complete. Iodoform ointment should be used to all sores.

Phagedæna in all forms and stages.—Iodoform is by far the most convenient, least painful, and most efficient agent. It will probably supersede all the older methods, Should it not succeed, constant immersion, the acid nitrate of mercury, or the actual cautery, may be employed. Mercury and the iodide should be given with opium. If all fail, the patient must be at once sent to the seaside, and the same remedies used there.

Disease of Arteries (indicated by Cerebral Attacks).—A long course of small doses of mercury or, less efficient, of the iodide.

Periostitis and all forms of Bone-affection.—Here the iodide of potassium is most efficient, and relieves pain more quickly than anything else. If the case resists, however, mercury should be used, and it will often succeed in removing hard nodes which the iodide had failed to influence.

Periostitis and Bone-affections in the Inherited Disease.—The same remedies must be used, but much less rapid results are to be expected. Very often nodes in this connection resist treatment for some time, and then suddenly disappear.

Lupoid Affections of Skin in Tertiary stage.—Rub in iodoform ointment, and apply it on lint; or, if the part be one to which this cannot be conveniently used, or the smell be an objection, apply the acid nitrate of mercury freely. Iodide of potassium may be given, but, if not successful, it should at once be substituted by mercury, which often succeeds when the iodide fails.

Phagedænic Lupus of Nose and Face from Inherited Syphilis.—The destruction may be very rapid, and the treatment must be prompt. Cauterise freely with acid nitrate, and then dress with iodoform ointment. Give iodide and bark.

Interstitial Keratitis of Inherited Syphilis.—Give a long course of small doses of mercury with bark. Send patient to sea or country during the treatment. Use atropine or belladonna fomentations.

Locomotor Ataxy or other Chronic and Aggressive Nerve-disease with Syphilitic Antecedents.—Give mercury in small doses to slight ptyalism. If benefit results, repeat the treatment after a month's interval, or give smaller doses without ptyalism over a period of six months or a year. Many such cases relapse, and need a repetition of treatment. Inunction is very useful, but

not more so than small doses by the stomach. Iodide of potassium is also very efficient, but probably less so than mercury.

In cases which resist mercury, and in which it is wished to induce ptyalism rapidly, use the hypodermic method, employing a third of a grain every day for three or four days. Or use mercury by the mouth or inunction, or insist that the patient shall keep his bed.

In cases of pregnancy in which it is desired to protect the fœtus, administer small doses of mercury (one grain of grey powder, or one drachm of the solution of bichloride three times a day), through the whole period. There is possibly an objection to this, that it may damage the child's teeth (first set), but upon this point careful observation is necessary.

In cases in which marriage is in prospect, let the patient take small doses of mercury continuously during the whole period before marriage. Abstain from the iodide. However efficient and long-continued the treatment, no one should marry until two full years have passed from the beginning of the disease.

JONATHAN HUTCHINSON.

T

TAGLIACOTIAN OPERATION. *See* RHINOPLASTY.

TALIPES. *See* CLUB-FOOT.

TAPPING. *See* PARACENTESIS.

TARSAL BONES, Caries of the.—The frequency of this disease is well known. The persistent way in which it follows on relatively slight injuries—e.g. sprains, slipping on the kerb, blows from a stone, jumping off a wall—may perhaps be accounted for by the delicate cancellous tissue of which the bones so largely consist, their intimate relation with complicated synovial membranes, the comparatively scanty blood-supply to the dorsum of the foot, its frequently lowered temperature, and the want of rest.

The diagnosis of caries will be spoken of when the chief sites of the disease are considered; but it may be stated here that the early recognition of the disease is of the utmost importance, for so long as the caries is limited to one bone, it will be possible to save a very useful foot.

The chief sites of caries of the foot from behind forwards are: (1) Os calcis; (2) ankle-joint; (3) astragalus; (4) scaphoid, and along with this, on account of the complicated synovial membrane in the middle of the foot, other bones—e.g. cuneiform, astragalus, and the bases of the metatarsal bones—are too often affected; (5) cuboid.

OS CALCIS.—It is important to remember that caries remains limited to one bone much longer in some of the above than in others, and in none longer than in some cases of caries of the os calcis. This may be present, originally, in three different sites: (*α*) Caries of the body of the bone; (*β*) caries of the astragalo-calcanean joint, which may begin as a primary affection after a severe twist or sprain of the ankle, or may be secondary by extension from the body of the os calcis or from the under surface of the astragalus; (*γ*) caries at the back of the os calcis between the body of the bone and the posterior epiphysis—an epiphysis which does not appear till the tenth year, and which does not unite with the body of the bone until the fifteenth to the nineteenth years.

Diagnosis.—The thickening is limited to the neighbourhood of the heel, where the swelling obliterates the natural sulci on either side; the sinuses are met with chiefly posteriorly, but may form as far forward as the calcaneo-cuboid joint, corresponding then to a point midway between the external malleolus and the base of the fifth metatarsal bone.

It will be pointed out, later on, that in disease of the ankle-joint, astragalus, &c., not uncommonly a probe can be passed across the instep beneath the soft parts, from sinuses on one or both sides. This is not the case with disease of the os calcis, but, in some severe cases of disease of the calcaneo-astragaloid joint, a probe can be passed across the heel through this joint. The movements of the ankle-joint will be found free and painless, an anæsthetic being given to a child if needful. Where calcaneo-astragaloid disease begins primarily, its diagnosis is a matter of more difficulty. The position of the swelling and sinuses may here approximate to those met with in disease of the astragalus or ankle-joint; the pain is

greater than in disease of the body of the os calcis, and the foot is sooner disabled. By the aid of an anæsthetic the ankle-joint will be found free, and probes, introduced by sinuses, may pass towards the upper surface of the os calcis, the level of which is known by its being on a line with the bony projection for the origin of the extensor brevis digitorum. Occasionally, as already stated, a probe may pass across the heel through this joint.

Disease between the epiphysis and body of the bone may be detected, not only by the position of the sinuses and swelling, but also by the age of the patient, and by the fact that, owing to the insertion of the tendo Achillis into this epiphysis, pain will be complained of and impairment of movement noticed, when the patient is asked to throw the tendon into action by raising the heel or rising on to the toes.

Treatment.—The surgeon, in deciding between (*α*) expectant treatment and (*β*) operative measures, either partial—e.g. exploring and gouging—or complete removal of the bone, will be led by the following considerations. If the patient is in fair health, if the viscera (especially the lungs) are sound, if the patient is in a fitting position to secure unbroken rest, constant attention, good food and air; if no sinuses have formed, or if the sinus be single and healthy-looking, if the origin of the disease be distinctly traumatic, then, under the above circumstances, expectant treatment is fully justified. But if, on the other hand, the subject of the disease be 'etiolated,' have been subject from infancy upwards to bad air, food, poor hygiene of every kind, if from the rank of life it is important to save time for schooling, apprenticeship, &c., then operative measures without further delay are as clearly indicated. These do not necessarily mean removal of the whole bone, an operation which, while it leaves a very useful foot, leaves also a very ugly one. In any case, the condition of the bone is best explored from its outer side, which has few important structures in relation to it.

An anæsthetic being given and the parts rendered bloodless by Esmarch's bandages, incisions are made which are modifications of those for removal of the entire bone. Thus, by making on the outer surface of the os calcis, on a level with its upper surface, a horizontal incision commencing at a point midway between the external malleolus and the base of the fifth metatarsal bone, and ending just outside the tendo Achillis, joined by a second incision at right angles to the anterior extremity of the first, as far as the sole but not encroaching upon it, a sufficient flap can be turned down for exploration of the bone. Now, if steel probes passed into any sinuses which may exist do not pass far into the bone, if the bone around them is hard, not soft, fragile, and ready to break down, and if the probes do not pass towards the calcaneo-astragaloid joint, the surgeon may be content with thoroughly gouging out the sinus and removing all carious bone or pulpy granulation-tissue. The softer the bone the more carefully must any gouging be carried out, for fear of setting up secondary inflammation, which will itself pass on into caries.

The cavity should then be firmly plugged with strips of gauze soaked in carbolic oil or the next best antiseptic dressing at command, the Esmarch's bandage removed, any bleeding points secured, and the parts brought together with a few points of suture. After one or two dressings, the strips may be replaced by a drainage-tube, which should be gradually shortened. When the cavity has filled up from the bottom, and the parts are healed, the patient should go about for six or eight weeks with a crutch, or a stick and a knee-rest.

If, on the other hand, the bone around the sinus is soft and friable, if the probes enter far, especially if they run towards the calcaneo-astragaloid joints, it will be wiser to remove the whole bone at once by prolonging the above incisions—the first farther inwards through the tendo Achillis, and the second farther into the sole. *See* Os Calcis, Excision of the.

If the disease of the bone has arisen in the calcaneo-astragaloid joint, and palliative treatment has failed, the surgeon has the choice of trying to eradicate the disease by getting at it, from above, by removal of the astragalus—an operation which will necessitate division of the anterior tendons, but which has the advantage of being readily converted into a Syme's amputation either at once or later on; or, by attacking it from below by removal of the os calcis, and then removing the articular surface of the astragalus with a chisel, and then getting completely rid of any pulpy disease or carious bone in the neighbourhood with the gouge, &c. This method only severs the tendo Achillis, which will take on a fresh attachment in the fibrous tissue and cicatrix, and leaves better drainage than the other; but it has this disadvantage, that it will hamper the operator if he finds it better to convert his excision into a Syme's amputation.

Caries of the Astragalus and Ankle-joint may be spoken of under one heading.

Diagnosis.—In both these affections the swelling is situated more anteriorly than in the preceding; the bulbous look and clubbing of the foot are more marked; if sinuses are present, probes will often pass right across the front of the foot beneath the soft parts, or, by aid of an anæsthetic, into cavities in the astragalus or across exposed bone on the non-articular part of the bone, when it alone is involved, or into the ankle-joint itself.

The ankle-joint may be found to be involved when the parts are examined with an anæsthetic, but, even if ulceration of cartilage be present, grating will not necessarily be obtained, as the intervention of pulpy tissue will often prevent the articular surfaces being brought into contact.

While the above points, together with the duration of the case, the number and direction of the sinuses, and the amount of crippling will aid in determining between the two diseases, it is often quite impossible to tell, till the parts are explored by operation, whether disease of the astragalus has involved the ankle-joint or not.

Treatment.—If palliative treatment has failed, or if the time for this has gone by, the question of excision of the diseased bone or of amputation of the foot must be faced. In deciding for or against the more conservative operation, the surgeon will be influenced by the considerations already spoken of with regard to the os calcis.

If it be decided to perform excision, the writer is convinced that in most cases of adults, and in all of children, this operation is best performed by a transverse incision, as no other sufficiently exposes the bones concerned and the limits of the disease, and as this readily admits of a Syme's amputation being performed now or later on. An anæsthetic being given and Esmarch's bandage applied, the soft parts are divided by an incision across the joint and going down to the tendons. These may be readily united, when the operation is completed, by passing silk through three or four of them above and below the points where they will be divided. The tendons are then severed, the sutures held out of the way, and the joint opened. The articular surfaces of the tibia and malleoli and the trochlear surface of the astragalus having been sawn off, any extension of the disease to the inferior tibio-fibular, the astragalo-calcanean, or astragalo-scaphoid joints should be examined into, and any suspicious patches of bone or altered synovial membrane removed with gouge, chisel, or sharp spoon. The anterior tibial and any other arteries should then be secured, the tendons stitched together, and the wound closed with a few points of suture, a drainage-tube having been passed from side to side.

The writer is strongly of opinion that in the majority of cases the above method will be found not only easier, but superior to that by lateral excisions along the lower ends of tibia and fibula. *See* Joints, Excision of.

Two points of advantage—the complete exposure of the parts and the possibility of readily converting it into Syme's amputation—have already been spoken of; as to the disadvantage of severing the tendons, it is to be remembered that, if reunion does not take place, the free examination of the disease secured is a great set-off, and that free mobility is not a point of such primary importance in the foot as a firm, sound basis of support.

Excision of the astragalus may be performed in the same way. The bone being exposed by freely opening the joint, the ligamentous structures are then divided by a careful use of the knife, especially at the posterior part, and the bone turned out by aid of the lion-forceps and elevator. The articular and synovial structures in the vicinity should then be carefully examined, and treated, if necessary, as directed above.

Where the articular bed, out of which the bone has been lifted, shows patches of caries, or pulpy, pink, grey masses, while the astragalus is soft and fatty, easily crushing down in the lion-forceps, the recovery will not be permanent. Owing to the facility with which disease of the astragalus extends into the ankle, to the scaphoid, and the large mediotarsal synovial sac, excision of the astragalus alone will not often be called for. But, if the writer's experience be correct, there is a small class of cases, met with in children, where there is necrosis of the astragalus, a sequestrum in it, or limited caries of the non-articular part of its dorsal surface. In these cases, especially where the mischief is recent and traumatic, the prognosis is much better after removal of the bone.

Disease of Scaphoid and Mediotarsal Joint.—Disease of the scaphoid by itself is not very common; far more frequently by contiguity of synovial membrane other bones are involved, especially the cuneiform and astragalus, by means of the large and complicated synovial membrane which is common to these and other bones.

Diagnosis.—In such a case, the most marked part of the characteristic bulbous swelling will be found more anteriorly in the foot than when the astragalus and ankle-joint are affected. This is also the case with the sinuses, and, by aid of an anæsthetic, steel probes will probably pass into the mediotarsal bones and joints, movements of the ankle-joint will be free, and grating may be obtained by lateral twisting of the centre of the foot.

Treatment.—Of all the sites of caries of the tarsus, this, on account of the number of bones which may become involved, and the difficulty of complete eradication, is one of the most important. If the disease is clearly extending, operative steps are called for early, and the surgeon has to choose between (*α*) attempting to remove all the diseased bone, (*β*) Chopart's amputation, and (*γ*) amputation at the ankle by the method of Syme or Pirogoff.

If the general and local conditions seem favourable to attempting to get all the disease away, one of the two following methods may be attempted. Free exposure of the parts by means of a flap adapted to the case, but made, if possible, mainly from the outer side, any tendons that admit of it being drawn aside, but others, where needful, being severed. The diseased bones and pulpy material being next thoroughly removed, sinuses freely laid open or scraped with a sharp spoon, and the synovial membranes along the tendinous sheaths on the dorsum examined if there be any suspicions of disease, the parts are brought together by a few points of suture, drainage being provided for.

The other method of trying to secure removal of all the disease, by going through sound parts in a case of extensive mediotarsal caries, is that practised by Dr. P. H. Watson of Edinburgh. Thus, when the disease is situated between the bases of the metatarsal bones in front and the astragalus and os calcis behind, lateral incisions three to four inches long are made from the centre of the os calcis to the middle of the fifth metatarsal bone, and from the neck of the astragalus to the middle of the first metatarsal bone, and the soft parts are then carefully dissected from the plantar and dorsal aspects of the foot through these incisions, the left thumb being kept between the point of the knife and the bones. The astragalo-scaphoid and calcaneo-cuboid joints are then opened up with a curved probe-pointed bistoury, and a keyhole saw passed between the plantar soft parts and the shafts of the metatarsal bones, and these are cut through from below upwards. The bones being removed, the wound is firmly plugged and pressure applied with pads and bandages before the Esmarch's bandage is removed. The first dressing is kept on for forty-eight hours, its object being to prevent hæmorrhage. That this operation is an excellent one in Dr. Watson's hands is shown by five out of his six cases doing well. The objections seem to be that it is done somewhat in the dark, and that, from the amount of bone which has to be removed by limited incisions, a good deal of damage may be done to soft parts unless great care is taken. But at the present time, with the advantage of antiseptic treatment, and the thorough plugging of such a wound which this allows, it will be well worth while to make use of the above method in favourable cases or where amputation is refused. The foot will of course be kept well raised, and morphia given freely if required after the operation.

(*β*) *Chopart's Amputation.*—Where the surgeon finds it unadvisable to attempt excision, when the astragalus and os calcis are really sound, he may, if urged to leave as much of the foot as possible, make use of the above amputation. But it should always be explained to the patient, especially when the disease has been of a carious nature, that he may pay a heavy penalty for the preservation of part of his foot in the shape of recurrence of the disease in two or more years' time. If the amputation be performed, the chief anterior tendons should always be stitched firmly into the plantar flap to counterbalance the tendo Achillis, otherwise tilting of the heel, fretting of the scar, and protrusion of the astragalus, the banes of this operation, are very likely to follow.

(*γ*) *Syme's and Pirogoff's Amputations.*—While the latter, when successful, leaves no doubt a firmer, longer stump, while it is accompanied by much less wasting of the calf-muscles, so that the power of quick flexion of the knee, as in rapid walking, &c., is much better performed, on the other hand, the result of a Syme, though inferior in the above points, is still so excellent and useful that it seems scarcely worth while to run the risks of recurrence of the disease and non-union of the cut bones, risks which are undoubtedly present where Pirogoff's amputation is performed in cases of disease. Where the bones, though externally healthy, are found soft and fatty on section, or where the patient is much pulled down with suffering or advanced in years,

Syme's amputation is certainly to be preferred.

Caries of the Cuboid.—Not very common, probably owing to the earlier ossification of outer side of foot. When present, may be associated with disease of fourth and fifth metatarsal bones. Excision should be resorted to with hope of good results.

Caries of the Metatarsal Bones. This is not at all uncommon in children; in adults it is also met with chiefly as caries of the first metatarsal bone, when attacking one bone only, or of the middle metatarsal bones when occurring in combination with disease of the mediotarsal joints. Any of these bones, if alone diseased, may be readily and successfully extirpated by a longitudinal incision over their dorsal surface, with small incisions at right angles to this at either extremity, if need be. The soft parts are to be carefully separated either by the point of the knife, kept close to the bone, or by a blunt director; the head of the bone is to be detached first and well raised, and the base then turned out, especial care being taken at this point to avoid the plantar arch. The cartilages of the cuneiforms or the phalanges should be carefully examined, one or two points of sutures applied, and drainage provided for, if need be, by puncturing the sole on the point of dressing-forceps and passing through a drainage-tube or 'drain.' The sesamoid bones of the great toe should always be left if possible. It will be found that the toes sink considerably towards the tarsus, but the foot is, subsequently, a very useful one. The writer considers the above method of removal by a single incision much superior to that (recommended for the great toe) by a single flap from the inner side or by oval flaps, as it entails less interference with soft parts, and as the resulting scar is more entirely out of pressure. The treatment of that form of caries and necrosis of the metatarsal bones which is met with in Perforating Ulcer has been described elsewhere. Caries of the metatarso-phalangeal joint of the great toe has been treated of under Bunion.

W. H. A. Jacobson.

TARSAL CARTILAGES, Affections of the. *See* Eyelids, Diseases of the.

TARSAL JOINTS, Diseases of the.—Acute inflammation of the tarsal joints is usually the result of injury, or is of pyæmic origin. The symptoms are pain, heat, and swelling over the affected joints. The pain is acute, and much increased by movement or the attempt to bear any weight on the foot. The swelling is most manifest on the dorsum of the foot.

For *treatment* the leg must be placed upon a splint with a foot-piece, and leeches or cold applied. In the acute inflammation following a sprain, much relief is obtained by the early application of leeches. In the pyæmic or other forms in which suppuration occurs, matter must be evacuated and long rest maintained, for ankylosis of these joints may leave a very useful foot.

Chronic disease of the tarsal joints is commonly of scrofulous origin. It may begin in a single joint, as that between the calcaneum and astragalus; or in a single bone, making its way thence into the adjacent joint; or, as is more commonly the case, in the synovial membrane common to several of the joints.

Here, the early treatment of the case need not necessitate the disuse of the limb. A moulded leather splint will keep the tarsal joints at rest, while the patient rests the bent knee on a peg-leg. The health should be carefully looked after, and counter-irritation by the cautery or small blisters be used from time to time. If suppuration occurs, and caries of the joint surfaces is suspected, or ascertained by crepitus on movement, an examination should be made of the foot during anæsthesia. The limitation of the disease will thus be more clearly defined; and if it is found to be confined to one joint, the thickened synovial membrane should be scraped away, and ankylosis aimed at. Not infrequently the disease, having started in one of the bones, is limited to the joints connected with that bone, in which case the most satisfactory results may be obtained by an excision of the bone and the removal of the diseased synovial membrane. If, however, a large number of the bones or joints of the tarsus are affected, and the disease is progressive, amputation either of the whole or part of the foot will be indicated. *See* Tarsal Bones, Caries of the.

J. Warrington Haward.

TAXIS, the, is the attempt to reduce a hernia by manipulation. It is performed by placing the patient in the recumbent position and then exerting a gentle, steady, and kneading pressure on the protrusion. The direction of the pressure must be in the direction of the hernia and towards the mouth of the sac; thus, in inguinal hernia the pressure should be upwards and outwards; in femoral hernia downwards, backwards, and then upwards and inwards; and in umbilical hernia directly backwards.

Taxis, if performed gently, is usually unattended with danger, but much knowledge and care are needed to ascertain the condition of the contents of the sac.

In the non-strangulated condition of hernia, taxis may be used for a quarter of an hour, but the patient must be carefully watched during the attempt at reduction; if the protrusion be intestine, taxis rarely accomplishes much after ten minutes; but in simple epiplocele the taxis may be kept up for a much longer time, if a sensible impression is made on its size.

In enterocele, the taxis should consist of uniform steady pressure, so as to empty the intestine of its gaseous and fluid contents, after which the gut is easily reduced; if the protrusion is an epiplocele, the taxis must be that of a kneading character, when the omentum is gradually replaced. In the latter case much pain is often referred to the epigastric region during the taxis, which may even be succeeded by faintness and vomiting.

While attempts at reduction are being made, the sac should be kept well pushed down by the fingers of the left hand, so that it is steadied and made as tense as possible while the hernia is being reduced by the other hand. This plan enables the hernia to be more easily reduced, while the liability to *réduction en bloc* is correspondingly lessened. When the hernia is large, it must be grasped by both hands.

The success of the taxis will be materially influenced by placing the parts in such a position as will render tense the fibrous margins of the rings. The position of the thigh recommended by most surgeons, prior to the attempt at reduction, is that of semi-flexion, adduction, and rotation inwards, the effect being to slacken the margins of the rings. The writer believes that in inguinal hernia the best position for reduction is that of simple extension of the thigh, and in femoral hernia that of abduction and rotation outwards of the thigh, thus rendering the apertures tense, so that they are not pushed in front of the protrusion when taxis is employed.

Occasionally, though very rarely, ill-effects have followed the taxis, it having been succeeded by peritonitis, and even by hæmorrhage from the bowels.

It is impossible to lay down definite rules as to the length of time taxis may be, with safety, employed in strangulated hernia. This must largely depend upon the experience of the surgeon, the condition and the previous treatment of the patient, the nature and the probable condition of the contents of the sac, and the anatomical relations of the hernia. If seen for the first time, the taxis should not be used for longer than ten minutes, and even then only gently, for more harm is likely to accrue from violent attempts at reduction than from herniotomy. Reduction may sometimes be facilitated by passing the tip of the finger into the inguinal, crural, or umbilical rings, so as to stretch them. A hot bath is frequently a valuable adjunct to the taxis in cases of strangulated inguinal hernia, but it seems to be of little use in those of the femoral variety. The administration of an anæsthetic is often of great use in the taxis.

Attempts at taxis should not be employed in cases in which there is evidence of sphacelus of the intestine, in those where there is much collapse of the patient, in those in which there is much abdominal pain, or in those in which the skin presents a dusky brown and œdematous appearance, indicative as this frequently is of gangrene of the intestine or the sac. Length of time of strangulation must influence efforts at reduction, and it is well not to attempt the taxis when an inguinal hernia has been strangulated more than four days, and a femoral more than three days. Apart from the danger of returning injured intestine, there is the great risk of returning highly septic fluid from the sac into the general peritoneal cavity. *See* Hernia, Strangulated.

John Langton.

TAYLOR'S SPLINT for the hip is composed of a metal bar long enough to reach along the outer side of the limb from the pelvis to the sole of the foot; it is provided with hinge-joints opposite the hip and knee, and the lower end of it is formed of two pieces, one of which slides within the other and is capable of being fixed at the requisite length by means of a ratchet. At the upper end of the bar there is a stout and well-padded metal pelvic girdle, which carries buckles to support a perineal band. There is another padded metal band attached to the middle of the thigh-piece, and a third band of soft leather fixed on to the leg-piece just below the joint for the knee. At the lower end of the splint there is a transverse bar, which may either be fixed to the sole of the boot or to a foot-piece. By turning a key, the splint may be lengthened or shortened as required. To apply the splint, the pelvic girdle and perineal band should be adjusted, and the foot should be fixed either to the foot-piece or into the boot, and then, by a turn of the key, the splint may be lengthened until the limb is

securely fixed. Finally, the bands for the thigh and leg should be buckled in position.

BILTON POLLARD.

TEALE'S AMPUTATION. *See* AMPUTATIONS.

TEETH AS A TEST OF AGE.—TEMPORARY TEETH.—The lower central incisors are erupted at the age of from six to nine months, the four upper incisors at ten months; the lower laterals and four first molars a few months later: then—after a rest of four or five months—the canines, and lastly the second molars; the whole being in place by the completion of the second year. But these dates are subject to variations, even in perfectly healthy children, and are of course much delayed by feeble health, and especially by rickets.

PERMANENT TEETH.—About the sixth or seventh year, the first molars come up, next the lower central incisors, then the upper central incisors, and a little later the laterals, this bringing us to about the eighth year. The first bicuspids appear in the ninth or tenth year, then the second bicuspids, and the canines about the eleventh year, the lower having often considerably preceded the upper. The so-called twelve-year molar is more generally a year later than its name implies, and the wisdom teeth are exceedingly uncertain, ranging from the eighteenth to the twenty-fifth year, or any later period.

When the teeth are all in place, a careful inspection of their working surfaces will reveal a varying amount of wear in young subjects, the teeth first cut having had a good many years of additional attrition; but, owing to the very various densities of teeth, too much stress must not be laid upon the absolute amount of wear, which will also be greatly influenced by the accuracy of the articulation of the upper and lower teeth.

CHARLES TOMES.

TELANGEIECTASIS. *See* NÆVUS.

TEMPERATURE.—Departure from the normal temperature of the body is so frequent and so important a sign of disease, that an accurate knowledge of the chief facts concerning the temperature in health is essential.

Source of Bodily Heat.—The body loses energy in two ways, in the shape of heat and in the performance of mechanical work. This energy is derived directly or indirectly from the food. Food consists for the most part of complex organic compounds, the molecules of which are held together by a large amount of potential energy. The whole of this force is set free when the molecules are broken up into their elements, and it makes no difference whether the disintegration is effected by one or many steps, or even if the downward course is now and again interrupted by synthetical processes, in which force is rendered latent.

When food-stuffs are burnt they set free large amounts of force, which have been carefully measured and expressed as units of heat or units of work. The amount of force set free by the combustion of any food-stuff is spoken of as its *heat-value*. Now, starches and fats are completely burnt in the body and yield up to it their full heat value; but proteids are reduced only to urea, so that it is necessary in their case to subtract the heat-value of urea from that of albumen, to obtain the amount of force they give up to the body.

When the body-weight is stationary, the daily discharge of carbon, hydrogen, and nitrogen will exactly equal the quantity of these elements taken in as food. Still, the food is not directly burnt by combination with oxygen in the blood, but is probably all assimilated by the tissues to repair waste, whilst worn-out portions of the latter unite with oxygen and are removed from the system. Combustion of the tissues is, therefore, the direct source of heat: all are being consumed and all yield energy. But destructive chemical changes go on much more rapidly in some tissues than in others, and two—muscle and gland—stand out prominently; of these, muscle must, on account of its great bulk, be regarded as the chief source of heat. Of the energy set free at each muscular contraction some disappears in doing work; the rest, never less than three-fourths, and often much more, appears as heat. When not contracting, muscle, like non-working tissues, is slowly burnt.

Heat may be derived, also, from sources external to the body—e.g. fire, hot bath, hot food—which affect it by radiation or conduction; also by transformation of other forms of energy, especially motion. Thus, much of the force with which the blood leaves the heart appears as heat.

Without some means of distributing the heat developed so excessively in muscle and gland, these tissues, or parts contiguous to them, would be very hot, whilst parts consisting of skin, tendon, and bone would be very cold. The circulation of the blood is the means by which the temperature of the different parts is rendered tolerably

uniform; it cannot be strictly compared to a hot-water heating apparatus, for the blood is not warmed at one furnace, but receives more or less heat from every tissue through which it passes. In some parts—e.g. the limbs, and superficial parts generally—it loses more heat than it gains; whilst in the central portion of the trunk it gains more than it loses, the blood in the hepatic vein being the hottest in the body. The more rapid the circulation in a part, the less the heat lost by a given quantity of blood in its passage through it; consequently, the temperature of a superficial part becomes more and more equal to that of the viscera as the rate of blood-flow through it rises, but sinks rapidly under opposite conditions.

Under such circumstances the temperature of the body cannot be the same everywhere; the more peripheral parts must be colder than the more central. Consistently with health the surface temperature may vary greatly; but that of the internal parts remains remarkably constant, even under conditions of great external heat and cold. This maintenance of the exact balance between the production and loss of heat indicates the existence of a very sensitive regulating apparatus, which may act either upon the loss or production.

Heat is lost by radiation and conduction from the surface of the skin, by evaporation from the skin and pulmonary mucous membrane, by warming air and other ingesta. It is easy to see how loss of heat, through these channels, may be increased or diminished as depression or elevation of the body temperature may require. With regard to the lungs, the larger the quantity of cool, dry air inhaled, the greater the loss of heat. We cannot make much use of this therapeutically, but in fever and during exercise respiration is naturally quickened. Much more heat is lost from the *skin*, and this loss is greater the more rapid the blood-flow through the skin. Dilatation of the skin-vessels, such as occurs during strong exercise, therefore tends to keep down the temperature. As a rule, dilatation of the cutaneous vessels is accompanied by increased secretion of sweat, but not always. The secretion of sweat-glands seems to depend upon stimulation of their secretory nerves, just as that of the submaxillary depends upon excitation of the chorda tympani, without which no congestion of the gland will produce secretion. So rapidly is heat lost from a freely sweating skin, that, if circumstances favour evaporation, little or no rise of temperature will be found in a person exposed to air at 100° C. (148° F.)

On the other hand, contraction of the skin-vessels diminishes loss of heat greatly; it is induced by external cold.

Next, there are many facts which show that the *production of heat* also varies, and takes its share in the regulation of temperature. Perhaps the most conclusive is the increased absorption of oxygen and discharge of carbonic acid upon simple exposure to cold, proving that increased combustion of tissue is going on; as occurs also in fever. From these and other facts it is believed that there is a centre above the medulla oblongata, possibly in the pons, which regulates the temperature of the body, being in close connection with the vaso-motor centre and having control over the metabolism of some, if not of all, the tissues.

An absolute *normal temperature* of man cannot be spoken of, for the temperature varies in different parts of the body; and even in central parts, where it is most constant, undergoes certain daily variations. Nor are the limits of these variations the same in all healthy individuals. A temperature which would be normal in one part at a certain time of day, would be abnormal in another part at the same time; and the normal temperature of a part in one person, might be abnormal for another person. The term 'normal temperature' is somewhat loosely used to express a temperature falling within the limits experience has fixed as the extremes, beyond which the temperature does not pass in health.

Diurnal Variations.—The rectal temperature in most healthy adults reaches a minimum of about 97°·5 F. (36°·5 C.) between 5 and 6 A.M. It rises somewhat rapidly up to 10 or 11 A.M., and then more slowly to 5 or 6 P.M., when it reaches a maximum of 99°·5 F. (37°·5 C.) After 8 P.M. it slowly falls. The total range is generally less than 2° F., in many people considerably less. The maximum and minimum are not attained at the same time in all people. Ordinarily, the temperature pursues the same course, whether the individual is sleeping or waking; but it is said that prolonged working at night and sleeping in the day will transpose the times of occurrence of the maximum and minimum.

Sex has no influence upon temperature; normal menstruation has no effect.

Age.—The new-born child is slightly warmer than the uterus of the mother, and for some days the average temperature is high. The diurnal variation in a baby is greater (3° F.) and less regular than in an adult. Up to puberty there is a slow loss of 0·4° F. on the average daily temperature;

and as much again is lost up to fifty. After sixty the average rises, and at eighty equals that of a baby. This rise is certainly not due to more active nutritive exchange, but perhaps is accounted for by the anæmic dry skin of old age.

Food.—It is said that during the solution of solid food a slight fall of rectal temperature occurs; all agree that during absorption there is a slight rise. Taken during the natural daily rise, food may temporarily increase it 0·5° F.; but it will not do more than delay the natural fall. Simple hot drinks cause a passing elevation, but, by increasing the cutaneous circulation, they render the loss of heat greater. Alcohol lowers the temperature, perhaps in a similar way. Strong coffee causes a rise of 0·4 to 0·7°F., reaching a maximum in an hour; tea has a weaker effect.

Exercise.—Muscular action raises the temperature; this is seen in infants after crying, between the pains of labour, in tetanus, and severe exercise. Rest lowers the surface temperature, a difference being noted even between lying and standing.

The Thermometer.—A mercurial instrument, maximum registering, to do away with the difficulty of reading *in situ*, is used. Besides being accurate, a clinical thermometer should be sensitive and quick-acting. *Sensitiveness* varies with the length of the degree; the larger the bulb and the finer the bore of the tube, the longer the degree. The bulb cannot be very large, as size would interfere with its introduction; the largest size and fullest contact with surrounding parts are obtained by making it cylindrical. *Quickness of action* is given by a small bulb of thin glass, and of such shape that the mercury exposes a wide surface to the tissues. Quickness of action may be increased by warming the bulb before insertion *almost* to the temperature of the patient. Sensitiveness and quickness of action therefore require somewhat different makes of thermometer; the mean must be struck, and strength for practical purposes must not be left out of account. Thermometers are best made without any external constriction between the bulb and stem. For clinical purposes, a degree clearly divided into tenths or even into fifths is sufficient; and only that portion of the scale lying between 95° and 110° is ordinarily required.

In *taking a temperature* it is necessary:

1. To be sure that no local influence—e.g. unusual exposure, passage of cold air, or of hot or cold fluids over it—has affected the temperature of the part selected.

2. To secure the most complete contact of the bulb with surrounding parts; for perfect accuracy the column of mercury should not be exposed.

3. To allow ample time for the mercury throughout to obtain the temperature of the cavity.

4. To read the thermometer with the axis of the eye vertically over the point of the index.

5. If the result is unexpected, to repeat the observation with extra caution and with a well-known instrument.

Temperatures are usually taken in the axilla or mouth; less often in the rectum (always in children) or vagina. Of these, the rectum is certainly the best; for it represents much more nearly than mouth or axilla the temperature of internal organs, and is much less exposed to disturbing local influences. Even its temperature is some tenths cooler near the anus than two to three inches up; the thermometer should therefore be passed well up the bowel. Ordinarily the axilla is ·5° to 1° cooler than the rectum; but in old people in health the difference may be as much as 3° (Charcot). Further, the temperature of the axilla continues to rise slowly for at least twenty minutes after it is converted into a closed cavity, by laying the arm across the chest.

The temperature of a limb can generally be taken by placing a thermometer in the fold of the flexed elbow or knee, and thus surrounding it. But it is difficult to obtain measurements of the temperatures of flat surfaces, as the scalp. Surface thermometers are generally made with long bulbs coiled at right angles to the stems, so that one side lies in close contact with the surface, the other being closely surrounded by wood, vulcanite, enclosed air, or some good non-conductor. Two thermometers should be used, a comparative observation on the opposite side being made. Half an hour's contact is generally necessary.

STANLEY BOYD.

TEMPORAL ARTERY, The, is one of the terminal branches of the external carotid; it commences opposite the neck of the condyle of the lower jaw, it ascends over the zygoma immediately in front of and above the tragus, and finally ends, on a level with the highest point of the ear, by dividing into anterior and posterior superficial temporals.

LIGATION.—The trunk of the artery is reached by an incision commencing over the zygoma just above and in front of the tragus, and carried vertically upwards for

the distance of one inch. Cut through the cutaneous structures, but raise the deeper tissues upon a director. Pass the needle from behind in order to avoid the vein and the auriculo-temporal nerve, which accompany the artery. The *anterior* temporal pursues a wavy course along the limit of the hair in front of the temple; the *posterior* temporal continues the vertical direction of the main trunk towards the top of the head. Either vessel may be secured at, or immediately below, a bleeding point by ordinary ligature or by acupressure.

JAMES CANTLIE.

TEMPORO-MAXILLARY ARTICULATION, Diseases of the.—Inflammation may lead to complete ankylosis of the joint, and consequent immobility of the jaws. Arthritis occurs as the result of injury or of constitutional affection.

In children it follows the exanthemata, and is often connected with suppuration in the tympanum.

In adults it is of a rheumatic or gouty, and therefore more chronic character. Rheumatoid arthritis also affects the temporo-maxillary articulation, and leads to great suffering, from the painful movement of the jaw. In two patients the writer has noticed the characteristic enlargement of the condyle and neck of the bone, with protrusion of the chin to the opposite side, described by Robert Adams in his great work on the subject. This disease does not, however, lead to the osseous ankylosis or synostosis, which is met with in cases of common arthritis with suppuration.

Treatment.—In acute inflammation of the joint, leeching and fomentations, with timely evacuation of pus, would be the appropriate treatment. In the more chronic forms, attention to the constitutional diathesis, and the frequent application of blisters over the joint, offer the best chance of relieving the patient, but the treatment is eminently unsatisfactory.

Dr. Goodwillie, of New York, has ingeniously proposed to produce extension between the surfaces of the temporo-maxillary articulation by fitting blocks upon the molar teeth, and then drawing up and fixing the chin, and gives several cases in which a cure was thus brought about.

The ankylosis resulting from articular inflammation may be fibrous or osseous, and the diagnosis can only be made when the patient is thoroughly narcotised.

Fibrous adhesions may be broken by forcibly opening the jaws, but very great subsequent care will be necessary to prevent re-union, and it may be better to do Esmarch's operation of division of the bone in front of the angle.

In cases of ankylosis of the temporo-maxillary joint, the operation of excising the condyle of the jaw has been performed in a few instances. The first removal of the condyle was by Professor Humphry, of Cambridge, and was undertaken for chronic rheumatic arthritis, and the writer performed the same operation in a case of enormous hypertrophy of the neck and condyle of the jaw. In cases of complete synostosis of the articulation, it is more satisfactory to chisel through the neck of the condyle and remove a portion of it rather than to interfere with the articulation itself. This operation gives very good results, and the slight damage to the facial nerve resulting from the necessary incision parallel to the zygoma is unimportant.

CHRISTOPHER HEATH.

TENACULUM is a sharp-pointed hook which is fixed on a handle; it was formerly used for taking up arteries on the surface of wounds, but for this purpose it is now superseded by Liston's bulldog-forceps. It is a very useful instrument for drawing the trachea upwards, and for steadying it whilst its rings are being divided and whilst the tracheotomy tube is being inserted.

BILTON POLLARD.

TENDONS, Affections of.—WOUNDS OF TENDONS may be subcutaneous or open. The former are usually inflicted surgically, and are treated of under TENOTOMY. It will be sufficient to say here of these wounds that they heal readily, give rise to no constitutional disturbance, and require very little treatment beyond what is necessary for the correction of the deformity on account of which the operation was performed. Open wounds implicating tendons will require to be treated on the general principles applicable to such injuries. *See* WOUNDS, Treatment of. As regards the tendon, the treatment is simple. The severed ends must be united. This may be effected by stitching with carbolised catgut, chromic gut, or silver sutures The two latter are better, because they do not loose their hold so readily as the common catgut. In an aseptic wound chromic gut is best, but in a suppurating wound silver would be necessary. In this last instance, however, it is very doubtful whether union would be effected, sloughing of a portion or whole of the tendon being more probable than union. In sewing the ends of tendons a curved

needle is best, and the continuous suture (unless silver is used). It is always advisable to make the parts aseptic, if possible, and prevent suppuration. For if the latter event occurs, there is apt to be spreading of the inflammation along the tendon sheath or sheaths, and sloughing of the tendons themselves. In the after-treatment such a position of the parts should be adopted as would relieve all strain on the tendon.

Rupture of Tendons occurs only in adults, is caused by sudden muscular contraction, and is most common in the lower extremity. The tendo-Achillis is most frequently torn, next the ligamentum patellæ, which is in reality part of the tendon of the quadriceps extensor cruris; in the upper extremity, the tendons of the biceps and triceps. The accident occurring in the lower extremity is usually from the person slipping, and making a sudden effort to prevent himself falling. The patient feels as if the part had been struck; there is a sharp pain for a moment; he falls to the ground and is unable to move the limb, and in some cases a crack has been heard. On examining the injured part, a distinct depression is felt at the point of rupture. The muscle is drawn up, and, in the case of the ligamentum patellæ, the patella is drawn up also, thus making the diagnosis easy as between fracture and rupture. Treatment is directed towards approximation of the torn ends of the tendon. This may be done by position. In the case of rupture of the tendo-Achillis, the leg should be flexed on the thigh and the foot extended. The patient may lie in bed or be permitted to go about with crutches, and the leg kept up by means of a cord passed through the heel of a slipper and secured to a belt round the thigh. When the ligamentum patellæ is ruptured, the limb should be kept straight and elevated, and the patella should be drawn down by strips of plaster, or by bandaging, as in fracture. *See* Patella, Fracture of the. A more thorough method of treatment is to suture the ends together. See *Wounds of Tendons*. This should always be done with strict antiseptic precautions. Such an operation cannot be performed when the tendon is torn from its insertion.

Union of Tendons.—Union takes place more quickly in cut than in torn tendons. Also much more quickly and accurately when they are stitched than when they are not. In children union has been observed in two or three days, and in adults use of the part has been possible after a fortnight, or even ten days. It is doubtful whether tendons contained in sheaths unite as readily as those which are not; but there is no doubt that the latter are more prone to slough after injury. Every care should be taken in their case, therefore, to promote union and avoid inflammation.

The new material which unites the ends of severed tendons is, at first, connective tissue with a large amount of cellular elements. Gradually the cells diminish and the fibres increase, the structure at the same time becoming stronger and harder, and like the original tissue. While this process is going on months may elapse, the time varying according to the amount of new material that has to be formed. At first this, when soft, is capable of being drawn out, and advantage of this fact is taken where tendons are cut (*see* Tenotomy) for deformities, most surgeons allowing the divided ends to unite first and then extending them gradually by apparatus. It must always be remembered that the new fibrous material has also the property of contracting, and retains this for a long time.

Dislocation or Displacement of Tendons.—Those most frequently supposed to be displaced are the long head of the biceps at the shoulder; the tendon of the extensor carpi ulnaris at the wrist, in cases of fracture of the lower end of the radius; and the tendon of the peroneus brevis at the outer ankle.

Causes.—Most of the cases recorded have been associated with arthritic disease, or connected with some injury, such as fracture. Dislocation of the tendon alone may, however, occur from injury, and in such a case diagnosis should be easy. The tendon will be felt in an abnormal situation, while a hollow will be left where it came from. The muscle which acts through it will be inefficient, and the joint acted on will be stiff or useless. The tendon will probably be easily replaced after it is relaxed, but will not be likely to remain in its position on account of the sheath being torn.

Treatment will consist in replacing and retaining the tendon in position, if possible, by strips of plaster, bandaging, or other means. Inflammation will be prevented by cold applications, and after a few days *passive* movements should be employed to prevent adhesion of the tendon. Should reduction or retention be impossible, the patient may be comforted with the assurance that the parts will ultimately become almost as useful as ever.

Dislocated tendons are favourite injuries with 'bone-setters.' What they generally treat as such (and not infrequently successfully) are adhesions of ten-

dons to their sheaths after injury or rheumatism. *See* Bone-setting.

Inflammation of the Sheaths of Tendons. — Tendons themselves do not often inflame, but their sheaths do. This affection is always a serious matter. It may be divided into three varieties:—1. *Simple Acute Thecitis*, or *Tenosynovitis*; 2. *Simple Chronic Thecitis*; and, 3. *Suppurative Thecitis*, of which last whitlow is a common example.

Acute Thecitis.—*Causes.* Injury, strain, wound, amputation, rheumatism, extension of inflammation from a neighbouring joint.

Symptoms.—Pain along the tendon or tendons, aggravated by movement or pressure, swelling extending at first in the line of the tendons, a peculiar sensation, resembling crepitation, imparted to the fingers when passed over the part, due to the presence of fluid in the sheath; lastly there may be fluctuation.

Results.—There may be recovery under proper treatment, supervention of chronic conditions, adhesion of the tendon to its sheath from effusion and organisation of lymph, suppuration, which is liable to extend, and lastly sloughing of the tendon or tendons.

Treatment.—Rest, fomentations, leeches, blisters, incision to relieve tension. When suppuration has taken place, immediate and free incision is always necessary if the tendon is to be saved. Even when the effusion is only serous or sero-purulent, *aseptic* incision may be advisable. Thorough drainage should be provided.

Chronic Thecitis.—*Causes.*—Previous inflammation, injury (more especially a sprain), and the rheumatic condition.

Symptoms.—Pain and stiffness, weakness of the part (always a prominent symptom), tenderness and swelling, crepitation, or creaking from effusion. Loose bodies like melon-seeds may be in the fluid contained in the sheaths. There is not infrequently rheumatic arthritis of a neighbouring joint.

Treatment should be constitutional if there is rheumatism or arthritis present; locally rest (if possible), counter-irritation, pressure by strapping or elastic bandaging, tapping if there is much effusion, or free aseptic incision if there are lymph-bodies. Permanent weakness of the part from want of use, contractions or adhesions of the tendons to their sheaths, are very apt to follow.

Diagnosis.—Sometimes some difficulty may arise in cases of acute or chronic thecitis in differentiating them from sprains or even fractures, and from disease of a joint. As regards the first, the two affections are often combined; in fact, inflammation along the line of one or more tendons is an almost necessary concomitant of a sprain of a joint. Where thecitis exists alone, the limitation of the pain and swelling at first to the line of the tendons, and the absence of ecchymosis afterwards, should be sufficient guides. The situation in which inflammation of tendon-sheaths is liable to be mistaken for fracture is above the outer ankle, where the peronei tendons cross the fibula, in which situation the presence of crepitation and pain on pressure are apt to make the hasty observer suppose that what he feels is the crepitus of a Pott's fracture obscured by swelling. The diagnosis should be made out by the absence of deformity and unnatural mobility at the painful part, by the ascertained integrity of the fibula, and by the mode of injury, which would not be eversion of the foot. Diagnosis from disease of a joint would be made by attention to the exact situation of the pain, swelling, &c.

Suppurative Thecitis.— This is most commonly met with in three forms. First, in connection with amputations and excisions, where there is suppuration which extends to and along the tendon sheaths; secondly, in cases of compound fractures or dislocations with suppuration; and, thirdly, in cases where the suppuration commences in the sheath, as in whitlow of the finger. The symptoms are those of suppuration generally; feverishness, often preceded by a rigor; swelling; heat; redness, which in the case of a whitlow disappears whenever tension is marked. Pain is always great.

Treatment consists in free incision. *See* Whitlow.

Tumours of Tendons. — Fibromata, Enchondromata, Osteomata, Cysts (in the form of ganglia), and Gummata. Tendons are not liable to be affected by new-formations, but, on the contrary, resist their invasion longer than most textures. *See* Tumours; Ganglion; Bursæ, Affections of.

A. G. Miller.

TENO-SYNOVITIS. *See* Tendons, Affections of.

TENOTOMY signifies the subcutaneous division of tendon or fascia.

A narrow-bladed knife is introduced a short distance from the tendon to be operated on, and, guided by the finger, made to divide it. On its withdrawal, a piece of folded lint, with a strip of soap-plaster

across to fix it, is placed on the puncture, and the foot is bandaged to a splint, and kept at rest for four or five days until the puncture is healed. The result is the same as if no wound of the skin at all had been made, and as if no communication had ever existed between the severed tendon and the external air.

It has been shown on dissection, and proved by experience, that the ends of a divided tendon become perfectly united by an intervening substance, which, after a time, becomes indistinguishable from the rest of the tendon, and that the lengthening of the tendon by this means can be regulated by the extent to which the new tissue is gradually stretched during the first few weeks after tenotomy.

In the performance of tenotomy, care must be taken to keep the knife *close* to the tendon to be divided, so that no artery or nerve may be injured. But, as in almost all cases requiring this operation, the tendon or fascia is unnaturally prominent, owing to its contracted condition, there is not the same difficulty in finding it that there would be in the normal state, nor is there the same danger of wounding adjacent structures.

The chief tendons and fasciæ that may require division are:—The tendo Achillis, the tibialis posticus, the tibialis anticus, the peroneus longus and brevis, the plantar and the palmar fascia, the extensor longus digitorum with the peroneus tertius, the biceps femoris, the semitendinosus and the semimembranosus, the sterno-mastoid. There are some others that may require division, but these require no separate description. The method in which the tendons mentioned above are operated upon is as follows:—

The Tendo Achillis.—The operator sits at the end of a table, with the assistant on his left. The patient lies on his face on the table, with his foot slightly overhanging the end. The assistant then grasps the calf of the leg with his left hand, and the anterior part of the foot with his right, and flexes it slightly, thus bringing the tendon prominently forward. The operator then puts his left thumb on the tendon, and introduces a sharp-pointed tenotome flatwise beneath it, and at this moment the assistant, making further extension, he turns the knife and divides it from below upwards. When the assistant feels the tendon give way, he relaxes the extension. This is important, for, if it is not done, there is some danger of the knife slipping through the skin. In this operation the knife may be introduced either on the inner or outer side of the tendon; but in the latter case it must be remembered that the posterior tibial artery is not far from the point of the knife, which should not be thrust in too deeply. With ordinary care there is no danger of wounding the vessel.

The Tibialis Posticus.—The operator sits at the foot of a table, with the assistant on his left. The patient lies on the same side as the deformed foot, and, the other foot being held out of the way, the assistant grasps the leg firmly just below the knee with his left hand, and with his right holds the foot well flexed in the deformed position. The operator then feels for the inner edge of the tibia, and just over this, and about an inch (two inches in an adult) above the tip of the internal malleolus, makes a puncture with a sharp-pointed tenotome, and passing it down to the edge of the tibia, and, guided by this, opens the sheath of the posterior tibial tendon. The sharp-pointed knife is then withdrawn, the assistant being careful to keep the foot in exactly the same position. The operator, now holding a blunt-pointed tenotome like a pen, introduces it into the opening, and insinuates the blade flatwise between the tendon and the bone. Having indicated to the assistant to evert the foot, he turns the edge of the knife towards the tendon, and, supinating his wrist, divides it and also the adjacent tendon of the flexor longus digitorum. A snap is felt at the moment of the division of the tendons.

The Tibialis Anticus.—The patient lies on his back, and the operator and his assistant place themselves as before. The operator works the foot from side to side, and feels with his forefinger for the tendon of the tibialis anticus. Keeping his finger over the tendon, he introduces a sharp-pointed tenotome with its edge towards it, between it and the tendon of the extensor proprius pollicis, and, the assistant making at this moment forcible extension, he divides it.

The Peroneus Longus and Brevis.—The patient lies on the opposite side to the deformed foot, and a cushion is placed under the lower part of the leg, with the foot extending over it. The operator sits at the foot of the table, with the assistant on his left. The assistant grasps the leg with his left hand, and with his right holds the foot up, so as to slacken the tendons as much as possible. The operator, placing his left forefinger on the tendons, introduces a strong, sharp-pointed tenotome flatwise, in an oblique direction, between

the fibula and the tendons two inches (in an adult) above the end of the malleolus, and having turned the edge towards the tendons, the assistant making extension, divides them.

The Extensor Longus Digitorum, and the Peroneus Tertius.—The patient lies on his back. The operator sits at the foot of the table, with the assistant on his left. The assistant grasps the leg with his left hand and the foot with his right. The operator, keeping the fingers of the left hand on the tendons, introduces a sharp-pointed tenotome between the tendon of the extensor proprius pollicis and the tendons to be divided, and guiding the blade beneath these tendons, he divides them. Care must be taken not to dip the point of the knife deeper than necessary, or the anterior tibial artery may be wounded. The duty of the assistant will be rather to prevent the foot from suddenly falling than to make extension.

The Plantar and Palmar Fascia.—In the subcutaneous division of fascia, the object of the surgeon should be to divide every portion of it as efficiently as possible, and to retain the divided edges as much apart as possible. If it be found that one puncture is not sufficient for this purpose, two or more may be made. In the case of the plantar fascia, it is best to cut it bit by bit rather than to attempt to divide it all by one sweep of the knife, and it is a matter of indifference whether the edge of the knife be directed towards or from the skin.

The foregoing descriptions apply to a surgeon operating with his right hand on the tibialis anticus and posticus, or on the plantar fascia of the *left* foot, or on the peronei or extensors of the *right* foot. If the contracted tendons, however, are situated on the other side, and the operator cannot use his left hand, he must stand facing the foot of the table which is on his right.

Biceps Femoris.—The patient lies on his face. The operator places himself on the same side of the table as the leg to be operated on. An assistant supports the leg in the flexed position. If possible, this operation should be performed without the previous administration of an anæsthetic. The patient should attempt to flex the knee-joint, the assistant holding the leg firmly at the same time. This will bring the tendon prominently forward. The operator then introduces a strong, sharp-pointed tenotome on the *inner* side of the tendon, keeping the blade close to it, and insinuates it under it. The knife then lies between the tendon and the peroneal nerve, and, cutting outwards and upwards, the tendon is divided and the nerve is uninjured. On the knife being carefully withdrawn, the nerve will be observed to come more prominently forward than before, and care must be taken not to mistake this for part of the tendon.

The Semitendinosus and Semimembranosus.—The knife should be introduced on the *outer* side of these tendons, and care must of course be taken not to dip the point deeper than necessary, owing to the position of the popliteal artery.

The Sterno-Mastoid. — Either the sternal or the clavicular portion of the sterno-mastoid may require division. If it be necessary to operate on both portions, a separate puncture must be made for each. The patient lies on a table, and the operator stands on the same side as the muscle to be divided. A puncture is made on the *inner* margin of the muscle in its lower third. A blunt-pointed tenotome is then carefully introduced, on the flat, through the opening, and, guided round the border of the muscle, is passed behind it. The sharp edge of the knife is then turned towards the muscle, and made to divide it from within outwards. The assistant, during the operation, holds the head firmly and keeps the muscle tense.

Henry F. Baker.

TESTIS, Diseases of the.—Acute Inflammation.—It is important to distinguish between inflammation of the epididymis and of the testicle proper or body of the organ. The former will be spoken of as epididymitis, the latter as orchitis. The two may be combined, the disease spreading from one organ to the other. Epididymitis is much more frequent than orchitis, and it is only rarely that the inflammation passes from the epididymis to the secreting part of the organ.

Causes.—The most frequent cause of *epididymitis* is inflammation or injury of the prostatic urethra or seminal vesicle, such as occurs in gonorrhœa, stricture, impaction of a calculus, the passage of a catheter or other instrument along the urethra, and lithotomy. Epididymitis is the commonest complication of gonorrhœa, occurring most often about the third week of the disease; it is due to a direct extension of the disease along the vas deferens, and not to metastasis. It is specially likely to occur in the subject of gonorrhœa after indulgence in alcohol, sexual excitement, violent exercise, or the use of strong injections or of a ca-

theter. Injury, such as a contusion against a saddle, is a frequent cause of epididymitis, and the disease is also excited by acute inflammation of the tunica vaginalis, such as is caused by stimulating injections in the radical cure of hydrocele. Acute hydrocele and epididymitis have also been met with in smallpox.

The causes of acute *orchitis* are injury, mumps, rheumatism, gout, and excessive ungratified sexual desire; very rarely it occurs in the course of typhoid or malarial fever. Orchitis is more frequent in certain epidemics of mumps than in others, and may occur without any affection of the parotid gland; it generally comes on towards the end of the first week of the disease, and is liable to be followed by atrophy of the organ. Acute inflammation of the testicle may be met with in infants and young children, as the result of injury, or, in some cases, as the result of phimosis; in other cases it appears impossible to assign a sufficient cause.

Pathology. — The inflammation is marked by hyperæmia of the vessels of the spermatic cord, of the epididymis and testicle, of the tunica vaginalis, and commonly also of the scrotum. In epididymitis, the greater part of the swelling is due to inflammatory exudation around the convoluted tube or tubes of this organ; but a similar exudation is found infiltrating the wall of the tube, and even filling up its lumen. In acute inflammation of the body of the organ, a small-celled inflammatory exudation is poured out between the seminal tubes; these are compressed by it, and, at the same time, become choked by the products of a hyperplasia of their epithelial lining. Inflammation of the tunica vaginalis very commonly accompanies acute epididymitis. This may lead to hyperæmia of the membrane and the effusion of a small quantity of fibrinous lymph on its surface, ending in adhesions betweeen the two surfaces, or entire obliteration of the sac; or there may be an effusion of a richly fibrinous fluid into the sac—acute hydrocele—which then adds considerably to the swelling of the part. When the inflammation of the testicle is intense, the scrotal coverings are reddened by hyperæmia, and the veins especially may be engorged, and the tissues œdematous.

The disease most often terminates in complete resolution, but, in not a few cases, a small hard nodule is left behind in the globus minor of the epididymis, which on examination is found to be caused by a thickening around the duct of the testicle and an obliteration of its lumen; the duct above this plug may be more or less dilated. This condition is of great importance, as, if it occur on both sides, it renders the subject of it sterile, and when of long standing it is incurable. Abscess is a rare termination of the disease, whether it affect the secreting part of the organ or its duct. A still rarer complication is gangrene of the scrotum, due to the intensity of the inflammation of the coverings of the testicle. When the body of the testicle is inflamed, the subsidence of the inflammatory process may be followed by atrophy of the organ. This more often occurs in connection with parotitis than in other varieties of orchitis, and is more frequent in some epidemics than in others, and it appears not to be dependent upon the intensity of the inflammation. Gonorrhœal epididymitis is more common on the left side, and rarely attacks both testicles simultaneously, although the second testicle may be attacked subsequently to the first. The affection is most frequent and generally most intense in the globus minor, and it is here also that the swelling remains longest, and is apt to leave behind a permanent thickening.

Symptoms and Diagnosis.—The onset of the affection may be very abrupt, but it is more often preceded by an aching pain along the spermatic cord of the same side, and, if an examination is made at this time, the cord is found full and the vas deferens more or less swollen. In exceptional cases, there is marked swelling of the cord for some hours previous to the swelling of the testicle. The severity of the symptoms of acute orchitis varies within somewhat wide limits; some patients are completely incapacitated by the disease, while the majority manage to attend to their usual avocations, albeit suffering more or less severely. The symptoms of the affection are swelling, pain, redness of the scrotum, together with evidences of constitutional disturbance. The swelling is always a marked feature of the disease, and has caused the name 'swelled testicle' to be commonly used for this complication of gonorrhœa. It varies in amount, position, and character with the parts affected.

When the epididymis alone is inflamed, the swelling is limited to the back part of the organ, where a slightly uneven, elongated, firm mass is felt, which projects above and below the unaffected body of the testicle. When the disease implicates the globus major or globus minor exclusively or principally, the swelling will be limited to or most extensive at the upper or lower

part of the organ. When the testicle is inverted, the swollen epididymis will lie along the front of the organ. The swelling due to orchitis proper is situated in front of the organ, and is more even in outline than that of epididymitis; owing to the unyielding tunica albuginea it never attains a great size. Acute hydrocele is a far more frequent cause of swelling over the front of the testicle. When the effusion is abundant, it greatly adds to the total bulk of the scrotal enlargement, and may cause a marked bulge in the front of the scrotum. This swelling is even in contour, and its fluid nature is recognised by the sense of fluctuation it affords. It obscures the testicle proper, but not the inflamed epididymis. The spermatic cord is more or less swollen and firm, the thickened vas deferens being tender to the touch. Œdema of the scrotal coverings may add to the general swelling.

The pain is usually severe. It is described as of a heavy, dragging character, extending up along the cord to the groin, and round to the loin of the same side. The position of the tenderness is of use for diagnostic purposes; when the epididymis is inflamed, the tenderness is limited to this part of the organ; when, however, the body of the testicle is also inflamed, the tenderness as well as the pain is most marked over the front of the inflamed organ. Care must be taken in making this examination, for pressure made upon a healthy part may be transmitted to an inflamed part, and cause pain; this error is, however, easily avoided. The scrotal coverings may be scarcely at all affected; generally the skin is reddened, the superficial veins are distended, and the dartos is more or less œdematous. The constitutional disturbance is manifested by fever, a quickened pulse, a furred tongue, anorexia, and constipation.

Under judicious management the pain, tenderness, and fever quickly subside, and the swelling gradually diminishes, in most cases leaving a painless induration of the globus minor of the epididymis, which slowly disappears but may be permanent. When the acute symptoms have subsided and the swelling has been entirely, or in great part, absorbed, the testicle may be left in a very irritable condition, painful, very tender to the touch and on contact with the clothes and thighs in walking; and this state, which is one of considerable importance, is apt to be chronic and difficult to alleviate. When the duct of the testicle is plugged by lymph, not only is the testicle useless for fertilising purposes, but the act of intercourse is apt to be followed by pain and swelling of the gland. The occurrence of abscess is attended with persistent and even increasing pain and tenderness, increase of the swelling at a particular part, and fluctuation; with these local symptoms there is fever, and there may be one or more chills or rigors. Abscess most often occurs at the globus minor and points at the lower end of the scrotum. In delicate, strumous subjects, the abscess may be subacute or chronic in its course. Gangrene of the scrotum is to be feared when the swelling of its tissues reaches a high grade. Gangrene of the testicle itself can only be verified when, at the bottom of an abscess of the scrotum, the sloughed organ is seen. Atrophy of the testicle gives rise to no symptoms except a wasting of the body of the organ, the epididymis not being affected.

The *diagnosis* of acute inflammation of the testicle, as a rule, presents no difficulty; the acute onset of the disease, the swelling of the testicle itself, the severe pain and tenderness, the fulness and thickening of the cord, and the fever are eminently characteristic. By the shape and position of the swelling, and the site of greatest tenderness, epididymitis is readily distinguished from true orchitis. The signs by which acute hydrocele, abscess, and gangrene are to be recognised have also been already stated. Acute inflammation of a retained testicle may be mistaken for a strangulated hernia. For the diagnosis, *see* Testis, Malpositions of the.

Treatment.—In the acute stage of the disease, it is very important that the patient should be at rest in the horizontal position with the scrotum well supported, either by a pillow between the thighs, a handkerchief suspender, or a broad strip of strapping passed across from groin to groin. When the case is seen early, and the patient is young and otherwise healthy, cold is the best local application. The usual plan is to suspend a bag of cracked ice to a bed-cradle, so that it rests lightly upon the scrotum; but a still better plan is to surround the scrotum by a coil of rubber tubing through which iced water circulates; the coil being similar to that used by Otis for the penis. Should cold fail to relieve the pain, or if the patient be old or cachectic, or the inflammation have lasted more than twenty-four hours before treatment is commenced, or be associated with mumps, or if there be great œdema of the scrotum, local heat is to be employed, combined with the application of belladonna or opium. Hot belladonna or poppy-head fomentations may be

used; but a simpler and equally beneficial plan is to cover the testicle with a thick layer of equal parts of extract of belladonna and glycerine spread on linen, and over that to apply hot fomentations, which should be renewed every hour, the belladonna being re-applied once a day. The diet should be restricted to unstimulating slops, and the bowels be well opened by a saline purgative combined with tartar emetic, a good formula being, a drachm of sulphate of magnesia with ¼ grain of tartar emetic, given every four hours until a distinct effect is produced upon the bowels. In robust, plethoric young men, this may be preceded by a purgative dose of calomel (gr. v. to x.), but in the majority of cases this is not requisite. Under this treatment the acute symptoms as a rule quickly subside, and the patient is able to get up in forty-eight or seventy-two hours, but convalescence is much hastened by a continuance of rest in the horizontal position. In the orchitis of mumps, neither cold nor any form of lowering treatment is to be employed, and, owing to the frequency with which atrophy of the testicle follows this form of the disease, great care is to be exercised in the treatment of even the mildest case; a diaphoretic and diuretic saline mixture is the best internal remedy.

When the tunica vaginalis is distended with fluid and the seat of acute pain, rapid and marked relief is obtained by puncture of this sac either with a fine trocar or a narrow knife; but the puncture should not extend into the testicle itself. When abscess is diagnosed, it should be opened by means of a fine knife, and a small drain of catgut, horsehair, or rubber tubing may be introduced into the cavity. If the œdema of the scrotum is so intense as to threaten strangulation of its vessels, it should be at once relieved by several incisions about three-quarters of an inch long, and over the part boracic acid fomentations should be assiduously applied. When there is great congestion of the scrotal veins, and the patient is plethoric and the disease acute, relief will be obtained by a local venesection. The man should stand up for a few moments, and then one or more of the largest veins of the scrotum should be opened by a lancet, and from three to six ounces of blood may be abstracted. When the disease is not very acute and the patient cannot rest entirely, the best local treatment is belladonna and glycerine on linen, covered by a thick mass of cotton-wool, the whole being enveloped in oiled silk or india-rubber tissue, and supported in a handkerchief. The handkerchief should be folded three-cornerwise, and a piece of tape is to be sewn to the middle of the longest side; this part is to be placed behind the scrotum, and the tape drawn up between the buttocks and fastened to a band round the waist; the two long ends of the handkerchief are to be drawn up along either groin and fastened in front to the same band, and the remaining corner is then to be folded up in front and pinned to the waistband. By this means the testicle is not only held up, but also kept forwards out of the way of the thighs in walking. Two or three times a day, the testicle should be well fomented with water as hot as can be borne. *See* Suspensory Bandage.

When the period of acute pain and congestion is passed, the patient should, if possible, still rest, but when necessary may be allowed to get up, wearing a well-fitting suspender. Gentle friction with a small piece of belladonna ointment night and morning is the only local treatment required in most cases. But where the effusion has been great, or its absorption occurs slowly, this may be hastened by carefully applied circular compression of the testicle. This compression may be obtained by strapping, an elastic bandage, or a laced suspender. Where an indolent nodule is left behind in the globus minor of the epididymis, friction with unguentum hydrargyri is the best application, and should be persevered with until no thickening or induration is to be detected. All urethral medication and instrumentation are to be suspended during an attack of epididymitis. The discharge of gonorrhœa usually lessens and disappears during the acute stage of epididymitis, but reappears on its subsidence; this is not evidence of metastasis, but of the derivative effect of the testicular inflammation. In malarial orchitis, which is liable to relapse, quinine should be exhibited. In gouty orchitis, the usual treatment for this diathetic condition is indicated, alkaline salines with colchicum being exhibited, and the diet being suitably restricted. Where the condition of irritable testicle, above referred to, exists, iodide of potassium (gr. x. to xv. a day) should be given; if the patient be anæmic, iron and cod-liver oil with change of air will afford most speedy relief. This condition is often very obstinate and difficult to relieve.

Chronic Inflammation.—*Causes.*—By far the most frequent cause of chronic orchitis is constitutional syphilis. The testicle becomes affected most often within two or three years of the occurrence of infection, between the subsidence of the

secondary eruptions on the skin and mucous membranes and the development of the deep tertiary diseases of bones and viscera. But syphilitic orchitis may come on at a much later period, and in patients in whom there is no other concurrent syphilitic phenomenon. It is believed that the affection is often excited in the testicle by slight blows or by venereal excesses. Occasionally, chronic orchitis develops in young infants the subjects of hereditary syphilis. Stricture of the urethra sometimes leads to chronic inflammation of the testicle, and, in some cases, exposure to cold and wet or prolonged venereal excess has seemed to be the starting-point of the disease. Gout, rheumatism, or long residence in malarious districts, may induce chronic orchitis; and very occasionally it is a sequel to acute traumatic orchitis.

Pathology.—The morbid change in the testicle consists in a chronic inflammation of the intertubular tissue of the organ, which, with rare exceptions, is limited to the secreting part of the gland, and does not spread to the epididymis. In many cases, if not in all, the inflammation first affects the tunica albuginea, and spreads in from this membrane along the fibrous dissepiments of the organ, involving lobe after lobe, but very rarely, if ever, extending as far as the rete testis and the vasa efferentia. The tunica albuginea becomes considerably thickened, and, as at first the disease is limited in area, the part has a nodular feel, but, as the affection spreads and involves more of the fibrous covering of the organ, this nodulation lessens and is lost. The inflammation may extend inwards uniformly over several lobes, or may be limited to certain lobes, and attain a higher grade in particular spots; and, in this way, variations in the appearance presented by the diseased organ are produced. The inflammatory exudation consists of small round nucleated cells and delicate fibres, which surround and separate the seminal tubules; the epithelium lining these tubules undergoes fatty degeneration and is shed. When the inflammation does not attain a high grade or continue very long, the exudation may be absorbed and the damage done to the tubules be repaired, the testicle being restored to its original structure and function; if, however, the injury done to the tubules have been too severe to permit of this, the absorption of the inflammatory exudation is attended with wasting of the organ, and, when this is total and bilateral, it induces both impotence and sterility. On the other hand, the inflammatory neoplasm may organise into dense cicatricial fibrous tissue, in which no trace of the tubules is to be detected, or it may undergo slow degenerative changes.

When a gradual obliteration of the arterioles occurs, with dry fatty degeneration of the tissue, typical gummata are produced. In other instances, the degenerated tissue breaks down into fluid débris; this may be encapsuled in firm fibrous tissue, or, inflammation being excited around it, the testicle becomes adherent to the scrotum, and an opening is formed through which the puriform matter is discharged. From the wall of the cavity thus emptied an active growth of granulation-tissue takes place, which fungates through the sinus. *See* Hernia Testis. Where the chronic inflammation has its chief seat in the tunica albuginea, the thick exudation on the outer surface of this membrane may undergo similar changes; the tissues of the scrotum then ulcerate and expose the testicle, from the surface of which granulations may sprout, or the part may exhibit the sloughy appearance common in cutaneous gummata. The tunica vaginalis is generally involved in the inflammation; at the early stage fluid is effused, generally in small quantity, which fluid, unlike that of simple chronic hydrocele, may coagulate spontaneously. Later on, the fluid is absorbed, and the two serous surfaces of the tunica vaginalis may be partially or wholly adherent. When hydrocele is combined with chronic enlargement of the testicle, the condition is known as *hydrosarcocele*; the fluid is occasionally so abundant as to entirely obscure the testicle. The vessels of the cord are engorged, giving a sensation of fulness to the part; very rarely it is indurated, and it has been known to become the seat of gummatous enlargement. The tissues of the scrotum are generally unaffected; but when the inflammatory products in the testicle soften down, the skin and subcutaneous tissues become inflamed, adherent, and at length ulcerated. Syphilitic orchitis affects both testicles more often than any other disease to which these organs are subject. It is rare for both testicles to be attacked simultaneously; more commonly, the inflammation advances for some time in one before spreading to the other organ, or it is only after the subsidence of the disease in the first that the second becomes affected, and there may be a considerable interval of time between the invasion of the two testicles.

The epididymis usually escapes altogether in syphilitic orchitis; it may, how-

ever, be involved either with or separately from the body of the organ. The change is the same as in the secreting part, consisting of an interstitial inflammation between the tubes of the globus major and in the fibrous covering of the coni vasculosi.

Symptoms and Diagnosis.—The onset of the affection is often unobserved by the patient, who has his attention first called to the part by accidentally feeling a hard lump in one testicle. In some cases, however, the testicle is tender from the first. In harmony with its insidious onset is the slow and painless course of the disease. The testicle is enlarged, and sometimes attains as much as three times its original bulk, being ovoid and flattened on its sides, and generally by its increased size obscuring altogether the epididymis. In the earlier stages, the enlargement is nodular and affects only a part of the body of the testicle, but, later on, the irregularities of the surface lessen and more of the organ may become involved, until no part of it is felt to be healthy. The inflamed part is firmer than natural, and oftentimes is of extreme and even stony hardness. The special testicular sensibility is lost early, and there may be an entire absence of both pain and tenderness; but more often the part is tender to pressure at some spot, and, occasionally, patients make considerable complaints of both pain and tenderness, but these acuter symptoms are rare and generally transient, the usual course of the disease being insidious, slow, and painless.

The spermatic cord is usually fuller than normal, but is not indurated. Fluid is often present in the tunica vaginalis in greater or less quantity, increasing the swelling and obscuring the exact outline of the testicle; this can be detected by the presence of fluctuation, and also by translucency of the anterior part of the scrotal swelling. The term *hydrosarcocele* is applied to this condition. The skin of the scrotum is generally of normal appearance, but when the inflammatory products in the testicle soften, it becomes adherent to the organ, reddened and inflamed, an abscess bursts and a sinus may be left, or extensive ulceration occur, or a hernial protrusion from the testicle develop. The opposite testicle may be healthy, or may be similarly affected, the disease attacking one testicle after the other. Relapses and recurrences of the affection are also met with. A history of syphilis is to be obtained in the great majority of cases, and in many cases there are other evidences of this disease present at the time. When both organs are involved in the inflammation, sexual desire and power are alike lost, and this condition is permanent when the testicles atrophy or the inflammatory products develop into dense cicatricial tissue. In some instances of apparent cure of the disease, the semen continues to be void of fertilising power.

Under suitable treatment, the induration and enlargement of the testicle generally disappear, testicular sensibility returns, and the part is restored to its former condition. In some cases, however, the organ wastes away, and nothing may be left but a small nodule adherent to the front of the unaffected epididymis. In other instances, when the disease has run a very chronic course, and has converted the testicle into a mass of cicatricial tissue, the organ remains of irregular outline, extremely hard and painless. Hernia of the testicle is considered elsewhere. When, with considerable enlargement of the testicle, one prominent nodule is felt, and this nodule resists the effects of treatment more than the surrounding parts, it is probably a gumma. Gumma of the testicle is not infrequently unilateral, and it is met with at a later period in the course of syphilis than simple interstitial inflammation. In many cases, it is impossible to recognise the presence of gumma except by dissection of the organ. When, in spite of careful and prolonged local and constitutional treatment, the testicle remains enlarged, hard, and the seat of occasional attacks of pain, it will generally be found, on removal of the organ, that it is the seat of a chronic abscess with a thick indurated wall of fibrous tissue surrounding the inflammatory débris.

The *diagnosis of Chronic Orchitis* is generally easy: the gradual painless enlargement of the testicle proper, with marked hardening and loss of its special sensibility, the absence of induration of the cord, the affection of both testicles in many instances, the existence of syphilis, and the good effects of anti-syphilitic remedies are the main factors in arriving at a diagnosis. *Hydrosarcocele* has to be distinguished from simple hydrocele; in the latter the testicle becomes enlarged and is generally somewhat tender; the enlargement, however, mainly affects the epididymis, which can be plainly distinguished from the body of the organ. In hydrosarcocele, on the other hand, when the fluid has been withdrawn from the tunica vaginalis, the body of the testicle will be felt enlarged and hard, and the epididymis will be obscured altogether; it is only rarely that the amount of fluid in the serous sac is sufficient to render this diagnosis at all doubtful. The swelling of *hæmatocele* usually follows upon an in-

jury and develops quickly; it is, moreover, less nodular and hard than that of chronic orchitis, being elastic or even fluctuating, rarely if ever bilateral, often attains a larger size than an inflamed testicle, and does not yield under anti-syphilitic remedies.

In the early stage, it may be impossible to distinguish *malignant disease* from chronic orchitis; but the continuous and rapid enlargement of the organ, the thickening of the cord, the adhesion of the scrotal coverings, the swelling of the deep inguinal and lumbar glands, and the freedom of disease of the opposite organ, as well as the effects of treatment, will quickly dispel all doubt as to the real nature of the affection. The diagnosis from *strumous orchitis* is very important, and usually it is very easy. In the strumous affection, the epididymis is the first and chief seat of the disease, and this part becomes enlarged and markedly nodular, which is in marked contrast to the slightly nodular and very hard enlargement of the body of the organ in chronic orchitis. Strumous orchitis is much less often bilateral; nodular enlargement of the cord and of the vesicula seminalis of the same side or prostate is common, while tubercular disease of the bladder and kidneys, or of the lungs, only too often renders the diagnosis clear. In strumous disease, the tendency for the inflammatory products to break down into an abscess, is much more marked than in syphilis. *Syphilitic epididymitis*, which occurs early in the course of the disease, and is much rarer than the affection of the body of the organ, will be recognised by the very slow, painless, hard, and bossy enlargement of the globus major, in a patient known to be the subject of syphilis. The chronic orchitis due to gout, malaria, or stricture of the urethra is more general, less nodular, and less hard and painless than that due to syphilis; gummata do not form in connection with it.

The chronic orchitis of infants must be carefully distinguished from malignant disease of the organ, which is also met with early in life. The slow and painless enlargement of the organ, the absence of glandular infection, the affection of both testicles, and evidence of the syphilitic dyscrasia, are points upon which a diagnosis of chronic orchitis may be founded. As in adults, so in infants, hernia testis may result from chronic orchitis.

Treatment.—The treatment of chronic orchitis must be both local and constitutional. Where the disease is syphilitic in origin, and the testicle is considerably enlarged, it should be firmly strapped with emplastrum hydrargyri or the emplastrum ammoniaci cum hydrargyro. In cases where the enlargement is slight and partial, inunction with mercurial ointment is a better local application, and if there is marked tenderness, unguentum belladonnæ, either alone or combined in equal proportions with ung. hydrargyri, will quickly relieve this symptom. In place of the common mercurial ointment, the ointment of the red oxide or red iodide of mercury, of the strength of ten grains to the ounce, may be used. When inunction is employed, a suspender should be worn. Mercury should also be administered internally in the majority of cases; the drug may be given in any of the usual forms—by mouth, by inunction, or in the form of vapour. Where the patient has not previously had a proper mercurial course, he should be quickly brought under the influence of the drug up to the point of slight swelling of the gums, and this condition should be kept up until all traces of the disease have passed away.

When the patient has been already submitted to a prolonged course of mercury, a milder treatment with the drug will usually quickly lead to improvement. It is a common plan, in such cases, to combine iodide of potassium with the mercury in the form of a biniodide. When the patient has been already thoroughly treated with mercury, and especially when the testicle is affected many years after the primary infection, or when, from the local condition, the disease is believed to be gummatous, and the patient is markedly cachectic, iodide of potassium should be given alone in full and increasing doses, combined with sarsaparilla or cinchona; and when cachexia is marked, cod-liver oil, iron, bracing sea-air, and good food are valuable adjuvants. Mercury is the drug to be relied upon in most cases, and iodide of potassium cannot be successfully substituted for it, unless the patient have been previously thoroughly treated with mercury. For the treatment of hernia testis, *see* Hernia Testis. When the tunica vaginalis contains only a small amount of fluid, no alteration in the treatment is required, the fluid being quickly absorbed under the influence of mercury; but when the hydrocele is a marked element in the case, greatly adding to the swelling, it is well to tap it, and then to strap the testicle, and should the hydrocele persist after subsidence of the orchitis, the radical cure of the former should be made; this is very rarely necessary. *See* Hydrocele. No treatment is of avail where the testicle is atrophied, or

is converted into a mass of dense fibrous tissue.

When, in spite of appropriate local and constitutional treatment, continued for some time, the testicle remains enlarged and hard and is the seat of recurrent attacks of pain, the organ should be removed, as in all probability it is the seat of a chronic abscess. Castration should also be resorted to when the testicle is riddled with chronic sinuses, or is greatly enlarged with gummata, and improvement is not speedily obtained from medicinal treatment. This operation should not be performed until the surgeon is persuaded that the testicle is beyond all hope of recovery; when the syphilitic cachexia is well-marked, the removal of an ulcerated gummatous testicle is often followed by marked improvement in the general condition. Chronic syphilitic epididymitis should be treated by local inunction with mercurial ointment and the internal administration of mercury.

In the few cases of chronic orchitis which are not due to syphilis, the enlarged organ should be carefully and systematically strapped; where there is marked tenderness, emplastrum belladonnæ is used with advantage; where the induration is a marked feature in the case, emplastrum hydrargyri should be used. If the patient is gouty, the diet and mode of life should be carefully regulated, and alkalies with colchicum should be given. When malaria is the probable cause of the affection, removal from the malarial climate—best of all a sea voyage—and the administration of quinine are the most successful measures to adopt. If quinine fails, arsenic should be tried, and iron and cod-liver oil are often of great benefit when the patients are anæmic and thin. When there is a stricture of the urethra, this should be treated. In all cases alike of chronic orchitis, the patients should abstain carefully from alcoholic excess and all forms of sexual excitement.

The chronic orchitis of infants requires the same treatment as that of adults; mercury should be administered internally in the form of grey powder or by inunction of ung. hydrargyri, and this ointment may also be applied locally. The little patients are usually cachectic, and require careful feeding and cod-liver oil.

Tubercular Disease of the Testis.—*Causes.*—In a large proportion of cases, the disease in the testicle is secondary to tubercular affection of other parts of the body, especially the lungs, bones, kidneys, and bladder; in some of these cases, an attack of acute gonorrhœal epididymitis, or local exposure to cold or injury has appeared to light up the disease in the testicle. In many cases, however, the tubercular disease of the testicle is a primary affection. Tubercle attacks the testicle in the same class of patients and under the same general conditions as other organs, and there is much reason to believe that it is connected with the development of the bacillus tuberculosis. The testicle may be affected in general miliary tuberculosis. The disease is occasionally met with in young children, and is most common in early manhood.

Pathology.—The common tubercular or strumous disease of the testicle consists of a chronic inflammation commencing in the epididymis, and sometimes spreading to the body of the testicle or to the vas deferens. The convoluted tubes of the epididymis become considerably swollen and filled out with cheesy débris. The inflammatory products usually undergo a slow caseous change, becoming yellow and friable, and they often, subsequently, soften down into abscesses containing thin pus with curdy or even calcareous flakes. Where the disease is very chronic, the cheesy masses are encapsuled by firm fibrous tissue, and may become calcified. Much more often, however, the inflammation spreads to the surrounding tissues, and the broken-down matters are discharged externally, and a sinus remains which may continue for months, or even years, to discharge a thin flaky pus, and in the more favourable cases may then gradually heal up. The disease most often, but not invariably, begins in the globus major, and, as it spreads to the rest of the organ, the tubercular deposit assumes a nodular form, and the separate nodules or masses often undergo their degenerative changes with different degrees of rapidity, resulting in a succession of abscesses and sinuses.

The disease generally spreads along the vas deferens, the walls of which become swollen and thickened, and nodular accumulations of caseous matter may collect in it. From the vas deferens the disease reaches the prostate and the vesicula seminalis of the same side. In these organs similar changes occur. They become enlarged and nodular, and cheesy masses of tubercular matter are found in them; these, like those in the epididymis, may soften down and open into the urethra or bladder, or discharge themselves through sinuses burrowing in the pelvis between the bladder and rectum. From these organs the disease extends to the bladder, and in some cases up along the ureter to the kidney; in the urinary

organs the tubercular deposit quickly ulcerates. From the epididymis the disease often spreads forwards into the body of the testicle, advancing in a regular manner from the mediastinum testis to the front of the organ. Here, the inflammatory products first assume the form of small, firm, grey, pearly nodules or 'granulations,' situated in the lobules of the organ—not in the fibrous septa—which increase in size and number and then coalesce into larger masses, undergoing fatty degeneration, caseation, and softening, as in the epididymis. If abscesses occur the scrotum becomes adherent to the testicle and inflamed, and the pus is discharged externally, and from the opening thus formed a fungous protrusion occasionally occurs. *See* Hernia Testis.

The rapidity and distribution of the morbid changes vary within wide limits. In all cases alike, the epididymis is first and most severely affected. In some cases, the body of the gland becomes involved early in the disease, large masses of tubercular deposit being found in it; in other cases, the change here is long delayed, and consists of such small deposits of tubercle that they occasion no external sign of their presence. This part of the organ may escape altogether. There is the same variation in the rapidity with which the vas deferens, prostate, seminal vesicle, and bladder become implicated. From the testicle tubercular infection may be carried to distant organs, especially the lungs, and the patient may succumb to general miliary tuberculosis. Similarly, the testicle may show fine grey granulations scattered through the secreting part of the organ, in any case of general tuberculosis. The opposite testicle is often attacked with tubercular disease; in other cases, the body of the unaffected organ rapidly wastes. The tunica vaginalis usually escapes altogether; it may, however, contain an excess of fluid, or its cavity may be partially or completely obliterated by adhesions.

Some difference of opinion exists as to the exact starting point of the tubercular inflammation; probably, it is in the lymphoid tissue that surrounds the tubes. The swelling, in its early stage, consists of a fine nuclear growth in a delicate reticulum, which infiltrates the walls of the tubes and lies in masses between them. The epithelium lining the tubes proliferates, and is shed into and blocks up their lumen. The small vessels in the part become thrombosed or obliterated by the pressure of the new-growth, and, as a result of the gradual diminution of the blood-supply, the inflammatory neoplasia undergoes fatty degeneration, and is ultimately converted into a dry granular débris. From more acute processes occurring around these cheesy masses, serum is exuded into them, softening them down into the thin, curdy, flaky pus which is so characteristic of strumous or tubercular abscesses.

Symptoms and Diagnosis.—The origin of the disease is very insidious, and the enlargement of the testicle often reaches some size before it is accidentally noticed by the patient. There is generally no pain or tenderness in the part until the tubercular deposit is softening down into an abscess; the pain then may be only trivial, but sometimes it is severe and is only relieved by the discharge of the pus. The first sign of the disease is a firm nodular enlargement of the epididymis, which generally commences in the globus major and then spreads to the rest of the organ, and forms an irregular crescentic mass behind the testicle. The swelling is firm, unyielding, and usually free from tenderness. The body of the testicle may be quite unaltered, or it may be shrunken and softer than normal, or, at a later period of the disease, a firm lump may be felt in it towards the back and continuous with the enlarged epididymis. The peculiar sensibility of the testicle is preserved, or only lost when the body of the organ is extensively diseased. Hydrocele is infrequent, and, when it is met with, is often partial and slight, being an accumulation of serous fluid in only one small portion of the sac. The cord is full, and early in the disease the vas deferens is felt enlarged—sometimes to the size of a pencil—and nodules may be found in it. The scrotal coverings are unaffected in the earlier periods of the disease.

The nodular enlargement of the epididymis may diminish, and, if calcification of the deposit occur, a very hard callous lump is all that can be detected. More often, the disease slowly but steadily advances, and softening occurs. As the swelling increases, the scrotum is found to be adherent to the contained organ at some one or more places, and it then becomes reddened and projects as a fluctuating tumour which, after a time, bursts and discharges thin pus with curdy or calcareous flakes in it; a sinus remains behind, which gives exit to a thin serous fluid, with occasional flakes of calcareous or cheesy matter. This sinus may heal up: more often it continues open. This process may be repeated at several spots until several sinuses exist, leading down to the epididymis and body

of the testicle, the organ being reduced to an irregular shrunken nodule. As the disease begins and is always most advanced in the epididymis, these abscesses and sinuses are most often found in connection with this part of the organ. Occasionally, a fungous protrusion of granulation-tissue from the testicle may be met with, but this is much less frequent than in connection with syphilitic sarcocele. *See* HERNIA TESTIS.

The opposite testicle may remain unaffected quite to the last, but often it, too, is diseased in the same manner; while, in some cases, atrophy of the organ is early and rapidly produced. When, as very often is the case, the vesicula seminalis and prostate are implicated, a nodular enlargement of these organs is detected on rectal examination, and the enlarged vas deferens may be felt lying on the inner side of the vesicle, immediately behind the prostate. When the disease spreads to the bladder and ulceration occurs, the patient's distress is greatly aggravated by the frequent painful micturition and the discharge of blood and pus in the urine. The general health of the patient at the same time suffers; he shows the pallor, anæmia, and debility so characteristic of tubercular diseases, and, as a rule, there is evidence of disease of the lungs, larynx, glands, or bones, which may precede or follow that in the testicle. In the later stages, wasting and hectic fever become more and more marked, and lead on to death; but in other cases a generally diffused miliary tuberculosis closes the scene. The existence of grey miliary tubercles in the testicle does not occasion any change in the organ, permitting of the recognition of this form of the disease during life.

The *diagnosis of Tubercular Sarcocele* rests partly upon local and partly upon constitutional signs. The local signs to be specially noted are the slow, painless, nodular enlargement of the epididymis, which only late, if at all, spreads to the body of the testicle, the preservation of the special testicular sensibility, the thickening and nodular swelling of the vas deferens, and the enlargement of the seminal vesicle on the same side, and often also of the prostate. Later on, these nodular masses tend to adhere to the scrotum, and break down into abscesses and leave sinuses discharging thin sero-pus. The site of the disease distinguishes it from chronic orchitis; the chronic syphilitic epididymitis, which is sometimes met with, has no tendency to soften into an abscess or to gradually spread and involve the rest of the organ, while it is accompanied by other evidences of secondary syphilis. Tubercular orchitis is rare in childhood and old age; and the frequent concurrence of phthisis, or of tubercular disease of glands, bones, or joints, together with the delicate appearance and general health of the patient, are the constitutional phenomena leading to a correct diagnosis.

Treatment.—When the disease is limited to the testicle, and there is no evidence of tubercle in any other part of the body, the diseased organ should be removed at the earliest possible moment, and afterwards care should be taken to place the patient in the most favourable hygienic conditions. Should the disease recur in the opposite testicle, the surgeon must not hesitate to remove it also, provided the disease be limited to that organ; and, if a patient present himself with tubercular disease of both testicles, but be free from tubercle of other organs, both testicles should be at once removed. The necessity for this prompt and radical treatment arises from the tendency of the disease to spread to the urinary organs, infect the lungs or other distant organs, or form the starting-point of generally disseminated tuberculosis. Unfortunately, owing to the insidious origin and slow painless course of the affection, it is rare for the patient to come under treatment at this early stage, while, in many cases, the disease in the testicle is secondary to disease in the lungs and other organs. Should the seminal vesicle or prostate be already enlarged and indurated, castration is not to be recommended.

In the more frequent case of disease of the testicle associated with tubercle in other organs, the best results will be obtained from careful attention to the general health. The patient should, if possible, reside at the seaside for a prolonged period, or, better still, take a long sea voyage. His diet should be carefully regulated, and cod-liver oil should be taken in such quantity as can be well borne. Other tonics, especially the iodide of iron, arsenic, and quinine, will be found useful under the varying conditions of the patient's appetite, &c. The testicle should be carefully suspended, and painting the scrotum with tincture of iodine, or inunction with an ointment containing ten grains of iodoform to the ounce or the ung. plumbi iodidi, appear to be useful. When there is local pain and tenderness, belladonna ointment may be advantageously substituted. Rest in the recumbent position must be maintained as much as possible. Sexual excitement should be entirely

avoided, and riding or violent exercise of any kind is equally harmful, although a gentle daily walk, short of producing a sense of fatigue, is a valuable adjunct to the general treatment.

When it is evident that the tubercular deposit has softened down, and fluctuation is detected, an incision should be made into the abscess, and if this subside into a sinus discharging a little sero-pus, the surgeon should content himself with keeping the part clean and injecting tincture of iodine into the sinus from time to time. When, however, the suppuration is more abundant, and fresh abscesses form, and particularly when the testicle is the chief seat of the tubercular disease, or the changes in it are believed to be the main cause of the constitutional condition, more active measures should be taken. The best plan is to enlarge a sinus and, through the wound thus made, to scrape out all the cheesy deposits by means of a sharp spoon. Care should be taken to do this thoroughly, as the success of the measure largely depends upon the removal of all the degenerated tubercular material. The cavity left should be stuffed with iodoform gauze, or powdered iodoform and salicylic silk, and allowed to close by granulation. When the disorganisation of the body of the testicle is so advanced that castration would be a simpler procedure, it should be preferred. The removal of the tubercular deposit, if completely executed, affords good results and is not a serious procedure, and it should certainly be undertaken in preference to castration when the degenerative changes are limited to the epididymis.

Irritability of the Testis. — Under this name are included cases of undue sensibility of the testicle.

Causes.—While the organs are undergoing their normal development at puberty, they may become hyperæsthetic; a more frequent cause of this condition is onanism, or excessive sexual indulgence, and in some cases the pain is traceable to prolonged but ungratified erotic excitement. Varicocele may be associated with 'irritable' testicle, and an atrophied testicle—whatever the cause of the wasting—is often the seat of excessive sensibility. More rarely, the affection appears to depend upon abscess or irritability of the prostate gland and prostatic urethra. In many cases there is no local cause for the malady, and such patients are generally weakly anæmic men, or are the subjects of dyspepsia.

Pathology.—There is no known pathology of this condition; in some cases the testicles, apart from any of the above local conditions, are rather soft and flabby.

Symptoms and Diagnosis.—The patients complain of an extreme sensibility of one or both testicles, often most marked in the epididymis. This may be so great that the movements of walking, the contact of the dress, or the gentlest digital examination, excites acute pain. The affection is often bilateral, and when it affects one testicle only is more frequent on the left side. If the patient is at rest, and particularly if the scrotum is suspended, there is no spontaneous pain. The organs are at the same time free from all obvious and coarse painful lesions, such as inflammation and new-growths. The diagnosis of irritable testicle is very readily made, but pains must be taken to determine its cause, as only when this is known can treatment be adopted with confidence and success.

Treatment.—In all cases a well-fitting suspender should be worn, either next the scrotum or over a layer of cotton-wool, and cold douches to the part are generally beneficial. Where the changes of puberty are supposed to be the cause, patience must be exercised, and the application of belladonna liniment or ointment may afford relief. All sexual abuses must be stopped, and in some cases the sedative influence of bromide of potassium is very valuable, while in other instances the regular sexual relation of marriage removes the morbid sensibility of the testicles. Where there is varicocele or disease of the prostate, appropriate measures must be taken to cure these conditions. Strict attention should be paid to the diet and the state of the digestive organs, and, where there is anæmia, iron should be administered. In all cases it is important to allay the patient's fears of impotence or sterility, or of the existence of serious organic disease of the parts, and he should be assured of the perfect curability of his disease. Healthy bodily and mental employment should be found, and efforts should be made to distract his thoughts from his sexual organs and all allied subjects; in this way travel will often be found useful. Castration should never be resorted to for this condition.

Neuralgia of the Testis.—This affection is characterised by recurrent attacks of severe pain in one or other testicle.

Causes.—Many causes of neuralgia of the testis are known, but in some cases it is quite impossible to assign any cause for the pain. Among constitutional causes, malaria, gout, and anæmia are the best ascertained. Among local causes must be

cited injury to the spermatic cord and nerves, a recent attack of orchitis, obstruction of the vas deferens or duct of the epididymis, a chronic abscess of the testicle, and severe injury to the testicle as by a bullet wound. Malignant disease of the spine affecting the upper lumbar nerves, calculous pyelitis, or the passage of a calculus along the urethra, are conditions which produce true neuralgia of the testicle, evidently through the agency of the spinal cord and nerves.

Pathology.—The pathology of neuralgia of the testicle is not known. In some cases the organ is fuller and plumper than normal, and it is stated to become actually inflamed as the result of neuralgia. Where the pain follows upon injury or inflammation of the part, it may be due to bulbous enlargements of the ends of branches of the spermatic nerves, or to compression of these nerves by contracting cicatricial bands.

Symptoms and Diagnosis.—The affection is characterised by the occurrence of intermittent attacks of severe pain in one testicle (very rarely both), which may be limited to the testicle or shoot up along the spermatic cord. These attacks of pain may recur at regular intervals, or quite irregularly, and they are independent of movement or friction of the testicle. When the pain is severe, the testicle is generally sharply retracted, being drawn quite up to the abdominal ring. Associated with the pain there is sometimes marked local tenderness—a condition of 'irritability' of the organ. In some cases the attacks of pain are excited by sexual excitement, particularly if there be obliteration of the duct of the testicle. Neuralgia of the testicle is easily distinguished from irritability of the organ by the paroxysmal character of the pain, and its spontaneous occurrence, apart from contact or friction. In every case a patient attempt to elucidate the cause of the pain must be made.

Treatment.—If there is any reason to suspect the influence of malaria, quinine should be freely administered, and if it fail to relieve, arsenic should be tried; if the patient be anæmic, iron and cod-liver oil are indicated, while if there be any signs of gout or lithæmia, the diet should be carefully regulated and alkalies be freely administered. Very great care should be taken to have the patient's constitutional condition as healthy as possible. Nothing is definitely known of the value of aconite, belladonna, phosphorus, and other neuralgic medicines administered internally. Locally, the testicles should be suspended, and cold douches, or the application of equal parts of aconite and belladonna ointment to the scrotum will be found beneficial. The injection of a small quantity of morphia (gr. $\frac{1}{4}$–$\frac{1}{8}$) into the testicle or into the loose tissues of the cord is the surest means of relieving the pain. Varicocele should be submitted to operation for its radical cure. Counter-irritation of the scrotum or along the cord by iodine or the Spanish fly may be quickly successful in some cases. When the neuralgia owns some distant cause, the treatment must be directed to the cure of that affection—e.g. renal calculus. When, however, all these general and local measures fail, and the pain is severe, and there is reason to think that the cause of the trouble is some condition of the testicle or cord, castration may be performed. This should only be resorted to in very rare instances and under the above conditions, and should never be pressed upon the patient. If the testicle is removed, and the actual cause of the pain is not at the same time removed, the pain recurs in the spermatic cord.

Tumours of the Testis.—*Causes.*—Injuries of the organ, blows and squeezes, are often the apparent starting-point of malignant tumours of the testicle; but in a large number of cases there is no history of previous injury or inflammation, or any circumstances of etiological importance. Dermoid tumours of the testicle are congenital in origin. Age exerts an important influence upon the development of the other forms of new-growth; sarcoma occurs most often before ten years of age, and between the ages of thirty and forty; carcinoma probably never occurs in children, and is most often seen between the ages of thirty-five and forty-five; pure enchondroma of the testicle is met with in young adults.

Pathology.—The commonest tumours of the testicle are sarcoma and carcinoma; of the former, round-cell, spindle-cell, mixed-cell, and lympho-sarcoma or adeno-sarcoma are met with. Carcinoma occurs as encephaloid, and possibly also as scirrhus. The naked-eye appearances of these two classes of tumours may very closely resemble each other. They may each of them occur as soft, pinkish-grey tumours, with patches of yellow and red from fatty degeneration and hæmorrhage. Sarcomata, however, vary much in their appearance; they may be firmer, being traversed by coarse bands of fibrous tissue, or contain nodules or larger masses of pearl-like cartilage. The cartilage may exist in small amount, may form branching pieces

which are believed sometimes to lie in dilated lymphatics, or nearly the entire mass of the tumour may be converted into cartilage, a thin layer of softer material being the only indication of the sarcomatous nature of the tumour. Along with cartilage, myxomatous tissue, and sometimes also striped or unstriped muscle-fibre, may be found.

Cysts are frequently found in these malignant tumours of the testicle. They are more frequent in sarcomata than in carcinomata. In number and size they vary within wide limits—at times only few and small, at other times they form the greater bulk of the tumour; and cystic tumour of the testicle has been described as a distinct variety of new-growth. This term, however, should only be applied to the very rare hydatid and dermoid cysts of the testicle, for in the multiple cystic tumours, sarcomatous tissue, or more rarely carcinoma, is always to be demonstrated between the cysts. The greater number of such cysts are smooth and lined with epithelium, and are developed from the tubules of the rete testis; others of them are irregular, with a flocculent surface, and are formed by the softening of the tumour-tissue or the occurrence of hæmorrhages into it. The former contain pale or variously coloured turbid fluid, and intracystic sarcomatous growths are frequently found in them.

Carcinoma starts in a proliferation of the epithelium lining the seminal tubules; sarcoma, on the other hand, begins in a cellular proliferation between the tubules, which pushes them aside, and remnants of the tubes can often be traced in large sarcomatous growths. These diseases most often start in the body of the testicle, the secreting structure being gradually replaced by the neoplasia, and the epididymis may remain unattacked for a long time. The resisting tunica albuginea at first yields very slowly before the new-growth, but, in actively growing tumours, the soft tissue may fungate through it into the scrotal coverings, and, these becoming involved, ulcerate, a fungus hæmatodes resulting. From the testicle the new-growth may spread up along the cord for a varying distance; but apart from this, owing to the extreme vascularity of these growths, both the spermatic artery and veins are enlarged, and make the cord feel full. Malignant disease is usually unilateral, but sarcoma may attack both testicles. Sarcoma has also been found growing from the visceral layer of the tunica vaginalis, and surrounding the testicle. Hydrocele, even to a considerable extent, may be added to the enlargement of the testicle itself when attacked with malignant disease.

Secondary growths, whether of sarcoma or carcinoma, are met with in the deep inguinal, iliac, and lumbar glands, and, when the scrotum is affected, the superficial inguinal glands also become infected. The abdominal growths are of the same nature as those in the testicle, and often attain a very large size, and press upon and invade the aorta, vena cava, iliac vessels, or the spine, and may spread to the kidney, liver, and lungs, and from thence to more distant parts. Pure enchondroma, in the form of a rounded or lobulated tumour within a fibrous capsule, and without any softer sarcomatous tissue, is occasionally met with. This form of tumour is not malignant, occurs in young persons, and is of very slow growth. Some cases of so-called fibroma of the testicle are, in reality, spindle-cell sarcomata, which have, to a large extent, developed into fibrous tissue; very rarely pure fibroma, a benign growth, has been met with. Dermoid cysts have been found to contain cartilage and bone, and sometimes an oily fluid which solidifies on cooling. Their origin is variously explained as due to fœtal inclusion, to partheno-genesis, or to *hétéropie plastique*.

Symptoms and Diagnosis.—The symptom of a tumour of the testicle is a chronic continuous enlargement of the organ which resists all local and constitutional treatment. It may be first noticed soon after an injury, but more often its origin is quite insidious. It commences in the body of the organ, and quickly obscures the outline of the epididymis, but the ovoid shape of the gland, and its smooth contour, may be long retained. The rapidity of the enlargement varies greatly both in different cases and in the same case at different times. In the one case, the difference depends upon the lower or higher grade of organisation of the neoplasia; in the other, it may be due to the restraining influence of the tunica vaginalis in the early stage, or to some alteration in the nature of the tumour, as when a chondrifying sarcoma ceases to organise into cartilage, and grows as a pure sarcoma. In the early stage the swelling is firm, even hard; but as it grows it may become softer, or, what is very characteristic, of unequal consistence in different parts; and along with this the regularity of the surface is lost. The more malignant tumours may attain an enormous size before death puts an end to their growth.

The scrotal coverings are at first stretched over the included tumour, and dilated veins course under the skin; later on the tumour becomes adherent to and implicates the skin; ulceration then quickly occurs, and allows the malignant growth to fungate, the fungus having all the characters of the well-known fungus hæmatodes; this is now rarely seen, as the organ is usually excised before this stage is reached. The front part of the swelling fluctuates if there is vaginal hydrocele. The cord is full from the increased size of the spermatic vessels, and in many cases it becomes enlarged and indurated from the tumour spreading up along it to the inguinal canal. The growth in the early stage is usually quite or nearly painless, and the characteristic testicular sense is early lost. The lymphatic glands, just above Poupart's ligament, are soon felt enlarged, and, from these, other lumps may be felt running up along the iliac vessels and in front of the lumbar spine; when the scrotum is implicated, the superficial glands of the groin are also enlarged, and in rare cases this is observed before there is any appreciable adhesion of the tumour to its scrotal coverings. With the growth of these glandular tumours there may come on œdema of one or both lower limbs. Enormous growths may occur in the abdomen, and in other parts. The patient at length dies from exhaustion, worn out by pain, discharge, and semi-starvation, or the special effects of certain local secondary deposits.

Tumours of the testicle have to be *diagnosed* from hydrocele, hæmatocele, chronic orchitis, and tubercular disease. The pyriform shape of the tumour, its translucency and fluctuation, usually at once distinguish *hydrocele*; when, however, the tumour is opaque from thickening of the wall, and the sense of fluctuation is obscure, reliance must be placed upon the detection of the testicle by its special sensibility, and the absence of change in the cord and lymphatic glands. Where doubt exists, it may be cleared up by an exploratory puncture, or, better, an incision. *Hæmatocele* is distinguished from tumour by its sudden onset after injury, often by its fluctuation, and also by the detection of the testicle in the mass by its special sensibility to pressure; the steady persistent growth of a tumour, its unequal consistence, the enlargement of the cord and lymphatic glands, are other points assisting in the diagnosis. Cases do occur, however, in which an exploratory puncture or incision is necessary to render the diagnosis certain. From *chronic orchitis* a tumour will be distinguished by the absence of the causes of inflammatory enlargements of the testicle; by the persistent, often rapid, enlargement of the organ, in spite of all treatment; by the inequality of the consistence of the tumour in many cases, and by the enlargement of the cord and lymphatic glands. When doubt is entertained, the system may be brought rapidly under the influence of mercury, and if, in spite of this, the growth continue, its malignant nature may be considered certain. *Tubercular disease* will be distinguished from tumour of the testicle by the early and marked swelling of the epididymis, the tendency to softening, and in many cases the presence of tubercle in other organs.

When the tumour has reached a great size, and the scrotal veins are much enlarged, or a mass of the growth fungates through the skin, there should be no difficulty whatever in arriving at a diagnosis. In the more malignant growths, the rapidity and persistency of the enlargement, the early loss of testicular sense, and the impossibility of detecting the testicle in the mass of the tumour, together with enlargement of the cord, are the most important diagnostic signs before glandular infection occurs. In benign tumours, the extreme chronicity of the enlargement, and its hardness or bossy outline, may at once afford ground for a correct diagnosis.

To distinguish between the different varieties of tumour is not always possible; but the following rules are of value. A rapidly-growing tumour, in a child, is certainly sarcomatous. A malignant tumour attacking both testicles is a sarcoma. A malignant tumour, in an adult, may be either sarcoma or carcinoma, but a uniformly rapid growth, with early and marked enlargement of the spermatic cord and lymphatic glands, points to carcinoma. A preliminary period of quiescence or of slow growth, with a sudden accession of activity and very rapid growth, is in favour of a tumour being a chondrosarcoma. A very gradual, painless enlargement of the testicle, forming a smooth ovoid tumour, without enlargement of the cord or lymphatic infection, indicates a cystic sarcoma. Sometimes, one or more of the cysts may project from the surface, and if, on tapping such a tumour mucoid fluid is withdrawn, the diagnosis becomes assured; this form of tumour is generally met with between the ages of twenty and forty. Great hardness of a

steadily-growing tumour occurring after forty years of age, with enlargement of the cord and lymphatic glands, would point to scirrhus. A slowly-growing tumour of great hardness, with a smooth oval or bossy surface, without implication of the cord or glands, and occurring in a man before thirty years of age, is probably a simple enchondroma; such a tumour may attain a very great size. A fibroma cannot be diagnosed with any approach to certainty; like enchondroma, it is of very slow growth and extremely hard, and destitute of all signs of malignancy. A dermoid cyst is to be recognised by the congenital nature of the tumour (if the history be known), by a more or less globular outline, by inequality of consistence—at places being solid, at others fluctuating; if such a tumour be tapped and oily fluid escape, the diagnosis is still more certain. As already noticed, tapping a cystic tumour may lead to the escape of characteristic fluid; in other cases this affords information of the density of the tumour. Both sarcoma and carcinoma bleed very freely; enchondroma and fibroma are much less vascular.

Treatment.—The only treatment of avail, for any case of tumour of the testicle, is removal of the diseased organ. In the rare cases of benign tumours this question presents no difficulty. In malignant tumours, it is most important to perform castration at the earliest possible moment, and certainly before the lymphatic glands are enlarged, or the cord is involved in the disease higher than the external abdominal ring, or the tumour is adherent to the scrotum. The spermatic cord should be divided as high as possible above the disease. In the rare cases of sarcoma affecting both testicles, the two organs should be removed. Only too frequently, when the patient is seen, the cord is enlarged quite up to the internal ring, and secondary deposits are already to be felt in the iliac or lumbar glands. In such cases, the operation cannot be done with any view of curing the patient; but if the tumour of the testicle be a great annoyance to the patient from its bulk or weight, or from the presence of a foul fungating sore, it may be removed simply as a palliative measure. Even when the surgeon operates early, he is only too often disappointed by rapid recurrence of the disease in the stump of the spermatic cord or in the abdominal glands.

But there is no doubt that operation, when performed in suitable cases, affords a chance of cure, and a certainty of immunity from disease for a time, and often for a considerable time. *See* Castration.

A. Pearce Gould.

TESTIS, Injuries of the.—*Causes.*—The extreme mobility of the testicles protects them from injury, but they are not infrequently contused by blows against the pommel of the saddle in riding, by being struck in fighting, cricket, &c., or by squeezes between the thighs. The testicle is much more rarely wounded; it may be punctured in tapping a hydrocele or hæmatocele, lacerated by a gunshot or other projectile, and, occasionally, self-inflicted wounds of this organ come under the notice of the surgeon.

Pathology.—In contusion of the testicle, blood is often effused between the tunica vaginalis and the tunica albuginea, and up along the cord, and in severe cases this effusion has been found to extend even up to the kidney. Hæmorrhage also occurs into the substance of the organ, and hæmatocele may be superadded. The injury may excite acute inflammation: when less severe, it may be the exciting cause of chronic orchitis, of hydrocele, or of malignant disease. Atrophy of the testicle frequently follows traumatic inflammation of the organ, and severe contusion of the testicles is a recognised method of producing sterility. Division of the tunica albuginea may be followed by protrusion of the seminal tubes, but not to any great extent, unless inflammation be set up. Gunshot wounds of the testicle are very frequently followed by atrophy of the organ.

Symptoms.—Sudden death has been caused by a severe injury to both testicles. The immediate symptoms of contusion of the testicle are a severe pain in the part extending up along the groin to the loin, with acute tenderness and general pallor, nausea, vomiting, and faintness, even to complete syncope. In favourable cases, the constitutional effects are soon recovered from; the testicle and cord remain tender for a few days, and then all symptoms pass away. In other cases, the symptoms of acute orchitis quickly set in, or chronic orchitis or hydrocele may come on at a longer interval, or, still later, a tumour may develop in the testicle.

A wound of the testicle is attended with similar sickening pain and faintness. When made in tapping a hydrocele, blood escapes with the serous fluid or collects subsequently in the tunica vaginalis (*see* Hæmatocele), or a small tender nodule may be detected on the surface of the gland. When impli-

cated in a severe wound of the scrotum, the organ is usually exposed; the tubules may not project at all, or they may bulge outwards in the form of a soft grey nodule.

Treatment.—After a severe contusion, the patient should be put to bed, and the testicle supported on a soft pillow or a broad strip of plaster fastened across the thighs, and an ice-bag applied. When less severe, it may be sufficient to rest for a few hours and to wear subsequently a suspender. When a testicle is wounded with a trocar, the patient should be confined to bed and an ice-bag applied. If the testicle is wounded by a knife, great care should be taken not to draw out any of the tubular structure, but, the part having been carefully cleaned, the edges of the incised tunica albuginea should be united with a continuous suture of fine catgut. Contused and lacerated wounds cannot be thus treated, but the usual surgical rules must be complied with. The surgeon should not remove the injured organ unless it is beyond question that the entire gland is disorganised, and every effort should be made to secure rapid healing of the part. Neuralgic pain is often complained of after gunshot and similar injuries of the testicle. *See* Testis, Diseases of the. A. Pearce Gould.

TESTIS, Malpositions of the.—There is no sufficient evidence that a supernumerary testicle has ever been met with—the supposed cases of this deformity being instances in which an encysted hydrocele, or a fatty or fibrous tumour, has been mistaken for a third testicle. One or both testicles may be entirely absent; but this condition can only be proved by dissection, as mere inability to find the organs during life cannot be accepted as evidence of their non-existence. Absence of both testicles (anorchism) is usually associated with other deformities in the sexual apparatus. In cases of 'retained testis,' the epididymis and lower end of the vas deferens may be found in the scrotum and separated from the imperfectly descended body of the testicle. The epididymis may also be the only part of the organ developed, occupying its usual position in the scrotum, the body of the organ being entirely absent, or represented by a small pea-like nodule of tissue. Another important deformity is a congenital absence of part or of all, or closure of either end of the vas deferens. This condition does not interfere with the structure of the testicle, which is plump and of its usual size; but of course its secretion does not reach the urethra. The development of the testicle, which usually takes place at puberty, may be delayed for a time or fail to occur altogether. The writer believes that this is in some cases (unilateral) associated with and perhaps caused by varicocele; in other instances (bilateral) the subjects of it are generally ill-developed and effeminate in appearance. Absence or non-development of one testicle may be accompanied by hypertrophy of its fellow.

The commonest malposition is that known as *inversion of the testicle*, in which the organ is rotated so that the epididymis is towards the front of the scrotum, and the body of the organ, with the tunica vaginalis, is directed backwards. This condition is easily recognised by the hand, which notices also that the vas deferens is in front of the other constituents of the cord. Inversion is frequently to be seen on one or both sides, and it is of considerable importance in hydrocele, hæmatocele, and epididymitis. In the two former, the testicle will be in front of the fluid in the tunica vaginalis, and may be wounded in the operation of tapping or incising unless its position be previously ascertained. In the latter, the painful swelling may be mistaken for inflammation of the secreting part of the gland: its shape, and the configuration of the back of the organ, as well as the condition of the cord, will lead to a correct diagnosis. A condition of *partial inversion*, in which the epididymis is directed towards the thigh, is very occasionally met with. *Reversion of the testicle* is the name given to the state in which the top of the testicle with the globus major of the epididymis is at the bottom of the scrotum, and the vas deferens comes off from the highest part of the organ.

Delayed Descent of the Testicle.—Instead of being in the scrotum at birth, the testicle may not descend until months or years afterwards. If the organ do not pass into the scrotum within the first few months after birth, its descent is generally delayed until puberty, accompanying the full development of the organ. In nearly all cases of descent after the age of one year hernia occurs, and in many instances the intestine is adherent to the testicle.

Incomplete Descent of the Testicle. Retained Testis.—1. *Etiology.*—Many conditions may interpose to prevent the complete descent of the testicle. Those best known are a fusion of the two testes (synorchism), a long mesorchium, intraperitoneal adhesions, a weak gubernaculum testis, and a small external abdominal ring. Other alleged causes are shortening of the

vas deferens, large size of the epididymis, and the pressure of a truss causing the gland to become fixed in the iliac fossa or inguinal canal. A testicle, which has completely descended, has been known to be drawn up into the inguinal canal and permanently retained there. See *Retraction of the Testis.*

2. *Pathology.*— The testicle may be of full size, plump, and presenting all its normal appearances when examined microscopically; in the majority of cases it is small and flabby, and it is impossible to draw out the seminal tubules as in a normal testicle. The epididymis may be quite normal, or it may show the same changes as the body of the organ, but to a less degree; but it is sometimes more or less separated from the secreting part of the gland, and may descend into the scrotum while the body of the organ is lodged in the inguinal canal. The epididymis has been found abnormally large. The testicle may be either movable in its serous covering, or more or less firmly fixed by adhesions which tend to increase as attacks of inflammation are repeated. The development of the gland, which should occur at puberty, as a rule does not take place. The vas deferens is generally found of its usual length, and coiled up in the belly; very rarely it is shortened. The scrotum may be quite normal in appearance, but is generally small and undeveloped on the affected side; it may contain only fatty tissue, but in some cases a serous sac is found in it. The serous sac surrounding the testicle may be shut off, but, as a rule, it communicates freely with the peritoneal cavity. Adhesions may be found passing from the testicle to one or more of the adjacent abdominal viscera, or the testicle may be found free in the peritoneal cavity, attached posteriorly by a long mesorchium. A hernia is very commonly associated with 'retention' of a testicle, and in such cases the coil of intestine may be firmly adherent to the top of the gland. The testicle may lodge at any spot between the kidney and its normal position in the scrotum; most often it is retained in the inguinal canal, and its next most common seat is in the iliac fossa, close above Poupart's ligament. In the latter situation it is more protected against injuries of all kinds than in the former, and is therefore less often the seat of inflammation, and the gland is more often plump and well-nourished than in the inguinal canal. As a general rule, a retained testicle is a sterile organ, but to this there are exceptions. The only way of accurately determining this important point is to examine the secretion of the gland for spermatozoa.

3. *Symptoms, Complications, and Diagnosis.*—There may be no symptoms occasioned by this deformity, and the patient's attention is drawn to his condition only by the empty state and small size of the scrotum, on one or both sides. When the testicle slips freely along the inguinal canal, it is apt to be nipped by the external abdominal ring, with the production of severe pain or of repeated attacks of inflammation. In the more common cases, in which the gland is more fixed in the inguinal canal, its liability to injury leads to attacks of inflammation. The diagnosis will be made by noticing the absence of the testicle from the scrotum, which is usually small or obviously asymmetrical, and by detecting the gland in the inguinal canal or in the iliac fossa, close above Poupart's ligament. The outline of the testicle may be quite distinct and unmistakable, or obscured by the thickening left by attacks of inflammation; the character of the pain caused by manipulation of the part will aid in the identification of the testicle.

The complications of retained testicle are hernia, including strangulated hernia, epididymitis, hydrocele, and malignant disease. The hernia may consist of a knuckle of intestine or a piece of omentum above the testicle, or the protruded viscus may fill the tunica vaginalis, obscuring the testicle, or may even pass on in advance of it into the scrotum, and then great care will be required to recognise the true condition. The presence of a hernia in addition to the retained testicle will be decided by the general characters of the swelling (*see* Groin; Scrotal Swellings), especially by the feel, reducibility, and resonance on percussion of the swelling, and by a gurgle on manipulation. Strangulation of the hernia causes the usual signs of that condition. Acute epididymitis which follows blows or strains, or comes on in connection with inflammation or irritation of the prostatic urethra, is characterised by a very painful tender swelling of the part, with more or less redness of the skin over it, without impulse on coughing, accompanied by fever, and often nausea and constipation —sometimes vomiting. An effusion of blood may occur in the scrotum, and render the diagnosis more difficult. It may be mistaken for a strangulated hernia; but the diagnosis will be made by attention to the history of the case, and by observing the acute local pain and tenderness in epididymitis, with fever but with-

out absolute constipation; in strangulated hernia the pain is less acute, and is generally referred to the umbilicus, local tenderness is less marked, the constipation is absolute, and the general symptoms are those of collapse. For hydrocele around a retained testicle *see* Hydrocele, Inguinal. Retained testicles are particularly liable to be attacked by malignant disease, owing to their exposure to repeated injuries and attacks of inflammation. For the diagnosis of this condition *see* Testis, Diseases of the.

4. *Treatment.*—Where the testicle is lodged deeply in the belly, no special treatment is required. When the testicle is placed close above the internal abdominal ring, a carefully-adjusted truss, which will prevent the descent of intestine without pressing upon the gland, is required. If the testicle be in the inguinal canal, but can be protruded beyond the external abdominal ring, a truss which will press it down and at the same time overcome the tendency to hernia, should be worn: a horseshoe-shaped pad is recommended in such cases. Where the testicle occupies the inguinal canal and can neither be pushed up nor down, a truss should not be worn, as the pressure of the pad upon the testicle excites pain, and may cause inflammation. Acute inflammation must be treated in the usual way (*see* Testis, Diseases of the); but when a testicle has been the seat of repeated attacks of inflammation, it should be excised, as it is in all probability functionally useless, as well as inconvenient, and very liable to become the seat of malignant disease. When there is a hernia present, and a truss cannot be worn or fails in its object, an operation should be undertaken to close the neck of the hernial sac and bring the pillars of the ring closer together. At the same time the testicle must be removed from its bed. If the gland is small, flabby, and evidently useless, it should be excised; but if the gland be plump and of good size, and not adherent or otherwise injured by inflammation, it should be freed from its position, and after a cavity has been cut for it in the scrotum, it should be fixed there by catgut sutures, and the superficial wound united in the ordinary way. Should the vas deferens be shortened, this procedure will be impracticable. The wound should be treated aseptically, as much of the success of the operation depends upon obtaining primary union throughout. It should not be undertaken in children under two years of age, nor in elderly persons, nor where the scrotum is so small that it cannot easily lodge the testicle. *See* Hernia, Radical Cure of.

When, in operating for strangulated hernia, a retained testicle is exposed, it should be excised. Should the testicle become the seat of malignant disease, excision is to be practised at an early period; but the operation is not so successful as ordinary castration, both on account of its own peculiar dangers, and because it is impracticable to divide the spermatic cord sufficiently high above the disease. If the lumbar glands are infected, as indicated by the presence of a tumour in the iliac fossa, or by pain along the lumbar nerves, or by œdema of the lower limb, the operation should not be performed. When the gland is in the inguinal canal, an oblique incision must be made from over the internal abdominal ring to the root of the scrotum, the external oblique should be divided on a director, and then the testicle is to be freed from its bed, and the cord tied as high up as possible; a drain should be laid in the wound, which is to be then sewn up. The external oblique muscle may be absent over the tumour, which then lies superficially. In the case of malignant tumour of the testicle retained within the belly, the operation of excision may be performed by a free vertical incision immediately over the mass, or by a median incision in the linea alba; experience is not yet sufficient to determine which of these methods is the better.

If consulted as to the propriety of marriage in cases of this deformity, the surgeon must remember that retention of one testicle —the other being sound—is no bar to fruitful marriage. Where both testicles are retained, all the facts bearing on the sexual powers of the patient must be carefully weighed. If the penis be small or ill-formed, or if there be an absence of sexual desire or of sufficient erections, and if with these signs there be an effeminate appearance—absence of beard, a heaping up of fat over the pubes, long, fine, silky pubic hair—marriage should be forbidden. Should there be all the usual signs of virility and the patient is the subject of sexual desire, he should be told that, although capable of sexual intercourse, he is almost certainly sterile; and if on examination of several specimens of the fluid of an emission no spermatozoa are found, the fact of his sterility may be considered as beyond doubt. Under these circumstances, it does not lie with a surgeon to determine the propriety of marriage.

Abnormal Descent of Testicle.—Instead of passing into the scrotum, the tes-

ticle may, after passing the external ring, slip down towards or into the perineum—*ectopia perinealis, testis in perineo*—or it may take an altogether irregular course and escape from the belly through the crural canal—*ectopia cruralis*. The cause of this deformity lies, probably, in some abnormality in the lower attachment of the gubernaculum testis.

Pathology.—Ectopia perinealis is much more common than the crural form. In it the testicle lies either in the furrow between the thigh and the scrotum, or in the anterior part of the perineum in front of the anus and to one side of the median line. The spermatic cord can be traced to it, and the organ presents its usual characters. In ectopia cruralis, the testicle may occupy the crural canal, or, passing beyond it, may present in the saphenous opening, forming a superficial tumour in the groin. In these cases there is a tendency to the development of a femoral hernia. The scrotum is usually small on the affected side, and of course empty.

Symptoms, Complications, and Diagnosis.—A testicle in the perineum is much exposed to injury in sitting, riding, &c., and is consequently the seat of repeated attacks of inflammation, and a great source of annoyance to the patient. The association with hernia is the most serious sequel of crural ectopia. The diagnosis will be made by noting the absence of the testicle from its proper position, the non-development of the scrotum (in most cases), and the general characters of the swelling caused by the misplaced organ. When inflamed in the perineum, it might be mistaken for a perineal abscess; in the groin it might be mistaken for a bubo or a strangulated hernia.

Treatment.—Ectopia perinealis. In early infancy no treatment is required. If the scrotum is well developed, an attempt should be made to fix the testicle in it, and this is most likely to be successful after two years of age and before puberty, when the child is of an age to admit of the successful application of antiseptic dressings. An incision is to be made over the spermatic cord, which is to be freed, and the testicle is to be drawn up from the perineum, any firm adhesions being divided with the knife. The wound is then to be prolonged into the scrotum, and the testicle fixed in place with catgut stitches. The cavity in the perineum left by the testicle is to be opened behind and a drainage-tube inserted, and then the wound in the groin and scrotum is to be carefully stitched up. Every precaution should be taken to render and to keep the wound aseptic, and to secure primary union. Should the scrotum be undeveloped it is of no use to attempt this operation, and after the age of puberty the prospect of success is so small as to render the attempt scarcely justifiable. Under these circumstances, the patients can sometimes be relieved by the application of a pad, which pushes aside the testicle into a place where it is less exposed to injury. If this fail, the misplaced organ should be excised.

Ectopia cruralis. If the testicle is reducible into the belly, a truss, as for femoral hernia, should be worn. Where irreducible, a truss with a hollow pad to fit over and protect the testicle should be tried. If this fail to prevent attacks of inflammation or contusion of the gland, or if there is a femoral hernia associated with the misplaced testicle, the gland should be excised, and the neck of the serous sac carefully stitched up, to prevent or to cure a tendency to hernia.

Retraction of the Testis.—*Causes.*—The most frequent cause of retraction of the testicle is calculous disease of the kidney, or the passage of a renal calculus along the ureter. It may also arise from irritation of the urethra, especially of the prostatic portion, and from injury to the groin and pubes. In some cases it has followed acute inflammation of the body of the organ; in others it has been found impossible to assign a cause for the condition.

Pathology.—The retraction is due to spasm of the cremaster muscle; the testicle is usually drawn up to the external abdominal ring, rarely within the inguinal canal, and it is stated that the testicle may even be retracted within the belly. When the retraction is constant and long-continued, the scrotum shrinks and the cord shortens, and adhesions may fix the testicle in its new position. When thus displaced, the testicle is exposed to injury and liable to attacks of inflammation, and possibly it may fail to secrete spermatozoa. When due to renal disease, the retraction occurs on the same side only; in other cases it is often bilateral.

Symptoms and Diagnosis.—The testicle is easily recognised in its new position by its size, shape, peculiar sensibility, and its absence from the scrotum. Its exposure to injury, and the pressure of the thigh upon it in walking and sitting make it a source of pain and annoyance to the patient. The only condition from which it has to be diagnosed is an imperfectly descended testicle; usually the history of the case clears up this point. When, however,

the history is not decisive, the surgeon must carefully notice the condition of the scrotum and the possibility of replacing the testicle in it. When the scrotum on the same side is fairly developed, although empty, and by moderate traction the testicle can be replaced in it, the case is one of retention rather than of non-descent. The occurrence of hernia, which is common in retained testicle, is a mere accidental association with retraction.

Treatment.—When due to renal disease or renal colic, the local irritation must, if possible, be removed, and heat and narcotics are to be used as palliatives. In other cases, all sources of urethral irritation —phimosis, gleet, sexual excess—must, if present, be remedied. Where no such cause of the affection exists, the testicle should be gently manipulated into its proper position several times a day, and, when a pad can be fitted over the inguinal ring above it, a light truss should be worn; cold douches are also recommended; gentle friction over the testicle with ung. belladonnæ has been found useful. Perseverance with these measures is usually successful, when treatment has not been delayed too long.

A. Pearce Gould.

TETANUS.—A condition of tonic spasm, in some cases limited to definite groups of muscles, in others affecting almost all the muscles with striated fibres in the body.

A distinction between idiopathic and traumatic tetanus has been very generally accepted, but does not appear to be of any practical importance. When the disease occurs in persons previously in good health, and without any injury, wound, or lesion, it is said to be idiopathic; but when it supervenes in the course of some other ailment, and after any lesion, however trivial, it is regarded as traumatic. The idiopathic form is very seldom met with in this country, but in tropical climates occurs more frequently. Exposure to damp and cold is believed to be a predetermining influence; but as this is also eminently conducive to the development of traumatic tetanus, and as this variety has, according to recorded cases, resulted from most insignificant injuries, such as the sting of a bee, the peck of a sparrow, or the too close paring of a finger nail, the distinction appears to be unnecessary.

Names have been devised to denote forms of tetanus in which definite groups of muscles have been especially attacked. When the muscles of mastication are solely or chiefly affected, the condition is known as *trismus*. The term is etymologically incorrect, as it is applicable to the grinding and gnashing of the teeth in convulsions, rather than to the tonic spasm of tetanus.

Opisthotonos denotes the predominant contraction of the muscles of the back and neck, by which the body is arched with the convexity forwards. *Emprosthotonos* and *pleurosthotonos* are used to denote respectively curvature of the body with the convexity backwards or to one side. *Orthotonos* signifies the flat and rigid position of the body, when the anterior and posterior muscles are alike and equally contracted. These words are very useless practically, and it is very doubtful whether the forms of the disease denoted by the terms emprosthotonos and pleurosthotonos ever occur.

Some confusion may also be caused by the usurpation of late years by physiologists of the word tetanus to denote the normal contraction of striated muscular fibre, with the exception of that of the heart.

Tetanus has also been classified as *acute* and *chronic*; but, as time is the only test, the distinction is of no use to a surgeon who may be consulted at the commencement of the affection.

Practical surgery has to deal with traumatic tetanus occurring after wounds or injuries, maliciously or accidentally inflicted, or after operations. The liability to tetanus has no relation to the severity of the injury. It has occurred after the extraction of a tooth or the ligature of a pile, as well as after the amputation of a limb or the ligature of a large artery in its continuity. The popular belief, that wounds of the hands or fingers are especially liable to result in tetanus, is not corroborated by the evidence of statistics.

There are no definite premonitory symptoms. Usually the first indication is that the patient, who has previously been progressing favourably, awakens from sleep in the morning, in many cases for the last time in this world, with a sensation of stiffness in the muscles of the sides and back of the neck, by which movement of the head is rendered painful or inconvenient. The patient generally regards it as 'stiff neck,' caused by exposure to a draught of cold air. It is sometimes so slight as not to excite complaint or even notice from the patient, and is only discovered by the surgeon on examination and inquiry, when his attention has been directed to the nature of the case by other symptoms. The muscles of the face and lower jaw are next attacked. If the contraction of the orbicularis oris

muscle predominates, the lips will be closely pressed together; more usually they are drawn asunder, so as to produce the 'risus sardonicus' by the action of the elevators and depressors of the lips. The elevators of the lower jaw are constantly and characteristically contracted. Of these, the masseters are most accessible to observation, and feel like rigid, unyielding bands. They are sometimes sensitive on pressure. The contraction is not at first complete, and the patient can voluntarily increase it so as to press the jaws more closely together, and can then relax this increased contraction, but he is unable to overcome the tonic spasm.

As the disease progresses, the contraction usually becomes complete, and justifies the popular appellation of 'lockjaw.' The muscles of the fauces and pharynx are very frequently spasmodically contracted, so that the patient complains of sore-throat, and deglutition is either difficult or impossible. The muscles of the trunk are next involved. The walls of the thorax are immovable, and the respiration is shallow and frequent. Pain is felt at the pit of the stomach, from spasm of the diaphragm. The abdomen is flat and unyielding, from spasm of the abdominal muscles; and opisthotonos frequently results from predominant contraction of the muscles of the back and neck. When the lower extremities are affected they are rigidly extended, and the feet are strongly flexed. The upper extremities may also become rigid, but the muscles which move the fingers frequently, or, according to some observers, always, are not affected. The pulse is frequent and feeble, and the skin is bathed in profuse perspiration. If the temperature be previously normal, it will not be raised in this stage of the disease; but if, from other conditions, it be abnormally high, the onset of tetanus will not cause it to fall. There is usually constipation, partly from spasm of the sphincters of the bowel, and partly from the condition of the abdominal muscles. The profuse perspiration, and the inability in many cases to swallow fluids, will naturally diminish the excretion of urine, but there may be retention of this diminished quantity, from spasm of the compressor urethræ and abdominal muscles. Examination should therefore always be made of the condition of the bladder, and a catheter, if necessary, be introduced.

There is no cerebral symptom. The patient continues intelligent throughout the course of the disease, and not infrequently complains of hunger, and deplores his inability to swallow. In many cases, death ensues at this stage from failure of the heart or from respiratory spasm. If not, symptoms of greatly increased reflex excitability appear. Violent convulsive exacerbations are produced by the lightest touch, or even by a current of air or a sudden noise. In these convulsions the tongue may be bitten or muscles ruptured. Sometimes, even bones have been fractured and dislocations produced. In this stage the temperature rises very considerably, and if death now ensues, the temperature has been found to increase appreciably for some time after death. If the patient still survive, these exacerbations may diminish in force and frequency, and at last cease altogether. The tonic spasm, which has hitherto been persistent, then begins to yield, and finally disappears. But so long as any trace of it continues, the patient is in great danger of a relapse. In many cases, however, death occurs from respiratory spasm during a convulsive attack. Sleeplessness is a characteristic feature in tetanus. If sleep can be induced by narcotics the tonic spasm is said to relax, and to instantaneously reappear when the patient awakes.

This is a general description of typical tetanus, but in individual cases there may be many variations. In infants, the spasm is usually limited to the elevators of the lower jaw, and thus constitutes the trismus neonatorum, popularly called 'nine-day fits,' from the time after birth at which the disease generally commences. In adults trismus alone is rare; it is usually associated with more or less contraction of the muscles of the neck and trunk. The extremities are sometimes not affected, and in some cases deglutition is only slightly, or not at all, impaired.

The *prognosis* in tetanus is always unfavourable. The mortality is less in idiopathic than in traumatic cases. But in each individual case, at the outset, the surgeon must, while endeavouring to prevent, yet expect a fatal result. In traumatic cases, the shorter the interval between the primary lesion and the appearance of tetanus, the more probably will death result. The duration of the disease is a very important element. Hippocrates observed that survival beyond the fourth day was a very favourable indication, and this has been corroborated by more modern experience. Death has, however, occurred thirty-nine days after the commencement of the attack. No correct inference can be formed from the apparent mildness of the symptoms. The writer had under his charge three cases of tetanus

in the year 1884, which all ended fatally, although the symptoms in each case were not severe.

The *diagnosis* does not present any difficulty. Sometimes inability to open the mouth, from some local inflammation, has been mistaken for trismus. In doubtful cases, a finger should be introduced between the teeth and cheek and the condition of the jaws explored; or, if necessary, an anæsthetic should be administered, and the cavity of the mouth and fauces examined. The existence of cerebral symptoms, which are always absent in tetanus, will sufficiently distinguish cerebro-spinal meningitis. Hydrophobia, in some respects, greatly resembles tetanus. The absence of trismus, and the complete intermissions between the convulsions, will prevent any doubt as to the nature of the case. The same distinctions apply to the tetanic convulsions produced by poisonous doses of strychnia. Hysterical trismus may be distinguished by the history of the patient and by the progress of the case.

The *treatment* of tetanus is very unsatisfactory. It happily occurs so infrequently in civil practice that the experience of any individual surgeon is necessarily limited. The literature of the subject is abundant, but as it includes cases which were certainly not tetanus, the statistics as to results of treatment are not of much value. In traumatic tetanus the wound or injury should be thoroughly explored, so as, if possible, to remove any source of peripheral irritation. The patient should be isolated, and complete quietude maintained. If deglutition be possible, easily assimilable nutriment, alcohol, and sedatives, of which chloral hydrate is perhaps the best, should be freely administered. If deglutition be impossible, rectal injections may be tried. But if these prove impracticable, then brandy and narcotics may be injected hypodermically. In the three cases above referred to, which have been recently under the writer's charge, calabar bean was tried with the first; this apparently relieved the respiratory spasm, but death ensued within twenty-four hours. To the second case bromide of potassium was given in large doses. The pharyngeal spasm relaxed so that the patient could swallow fluids, but death occurred on the third day. In the third case, commencing convulsions of the muscles of mastication yielded to large and repeated doses of chloral hydrate, and the patient felt generally relieved, but death occurred on the third day.

Cold baths were formerly advocated, but are no longer used. The result in one instance is worthy of notice. The patient was, at his own request, immersed in cold water. All symptoms at once ceased. He was instantaneously removed from the bath, but he was dead. Warm baths have been tried, but there are obvious difficulties in using them for cases of general tetanus, and the result, when they have been employed, is not encouraging. The constant application of ice to the spine, by means of Chapman's bags, has not proved of much benefit. Nicotine has been successfully used in some cases, but has failed in others. If tried, it should be given in doses of from one to two drops every two hours, and the effect on the action of the heart carefully observed. According to recorded cases, almost every drug in the Pharmacopœia has been tried without success. If benefit resulted in one or two cases, the hopes thus excited were soon disappointed by failure in other cases. Much was once expected from curare, but experience has not confirmed the expectations. Electro-therapeutics may possibly prove serviceable when our knowledge has been enlarged by greater experience in their application. Nerve-section and nerve-stretching have been also tried, but with disappointing results. In a few cases amputation has been successful, but this measure should only be adopted when there is distinct evidence of peripheral irritation from some otherwise irremediable cause, such as an irreducible dislocation.

The *pathology* of tetanus is very obscure. The considerable diminution in the number of cases of trismus neonatorum in the Dublin Lying-in Hospital when improved hygienic conditions were established, the experience of army surgeons in time of war, and the occurrence of so-called idiopathic tetanus, seem to prove clearly that unhealthy surrounding conditions may cause this disease. It is possible that under such conditions some poison may be engendered in, or absorbed by, the system, which may act specifically on the medulla oblongata and spinal cord. On the other hand, the great numerical preponderance of cases of traumatic tetanus, and the few cases where relief has resulted from the removal of some peripheral irritation, seem to indicate that some as yet unknown condition of a peripheral nerve may be the exciting cause. But it is inexplicable why one patient, for whom a pile may have been ligatured, should develop tetanus, while thousands of other patients, treated in a similar manner, should be free from such a result; or, why the injury of a peripheral nerve should primarily affect the centres of the fifth,

seventh, and eleventh cranial nerves. In a few cases the characteristic spasm has commenced in the muscles at the seat of injury. But this is a very rare and exceptional event. Post-mortem examinations have not advanced our knowledge of the subject. Macroscopically, congestion of the thoracic viscera, of the cerebro-spinal membranes, and of the grey matter of the brain and spinal cord, is discovered in all cases. Sometimes, portions of the spinal cord are soft or even diffluent. Microscopically, localised degeneration in both the grey and white substances of the brain and spinal cord, and granular exudations have been found in some cases. These are, however, probably only secondary results of some as yet unknown primary condition.

JEREMIAH MCCARTHY.

THECAL ABSCESS. *See* WHITLOW.

THERMO-CAUTERY. *See* CAUTERY.

THIGH, Amputation of the.—The alleged merits as well as defects of the 'circular' and 'flap' methods of amputation are more conspicuous in this group of operations than in any other, the advocates and opponents of each of the procedures alluded to having urged their arguments chiefly in reference to thigh amputations.

The advocates for the old, and what may be termed the classical, method—the *circular*—maintain that there is diminished risk to the patient, from the shock of the operation being less, that the area of the wound is necessarily not so great in extent, and that there is less danger, owing to the way the vessels are divided, of phlebitic inflammation. The supporters of flap operations, on the other hand, hold that there is less danger of a conical stump resulting, greater facility in getting sufficient covering for the bone, greater shapeliness of stump, and one better adapted for the subsequent adjustment of prothetic mechanical appliances. Again, the cicatrix not being on the face of the stump, the inconvenience and pain to the patient produced by pressure on it are avoided. In order to secure a more ample covering than at times is obtained by the ordinary circular method, the modification of Syme already discussed in speaking of amputations of the leg is to be recommended—making, namely, an incision involving skin, fat, and fascia only, somewhat lunated in form, both on the anterior as well as posterior aspects of the limb, and combining that with circular division of the muscles.

The principles to follow in performing thigh amputations by the ordinary circular method, differ in no respect from those already indicated in describing amputation of the arm, and the other amputations in which the circular method is applicable.

Teale's rectangular method is, in the writer's opinion, specially applicable to thigh amputation, more particularly in its lower third. The measurements to be taken previously to the operation are: first, the circumference of the limb. Half of this will correspond to the length of the anterior flap as well as to its width, and one-fourth of the length of the anterior flap, or one-eighth of the circumference, will give that of the posterior flap. In making these rectangular flaps, care should be taken that the incisions in the first instance should not involve more than the integument, fat, and fascia. On making the deeper incisions, the divided edge of the integument, which has to a certain extent contracted and retracted, should be accurately followed. If this precaution be not taken, it will be found on adjusting the flaps that there will be considerable bulging or protrusion of the muscular tissues through the edges of the wound, which may materially interfere with a prompt and satisfactory union of it. The advantages of the operation are that the cicatrix is well drawn up behind; that all fluids which may accumulate find a ready exit from the wound, when the flaps are adjusted, being on the posterior aspect of the limb; that the flaps afford an ample covering for the bone; that there is diminished danger of the formation of a conical stump, and that the principal nerves and vessels, being for the most part in the posterior flap, are removed from the effects of pressure. The modifications of Sir Joseph Lister and Mr. Wharton have been already discussed. *See* AMPUTATIONS.

The other *flap amputations* of the thigh deserving of notice are Sédillot's, by a long anterior and no posterior flap; Spence's, which is analogous if not identical with that of O'Halloran and Benjamin Bell, and in which there are a long anterior oval and a short posterior flap. The length of the flap in Spence's operation should equal the diameter of the limb, and the breadth of its base be one half of the circumference. According to Sédillot, the breadth of the base should be even more. Care should be taken to avoid having the flaps too thick, which can be accomplished by oblique division of the muscles. Luke's amputation is done by antero-posterior flaps of equal length. In order to obtain this

with accuracy, he recommended the posterior flap to be made in the first instance, and subsequently on its retracting—which the posterior tissues do to a greater extent than the anterior—to form the anterior, making it of the same length as the posterior after its retraction. When the two flaps are brought together they should remain in accurate apposition, and the chances of a gaping wound subsequently occurring from the retraction above alluded to are largely diminished. Both flaps are made by transfixion.

A bilateral-flap method has been recommended by Vermale, both flaps being made by transfixion, and a somewhat similar method has been proposed by Von Langenbeck. In the latter procedure, however, the flaps are cut from without inwards. In both operations there is the danger of bone-protrusion, from the tendency of it to be tilted forwards through the wound. In consequence, neither operation finds, as a rule, much favour with operating surgeons.

For the control of hæmorrhage during the operation, Esmarch's elastic bandage will, in the great majority of cases, be found the most efficient method to employ. Elevation of the limb for a short time previously to the application of the bandage is to be recommended, as it removes or diminishes the necessity for any very firm pressure of the elastic bandage, which is to be avoided.

As regards the mortality of thigh amputation, there is no operation of the kind, excepting, perhaps, amputation at the hip-joint, which illustrates so signally the benefits that are to be derived from the employment of strict antiseptic precautions during and subsequent to the operation. Formerly, at no very remote date, septic complications played the main *rôle* in producing a mortality so high—upwards of 60 per cent.—as to justify the gravest apprehensions on the part of the operator. Now, however, when a rigid system of Listerian asepticism is employed, the surgeon can, in the great majority of instances, undertake the operation with a pleasing confidence as to a satisfactory result being obtained, which was wholly unknown to the surgeons of the pre-aseptic era.

Although some surgical operators of intelligence and experience are of opinion that the shock is greater after 'flap' than 'circular' amputations, and that, therefore, the latter method should be selected when the patient is in early childhood, or in cases of extreme debility or exhaustion from protracted suffering, hæmorrhage, or long-continued profuse suppuration, still the writer's experience fails to afford him evidence that there is any solid foundation or reason for holding such a view. On the contrary, he is disposed to think that, in connection with amputation of the thigh especially, the 'flap' methods, notably those of Teale, Sédillot, or Spence, or, if the case will admit of a low femoral section, the 'supra-condyloid' method, are not attended with greater shock than the 'circular' or any of its modifications. *See* Knee-Joint, Amputations at the. They have, among other merits, the undoubted one of resulting in greater shapeliness of stump, with the cicatrix on its posterior aspect and thus relieved from the trouble that often attends pressure on it, and in every way better suited to the subsequent adaptation of mechanical appliances.

William Stokes.

THIGH AND LEG, Diagnosis of Affections of the.—For the diagnosis of affections of the lower extremity it is of great importance to carefully compare the two limbs. Measurement from the anterior superior iliac spines to the internal or external malleolus can only be relied on as correct, when the spines are at the same level, and the limbs are placed in a symmetrical position as regards a vertical line through the umbilicus and symphysis pubis. If any swelling of the limb causes a deviation of the tape, a T square should be employed.

It is often necessary to ascertain the respective lengths of the femur and tibia. The most prominent point of the internal condyle of the femur and the inner articular edge of the tuberosity of the tibia should be marked, previously to taking the measurement. For the diagnostic importance of the relative positions of the trochanter and the head of the femur, reference must be made to Hip-Disease.

The diagnosis of a *femoral hernia* ordinarily presents no difficulty, and the position of its neck below Poupart's ligament and external to the pubic spine will at once distinguish it from an inguinal hernia. An irreducible omental femoral hernia, especially if the omentum be inflamed, is, however, often difficult to distinguish from a glandular swelling in the crural region. Impulse on coughing, and some variation in the size of the swelling on manipulation, together with the history of the case, will usually determine its nature. When strangulation exists, the seat of greatest tenderness will be at the neck of the sac, and not

over the general body of the swelling, as in an inflamed gland; but a most careful examination is necessary, and sometimes an exploratory incision will alone clear up the diagnosis. *See* GROIN.

An inflammatory enlargement of a *gland* or glands in the crural region sometimes occurs without any manifest cause.

An *acute abscess* in the upper part of the thigh presents no special difficulty in its recognition; but a chronic fluctuating swelling, or one that has appeared suddenly, unattended by active inflammatory symptoms, must be examined with special reference to its possible abdominal origin.

A *psoas abscess* often presents on the inner side of the thigh, at a lower point than a femoral hernia. There is an impulse on coughing, and the swelling is less tense when the legs are raised. An examination with the abdominal walls relaxed will generally discover a fluctuating swelling above Poupart's ligament, communicating with that in the thigh by a prolongation, which is first external to and then behind the femoral vessels. Such an abscess generally arises from vertebral caries, and a most careful examination of the back must be made before eliminating vertebral disease as a cause. *See* PSOAS ABSCESS.

An *abscess* situated just below the outer part of Poupart's ligament, which communicates with a swelling in the *iliac* region, may depend on hip-disease or pelvic bone mischief, or may have descended into the thigh from the abdomen, and be an extension of a subperitoneal or subfascial iliac abscess. The kidney, cæcal region, and pelvic organs must be examined. As an exceptional condition, an empyema may travel downwards and present in this situation.

A gaseous or *tympanitic abscess* is occasionally met with in the upper part of the thigh, and is either in connection with a femoral hernia; or the abscess has descended into the thigh from above Poupart's ligament, and is in close connection with bowel at its origin.

A fluctuating rounded swelling situated deeply in the groin under the psoas tendon, without impulse, and with entire absence of hip-symptoms, except perhaps some discomfort on extending the leg, is very likely to be a distension of the normal *bursa* in that situation. Occasionally, the communication with the joint is open, and the bursal contents can be partially emptied into the joint.

A chronic fluctuating swelling on the outer side of the thigh over the great trochanter may be an *abscess*, or a distended condition of the multilocular *bursa* under the insertion of the gluteus maximus. In the latter case pressure will often permit of small seed-like bodies being felt, and the displacement of the fluid gives a peculiar and characteristic sensation to the fingers. An abscess in this situation may depend on hip-disease, or on disease of the trochanter, or be a chronic subfascial suppuration. A gluteal abscess not infrequently presents at the back part of the thigh near the trochanter, and may therefore be in connection with pelvic or vertebral bone-affection. *See* GLUTEAL REGION.

Acute bone-inflammation near the articular ends of the femur is not uncommon in young subjects. The fever and general constitutional disturbance are well-marked, and there are pain and tenderness on pressure over the part of the bone affected. Rapid inflammatory infiltration of the soft parts and formation of abscess occur. Deep abscess in the front of the lower part of the thigh, when acute may, however, be secondary to suppuration of the knee-joint, the pus having perforated the upper synovial pouch, and become diffused under the muscles. Pressure over the abscess would then probably cause the joint to refill.

Where the femoral artery is superficially placed, an *aneurismal dilatation* will readily be recognised. Any fluid or soft swelling placed over the femoral would not possess the characteristic expansile pulsation. A pulsating soft sarcoma of bone might push the artery forwards, and diminish by pressure the pulse in the vessels at the ankle. The swelling, however, would have fixed deep connections, and the bone would be felt to be enlarged. No alteration in the size or tension of the swelling would be noticed, when pressure was made on the vessel above or below its apparent expansion. The appearance of similar pulsating tumours in other parts would of course greatly simplify the diagnosis. A glandular or other non-pulsating tumour, placed over or surrounding the artery, would not be so likely to be taken for an aneurism, since expansile pulsation and bruit would be absent or ill-defined.

An aneurism in *Hunter's canal*, which had undergone consolidation, might easily, with a hasty examination and an absence of correct history, be mistaken for a tumour.

It is frequently difficult to determine the nature of a deep-seated soft swelling in the thigh. Care must be taken, in testing for fluctuation, to apply the fingers in the direction of the muscular fibres, and not across

them. A soft tumour, especially a *fatty* one deeply placed, will sometimes deceive the most experienced surgeon, and an exploratory puncture or incision will alone decide the question of the presence of fluid. If there be reason to suspect the presence of a *cavernous angeioma*, circular pressure should be made round the upper part of the thigh, and the patient examined in the erect position; such a swelling would then become much more tense and prominent. The vasti and other muscles of the thigh may be affected by *syphilitic infiltrations*; in cases of doubt, the administration of iodide of potassium will often assist the diagnosis.

The lower end of the femur may be considerably enlarged by a central *necrosis*; as a rule sinuses are present, and there is a history of a previous inflammatory attack.

A *myeloid* tumour may cause great expansion of the bone, without any involvement of the cartilage or joint. At an early stage of its growth, such a tumour might be confounded with a chronic bone-abscess or some inflammatory enlargement, more especially as the patient in either case is usually young. A uniform expansion of the end of the bone, not attended by much pain or tenderness, and not interfering greatly with the movements of the joint, and with a recent history, will, in all probability, be a central sarcoma. Pulsation, if present, would make the probability greater; but the diagnosis must be made clear by a careful exploratory operation.

A *periosteal sarcoma* of the lower end of the femur does not end so abruptly as a central tumour; the growth, as a rule, more rapidly increases in size, and feels rather elastic than fluctuating. If the growth be very soft or cystic, fluctuation may be present; but an exploratory puncture will yield either blood or evidences of broken-down growth. Patients occasionally give a history of recent injury, and the swelling may at first simulate a blood-effusion or inflammatory thickening of the upper synovial pouch, but a very short observation of the progress of such a case will excite the surgeon's suspicions of its true character.

The Knee.—In any case of doubtful *fracture* near the knee, an examination under an anæsthetic should be made, and it should be ascertained if there be movement between the two condyles of the femur. A displacement at the knee will generally be found associated with a fracture of one of the condyles of the femur, or with an oblique fracture of the head of the tibia.

A recent displacement or fracture of the *patella* is, as a rule, sufficiently evident, but if much swelling be present, or if the fragments remain in position, it might be overlooked. Pain on pressure over the bone would direct attention to the part. A careful comparison of the two knees must be made, any irregularity of the patella noticed, and the different parts of the bone tested for mobility and crepitus.

The condition of the quadriceps tendon and of the ligamentum patellæ must be determined. A *rupture* of either of these structures would occasion a considerable gap, which would be recognised by the finger. With a complete rupture of the ligamentum patellæ, the patella would be displaced upwards.

After a sprain of the knee some effusion into the joint may be expected, and tenderness and pain about the internal or external lateral ligaments. A displacement of one (usually the internal) of the *semilunar cartilages*, if unreduced, would give rise to a swelling corresponding to the margin of the cartilage, if the displacement be extra-articular; or to a depression, when, as more rarely happens, the cartilage is luxated inwards or centrally. Complete and free flexion and extension of the joint would only be possible when the displacement was reduced, and the patient would be conscious of the slipping of the cartilage back to its normal position, and of the relief at once afforded. The displacement is apt to recur on slight provocation, but is generally first caused by a severe and sudden strain. The impaction of a *loose body* between the articular surfaces occurs generally during the ordinary movements of the joint, and the patient is usually conscious that he has such a body moving about in his joint. It sometimes requires patient and repeated search by the surgeon before one of these movable bodies can be actually fixed under the finger. The distress and pain occasioned by the locking of the joint, from a foreign body getting between the bones, is often greater than that arising from a partial luxation of a semilunar cartilage.

Under ordinary circumstances, there is no difficulty in recognising an *effusion of fluid* into the knee-joint. Occasionally, some of the fluid can be pressed out of the joint into a hernial pouch or communicating bursa in the popliteal space. A pulpy thickening of the synovial membrane, from chronic inflammation or from gummatous infiltration, may give rise to a false sense of fluctuation; but the feeling of fluctuation is always indistinct, and limited to certain parts of the joint.

Periarticular swelling and joint-effusion can hardly be mistaken for one another, but occasionally the two conditions may be present; for example, after an injury there may be an effusion into the joint, associated with blood-extravasation around an inflammation of the prepatellar bursa, or peribursal suppuration.

A rounded fluctuating swelling situate above the patella, but with no fluid in the general cavity of the joint, is probably an effusion into the *suprapatellar bursa*. When there is no fluid in the knee-joint, and the ligamentum patella is prominent owing to a fluctuating swelling beneath it, and especially when the swelling is made more prominent on either side of the ligament by pressure on the same, an effusion into the *infrapatellar bursa* may be diagnosed.

The line of junction of the epiphyses at the knee is a favourite position for *exostoses*. They may be multiple, are usually pedunculated, and often have a small bursa over each of them. In cases of genu valgum and varum, an examination of the fascial and tendinous structures round the knee must be made. The leg should be fully flexed, in order to determine how much of the deformity depends on the articular ends of the femur or tibia, or both.

The examination of a knee-joint for *arthritis* must be conducted on the same general principles as in other joints, and a careful comparison made with the opposite leg. It is of great importance to examine the articular ends of the femur and tibia, and any enlargement or tenderness on superficial or deep pressure should be noted. In young subjects, the epiphysial junctions should receive special attention, and, in all cases, the size and position of the patella and the articular margins of the bones made out. The examination must be made in every position of the joint, and the mobility and effects produced by bringing different parts of the articulating surfaces into contact tested. In many cases, valuable information is obtained by relative measurement of the two limbs. Some elongation of femur or tibia is not infrequently present, when there has been a chronic inflammatory affection of their articular ends.

In all cases of progressive, destructive arthritis of the knee there is a tendency for the limb to assume a flexed position at the joint, and for the tibia to drop backwards and to be rotated somewhat outwards. *See* Knee-Joint, Diseases of the.

A *popliteal aneurism* can hardly be overlooked when the symptoms are at all marked, but the patient may not be conscious of any tumour behind the knee, and apply to the surgeon for some swelling of the foot, or for nerve-pain down the leg. Unless there be an obvious cause for such a condition, the surgeon should examine carefully the popliteal space, and more especially if the patient be a man from thirty to fifty years of age. *See* Popliteal Aneurism.

When seen for the first time, and in the absence of a correct history, a *consolidated aneurism* might easily be mistaken for a solid tumour pressing on the artery and causing diminution of the pulse in the vessels in the leg. If the sac has inflamed, and suppuration takes place round it, the diagnosis in the absence of pulsation would be still more obscure. A solid or bursal tumour can generally, when the leg is flexed, be shifted away from the vessel, and any communicated pulsation will then at once cease. An abscess situated between the artery and the bone will displace the vessel towards the surface, but the pulsation will only be evident in the line of the artery, and expansile pulsation and bruit will be absent, and in most cases there would be evidence both constitutionally and locally of the presence of pus. A pulsatile sarcoma springing from the popliteal aspect of the femur might closely simulate an aneurism. A few of the points in the diagnosis of such a case have been mentioned in reference to femoral aneurism.

In the absence of any history of previous swelling, it might be difficult to distinguish between a sudden *rupture* of the popliteal artery and the traumatic rupture of an aneurism, since in both cases there would be great tension from effused blood and interference with the circulation of the leg. A rupture of the artery can only occur when the violence is considerable or the vessel diseased.

An effusion into the bursa between the semi-membranosus and the gastrocnemius can be recognised by its position on the inner side of the popliteal space. However tense such a swelling may be when the leg is extended, its limits can readily be felt when the leg is flexed. A communication with the joint can sometimes be demonstrated by squeezing some of the fluid out of the sac. *See* Popliteal Space.

The Leg.—There are two *fractures* of the leg which are likely to be overlooked—namely, a transverse fracture of the tibia without displacement, and a fracture of the

fibula where the bone lies under cover of the muscles. The transverse fracture of the tibia generally occurs in a young subject. Tenderness over the seat of fracture is always present; the patient might be able to stand, but would have pain referred to the seat of injury. Mobility and crepitus would be difficult to elicit, unless the examination was made under an anæsthetic.

Not infrequently, the only evidence of a fracture of the fibula will be the fixed pain and tenderness over the seat of fracture, and pain referred to the same point when pressure is made on either end of the bone: the patient may be able to walk, but will complain of pain at the seat of fracture. Any irregularity of the bone must be carefully felt for, and the rebound of the fibula, when pressed against the tibia, tested by comparison with the sound leg.

If, during some muscular effort, a patient has felt a sudden severe pain in the calf and a sensation of something snapping, and on examination it is found that voluntary efforts to extend the foot give pain, and that there is some tenderness and ecchymosis of the calf, then, if the tendo Achillis be intact, the diagnosis of a *ruptured plantaris* may be made.

The upper end of the tibia is a common situation for *myeloid tumour*. The bone may, however, be considerably expanded by abscess, and, in some cases, the diagnosis can only be made by an exploratory operation. As the tibia is so superficially placed, acute and chronic bone-affections can for the most part be readily detected; but occasionally, when the disease is limited to the posterior part of the bone, the symptoms may be at first obscure.

In the *acute diffused periostitis* of the tibia of young persons, the inflammatory swelling and redness of the soft parts covering the bone somewhat resemble an erysipelatous attack; but the extreme tenderness on pressure, and the limitation of the redness and œdema to the shaft of the bone, render any mistake in the diagnosis almost impossible. *See* Periostitis.

Erythema nodosum on its first appearance occasionally simulates a circumscribed periostitis of the tibia. The affection is usually symmetrical, and sometimes to be found on the arms; but patches of erythema can generally be found away from the bone, and those situate over the bone are movable with the skin, and the general course of the affection is characteristic. *See* Erythema.

For the diagnosis of ulcers of the leg, *see* Ulcers. It must be remembered that a syphilitic ulcer may occur on the lower part of the leg, and on a leg predisposed by the condition of the veins to simple ulceration. Rapid extension of an ulcer of the leg, without obvious cause (such as maltreatment), makes its syphilitic origin probable.

Bernard Pitts.

THOMAS'S HIP-SPLINT consists of a piece of malleable iron, reaching from the lower angle of the scapula to just below the calf, and having three cross-pieces of the same metal attached to it. The first one is placed at the upper end of the splint and reaches partially round the chest, but more on the sound side than the other, being completed by a padded strap and buckle; the middle one is placed just below the nates, and the third one at the lower end of the splint. The vertical bar should lie between the trochanter and the tuber ischii, and below this over the middle line of the thigh or leg; the splint is supported by shoulder-straps, and is bandaged to the pelvis and to the limb between the lower two hoops; the foot is raised from the ground by a patten fitted to the boot of the sound leg, and the patient is taught to walk on that leg with the aid of crutches. The malleability of the splint allows of its being moulded to the shape of the limb, and of being altered as the deformity is rectified. *See* Hip-Disease.

It is, however, important that the splint be not made to fit the deformity accurately, for that would assist in maintaining it. In hip-joint disease, when the leg is brought straight down on to the bed, the lumbar spine arches forwards, and, if the splint were made to fit that arched condition of the spine, the deformity would be perpetuated. The portion of the splint which reaches from the buttock to the angle of the scapula should be nearly straight, for although it will not fit accurately when first applied, the spine will soon accommodate itself to the splint by gradual extension taking place at the hip-joint, and thus the deformity will be remedied.

Bilton Pollard.

THOMAS'S KNEE-SPLINT is composed of two stout metal rods, which are fixed above to a well-padded and obliquely-placed ovoid ring, and below to a patten. When applied, the ovoid ring should rest against the tuber ischii on one side, and just below the crista ilii on the other, and the patten should be so far below the foot that, when the latter is extended, the toes cannot reach to the level of it. When the patient gets up, the splint is supported by a

strap over the opposite shoulder, and, when he walks on the splint, a patten must be fitted to the boot of the other foot in order to equalise the length of the limbs.

The success of this splint, as a means of fixing the knee, depends altogether on its being properly applied. Immobility of the limb must be secured in the longitudinal, lateral, and antero-posterior directions. Two strips of strapping, about three inches wide, and long enough to reach from the head of the tibia to twelve inches beyond the sole of the foot, should be prepared and fixed along each side of the leg; they should be secured by another strip, about an inch wide, wound spirally round the leg, and by a flannel bandage applied over all from the ankle to the knee. The splint should next be put on and pressed firmly upwards, so that the collar at the upper end rests against the tuber ischii, and then the free ends of the pieces of strapping above described should be fixed to the ring at the lower end of the splint; by this means longitudinal displacement is checked. Transverse and antero-posterior displacement must be prevented by applying transverse strips of strapping round the limb and the splint, opposite the middle of the thigh and the middle of the leg, in the following manner: A piece of strapping, about three inches wide, should be fixed round one of the lateral bars of the splint opposite the calf of the leg; the strapping should then be carried beneath the leg and round between it and the opposite longitudinal bar of the splint, and returned to the bar from which it started. It should next be carried beneath the limb to the opposite bar, round which it should be passed at a slightly higher or lower level than on its fellow; the strapping should finally be carried round the leg, between it and the bar from which the strapping originally started, and should be finished off by encircling the entire splint. The piece of strapping for the thigh should be applied in a similar manner, but it should start from the opposite bar. A third piece of strapping should be carried from bar to bar behind the limb, opposite the popliteal space; and a flannel bandage should be put on over all, from just above the ankle to the groin.

BILTON POLLARD.

THORACENTESIS. *See* PARACENTESIS THORACIS.

THORACIC DUCT, Injuries and Diseases of.—INJURIES.—Some six cases have been reported where the thoracic duct has been divided by a stab or gun-shot wound, or has been ruptured by external violence. In three of these cases a white chylous fluid—which was whiter and more opaque after meals—escaped at an external wound. In one instance this fluid was effused into the pleural cavity, which had to be repeatedly tapped.

A diagnosis of the injury is impossible without evidence of chylous fluid either escaping from a wound or obtained from the pleural cavity by tapping. In every case death must follow (within a period of time measured by weeks rather than by months) from marasmus consequent upon the discharge.

The treatment is purely symptomatic.

DISEASES.—The duct may be narrowed or occluded as a result of inflammation of its coats, or the blocking of its lumen with cancerous or tubercular material, or by the pressure of an aneurism, tumour, or contracting cicatrices. The whole of the cavity of the duct has been in some cases obliterated. Complete obliteration need not cause death, nor even conspicuous symptoms. The veins appear in such instances to act vicariously, and it is probable that by means of collateral channels much lymph is brought into the right common duct. In a case of Dr. Cayley's the duct was occluded at its point of entry into the vein. It became in consequence enormously dilated, and, rupturing, led to fatal peritonitis. In other cases severe ascites has developed, or some of the lacteals have ruptured. The condition of the duct cannot be diagnosed during life.

The duct has been found enormously dilated as a result, in some cases, of obstruction, and in others as an outcome of unknown causes.

The wall of the duct has been found calcified. Its lumen may be occupied by tubercular or cancerous material derived from some focus of disease in the periphery. So far as the writer can ascertain, no instance of primary growth in the duct has been recorded. FREDERICK TREVES.

THROAT, Injuries of the.—*Wounds* of the throat are very serious: in the first place on account of the important structures which lie in this region; and in the second place because of the arrangement of the cervical fascia, which brings the deeper tracts into close relation with the cavity of the thorax. Many wounds are the result of suicidal attempts, and therefore have an additional element of danger in the depressed condition of the patient.

Those which are produced by accidental violence are most frequently of the punctured form, and they are usually accompanied by some contusion or laceration.

Below the hyoid bone, the cervical fascia divides the tissues into several compartments. In the first there are the superficial structures, together with the platysma myoides, and the vessels and nerves which lie outside the deep cervical fascia. Next, we come to a somewhat limited space, contained between this fascia and the aponeurosis which, after enveloping the depressors of the hyoid bone, terminates by reaching the posterior aspect of the sternum and clavicle. A small quantity of fat and a few lymphatic glands are contained in this space, which is also traversed by the anterior jugular vein. The third space lies between the aponeurosis of the depressors and the prevertebral fascia. The most important structures in it are the larynx and trachea, the pharynx and œsophagus, the thyroid body, the common carotid arteries and the internal jugular veins. The fourth and deepest stratum of all lies underneath the prevertebral fascia, and in close relation with the bodies of the cervical vertebræ.

Many wounds only affect the first or the first two of these compartments, and are usually of a trivial character. The external jugular vein, however, may be wounded, and death has occurred from the entrance of air into its cavity. Diffuse suppuration sometimes follows in the loose tissue beneath the platysma myoides, similar to that which occurs under the aponeurosis of the occipito-frontalis. The edges of the skin-wound are apt to be inverted from the contraction of the platysma fibres. Care should therefore be taken, after thoroughly cleansing the wound, to accurately adapt its edges by fine sutures, either interrupted or continuous, and provision should be made for the drainage of the deeper parts of the wound. The venous hæmorrhage may be arrested by pressure.

The great majority of wounds which affect the deeper parts are transverse in direction, and their most frequent situation is between the thyroid cartilage and the hyoid bone. It will be best to consider the dangers of these wounds and their treatment under the headings of the several structures which may be implicated.

The Blood-vessels.—The large vessels, and more especially the common carotid and internal jugular, frequently escape injury. Their immunity is due, first, to the fact that the incision is usually made so high that the knife is met by the resistance of the cartilages in the middle line and the sterno-mastoids at the sides, before it reaches the deeply seated vessels; secondly, to the tough but yielding character of the vascular walls, which causes them to retreat before the knife; and lastly, to the fact that, as soon as the air-passages are opened, the air rushes out, the chest collapses, and the arms are in some measure disabled from continuing the suicidal attempt. A wound of one of these vessels usually proves fatal in a few minutes from loss of blood, or from the suffocation which follows its entrance into the air-passages. If the wound is high, the lingual and facial arteries, with their branches, may give rise to free hæmorrhage. Lower down, the superior thyroid is especially exposed to injury, and patients have been gradually asphyxiated from the trickling of blood into the trachea after division of the small crico-thyroid branch. Occasionally the inferior thyroid has also been wounded. The patient may for a time recover from the loss of blood immediately following the wound, but succumb afterwards to reactionary or secondary hæmorrhage. There is also more danger of air entering the veins in wounds of this region than in those of any other part of the body.

The Air-passages.— The chief immediate danger is from the entrance of blood, but in some cases the partial detachment of the soft parts or cartilages may cause obstruction to the glottis. Thus, when the wound is above the hyoid bone, the back of the tongue, with the epiglottis, may fall back upon the opening of the larynx. If the thyro-hyoid membrane be divided, portions of the epiglottis or arytænoid cartilages may occlude the rima, and, when the trachea is opened, there may be danger from the bulging in of the adjacent soft parts. The inflammation which follows the wound may cause swelling of the false vocal cords, and so impede respiration; or it may spread along the mucous membrane of the trachea and bronchi, so as to set up broncho-pneumonia. This, which is the most frequent cause of death, when the patients have survived the immediate effect of the injury, is aggravated, and in many cases originated, by foreign materials such as blood, particles of food, and inflammatory products which find their way into the air-passages. There may be temporary or permanent loss of voice from interference with the actions of the vocal cords.

The Food-passages.— If the pharynx or œsophagus be wounded, swallowing will be impeded or prevented; the food will es-

cape through the wound, or be extravasated into the adjacent tissues; or it may enter the air-passages, setting up violent fits of coughing, and leading to dangerous inflammation within the thorax. The food may also enter the air-passages even when the injury is confined to the larynx, on account of the disturbance produced in the muscular movements by which the opening of the glottis is protected during deglutition. When the wound is high up, large quantities of saliva may flow away, causing dryness of the fauces.

The Connective Tissues, Glands, &c.—Air may be forced through the opening into the various compartments of the cervical fascia, and emphysema will be thus produced, which may spread to the face and thorax and even farther. This is especially likely to occur when the external opening is small, or not exactly opposite the wound of the air-passages. The tendency to this complication may also be increased by sewing up the wound in the skin. From the introduction of air, decomposing blood, or food, extensive suppuration frequently follows, and this may cause severe pressure upon the air and food passages, or it may run down into the mediastinum, and give rise to inflammation of the pleuræ and lungs. If the wound is high up in the neck, the salivary glands may be injured. Their secretion will flow from the wound, and a salivary cyst or fistula may ensue. If the wound is lower down, it may implicate the thyroid gland, and set up free hæmorrhage from its vascular parenchyma.

The Nerves.—The hypoglossal, the superior and inferior laryngeal nerves are liable to injury, and paralysis may consequently occur in the muscles of the tongue and larynx, or there may be some diminution of the sensitiveness of the laryngeal mucous membrane. Persistent aphonia may follow an injury to the inferior laryngeal nerve. It is possible also that the pneumogastric and phrenic nerves may be pressed upon in emphysema or suppuration of the deeper parts.

Treatment.—The first point is to stop the hæmorrhage, and to provide for the free ingress of air into the lungs. If any large vessel has been wounded, the finger must be introduced at once, and the bleeding point compressed. The patient should be laid upon his back in the horizontal position, and, after rapidly cleaning out the clots from the orifice of the glottis, it may be necessary to resort to artificial respiration until the patient is able to breathe naturally. The head and neck should now be somewhat extended, so as to open the wound and enable the surgeon to find the source of hæmorrhage. When the internal jugular or one of the carotid vessels is wounded, it is desirable to apply a catgut or silk ligature both above and below the opening. All bleeding points should be secured, and the ends of the ligatures should be cut short, so as to leave nothing dangling from the wound which might be entangled in the dressings, or laid hold of by the patient, if he should persist in his suicidal attempts.

A careful examination should be made, to see whether any of the divided tissues are likely to interfere with respiration. Portions of the epiglottis or the other laryngeal cartilages may be secured in their places with sutures, and in the same way the posterior part of the tongue may be drawn forward. The divided edges of the trachea should also be accurately adapted with sutures. The patient should be placed in a warm moist atmosphere, and the same precautions adopted as after tracheotomy. In some cases it may be desirable to insert a tracheotomy tube through the opening, if it should be below the true vocal cords. In others, upon the supervention of dyspnœa or other symptoms indicating œdema glottidis, it may be necessary to perform laryngotomy or tracheotomy. Expectorants and the carbonate of ammonia will be required, should any evidence of bronchitis or pneumonia be detected.

If the œsophagus should be wounded it will be expedient to bring together the edges with chromicised catgut sutures. When either the air or food passages are implicated, food should be given by an œsophageal tube introduced through the mouth or nose. If this cause much disturbance it may be better to leave the tube in the œsophagus, or nutrient enemata may be given. The tube should not be introduced through the wound. Great care should be taken to ascertain that it has not entered the trachea. This would be indicated by the coughing it sets up, and by the current of air which would escape from the open end of the tube.

One or two sutures may be put in the extremities of the wound to lessen the gaping, and to prevent the inversion of the skin; but it is of great importance to leave the external wound open, so that any blood or food which may get into its deeper cavities may at once escape. With this object in view the approximation of the cutaneous margins should be procured by position

only. The patient's neck should be kept slightly flexed by means of pillows and sand-bags. A long piece of calico bandage should be placed with the centre over the vertex, and the two ends hanging down by the side of the neck and in front of the thorax. A band of calico should now be placed round the head to secure the central portion of the bandage, while the two extremities are firmly attached to the front of a belt of calico placed round the thorax. It may be desirable to substitute strapping for the calico bands, in order to obtain greater security. A light dressing of carbolic gauze should be placed in front of the wound, and secured there by a few loose turns of bandage. This will filter and to some extent purify the air. The patient should be constantly watched by an attendant, to prevent a repetition of the suicidal attempt, and to give warning of the first signs of reactionary hæmorrhage. Later on, the wound is apt to become very foul, and it will be necessary to apply iodoform powder or some other antiseptic to cleanse the parts. Otherwise the fetid discharges may pass into the lungs and set up pneumonia. Abscesses which form should be at once opened, and the ready discharge of their contents should be promoted by drainage-tubes. Quinine may be required to combat the tendency to septicæmia. Fistulous openings into the trachea or œsophagus may persist, and they will have to be closed by operation when the patient has recovered from the more immediate effects of the injury.

Burns and Scalds.—The exposed position of the throat renders it liable to severe injuries of this description. When confined to this region the lesion is not dangerous, but it often gives rise to great deformity, such as the dragging down of the lower lip with the exposure of its mucous surface, and it may even distort the inferior maxilla and evert the lower teeth. Great care will therefore be required, while the granulating surfaces are healing, to resist this tendency, by maintaining the head and neck in the position of complete extension. *See* Burns; Cicatrices, Pathological Conditions of.

N. Davies-Colley.

THROMBOSIS, the formation of clot within a blood-vessel, the lumen of which is thereby more or less completely obstructed.

Thrombosis is a necessary factor in the healing of injured blood-vessels, the primary change in cases of so-called adhesive phlebitis, and the most frequent source of emboli. Thrombi are met with both in veins and arteries, also commonly within the heart, developed on the valves (vegetations), between the muscular trabeculæ or in the auricular appendages. They may be parietal and partially obstruct the circulation, or may completely occlude the vessel in which they are situated. They are usually divided into primary or autocthonous, and secondary thrombi. The former term is applied to the clot deposited at the immediate seat of the disease or injury; the latter to that developed later, stretching to collateral branches, or to that formed around an embolus or foreign body which may have gained entrance to the circulation.

Circumstances under which Thrombosis may occur.—The process depends on the subjection of the blood to such conditions as prevent the maintenance of its fluid state. The coagulation of the blood depends on the union of the two substances fibrinogen and paraglobulin in the presence of the so-called fibrin ferment. Fibrinogen is a constituent of blood-serum; paraglobulin is contained partly in the serum, mainly in the white blood-cells, and these latter are the sole source of the fibrin ferment. This union is promoted by any change from the healthy state in the endothelial lining, or by interruption of the circulatory flow. To the existence of one or both of these morbid conditions thrombosis is to be referred.

Causes of Thrombosis.— 1. Increased intravascular resistance, such as may be caused by pressure upon veins by tumours, or by the ligature of a vessel. In the veins in such cases, as a result of the slowing of and resistance to the circulation, the valves stand open and the blood stagnates behind them; hence this is the common starting-place of thrombi.

2. Slowing of the blood-current as a result of abnormal dilatation, seen in phlebectasis and aneurism.

3. General weakness of the circulation, as seen after fevers or in cardiac disease.

4. Trauma, with varying amount of injury to arterial or venous wall.

5. The entrance of foreign bodies, as in transfixion of a vein by a needle or ligature during an operation on the neighbouring artery; coagulating fluids injected.

6. Disease of the vascular wall—(*a*) acute, as seen in ulcerative endocarditis or endoarteritis; (*b*) chronic, as in atheromatous disease.

7. Extension of inflammation from neighbouring tissues, or pressure by inflammatory exudation.

8. The entrance of specific organisms.

Structure of Thrombi and subsequent Changes observed.—Thrombi may be white, red, or mixed. The large majority are of the white or mixed variety, consisting almost entirely of white cells in a fibrinous meshwork arranged in concentric laminæ; the mixed thrombi contain a variable proportion of red discs also. They are developed as long as any circulatory flow exists; the red only when complete stagnation exists, in addition to defective nutrition of the vessel-wall. The changes which take place in thrombi, subsequently to their deposition, are of a twofold character—degenerative or towards organisation.

A. *Degenerative Changes.*—1. The clot may simply dry up and shrink, eventually undergoing fatty or calcareous degeneration. 2. Simple regressive changes may start from the centre, puriform degeneration taking place. If such a clot be cut across, the central portion is found in a semi-fluid condition, the fluid consisting of a varying quantity of white blood-cells, broken-down red discs, blood-pigment, and granular detritus. The process may be followed by the detachment of irritant emboli. 3. Yellow purulent softening. The change here is a septic one, the broken-down clot being loaded with septic organisms. Emboli from such a source infallibly give rise to metastatic deposits. This change occurs in connection with septic inflammation around the vein.

B. *Organisation.*—In this case a more or less permanent plug is developed. The first change is the migration of leucocytes into the recent clot, followed by its vascularisation. The origin of the active cell-elements has been much disputed; the larger number are no doubt derived from the white blood-cells furnished by the vasa vasorum, but two other sources are described—(1) the white blood-cells contained in the original clot, and (2) endothelial proliferation. The question as to the first is of little moment, as the number of cells is unimportant, but the latter is said by good observers to be the most abundant. Although denied, it has been in no sense disproved, and when the continuity of the lining membrane of blood-vessels, lymphatics, and connective-tissue interspaces is remembered, it cannot be regarded as improbable. In the presence of the new cell-elements the granular fibrinous meshwork disappears, the red blood-discs break down, and the pigment becomes absorbed. The new cells take on the spindle form, new blood-vessels develop, clefts in the clot lined with spindle-cells forming connections with the vasa vasorum, and young connective tissue is the result. In favourable cases, vascularisation is apparent at the end of six to seven days; in others it may not be complete for months. Further changes may be simply cicatricial, or canalisation may follow.

The immediate results of thrombosis are not so serious as those of embolism, on account of the gradual nature of the process. Their gravity depends on the size and situation of the vessel affected. General cardiac thrombosis is usually the precursor of death; the parietal vegetations, on the other hand, are chiefly dangerous as the source of emboli. Arterial thrombosis gives rise to primary anæmia and interference with function, which may be followed by congestion due to regressive venous flow from removal of *vis-à-tergo*. Venous thrombosis in the limbs is followed by œdema, which, if permanent, leads to a general condition of lowered vitality and chronic inflammation. If very extensive, gangrene may result. In the organs, temporary interference with function is the usual result, the collateral circulation even in the case of the portal vein being generally sufficient to allow of recovery. The relation of thrombosis to embolism is considered separately; also the local changes in the vessel wall. *See* Embolism.

Symptoms.—The general symptoms will depend simply on altered function, if an organ be affected. The local signs are the palpable presence of a clot, if the vessel be superficial or tangible; otherwise, the presence of anæmia or congestion and œdema.

Treatment.—This consists in the adoption of means calculated to facilitate the circulation in its embarrassed condition, such as rest, the raising of an extremity, the employment of moderate pressure, and, in certain cases, the employment of mild counter-irritants to promote the absorption of clot. The important prophylactic point of avoiding disturbance of recent clot, has been adverted to in the article on Embolism.

G. H. Makins.

THUMB, Amputation of the. *See* Fingers, Amputations of the.

THUMB, Dislocation of the. *See* Hand, Dislocations of Bones of the.

THYROID GLAND, Diseases of the. *Preliminary Remarks.*—Considering the new light which has been recently thrown upon the unsettled question of the physiology of the thyroid body, and the great importance of this question as regards surgical

interference with that organ, it appears desirable to state briefly, before its diseases are discussed, the results of the latest physiological and pathological observations elucidating the consequences arising, to the animal economy, from loss of the function of the thyroid body.

Up to a very recent period it had been, roughly speaking, surmised that the thyroid had no functions at all, though it had been known for centuries that its absence or degeneration was very often connected with cretinism; that both cretinism and goître were endemic in the same localities; and that goîtrous parents often produced cretinous offspring.

In 1874 Sir William Gull described a cretinoid condition supervening in adult women, and characterised by swelling of the body, a particular flush of the cheek, languor of movements and thought, thickness of speech, general placidity of temper interrupted by occasional nerve-storms. Sir William declared himself unable to pronounce definitely about the state of the thyroid in these cases.

Four years later, Dr. Ord, who had the opportunity of making a post-mortem examination in a case of this sort, and who found overgrowth of connective tissue, the interstitial cement of which yielded enormous quantities of mucin in all parts of the body, gave to this condition the name of *myxœdema*. This author first drew attention to the diminution of the thyroid body, associated with an almost complete annihilation of the proper gland-tissue by the mucoid infiltration.

This diminution, sometimes amounting almost to a disappearance of the gland, was noted by many later observers. Still, it was generally supposed to be a result of the pathological process, not a working factor in the production of the other phenomena. Matters remained in this state up to the beginning of 1883. In that year, Professor Kocher of Berne described a curious collection of symptoms, which he had noted as gradually supervening in all his cases of *total* removal of goître. Only those of his patients in whom there were either accessory thyroid bodies, or in whom a part of the enlarged gland had been intentionally or inadvertently left behind, remained free from these symptoms. Similar observations had been made by the Messrs. Reverdin of Geneva. On the other hand, it is but fair to state that Professor Billroth of Vienna, who has extirpated more goîtres than any living surgeon, states that he has never seen unusual symptoms develop after the operation. Kocher gave to the state of things developing after the total removal of goîtres (goître is called in German scientific language 'struma'), the name of 'cachexia strumipriva.' The writer of this article, when reading Kocher's paper, came to the conclusion that myxœdema and cachexia strumipriva were practically identical; that the cause of both was loss of the function of the thyroid body, and that the only symptom peculiar to the latter, when total removal of a goître had been practised in *young* individuals—viz. arrest of the growth of the body—was undoubtedly to be explained by the fact that (in these cases) the loss of the thyroid made itself felt before the evolution of the body had been completed, whilst myxœdema, on the other hand, was essentially a disease of adult life.

It is, indeed, possible to go one step farther, and to account for endemic cretinism by assuming that it is due to loss of function of the thyroid body, from conditions occurring during intra-uterine life. The writer, in fact, when communicating Professor Kocher's observations to the Clinical Society in 1883, ventured to enunciate the proposition that cretinism, myxœdema, and cachexia strumipriva were merely different phases of one and the same condition, and due to one and the same cause—viz. to arrest of the function of the thyroid gland. This proposition soon found corroboration by the publication of a very remarkable case of total extirpation of the thyroid gland, performed in 1867 on a bright, well-developed boy, then ten years old. Professor Paul Bruns of Tübingen, who saw the patient seventeen years later, reports that he had not merely developed all the usual symptoms of myxœdema, but that the growth of the trunk and of the limbs had become entirely stunted, whilst the head alone had continued to grow; that the patient's mental faculties had undergone not merely arrest but even a retrograde change, and that, in fact, the lad had become a dwarfy cretin.

A further and still more important corroboration of the writer's proposition has quite recently been furnished by Mr. Victor Horsley, who has succeeded in producing myxœdema in the monkey by extirpating the thyroid gland, and who, from his anatomical, chemical, and experimental researches, comes to the following conclusions:—

1. The thyroid body appears to consist of two portions: (*a*) a glandular, consisting of highly vascular acini, which excrete a

mucoid substance—a mucin-excreting portion (?); and (*b*) highly vascular lymphoid nodules—hæmatogenous function (?).

2. Excision of the gland is followed by a great increase in the quantity of mucin found in the tissues, an increased activity of the mucin-producing glands, and a change in function of other non-muciparous glands, whereby they become mucin-formers.

3. Profound changes also ensue in the blood. The red blood-corpuscles are decreased with leucocytosis, the coagulability is lessened, and its albumens are altered in character.

4. Nerve-symptoms also appear, changes taking place in the lowest motor centres, causing rigidity, tremors, and paresis. Changes occur in the higher psychological centres, whereby imbecility and cretinism occur, followed by death, which usually occurs in a condition of coma.

Reviewing these facts, Mr. Horsley points out that it is clearly shown that removal or alteration of the function of the thyroid is the cause of the general bodily condition. Whether such changes may be due to the intermediate action of the vaso-motor or of a trophic centre, it is impossible to say. When it is remembered that the thyroid body contains a mucinoid material, and that after its removal mucin appears largely in all the tissues, it becomes a question whether the thyroid may not be an excreting gland, the removal of which, as is usual in analogous cases, induces death. In support of this, it is urged that removal of one lobe causes hypertrophy of the other. If, subsequently, the second lobe be removed, myxœdematous symptoms arise.

Thus the question stands at the present moment. The limited space allotted to the writer does not permit him to discuss the results and views of other observers (Schiff, Zesas, Wagner, Tauber, Credé, Hadden, Sanquirico, Canalis, and others).

Inflammation. — *Causes.* — Inflammation of the thyroid gland (thyroiditis) may be of three types: idiopathic, traumatic, metastatic. It may be mentioned here, at once, that inflammation of a previously healthy thyroid gland is altogether rare, and that it occurs much more frequently in cases of enlarged glands (goîtres), when all the symptoms hereinafter described are present, as a rule, in still more aggravated form. The idiopathic form is very rare, and its etiology obscure. It is generally attributed to catching cold. Traumatic inflammation may be caused by any violent injury to the gland. Metastatic thyroiditis may occur in the course of or subsequently to typhoid fever, pyæmia, or puerperal fever; in some rare cases it has followed pneumonia and bronchitis; once it has been observed to alternate with orchitis.

Pathology.—All forms of acute thyroiditis are characterised by the usual changes occurring in inflammations: congestion of the vessels, exudation of serum, emigration of leucocytes. The inflammation may end either in resolution, or in suppuration, or in gangrene. Resolution not rarely occurs in acute idiopathic thyroiditis. Suppuration is the most frequent end of all forms of inflammation of the thyroid gland. Sometimes several abscesses are formed, which generally point outwards, or more rarely perforate into the mediastinum, the air-passages, or the œsophagus. Gangrene is very rare; it may occur when suppuration extends to the connective-tissue capsule of the thyroid gland, and causes phlegmonous inflammation of the fasciæ of the neck.

Symptoms.—Febrile symptoms, sometimes rigors, first occur. There are vague pains about the face, neck, upper part of the trunk, and occasionally the whole body, associated with a feeling of constriction about the throat, dysphagia, sometimes slight dyspnœa. Soon the gland, and shortly afterwards the whole neck, begins to swell; sometimes the whole gland, in other cases only one lobe is thus affected. The inflamed part projects beyond the generally tumefied neck as an isolated tumour of either firm or more brawny consistence. The veins of the neck are turgid, the inflamed region is very tender to the touch, there is continuous or intermittent pain. Owing to the swelling, the following symptoms may occur: compression of the deeper vessels leads to headache, dulness, giddiness, cyanosis of the face, sometimes to epistaxis; compression of the œsophagus to increased dysphagia; pressure upon the trachea and the motor nerves of the larynx to dyspnœa, often very considerable, sometimes fatal, and to dysphonia. Under these circumstances, patients have been observed to bend the head, by preference, backwards.

If the case tends to resolution, all these symptoms may disappear within a few days or weeks. The occurrence of suppuration, on the other hand, is manifested by continued fever, renewal of the rigors, redness, fluctuation where the skin is red, and finally bursting of the abscesses. In rarer cases, suppuration occurs in more centrally situated parts of the gland, when it may be difficult to detect the exact seat of the abscess, and death may be caused by perfora-

tion into the trachea or the mediastinum. In some cases of metastatic thyroiditis, suppuration may occur in the form of an almost painless, cold abscess.

Diagnosis and Prognosis.—Acute inflammations of the thyroid gland can hardly be mistaken for other affections. The prognosis, unless general septicæmia or pyæmia occurs, or unless—as in the metastatic form—the original disease tends to a fatal issue, is not unfavourable, even if gangrene should occur.

Treatment.—The treatment of all forms of acute thyroiditis must be antiphlogistic. In the first stage, constant applications of ice ought to be made over the inflamed organ; leeches may be applied to the supra-clavicular regions, and local or general venesection may become necessary. If, in spite of these measures, suppuration threatens, warm poultices must be substituted for the ice applications, and, as soon as fluctuation occurs, the abscess or abscesses must be opened by incision under antiseptic precautions, or by means of trocar and canula. In cases of deep-seated abscess, the incision must not be too small, and a drainage-tube had better be inserted. Lücke recommends, in those cases in which the trocar is used, after evacuation of the pus to wash out the cavity with carbolised water and to inject some tincture of iodine, after which the wound is to be closed by plaster.

Goître.—All tumefactions of the thyroid gland not due to inflammatory or malignant diseases, or to the immigration of parasites, are usually comprised under the name of goître.

Goître occurs generally in an endemic form, sometimes epidemically (this especially, though not exclusively, in soldiers whose garrison has been changed to a locality in which the disease is endemic), in other cases sporadically. It may be either congenital or acquired. The latter form is most frequently developed at, or immediately after, the period of puberty. The female sex is much more frequently affected than the male, but it is stated that, in India, both sexes suffer in almost equal proportions.

Goître forms one of the symptoms of the malady known as 'Graves's' or 'Basedow's' disease, or as 'exophthalmic goître,' which is characterised by prominence of the eyeballs, usually a pulsating swelling of the thyroid gland, palpitations of the heart, and general nervous irritability. In localities where goître prevails endemically, the domestic animals are not rarely goîtrous. Geographically, endemic goître may be said to occur mostly in mountainous districts. Thus, according to Lücke's careful compilation, in Europe, the Alps, Pyrenees, Carpathian Mountains, the Black Forest, Thuringia, the Hartz, the Erzgebirge, Riesengebirge; in America, the Cordilleras; in Asia, the Himalayas, are the main localities of endemic goître. On the other hand, there are mountainous districts in which goître is little known, such as the mountains of Sweden and Norway, the Scotch Highlands, the Apennines.

In mountainous regions where goître prevails, deeply cut valleys suffer more than high plateaux. Then, again, whilst large plains are usually free from endemic goître, the affection prevails in some such plains, as in the Rhine Valley, in Silesia, in Northern Italy, in many districts of France, in the Punjaub, and the valley of the Orinoco. It is to be noted that in all the regions just mentioned there are large rivers, often inundating their borders, and marshy low grounds. Low seacoasts are, on the whole, free from goître; but here also there are exceptions, such as the island of Arran and the Azores.

Causes.—The causes of endemic goître are at present still enshrouded in mystery. Of all the numerous theories propounded to explain the endemic occurrence of tumefactions of the thyroid gland, none appears to cover the whole question, though each may claim a certain degree of plausibility. Thus the condition of the atmospheric air (especially a humid climate); impurities of the drinking water (snow water, excess of mineral or of metallic contents, organic impurities, want of bromine, iodine, or carbonic acid); geological conditions of the soil (especially those formations which produce water containing an excess of magnesia); a certain 'goître-miasma,' and individual predisposition (age, sex, heredity, occupation, food, ventilation, and situation of dwellings, &c.), are all accused of producing, alone or conjointly, endemic goître.

In the etiology of sporadic goître, heredity plays the most important *rôle*; next to it, changes in the circulation, arising from the sexual functions of females (menstruation, pregnancy, parturition); finally, all those conditions which favour congestion to the head and stasis in the veins of the neck (carrying of heavy weights on the head, mountain climbing, blowing of trumpets, &c.).

Epidemic goître may be most fitly designated as a quick development of tumefaction of the thyroid gland in a number

of persons, under conditions favouring the development of the endemic form of the disease.

Exophthalmic goître is probably due to an affection of the cervical sympathetic nerve, the swelling of the thyroid gland more especially to paralysis of the vaso-motor branches of the sympathetic, giving rise to chronic hyperæmia of the vessels of the gland, and thus favouring the conditions necessary for the production of goître. This view, however, though probably correct, is not yet definitely proven.

Pathology.—Though, of late, a great many subdivisions of the different forms of goître have been made, notably by Wölfler, based upon well-marked anatomical differences, it will, for practical purposes, suffice to distinguish between three main forms—viz. simple hypertrophy, cystic and fibroid enlargements of the gland. Between these three forms all possible varieties of transition occur. The enlargement may concern the whole gland or only parts of it. Practically, it is important to note that, in cases in which an accessory gland exists, this may either become goîtrous together with the main gland, or even alone. Goître may form very rapidly, or—and this is more usual—very slowly and insensibly.

In all forms of goître, the vessels of the gland, especially the veins, are considerably dilated. Goîtres in which the vascular changes predominate over the parenchymatous have been called 'vascular,' and, if pulsation exists within them, 'aneurismal' goîtres. It is, however, from a practical point of view, as little necessary to describe them as distinctly separate forms, as to look upon the goître of Graves's disease, in which the vascular changes also often play a predominant *rôle*, as an individual and distinct form. In reality, exophthalmic goître may and does occur in any of the three main types just mentioned, though, most frequently, it is the soft parenchymatous form with great vascular dilatation in which it is met with.

Goître may assume enormous dimensions, or its growth may after a time be arrested; sometimes, even spontaneous resolution is said to take place, especially if the individual leaves a goîtrous district, or if he be attacked by an acute febrile disease.

The different forms of goître, as well pointed out by Lücke, whose classical description is mainly followed in this paragraph, generally represent merely different phases of one and the same pathological process. In the simplest forms (parenchymatous or follicular goître), permanent hyperplasia of the follicles is produced by over-nutrition resulting from repeated or constant congestion of the vessels of the gland. The interstitial connective tissue may become atrophied by pressure, whilst the hyperplasic part may be surrounded by a thick connective-tissue capsule. If, on the other hand, the interstitial tissue shares in the process of nutritive irritation, which it generally does in somewhat later stages of parenchymatous goître, it begins to grow exuberantly. Then, the second form of goître, the fibroid, is produced. The fibroid enlargement may be either diffuse or localised. In the former case, the glandular masses appear to be imbedded in very tough bands of fibroid tissue. In the latter case, hard nodules may be found, movable and well isolated from the rest of the gland and from each other. The follicles in these nodules greatly atrophy, and finally only small remnants of them remain, which may undergo cystic degeneration. Sometimes, calcification takes place in very large and very long-standing fibroid goîtres.

Parenchymatous goître frequently degenerates. A rare form of such degeneration is the amyloid, a much more frequent one the colloid, which in turn leads to the development of cystic goître. The contents of the enlarged follicles being continually changed into colloid material, there is an increase in size, often gained at the expense of the interstitial tissue, which atrophies. The adjacent follicles then coalesce and fill with gelatinous material, and thus, finally, large cysts may be formed. At the same time, the colloid material itself undergoes further changes, hæmorrhage often takes place from the cyst-walls into the cavity, and, finally, a brownish-red fluid containing mucin, albumin, blood, and its constituents, organic detritus, &c., is found to form the contents of the cyst. In rare cases, transparent fluid similar to that of hydrocele has been found. Occasionally, cholesterin, colloid material, phosphate of lime, &c., form the contents of cysts. Parenchymatous goître may, however, become cystic without passing through the colloid phase. This happens when the follicles undergo fatty degeneration, their contents being replaced by an albuminous fluid. The further progress is the same as that of the colloid variety.

Several cases of hydatid of the thyroid gland have been observed. In some cases, the development of the parasite led to great enlargement of the gland, and even pro-

duced serious dyspnœa. Two cases are known in which the cysts perforated the trachea, and immediate death ensued.

Most cystic goîtres are multilocular; a unilocular cyst being formed only by atrophy of the septa between the cysts. Often, however, even in such cases, a kind of fibroid stroma traversing the cyst remains. The capsule of the cyst is generally thick and smooth. Not rarely, more or less extensive calcification or ossification takes place within large, and even within small, cysts. Large goîtres, in consequence of their gravity, generally become pedunculated, the pedicle consisting of connective tissue, vessels, and nerves.

Finally, it must be stated that goîtrous thyroid glands show a decidedly greater tendency to become inflamed and to undergo malignant degeneration, than previously healthy glands.

Symptoms.—Apart from the external disfigurement of the neck, the main symptoms of goître are due to pressure exercised by the tumour upon neighbouring parts, especially upon vessels, nerves, muscles, air and food passages. All these symptoms are the more marked the less pedunculated the goître is; thus, enormous tumours hanging down in front of the chest often cause much less serious symptoms than much smaller tumours, which from their situation interfere with the function of important parts in their vicinity.

Amongst the first and most frequent symptoms, caused by small or non-pedunculated goîtres, is stasis in the veins of the tumour themselves, and in those of the neck and head. The former often appear as a large plexus on the surface and in the parenchyma of the gland, the superficial veins of the neck being at the same time much enlarged. With every effort these veins are further dilated. The veins of the head also sometimes suffer similarly, the face of the patient appearing turgid and red with every effort. The return of blood from the veins of the brain being sometimes impeded, the patient is apt to suffer from headache, giddiness, drowsiness, &c. On the other hand, tumefaction of the thyroid gland may lead not only to very considerable dislocation forward or backward of the carotids, but also to compression of these vessels, to diminution of the blood-supply to the brain, and to more or less marked phenomena of cerebral disturbance, such as convulsions, tetany, epileptoid attacks, the so-called 'goître-asthma,' and perhaps also to—sometimes fatal—spasm of the glottis from cerebral anæmia.

It is probably to such disturbances of the circulation in the brain, and not to pressure upon the pneumogastric nerves, that the transitory and varying paralysis of the adductors of the vocal cords, accompanied by aphonia, sometimes observed in young females affected with soft goîtres, and mostly occurring at times of general disturbances of the circulation (menstruation, pregnancy) must be ascribed.

Direct pressure upon the nerves of the neck is often met with in the harder forms of goître. The motor laryngeal branches of the vagi suffer almost exclusively. More sudden pressure may cause phenomena of irritation—i.e. spasm of the glottis (which, however, as shown above, may have an entirely different origin); more gradual pressure produces in the first place paralysis of the abductor fibres of the recurrent laryngeal (of both, if there be simultaneous pressure upon both recurrents, or pressure upon *one* pneumogastric nerve). Later on—i.e. when *all* the fibres of the nerve are disabled—complete paralysis of the corresponding vocal cord results. *See* Larynx, Neuroses of the.

Of muscles, the sterno-mastoid is most liable to be thinned and flattened out by pressure.

The most frequent and most important symptom caused by hard, non-pedunculated goîtres is dyspnœa, due to pressure upon the air-passages, notably upon the trachea. The larynx is not rarely considerably displaced, but hardly ever actually compressed. The trachea, on the other hand, is not only displaced, but the pressure causes at the same time softening of its cartilaginous rings and actual changes of its calibre. Thus, the wall of the windpipe may be either bulged inwards on one or both sides, or from the front; or a circular goître may constrict it on all sides, or it may be pressed against the vertebral column, or be quite bent over a hard goitrous nodule, &c. The dyspnœa is in proportion to the degree of narrowing. In slighter cases, tracheal stridor only occurs after efforts, in more severe cases it is constant. The dyspnœa is sometimes of the most serious kind, especially in cases of small substernal goîtres pressing the trachea against the vertebral column ('goître plongeant' of the French). Even if not immediately fatal, the deficient aëration of the lungs, coupled with ever-present increased respiratory efforts, generally causes, after a time, important organic changes of the thoracic organs, emphysema, pulmonary catarrh, dilatation of the right side of the

heart, &c. In cases of *tracheal* narrowing, the larynx does not rise and fall in respiration, however great the dyspnœa may be.

From a surgical point of view, attention is once more to be directed to the fact that the same goître may dislocate and compress the trachea, and simultaneously paralyse both abductors of the vocal cords. In such a case, a *double* stenosis of the air-passages results; an upper by diminution of the glottic aperture, a lower by compression of the trachea. It is rare that the gullet is compressed by goître. A small so-called 'aberrant' goître may be situated between the trachea and œsophagus and compress both canals, or the enlarged lateral lobes of the gland may not allow the gullet to shift its position. Dysphagia then occurs.

Sudden increase of a cyst means, usually, hæmorrhage from the lining walls into its interior; rapid increase of volume of a goître which had for a long time remained stationary, together with pain and swelling of the lymphatic glands of the neck, points to malignant degeneration.

Diagnosis.—The diagnosis of goître is for the most part easy. There are, however, cases in which it is very difficult, if not impossible, to distinguish goître from other tumours of the neck; and, again, it may be very difficult to differentiate between the individual forms of goître.

A general diagnosis will be arrived at by considering the history of the case, the characters of the tumour, and the associated signs: enlargement of vessels, paralysis of one or both vocal cords, bulging inwards of the trachea. In arriving at a differential diagnosis of goître from other tumours of the neck, it is a very important factor that goître rises during the act of swallowing, whilst other tumours do not, unless fixed by newly-formed connective tissue to the air-passages. Small substernal goîtres are sometimes apparent to sight and touch during the act of swallowing only.

Simple congestive swellings of the thyroid gland are generally transitory, and are due to menstruation, pregnancy, &c.; the neck appears somewhat full, and it is often difficult to make the gland out by palpation.

Parenchymatous goître is more resistant and more sharply limited. Generally, only parts of the gland are hypertrophied. These are smooth, somewhat elastic, only moderately enlarged. Fibroid goître is characterised by a number of single, movable, hard nodules, which project from the generally hypertrophied gland. If there be calcareous deposits in the nodules, their hardness is still more pronounced. Fibroid goîtres often assume enormous dimensions.

Cystic goître is usually globular or ovoid, sharply limited, and, when filled with thin fluid, shows distinct fluctuation. If, however, the wall be very thick or the contents more atheromatous, it may be very difficult to be sure whether there is fluctuation. Under such circumstances, an exploratory puncture must be made with a very fine trocar. Great care, however, should be exercised when this proceeding is determined upon, for dangerous hæmorrhage may be produced if the trocar unfortunately should injure a large vessel. The puncture should always be made under antiseptic precautions.

The goître of Graves's disease is characterised by vascularity, often by pulsation, and by the accompanying exophthalmos, rapid pulse and palpitations; often by bloodmurmurs of the heart, in the carotids, and in the vessels of the thyroid gland.

Mixed forms (multilocular cysts, fibroid nodules, general parenchymatous enlargement,) are to be diagnosed by their unequal consistence, and, if necessary, by exploratory puncture.

The differential diagnosis of goître from other tumours of the neck, is rendered in some, fortunately rare, cases exceedingly difficult, by the fact that occasionally so-called 'accessory' or 'aberrant' portions of thyroid tissue at a considerable distance from the natural situation of the thyroid gland, undergo goîtrous changes. Even greater difficulties may present themselves when such aberrant masses of thyroid tissue are situated near the hyoid bone, behind the sterno-mastoid muscle, in front of the substernal portion of the trachea, between the trachea and œsophagus, &c. It will, therefore, be advisable to remember, in every case of tumour of the neck, the possibility of its being an 'aberrant' goître. The tumours most likely to be confounded with goître are congenital cysts (sometimes with sebaceous contents), blood-cysts, hydatid cysts in the gland itself or in other tissues of the neck, cold abscesses originating from broken-down lymphatic glands, fatty growths, adenomata, lymphomata and sarcomata of the lymphatic glands, and malignant tumours of the thyroid gland. The nature of cystic tumours, in the situation of the thyroid gland, will generally have to be made out by exploratory puncture. From malignant tumours of this neighbourhood, whether they start from the thyroid gland itself or from other structures, goître is distinguished by its usually slow growth,

painlessness and absence of tenderness on pressure, non-infiltrating character, and absence of general cachexia. It has been repeatedly mentioned that goître may undergo malignant change. This occurs sometimes, without any apparent cause, in cases in which a goître has been in existence for twenty years or more. All the symptoms just mentioned will then arise.

Treatment.—If an individual living in a goîtrous district becomes affected with goître, he ought to leave the neighbourhood as quickly as possible. Recent goîtres often disappear without further medication, if a change of residence into a non-goîtrous locality, especially to the seaside, can be effected. It has also been advised that the patients, and, in fact, all living in goîtrous districts, especially all those who have recently moved into them, should drink only *boiled* water.

The treatment varies considerably according to the nature of the goître.

Apart from change of residence, sojourn at the seaside, &c., iodine preparations are most serviceable in cases of soft, parenchymatous goître. They may be administered in the form of an iodide of potassium mixture (5–10 grains twice or three times daily) combined with the external use of an iodine ointment. The writer has often seen good results from the use, once or twice daily, of a combination of one part of the ung. iodi (B.P.) to 2–4 parts of the ung. potassii iodidi (B.P.). Broadly speaking, the effect of this treatment is the better and quicker, the younger the individual and the more recent the goître. In recent cases, even comparatively large goîtres often very rapidly and entirely disappear; in goîtres of longer standing, some diminution generally takes place, but not complete cure. The biniodide of mercury ointment, the applications of which in India are reported to be so marvellously successful, appears to have yielded less satisfactory results in the hands of European practitioners. Possibly the absence of the tropical sun, to the rays of which, in India, the neck of the patient is exposed during and after the application, may in some measure explain the difference. Dr. Morell Mackenzie recommends counter-irritation to the neck by means of applications of the liquor epispasticus (B.P.) in cases of soft goître. The iodine treatment above described will, however, be found to suffice in most cases.

Recently, Dr. Moritz Schmidt has advised, in cases of soft and of fibrous goître, the permanent application of cold to the patient's neck by means of Leiter's hollow lead-tubes, which are fastened round the patient's neck, and through which a current of cold water constantly circulates. In simple cases, these tubes are to be worn twice daily, each time for three hours; in cases in which dyspnœa is present, day and night. Dr. Woakes has lately recommended the internal use of hydrofluoric acid as an adjunct in the treatment of bronchocele. He administers ten minims (or more) of a half per cent. solution of the redistilled fluoric acid in an ounce of water, twice daily. The results appear to be somewhat uncertain. Several observers have added their testimony to its satisfactory effects; but in the hands of others—and the writer must class himself amongst them—the remedy has not yielded appreciable results, in spite of long-continued and repeated trials.

Should no good effect follow medicinal treatment in long-standing cases of soft goître, parenchymatous injections of iodine may be resorted to with a good prospect of effecting a cure; and this form of treatment will also be found useful in cases of fibrous goîtres, provided that the latter are not too old, too hard, and partly calcified.

The rules adopted by the writer are as follows:– (1) Select suitable cases only —i.e. cases in which the gland-substance is so thick that one may be fairly certain that the injection can be made into the parenchyma proper, and in which, on the other hand, the interstitial fibroid change has not progressed too far. (2) Inject every third day into the gland-substance proper a quantity, from 20 to 30 drops, of an alcoholic iodine solution (1 part of iodine in 12 parts of absolute alcohol), with a well-made and well-cleaned hypodermic screw-syringe. (3) Vary as much as possible the place of injection, and never inject into the same neighbourhood on two consecutive occasions. (4) Avoid wounding superficial veins and injecting air. A piece of tape may be tied round the neck below the tumour, so as to compress the superficial veins. (5) Neither insert the point of the needle *too timidly*, when the injection-fluid will very likely pass into the cellular tissue, suppuration resulting; nor *too violently*, when it may completely perforate the gland, and the injected fluid may be thrown into other important tissues. It is a good plan to let the patient swallow when the needle has been inserted, before the injection is proceeded with, the body of the syringe being held quite loosely in the operator's hand; if the point of the needle is in the gland-substance, the *foremost*

part of the syringe will rise with the rising gland; if it be in front of the gland, no movement will ensue; if it have perforated the gland, the *hindermost* part of the syringe will chiefly rise. (6) Never inject in such a direction that the point of the needle points directly towards the trachea or towards the great vessels and nerves of the neck. (7) Inject very slowly, and watch especially the effect of the injection of the first few drops. Select the place of injection carefully beforehand by palpation, and steady the tumour with the left hand whilst making the injection. Previous freezing of the surface with anæsthetic ether round the point selected for injection may be resorted to, but is not necessary.

Attention to the foregoing important precautions is very necessary to avoid unpleasant results. It must, however, be confessed that, even if they are punctiliously attended to, this form of treatment is not altogether devoid of risk, the principal dangers being—(1) injection of iodine or air into a vessel, causing embolism and sudden death; (2) lesion of the pneumogastric or of the recurrent laryngeal nerve, followed in some instances by spasm, in others by lasting paralysis of the vocal cord or cords; (3) suppuration and putrefaction of the goître. All these dangers are fortunately very rare, but, without any doubt, their occasional occurrence has been positively ascertained by clinical observation and by post-mortem examination, whilst, at the same time, they are—at least to some extent — uncontrollable. The writer, therefore, is of opinion that it is the duty of every surgeon not to represent the operation as a perfectly safe one, but to inform the patient or his friends, before beginning the treatment, of its risks.

Frequently, the patient complains, at or immediately after the injection, of radiating pains in the teeth, the occiput, the chest, &c. These symptoms are of no serious import, and usually pass away after a few moments. Shortly afterwards, slight tenderness and swelling over the point of the injection generally result, which are easily relieved by cold-water dressings. No definite statements can be made as to the number of the injections necessary to complete a cure, or the time required for treatment, both depending on the duration of the goître, its size, and character.

Instead of iodine solutions, other injection-fluids have been recommended at various times, notably pure alcohol, ergotine d'Yvon, liquor arsenicalis, and hyperosmic acid, but none of these have come into general use.

The treatment of parenchymatous, and especially of fibroid, goître by means of setons, which was at one time very much in vogue, has been almost entirely superseded by the iodine injections.

For the treatment of cysts three methods are employed: puncture with subsequent injection of an irritant fluid, incision, and excision. Simple aspiration has been given up almost entirely, as experience shows that the cyst, when simply emptied, almost always fills again very rapidly. Besides, simple aspiration is not quite safe.

In the writer's experience, the injection of perchloride of iron into the cyst yields more satisfactory results than injections o iodine, though it cannot lay claim to absolute safety. The best method of injection is that described by Dr. Morell Mackenzie in the following words:—'In carrying out this mode of treatment, I use a watery solution of perchloride of iron (25 per cent.), and I have for many years employed a syringe of somewhat peculiar construction. It consists of an ordinary glass barrel and piston, with a tapering metallic tube fixed at a slightly obtuse angle to its distal extremity. A circular ring, screwed on to the shank of the piston, regulates the distance to which the latter can descend. The object of this cylinder is to prevent the accidental passage of air into a cyst, and thus into a vein. . . . .

'The cyst is first punctured and emptied with a trocar at its most dependent part, a drachm or two (according to the size of the cyst) of the solution of perchloride of iron is then injected, the canula with its plug, and the iron solution being left in the cyst. After seventy-two hours the plug is removed, and the contents of the cyst withdrawn.

'If the fluid be then found to contain much blood, or if it be thin and serous in appearance, a second injection must be made. In other words, whilst hæmorrhage must be carefully prevented, a slight inflammation of the lining membrane of the cyst is essential. One injection is generally sufficient, but, if the first injection-fluid be too quickly removed, the process may have to be repeated three or four times at intervals of two or three days.

'When reaction has taken place, and the discharge is free from blood, the canula, with its plug, must still be kept in the cyst. Poultices of linseed meal should be kept constantly applied for three or four weeks,

sometimes longer. When suppuration is well set up, the plug may be removed, the canula, however, being allowed to remain until the secretions become limited in amount and thin in consistence.

'When the cyst is very large, it is best to try to reduce the quantity of the fluid before injecting. This can often be done by drawing off a small amount, say two or three drachms, at intervals of a day or two on several occasions. No attempt must, however, be made to empty the sac entirely, for if this is done, hæmorrhage takes place from the lining membrane of the cyst into its cavity, which soon becomes full again.

'The duration of the treatment is from three weeks to four months, according to the size of the cyst, the usual time being six to eight weeks.'

Incision of the sac, followed by suture of the free edges of the lining membrane to the edges of the skin-wound, has been recommended and executed with satisfactory results in a considerable number of cases; but there are several drawbacks to this treatment, amongst which may be enumerated the possibility of primary and secondary hæmorrhage, putrefaction within and around the sac, formation of fistulous communications with neighbouring parts, &c. The operation and the after-treatment should be carried out under strict antiseptic precautions, and all bleeding vessels be tied immediately, which is not always easy, especially if secondary hæmorrhage in the bottom of the sac occurs. In some cases, plugging of the sac with styptic tampons may be unavoidable.

In cases in which it is found that a large cyst, enclosed in a very thick fibrous wall, is only loosely connected with the surrounding parts, extirpation might be advantageously undertaken. This operation will best be performed, under antiseptic precautions, by shelling the sac out of its surroundings as much as possible by means of the finger or of blunt instruments, by ligaturing every vessel torn during this proceeding, and by dressing the resulting wound antiseptically.

Whilst, by means of one or the other of the above methods, it will be possible, in the larger number of cases, to prevent the occurrence of those grave symptoms which have been described in the paragraph on symptomatology, yet there are some goîtres which unfortunately do not appear to be amenable to any form of treatment; whilst others come under observation when these symptoms have already been fully developed, and when no relief can be expected from the adoption of any of the methods above recommended.

The grave symptoms referred to are mainly those of narrowing of the air-passages, which in turn, as has been shown, may be produced—(*a*) by direct compression of the trachea, (*b*) by spasm of the glottis, (*c*) by paralysis of the glottis-openers, (*d*) by the simultaneous existence of the conditions mentioned under (*a*) and (*c*). Now it is clear that, if we could be certain of opening the air-passages below the seat of the obstruction, this would be the simplest way of averting impending suffocation; but, in the first place, it is often impossible to say how far down the trachea is obstructed, and, secondly, the technical difficulties of tracheotomy in cases of large goîtres are often enormous, sometimes insuperable. Unless the goître extends too high up, the operation consists in opening the fascia propria, pulling down the isthmus of the gland by means of blunt instruments, opening the air-passages above the gland, and inserting one of Koenig's long flexible silver canulas, which are intended to force their way through the compressed part of the trachea, or, should no such canula be at hand, using a common elastic catheter for that purpose. In other cases, the surgeon may be compelled to ligature the isthmus on both sides, to split the ligatured part in the middle line, and then to open the trachea in the usual way. If, however, the goître be large, it will often be found that, in spite of the ligature *en masse*, severe hæmorrhage occurs when the isthmus is split, and the bleeding vessels will then have to be tied *seriatim*.

Much precious time is often thus lost, in cases in which the operation is performed in the greatest hurry to save the patient from impending suffocation. If the operation be performed at all, it is very important to keep the head very steady during the whole of the operation to prevent collapse and tilting of the trachea, and to keep it so afterwards by sandbags.

In order to reach the cause of the evil, and to ensure a radical cure in serious cases, removal of the goître may be necessary. The operation, which in former years was very fatal, is now, owing to advances in antiseptic surgery and improved methods, far less so than formerly; to the actual dangers of the operation must be added the possible occurrence of subsequent symptoms of myxœdema, due to the loss of the thyroid gland. It appears, however, that

myxœdema is not likely to occur if a small portion of the gland is left behind. The writer is, therefore, of opinion that extirpation of a goître may be undertaken when the condition of the patient appears to render this strictly necessary, provided that it is possible to leave behind a portion of the tissue of the gland.

With regard to the operation itself, there is at present considerable difference of opinion, but probably Kocher's method is the best. It is thus described by Sir W. MacCormac:—

'The manner in which the enlarged thyroid gland may be excised varies. It is essential to provide for an aseptic condition of the wound, and so avoid septic infiltration of the cellular tissue of the neck, which is very sudden in appearance, often without any very marked external change, while the result is almost always fatal. It is not less important to control hæmorrhage, as far as possible, and to avoid injury to the recurrent nerve. The superficial incision may be of two kinds, an angular and a Y-shaped. Where the enlargement is chiefly confined to one side, a median incision should first be made from the upper margin of the tumour to the notch of the sternum. In this way, only the transverse communicating branches of the veins will be divided, and from the upper extremity of this incision ample room can be obtained by making an oblique incision upwards and outwards, which should extend from the level of the cricoid cartilage to the anterior border of the sterno-mastoid muscle, or further, if necessary, in the direction of the mastoid process. The skin and platysma having been divided, the superficial veins will be cut through at right angles, and may at once be tied with double ligatures. Where the thyroid enlargement is bilateral, a similar oblique incision may be made on the opposite side. After the platysma and superficial fascia have been divided, the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles appear spread over the tumour. As a rule, especially if the tumour be large, these must be divided, and, in some cases, part of the sterno-mastoid muscle as well; but this entails no serious after-consequences. The tumour will now be fully exposed, with enormously dilated veins covering, probably, its entire surface. These veins must be tied, one by one, with a double ligature before division.

'The greatest care must be taken at this stage, for the veins are not only huge in size, but their walls are very thin and easily torn or cut through by the ligature. The tumour may now be carefully separated by the finger, or handle of the scalpel, until the position of the superior thyroid artery at the superior lateral extremity of the thyroid body shall be reached. Here the superior thyroid artery will be found entering the tip of the thyroid tumour, and, either separately or together with its vein, must be carefully double-ligatured and divided between. The artery is generally much enlarged, and its walls are very thin.

'Search is now made for the inferior thyroid artery, which must be most carefully isolated previously to ligature. This may be applied as far as possible from its entrance into the tumour. . . . In this way the recurrent nerve will be well protected from injury. The inferior thyroid artery, after leaving the thyroid axis, passes transversely behind the outer border of the thyroid, and for some distance on its posterior surface before it penetrates the gland, after dividing into several branches. Close to the trachea, the trunk of the artery passes behind the recurrent nerve, which it partly encircles. The branches of the artery may be divided, after ligature, close to the surface of the gland, and bleeding will not occur owing to the preliminary ligature of the main trunk. . . . The tumour may now be turned towards the median line and lifted from the trachea. The further isolation should be conducted as carefully as possible until the isthmus is reached, which should be most carefully divided, each bleeding point being secured as it appears. When the enlargement is bilateral, the same operative procedure must be conducted on the opposite side. It is very important, if possible, to avoid performing tracheotomy, as it enormously increases the subsequent risks. . . . When tracheotomy is necessary, as it fortunately seldom is, the wound becomes speedily septic. It is better under these circumstances to treat it as an open wound with frequent irrigation, in the hope of preventing the fatal mediastinal infiltration which so often occurs.'

Finally, an operation must be mentioned, which, though only in its infancy, promises to be of excellent service in those cases in which operative interference is indicated on account of attacks of severe dyspnœa. This is *resection of the isthmus*, with or without the innermost part of the lateral lobes of the enlarged gland, an operation first advocated by Sir Duncan Gibb, and repeatedly performed with suc-

cess during the last few years by Mr. Sydney Jones. The operation is very simple:—The isthmus is carefully isolated. After having been exposed by a median incision, double ligatures are passed round its lateral parts, and the ligatured part is cut out, every bleeding point being secured as it appears. From the deep gutter thus created in front of the trachea, free drainage is secured during the process of healing. The results obtained by Mr. Jones with regard to relief from dyspnœa, dysphagia, laryngeal cough, &c., were very satisfactory. Perhaps the most remarkable result of this operation, however, is the fact that the lateral lobes left behind appear to shrink after the removal of the isthmus. FELIX SEMON.

THYROID GLAND, Injuries and Wounds of the.—Injuries and wounds of the thyroid gland are comparatively rare. When they do occur, other and more important organs (larynx, trachea, carotid artery, jugular vein, vagus, œsophagus) are, usually, simultaneously implicated. The isthmus is exposed to injury during operations performed in order to open the air-passages, and in homicidal attempts. The hæmorrhage which results is sometimes considerable. If the gland be injured by gunshot wounds, there is generally at first parenchymatous bleeding, not rarely violent secondary hæmorrhage. If larger vessels are injured, they should be ligatured if possible; if this, however, is impossible (especially in cases of secondary hæmorrhage), it may be necessary to tie the carotid or the subclavian. In parenchymatous hæmorrhage, digital compression ought to be tried; styptics must, if possible, be avoided, as extensive suppuration may be the result. There is no objection to sutures in incised wounds of the thyroid gland; under antiseptic precautions they often will heal by first intention. In addition to wounds, the thyroid gland is exposed to contusions, which may be followed by subcutaneous rupture of vessels. In all forms of injury, extensive infiltration, partly sanguinolent, partly œdematous, of parts of the gland or of the whole gland, and even of the neighbouring tissues, may ensue. This in turn may lead to active inflammation, manifested by any or all of the symptoms mentioned under that heading. *See* THYROID GLAND, Diseases of the. In the first stage of all injuries of the gland, energetic antiphlogistic treatment (ice, or Leiter's tubes to the neck, &c.) ought to be adopted; should active inflammation occur, this must be treated in the same manner as a common inflammation of the gland.

If, instead of a normal, an enlarged thyroid gland is injured, the chain of events is practically the same, only the symptoms, especially in the cystic forms, may be much more severe. Thus, in consequence of contusion, considerable hæmorrhage may take place into a cyst, leading to rapid and enormous enlargement of the latter, with compression of vessels and nerves, of the trachea, of the œsophagus, &c. Should the symptoms (dyspnœa, dysphagia) in cases of this kind be very severe, it may be necessary to puncture or even to incise and plug the cavity. In cases in which the symptoms are not so severe, the treatment recommended for wounds and contusions of the normal thyroid gland may be adopted. If possible, the bleeding vessels should be tied one by one. If a cyst has been opened by an injury, it will be best to treat it as if the cyst had been intentionally incised. In conclusion, it may once more be stated that all wounds of the thyroid gland in which the air passages have not been opened ought to be treated antiseptically, and that the artificial opening of the air-passages ought to be, if possible, avoided, as the wound becomes speedily septic under these circumstances. FELIX SEMON.

THYROID GLAND, Malignant Disease of the.—The malignant new-formations developing in the thyroid gland may be sarcomatous or cancerous. The causes of their origin are unknown, but it is certain that enlarged thyroid glands are much more liable to malignant degeneration than previously healthy glands. It is not very rare for a goître which has been in existence for twenty years or more, and the progress of which has been entirely arrested for a considerable number of years, suddenly, without any external injury or other evident cause, to undergo malignant change.

Sarcoma of the thyroid gland is comparatively rare. It may be very vascular, and may be either of the spindle, or of the round-celled variety. It develops very rapidly, early infiltrates the skin and the tissues of the neck, though it usually leaves the glands of the neck free, and encircles especially the great vessels. The air- and food-passages, however, are not frequently pressed upon to any serious degree. The reason of this is probably to be found in its very soft consistence, which may actually give rise to mistakes with regard to apparent fluctuation. The growth is very liable to sloughing and ulceration, with violent hæmor-

rhages and putrefaction. High fever and death from the local changes ensue, usually in the course of the first year after the growth has been noticed; in other cases metastatic tumours appear in the lungs and in the liver, and cause death.

Primary cancer of the thyroid gland is by no means so rare as had been supposed up to recent times; especially in goitrous districts it comes comparatively often under observation. *Metastatic cancer* of the gland, on the other hand, does not appear to be frequent. The different forms of cancer which are met with in the thyroid gland are simple glandular carcinoma, epithelioma, and scirrhus. The glandular character, unless masked—as in the scirrhous forms—by proliferation of connective tissue, is very marked. The epithelial type may vary; some forms show more the character of cylinder-epithelial, others of pavement-epithelial, carcinoma.

Sometimes *secondary* tumours are observed, especially in the bones, which marvellously imitate the characters of the primary tumour, and which may attain a very considerable size. In other cases, metastasis occurs in the lungs and other internal organs. The progress of carcinoma of the thyroid gland is, usually, rather slow. There is generally, at first, gradual increase in size of the thyroid body, with occasional lancinating pains and enlargement of the anterior cervical lymphatic glands. After some time, the different organs of the neck are either compressed or infiltrated; the trachea may be displaced and narrowed, the œsophagus greatly compressed, the arteries and veins either compressed or entirely obliterated. The pneumogastric, recurrent laryngeal, cervical sympathetic nerves, and the brachial plexus may be involved.

The *symptoms* vary according to the organs interfered with: if the trachea be compressed, dyspnœa will ensue; if the œsophagus be narrowed, dysphagia will arise. Should the great veins be compressed or obliterated, œdematous swelling of the whole part will be produced; should the carotids be compressed, symptoms of cerebral anæmia may occur.

The nervous symptoms are equally variable. Compression of the sensory nerves of the part leads to very violent pains in the neck, which may also radiate into the occiput, the teeth, the area of the brachial plexus, &c. Compression and gradual destruction of the vagus may cause cardiac palpitation, and paralysis of the vocal cord or cords. *See* Larynx, Neuroses of the. Compression of a recurrent laryngeal nerve leads to paralysis of the corresponding vocal cord, the abductor fibres suffering first. Compression of the cervical sympathetic is the probable cause of the ptosis, sometimes seen on the side corresponding to the side on which the tumour is chiefly developed. Compression of the motor roots of the brachial plexus leads to more or less complete paralysis of the corresponding upper extremity.

Sometimes, there is a period of arrest even after the cervical glands have become infiltrated. This occurs, especially, when calcification takes place simultaneously in the thyroid body and in the affected glands. More frequently, however, the tumefaction steadily increases. Occasionally, adhesions are formed with the skin, which is gradually destroyed, and the tumour fungates. As a rule, however, general cachexia, dyspnœa, impossibility of swallowing, hæmorrhage, perforation of the malignant growth into the trachea or veins, secondary metastases, &c., bring about the fatal end before the tumour breaks down.

The *diagnosis* of carcinoma of the thyroid in its initial stages is not easy. It is always a suspicious circumstance when, in a person above the age of thirty-five, a goitre which has remained stationary for several years begins to grow afresh and becomes painful. The further progress, the usually very great hardness of the tumour, the early dysphagia, the infiltration of the neighbouring lymphatic glands in cases of carcinoma, the almost fluctuating softness in sarcoma, finally confirm the diagnosis.

The only *treatment* which offers any prospect of relief is total extirpation of the diseased organ, and cases in which, at a comparatively early period, the existence of malignant disease has been diagnosed with certainty are, indeed, the only ones in which total extirpation would appear to be justifiable. In not a few cases, however, even of apparently *early* malignant degeneration, the surgeon who undertakes the operation will find the usual difficulties of extirpation increased tenfold, owing to the infiltrating character of the malignant growth. In not a few cases he may be compelled to leave the operation unfinished, owing to involvement of the large vessels or nerves in the tumour; or, on the other hand, to extirpate other parts (larynx, part of the œsophagus, or pharynx), together with the diseased thyroid body.

The *prognosis* is, under any circumstances, most serious. Still, there are several

cases on record in which the patients survived the operation for several months, and as lingering and terrible death is certain unless the diseased gland is removed, the operation, serious as it is, is fully justified.

FELIX SEMON.

THYROTOMY.—This term is used for the operation of laying open the thyroid cartilage in order to gain access to the larynx, less for purposes of facilitating respiration, than with a view to remove any mechanical conditions which may be interfering with laryngeal function or be otherwise dangerous to life. For the former purpose, the proper operation is either LARYNGOTOMY or TRACHEOTOMY.

The *indications* for thyrotomy are not numerous; among these, as the most common may be mentioned—certain cases of foreign bodies tightly wedged in the neighbourhood of the vocal cords, or in the laryngeal ventricles; strictures following ulcerative disease, burns, or other injuries; morbid sessile growths on (and chiefly below) the vocal cords, especially in the case of young and delicate children. Thyrotomy pure and simple is very unlikely to be performed on the living subject, for the cases, in which such an operation is called for, almost of necessity involve the subsequent use of a tracheotomy tube. Hence the question always arises, Shall the entire larynx, including two or three rings of the trachea, be laid open, or shall tracheotomy be performed independently, and, if so, shall this operation be done at the same time as, or a few days previously to, the thyrotomy? Unless there is something specially indicating the latter mode of procedure, the writer would recommend one operation. The chief object of a thyrotomy is to secure a free and full view of, as well as access to, the larynx. This will be best accomplished by opening the entire larynx and upper part of the trachea simultaneously; among other advantages, the alæ of the thyroid cartilage can be more widely separated than when a shorter incision is made.

THE OPERATION.—The patient being anæsthetised, a vertical incision, commencing a little above the pomum Adami, is made through the skin and fascia in the median line of the neck. This must be prolonged downwards to the isthmus of the thyroid gland; the muscles in front of the trachea and cricoid cartilage must be separated and drawn aside; any vessels which are met with must be treated in the same way; the trachea and cricoid cartilage are then incised (*see* TRACHEOTOMY) in the usual way, and a dilator inserted. This proceeding relieves all dyspnœa and any local blood-stasis which may have resulted. In some cases of papilloma, the growth will be visible through the wound at this stage. It may be well now to insert a tracheotomy tube, or a tampon; a piece of india-rubber tubing, of suitable calibre and length, lightly wedged in the trachea with a small bit of sponge to prevent blood trickling down, will be found both handy and efficient. The incision is next prolonged upwards through the crico-thyroid membrane, and thence into the thyroid cartilage, great care being taken to make it *exactly in the median line*. Suitable retractors being now inserted, the surgeon will see whether it is necessary to prolong the incision, and how far. An attempt should be made to preserve the integrity of the cords; if their anterior commissure must be cut, it is desirable to not quite sever the two thyroid alæ. In children and young subjects, in whom the cartilage is still elastic, retraction will accomplish much; but in old people, and in cases where it is necessary to get at the ventricles, or where the growth is very large and sessile, the incision may have to be carried not only through the alæ, but even into the thyro-hyoid membrane. To secure still more room, horizontal incisions may be made through the crico-thyroid and thyro-hyoid membranes, close to the upper and lower borders of the thyroid cartilage respectively. Bleeding vessels should be caught up and tied one by one: as a rule, the hæmorrhage is not great, and is easily arrested provided there is free respiration. In old people, the cartilages are so ossified that a fine saw is required to cut through them.

The subsequent steps of the operation will be determined by the nature of the lesion. If a foreign body, such as a piece of mutton bone, be found impacted in the ventricle or between the cords, or partially embedded in the wall of the larynx, it must be carefully enucleated and any necrosed tissue around it scraped away. If a new-growth be found, it must be eradicated in one way or another. In operating on a child for extensive papilloma recently, the writer found it very difficult to seize hold of the growth, owing to the reflex excitability which the approach of an instrument set up, notwithstanding deep narcosis. The use of cocaine in such cases will materially aid the surgeon, and permit him to ascertain accurately the exact mode

and place of attachment. Evulsion with forceps is to be deprecated, for fear of injuring the vocal cords. If the growth is pedunculated there will be no difficulty: it may be snipped off with a pair of fine curved scissors. In young subjects, the growths are usually sessile and often multiple; they must be caught up with forceps, one at a time, and snipped off with fine scissors curved on the flat, as near to the base as possible, which should then be touched with chromic acid. In cases of laryngeal cicatrix leading to stenosis, with or without implication of, or adhesions between, the cords, no exact line of practice can be laid down. In one case seen by the writer there appeared to be a kind of keloid in the cicatrix, and the aphonia which had existed appeared to have been due to displacement of one vocal cord from this same cause.

After the removal of the foreign body or the morbid growths, and the arrest of all hæmorrhage, the edges of the thyroid cartilage are to be most carefully adjusted, for on this depends much of the success of the operation. Two or three fine silver-wire sutures should be used; they need not penetrate through the entire thickness of the cartilage. The skin-wound should be sutured separately, and then covered with a pad of wet boracic lint. A tracheotomy tube must be left in the lower part of the wound.

After-treatment.—Too great care cannot be exercised to keep the patient absolutely quiet. All attempts at speaking must be disallowed until firm union has taken place; coughing is very prejudicial, for the increased volume of air forced into the larynx, even while a tube is worn, is very apt to burst the alæ of the thyroid cartilage apart. Let the patient be provided with a slate and pencil, and make known his wishes in writing. The croup bed, with a supply of steam (as described in the article on Tracheotomy), together with sedative inhalations, will be found of great advantage. Similar *complications* to those which follow tracheotomy may possibly occur, but they are much less frequent.

Prognosis.—The great danger of permanently interfering with vocalisation is a strong contra-indication to thyrotomy: hence the operation must never be undertaken when other measures are available. For morbid growths, the intra-laryngeal method of removal is now advocated by the best laryngologists, even in quite young children. Persistence and manual dexterity, they say, generally accomplish the desired end. The time, however, which is required for the repeated trials, not altogether free from danger, the risk of converting simple into malignant growths by the long-continued irritation, the chance of failure in the end, the necessity, in many of the cases, for wearing a tracheotomy tube to relieve the dyspnœa, with all the risks which this entails, in the writer's opinion, render the more radical operation preferable, in the case of children at any rate. The improved methods of operating, the local anæsthesia, the more certain attainment of healthy healing, the knowledge gained by past experience and failures, render the re-consideration of the intra- and the extra- laryngeal methods for growths desirable. *See* Larynx, Growths in the.

Robert William Parker.

TIBIAL ARTERIES. — The Posterior Tibial Artery runs from the lower border of the popliteus muscle, two and a half inches below the knee, downwards between the muscles of the calf and the deep group; it ends on the inner side of the ankle as low as a line drawn from the internal malleolus to the internal tuberosity of the os calcis.

The coverings, posteriorly, are the skin, superficial fascia, the muscles of the calf for the upper three-fifths of the leg; but at the lower part the cutaneous structures only. On the artery is the posterior tibial nerve, which is first on the inner side, then on the top, and finally on the outer side, at the ankle. Anteriorly, the vessel rests on the tibialis posticus, the flexor longus digitorum, the tibia, and a fatty envelope separating it from the ankle. Venæ comites accompany it. Around the artery and veins is a sheath continuous with the deep fascia of the leg.

Ligation of the artery is performed for wounds only. The wound is taken as the guide, and incisions made from it in the course of the artery. On the dead body the following are practised.

1. *To Tie the Artery in the Upper or Middle Third.*—Ligation of the lower third of the popliteal may be done by a similar operation to that of the upper third, except that the incision is made behind the internal tuberosity of the tibia, and the soleus is not cut through.

Place the patient on the back, semi-flex the knee, and abduct the limb. The operator stands upon the outside of whichever limb is being operated on. Make an incision one finger's breadth behind the internal border of the tibia, opposite the upper

or middle third of the tibia—say the middle. Cut through skin; superficial fascia, avoiding the internal saphenous vein; the deeper fascia; pull back the free exposed edge of the gastrocnemius; detach or cut through the soleus; pull the nerve backwards, open the sheath, disassociate the veins, and pass the needle from behind forwards—i.e. between the nerve and the vessels. The soleus muscle requires attention. On dividing the soleus parallel to its fibres, an aponeurotic sheath is reached, tense and pearly; when this is cut through, muscular fibres are again found, and require separating before the deep fascia of the leg, covering over the deep muscles and enclosing the tibial vessels, is reached. The muscular fibres upon the under or anterior surface of the soleus increase in number from above downwards.

2. *At the lower third of the leg* the artery is covered only by cutaneous structures, and is easily reached. Lay the foot on its outside; point the toes; make an incision over the lower third of the artery midway between the inner border of the tibia and the inner border of the tendo Achillis. Here the artery is found with a fatty surrounding, the nerve lying upon it or just to its outside.

3. *At the ankle* the artery is reached by a curved incision two inches long, and three-quarters of an inch behind the internal malleolus. In addition to the structures met with above are:—the internal annular ligament, a plexus of veins of the internal saphenous, and the venæ comites remarkably large. The posterior tibial nerve is one-eighth of an inch to the outer side.

The Anterior Tibial Artery runs, from the bifurcation of the popliteal at the lower border of the popliteus muscle, forwards over the top of the interosseous membrane between the tibia and fibula. From thence it runs down upon the interosseous membrane in a line from the head of the fibula to the middle of the ankle.

Coverings.—There is but little fat present in the superficial fascia, in which are branches of the internal and external saphenous veins and nerves; the deep fascia is tightly fixed above, below, and to the bony ridges laterally; the muscles are, from within outwards, the tibialis anticus, the extensor proprius pollicis, the extensor longus digitorum.

Lateral Relations.—In the *upper* fourth the artery has the tibialis anticus on the inner side, the extensor longus digitorum outside. In the *middle* two-fourths the artery has the tibialis anticus internally, and the extensor proprius pollicis externally. Just above the ankle the artery has the extensor proprius pollicis within, and the extensor longus digitorum without. The *anterior* relations are the coverings; the nerve is at first to the outer side, then it lies on the artery, and at the lower part is slightly outside again; the tendon of the extensor proprius pollicis crosses the artery just above the ankle. *Posteriorly*, the artery rests on the interosseous membrane above, and the tibia below for the lower fourth of its length.

Ligation of the vessel is performed for wounds of its trunk, and the operation is performed according as the wound is placed. The dead body operations are:—

1. *In the Upper Third.*—Semiflex the leg on the thigh, let the sole of the foot rest flat on the table, and adduct the knee slightly. In operating stand in front and make an incision in the guiding line for a distance of four inches. Cut through skin and superficial fascia. Then comes the question about the white line to be seen in the deep fascia; do not expect to see this white line, but cut through the deep fascia by an obliquely longitudinal cut or a crucial incision, and find out with the handle of the scalpel or director the separation between the muscles. Now flex the foot to relax the muscles, pull the lateral muscles outwards and inwards, open the sheath, avoid the nerve on the outer side, and pass the needle.

2. *In the Middle Third.*—Proceed in precisely the same way as above until the deep fascia is reached, when it is opened by a crucial cut. Then flex the foot on the leg, find the outer border of the tibialis anticus, and, entering the partition between it and the easily recognised tendon of the extensor digitorum, find the extensor proprius pollicis muscle. Pull the latter muscle outwards: carefully also pull the nerve to the outer side, open the sheath, and pass the needle.

3. *In the Lower Third* the artery is reached by an incision in the guiding line, which corresponds with the outer side of the tendon of the tibialis anticus. Do not carry the incision so low as seriously to cut the anterior annular ligament. The artery may be reached by pulling the exposed extensor proprius pollicis outwards or inwards. The nerve is pulled outwards as the needle is passed.

James Cantlie.

TIBIAL ARTERIES, Wounds of the.—Severe arterial hæmorrhage from the leg commonly occurs from the tibial or peroneal arteries, and may be considered as

arising under two distinct conditions—(1) hæmorrhage following amputation of the leg; (2) hæmorrhage following injury to the vessels in continuity.

(1) *Hæmorrhage following Amputations.*—Primary hæmorrhage occasionally gives rise to serious trouble in amputations of the leg, especially when performed through the upper third. This trouble does not, as a rule, occur in healthy subjects, but only in those whose arteries are brittle from atheromatous disease. The difficulty is a mechanical one, arising from the arteries lying between the bones rendering them difficult to seize with a forceps and to secure with a ligature. If the arteries are healthy, they may be drawn down somewhat, and by a little manipulation securely tied; but when diseased, they may be so brittle as to break away on each attempt to apply a ligature, making it impracticable to restrain hæmorrhage in this way, and necessitating an immediate amputation above the knee.

(2) *Hæmorrhage from Wounds of the Tibials in continuity.*— There are three chief varieties of wounds of the arteries of the leg—(1) incised wounds; (2) punctured wounds; (3) injury by a fractured bone.

Incised Wounds. — In these circumstances there can be no doubt that the bleeding vessels should be sought for and tied, for here, owing to the nature of the injury, the exact locality of the injured vessels is easily determined.

Punctured Wounds.—These, if occurring through the thick part of the calf or leg, give rise to serious questions in the matter of treatment.

Unpromising as the treatment may appear owing to the depth of the vessels, pressure and bandaging should be tried in the first instance, and cases are recorded in which this method has proved successful. For instance, in one case in which both tibials were wounded, it is mentioned that, 'on relaxing the tourniquet, and retracting the lips of the wound, the blood jetted up in several directions. It was found impossible to ligature the vessel without enlarging the wound to a considerable extent.' The limb was, therefore, bandaged from below upwards, and the patient recovered without further hæmorrhage. Again, another interesting case is recorded, in which a musket ball passed through the leg of a soldier three inches below the knee. Violent secondary hæmorrhage occurred, leaving the patient almost pulseless. The hæmorrhage was permanently arrested by pressure and bandaging, and the man recovered. Such cases are encouraging, and at least indicate that a trial of pressure should be made. Should pressure fail, or a traumatic aneurism form, operative procedures must be resorted to.

In the lower third of the leg, where the vessels are superficial, the wound should be enlarged, and the vessel sought for and tied; but, in the upper part of a thick limb there is some question whether the enlargement of the wound is the best form of treatment.

If the wound has been inflicted by a long narrow missile or instrument, the position of the bleeding vessel is often doubtful, for the puncture may run obliquely in any direction; and it is even possible that the divided artery may be on the side of the interosseous membrane opposite to the external wound. Dupuytren, when writing of a case of hæmorrhage from the calf caused by a pistol ball, thus describes the difficulty:—'Should a ligature be placed on the ends of the divided vessels? But, what were those vessels? Was it the anterior or posterior tibial, or the peroneal, or the popliteal? Was it several of them at the same time? Should they be attacked before or behind?'

Billroth, in his letters from the seat of war, draws a graphic picture of the difficulties, and in some cases the impossibility of tying a vessel in a granulating wound. He concludes by saying that in most of such cases, after much loss of blood has been incurred in the attempt, the main artery has, after all, to be tied. Beck and Stromeyer also congratulate themselves on the successful result of ligature of the main vessel.

The writer can verify the opinion of these eminent authorities by what occurred in a case where he was present, in which the posterior tibial was sought for and tied in a punctured wound in a large calf. The operation was a most severe and prolonged one, and, although with the greatest difficulty the vessel was ultimately found, the patient never recovered from the shock of the operation, dying on the third day.

Of course, it may occasionally happen that hæmorrhage from the calf occurs from punctured wounds, which, from the nature of the instrument inflicting them, cannot be very deep. In such cases, the wound may be enlarged and the vessel sought for, but if the calf be thick and muscular, and if there be violent hæmorrhage from a punctured wound of unknown depth; or should bleeding occur from the bottom of a deep granulating wound, and the hæmorrhage cannot be restrained by pressure, the main artery of the leg in the nearest accessible

position—namely, in Hunter's canal—may be ligatured with a fair prospect of success.

Wound from a Fractured Bone.—It has been taught, by an eminent authority on modern surgery, that a fracture of the leg with laceration of the tibials is a case for immediate amputation, but when such surgeons as Cæsar Hawkins, Dupuytren, and Syme have successfully treated cases of simple and compound fracture, with hæmorrhage from one of the tibials, by the Hunterian operation, it cannot be admitted that all such accidents should be treated by amputation. If the patient be young and healthy, and the soft parts but little damaged, it would certainly be right to attempt to save the limb by compression or ligature of the main vessel. In an old person or one in whom the skin and soft parts were much involved, doubtless the right plan of dealing with the accident would be by immediate amputation. HARRISON CRIPPS.

TINEA FAVOSA. *See* FAVUS.

TINEA TONSURANS (*Synon.* Ringworm; Herpes Tonsurans; Tinea Circinata).

Definition.—Tinea tonsurans is a contagious disease, chiefly attacking the scalp in children, and producing partially bald scurfy patches. It is caused by a vegetable parasite called trichophyton tonsurans.

Ringworm was first noticed by Willan under the name porrigo scutulata, and was subsequently very accurately described from a clinical point of view by several writers, especially Plumbe and Mahon, before the pathology of the disease was discovered by Gruby in 1844. His discovery that the disease was due to a minute vegetable parasite was quickly confirmed by others, and has ever since been generally, though not universally, accepted by the profession. The same parasite is now known to produce the less common forms or rather distributions of ringworm, called parasitic sycosis and parasitic onychia.

Symptoms.—Tinea tonsurans on the hairy parts presents features somewhat different in appearance from the same disease when seen on other parts of the body, and therefore a brief description of each is necessary. *On the scalp*, it is commonly met with in the form of roundish scurfy spots, which itch slightly; rarely, a few small vesicles are seen round the margin of the spots. Soon the hairs begin to be affected, they lose their lustre and break off near the scalp so as to produce partially bald patches, the short, stumpy, broken hairs being visible over the part affected; these stumps, which have frayed or bent and twisted ends, are of a rather darker colour than the healthy hairs, and give to the disease its characteristic feature. The general appearance of the patch, before it has undergone any treatment, has been not inaptly compared to the skin of a plucked fowl. On the scalp, ringworm spots sometimes occur singly; more commonly there are several, of sizes varying from a threepenny to a crown piece or larger; the larger patches often lose the rounded form. In some instances the patches spread rapidly at their margins, in others the process of development is comparatively slow. In addition to the breaking of the hair near its root, which is the *rule* in ringworm, there is also sometimes a shedding of the hair—that is, the hairs fall out with their roots attached; this is, unfortunately, quite exceptional. When it does occur thoroughly the disease gets well quickly, for with the complete shedding of the hair the fungus is also removed. Ringworm is quite unsymmetrical in its distribution, the spots being scattered about the head with marked irregularity; this is quite in accordance with the fact that it is strictly a local affection. Of course, in neglected cases the disease must tend to become symmetrical by the simple process of spreading over the scalp.

Tinea tonsurans of the hairy parts of the face is far from common; it now and then attacks the eyebrows of children who are suffering from ringworm of the scalp, but it is not very clear why this does not often occur; it is, in fact, rarely met with. Ringworm of the beard, constituting the parasitic sycosis of writers, is also a rather rare disease; when met with, it will generally be found that the sufferer is the father of children who have ringworm of the scalp. When the disease attacks the hairy parts of the face in adults, it causes more vesicular inflammation of the skin than is usually seen on the scalp in children, and for this reason is more likely to be mistaken for eczema. The diseased hairs sometimes fall off, but do not break off so readily as they do on the scalp, and therefore one valuable diagnostic mark is often absent. The patches spread at the margin and have a tendency to heal in the centre, and thus a ringed or serpiginous appearance is produced, which resembles a healing psoriasis. A similar condition is sometimes produced by ringworm about the pubes and scrotum, though in this country it is far from common in that region. All forms of ringworm of the hairy parts of the body are extremely

chronic and difficult to cure. When the disease spreads about the nates, as it sometimes does in those who follow sedentary occupations, such as shoemaking, and who sweat easily, it presents a well-defined raised margin, and hence was formerly called eczema marginatum, a term which ought now to be dropped out of use.

Tinea tonsurans of those parts of the body on which the hair is but little developed—such as the neck, trunk, and extremities—differs in appearance from the same disease on the scalp. On the body it is often called tinea circinata, but the name tinea tonsurans is to be preferred. It is usually seen in an early stage as a small round patch, or patches, of a slightly scaly appearance and of a pale red colour, with a sharply-defined and brighter red margin, which is a little more raised than the rest of the patch; as the patch increases in size, the central part assumes a comparatively healthy appearance, so that the spot becomes ring-like. Now and then a ring of small vesicles can be seen round the margin, and occasionally, though rarely, one ring forms within another, spreading apparently from a small central vesicle, and thus the so-called tinea tonsurans iris is formed. The general appearance of ringworm of the body is that of rounded patches of dry eczema with a well-defined margin and an unsymmetrical distribution; the itching is usually slight. Ringworm of the body is more difficult to diagnose than the same disease of the scalp, but is of much less importance, and is easily and quickly cured.

Morbid Anatomy of Tinea Tonsurans. For a general examination of the scalp, all that is required is a good-sized common magnifying glass; with this the diseased spots can be easily examined for affected hairs; two or three stumps should then be removed with a pair of forceps, and placed in a drop of liquor potassæ on a slide under thin glass, and examined with a good quarter-power under the microscope. The shaft of the hair will then be seen to be infiltrated and more or less split up with minute, round, bead-like bodies of about $\frac{1}{5000}$th of an inch in diameter; these are the *conidia*, or *spores* of the fungus, and, in addition, very fine filaments or threads may be seen permeating the shaft of the hair. These threads are the *mycelium*; they are not quite so easily distinguished as the conidia. Dr. Frederick Taylor's observations lead to the conclusion that the fungus does not usually extend downwards beyond the upper part of the bulb of the hair, and that, laterally, the spread of the fungus is limited to the inner root sheath, the *outer root sheath*, the *papillæ*, and the *walls of the follicles* being free from fungus. Clinical observation would tend to confirm Dr. F. Taylor's microscopical observation, for when *all* the hairs fall out over a patch of ringworm (as happens sometimes naturally and sometimes from artificial causes), leaving smooth, perfectly bald patches, the ringworm is entirely cured by the complete removal of the fungus; this could hardly be the case if the fungus extended much beyond the limits assigned to it.

Etiology.—It is now generally admitted that the *trichophyton tonsurans* is the essential cause of ringworm in all its forms, and that the disease is highly contagious, especially amongst children. Although it is very natural to suppose that the spores of ringworm might be transmitted through the air and thus reproduce the disease, yet there is very little evidence to show that this is really the case. The effect of implanting the fungus on a suitable soil is that it grows quickly, and in a few days may set up a little local inflammation, which is the first noticeable sign of the disease. If the soil is unfavourable, the growth of the plant is more slow, or it may even fail altogether, as is no doubt generally the case with adults. As a rule, when overlooked, it spreads rapidly in schools and amongst the younger members of a family, while those over the age of sixteen or seventeen often escape altogether. There is a prevailing opinion that young infants are not so susceptible of the disease as older children; they are, however, quite as susceptible, but they are generally washed all over once or even twice a day, and therefore the spores have not the same opportunity of taking root; moreover, in infants, in consequence of the poorly-developed hair, the disease is easily cured by very mild home remedies without medical help. Mothers, for example, among the poorer classes in London, are quite successful in curing ringworm on babies with common ink, though they fail entirely with the older children.

It is not very easy to explain why ringworm should be much more common in some parts of Europe than in others. It is perhaps most common in England, and least common in Northern Germany. The most reasonable explanation appears to the writer to be, that a humid climate with a mild winter is favourable to the development of the disease.

There is very little doubt that tinea tonsurans is not confined to human beings,

but is also occasionally met with in the domesticated animals. The writer has met with several instances where the disease has spread from cattle to the arms and hands of men tending them; in all these instances the ringworm has been of a severe type, and has given rise to much inflammation.

The differential diagnosis of tinea tonsurans on the scalp is usually very easy. The scurfy, partially bald spot with short, bent, stumpy hairs is very characteristic, and in doubtful cases the microscope will always determine the point. On the hairy parts of the face the diagnosis is much more difficult, and a microscopical examination of hair is always necessary.

Under some circumstances, the diagnosis of ringworm of the scalp is a little difficult: (1) when complicated with moist eczema or impetigo, so that the hair gets matted together; (2) when the hair is shed very rapidly, leaving smooth bald patches, very like those of alopecia areata. In both these cases we must chiefly depend on a careful examination of hairs under the microscope.

When the ringworm is confined to the non-hairy parts of the body, the diagnosis is sometimes difficult. The patches look like dry scurfy spots of eczema or psoriasis; but, unlike these diseases, ringworm often consists of a single round spot spreading from a centre, and, even when several spots exist, they are generally arranged in an unsymmetrical manner. Again, the ringworm spot has a very narrow, slightly raised margin, often of a brighter colour than the rest of the patch; this bright edge is very characteristic of the disease. If the disease has not been treated in any way, some of the scales may be scraped off and examined in liquor potassæ under the microscope.

Treatment of Ringworm.—The number of different remedies that have been discovered from time to time for the cure of ringworm of the scalp is almost endless. Those that have been recommended by experienced observers are all good remedies, but they are not all equally good, therefore the business of the medical man is to choose the most suitable one for the case before him, being guided in his choice by the circumstances of the case, such as the duration and extent of the disease, and the age of the patient. Whatever discoveries may hereafter be made with regard to new remedies, the difficulties will always remain, and well-established ringworm will always be a tedious disease to cure. The difficulty arises entirely from mechanical causes, which make it next to impossible to get the remedy in contact with the disease, this being, metaphorically speaking, under ground. The importance of this mechanical factor in the problem is well illustrated by the fact, that no disease is more quickly or easily cured than ringworm of the non-hairy parts of the body. In consequence of the very tedious nature of this disease on the scalp, patients often become the prey of quacks, in the vain hope that ignorant humbug will be successful where honest science has failed.

The *treatment* of ringworm in a very early stage is very simple, and consists in painting all the spots well over with the strong acetic acid. If the glacial acid is used it must be diluted with two parts of water, and applied carefully. If the ringworm is strictly confined to the surface, it may sometimes be cured in a few days by the strong acetic acid. Unfortunately, it very rarely is confined to the surface of the scalp, and therefore, after the acetic acid has been used for a week or fortnight, it should be discontinued, the sore places should be allowed to heal, and then a different plan of treatment should be adopted—namely, the inunction of an ointment. Of all the ointments that have been recommended, the writer has no hesitation in saying that the oleate of mercury is the most generally useful. It should be made by Dr. Shoemaker's double decomposition process. The pure oleate of mercury should be dissolved in melted benzoated lard, the temperature of which must not be much raised; the ointment may by used of different strengths according to circumstances, ranging from ten to twenty per cent. Before the treatment by ointment is begun, the hair should be cut quite short all over the head—as short indeed as is possible with a pair of scissors; this is better than shaving the head, because the spots of ringworm can be distinguished better when the head is not shaved. When the hair has been removed, the ointment should be *well rubbed* on all the spots night and morning. When an ointment is used, the head should not be washed oftener than once a week; if a lotion is used, it may be washed much oftener.

After the ointment has been used for some weeks, the process of epilation may be commenced, provided a fair number of hairs can be extracted entire: if nearly every stump breaks, it is useless to continue the process, but it should be tried again from time to time. The best plan of extracting is to take several hairs together,

and pull them steadily in the direction in which the hair grows; it is more easy to get them out this way than any other. If a mercurial ointment is inadmissible, the ointment of sulphurated potash of the P.B. may be used, but it must be often renewed, as it keeps badly. The oleate of copper ointment, of strength from one to three drachms to the ounce of lard, is a useful ointment and quite safe, but inferior to the oleate of mercury ointment; the bright colour is also a slight objection. Of lotions, that suggested by Dr. Cavafy is one of the best and least disagreeable, and is especially useful when the ringworm has spread rapidly over a large area, and is not of very long standing. By means of the lotion the area of disease may be greatly reduced, and then the obstinate spots may, if necessary, be dealt with by more vigorous treatment. The formula for the lotion is boracic acid ʒj., ether fʒj., rectified spirit to fʒvj. The lotion should be well applied with a small sponge two or three times a day. When using this lotion, there is no objection to the head being washed daily with warm soap and water, provided it is always carefully dried afterwards.

Disseminated ringworm is a very chronic form, in which the disease is scattered over the head in small groups or as single stumps, entirely concealed by the healthy hair round. This form of the disease requires especial care in its recognition and treatment, and can only be dealt with by Dr. Alder Smith's method, which he thus describes:—'In some inveterate cases —which have resisted the action of parasiticides—where all the patches have disappeared and the disease has passed into the *disseminated variety*, I believe the best chance of a cure is to subject the entire scalp to a very close examination with a lens, and to place, by aid of a *very* fine sable brush, a *minute* drop of croton oil wherever the isolated stumps or black spots can be seen. (A case where black dots are observed is one of the most difficult to cure.) If there are only a limited number, the oil can be pressed *into* the follicles by running the point of a very fine blunted gold pin into them by the side of the diseased stumps. The oil usually causes a pustule, and the loosened stump comes out with the discharge, or can afterwards be removed with a pair of forceps.'

The complications of ringworm are not many, but they are important—(1) Eczema and impetigo, (2) Kerion. Eczema and impetigo of the scalp are very troublesome additions to tinea tonsurans, for they not only prevent the necessary treatment of the latter disease being carried out properly, but they often favour the rapid growth of the trichophyton. The best plan, under these circumstances, is to dry up the eczema as fast as possible, and when that is cured, deal with the ringworm chiefly by mild remedies, such as boro-glyceride and the extraction of the hairs by the forceps.

Kerion is a peculiar circumscribed swelling of the scalp due to an acute inflammation of the follicles, which become dilated and discharge a sticky fluid. The portion of the scalp affected forms a soft raised swelling, which feels boggy to the touch, and strongly suggests a subcutaneous abscess; and under the erroneous impression that this is the case a kerion has often been cut into, to the disappointment of the surgeon, who finds nothing. The kerion should be simply treated with a little lead lotion on lint, and when the inflammation subsides, the hairs over the part affected fall out and the ringworm is cured.

The preventive treatment of ringworm is very simple, but often very important in large families of small children. The writer, in common with others, formerly recommended carbolised glycerine and carbolised oil as preventives, but a more extended experience has satisfied him that these remedies are needless and disagreeable, and do not always answer the purpose intended; indeed, *nothing sticky or greasy* should be used. The best plan is to keep the hair very short and the head well washed every day with warm water and soap; this keeps the skin and hair dry, and at the same time hardly allows time for the ringworm to get established.

Medical Certificates.—It cannot be denied that it is often very difficult to say whether a case of ringworm is absolutely cured, so as to justify a *formal certificate* to that effect. This is not surprising, when it is remembered that a single remaining stump containing spores may form a centre from which the ringworm may break out again, perhaps weeks or months after it was believed to be cured. Even the most skilful and careful medical men must sometimes make mistakes in this matter. But besides these excusable mistakes, there are many more made from want of experience and want of care. No formal certificate ought, of course, to be given that a case of ringworm is cured without a most careful examination. Very unfair pressure is often brought by parents to bear on medical men, in order to induce them to give certificates prematurely that children are perfectly

cured and may return to school without risk to others. There are of course different degrees of risk; the greatest occurs in elementary boarding schools, where the children are young and consequently very susceptible, and have bedrooms in common, and where there is more or less indoor romping. Under these circumstances, even when the treatment is carefully carried out, there must be risks of the disease spreading. In the case of day-schools where the children do not play or sleep together, the risk, under careful treatment, is much diminished. In the case of lads of fourteen or fifteen under good treatment, who have separate bedrooms and studies, and whose active association with other boys is chiefly in outdoor games, the risk is reduced to a minimum; but in all cases it is the duty of the medical man to withhold a *formal certificate*, however slight the risk may be, until the case is quite cured. ROBERT LIVEING.

TINEA VERSICOLOR. *See* PITYRIASIS VERSICOLOR.

TINNITUS. *See* EAR, INTERNAL, Diseases of the.

TOES, Amputation of the. *See* FOOT, Amputations in the.

TOES, Dislocations of the. *See* FOOT, Dislocations of Bones of the.

TONGUE, Diseases of the.—The diseases of the tongue will be treated in the following order:—

1. Congenital defects: atrophy; hypertrophy; tongue-tie. 2. Inflammatory diseases: acute glossitis; chronic superficial glossitis. 3. Leucoplakia (ichthyosis). 4. Eruptions or rashes: aphthæ; wandering rash. 5. Pigmentary affections. 6. Neuralgia: paralysis. 7. Tuberculous disease. 8. Syphilis. 9. Non-cancerous tumours in and beneath the tongue. 10. Cancer.

ATROPHY of the tongue may occur as a consequence of lesions affecting its motor nerve-supply. The wasting may be unilateral or symmetrical, and the degree to which it occurs will vary very much in correspondence with the cause. In ordinary hemiplegia the wasting may be scarcely noticeable; while, on the other hand, in disease of the medulla oblongata involving the hypoglossal nucleus, or after injury of the hypoglossal nerve, the atrophy may be considerable. The disease requires mention only here, as no question arises with respect to surgical treatment.

Congenital absence of the tongue is excessively rare, as are also defects of development to a less extent, in the form of fissures or clefts.

HYPERTROPHY OF THE TONGUE (*Macroglossia, Prolapsus Linguæ*) is a comparatively rare disease. Almost always beginning as a congenital affection, and in its early stages often overlooked, it may increase in severity until the tongue becomes too large to be retained within the mouth. It may even project beyond the level of the lips for two or three inches; the increased growth being helped by the irritation to which the organ becomes subject by its protrusion from the mouth, and its greater liability to be injured by the teeth. The hypertrophy may affect both sides symmetrically or one side more than the other. In the more severe cases, from exposure and constant irritation the mucous membrane becomes thickened and callous, and in some parts ulcerated from pressure on the teeth. The latter, after a time, become everted, from the constant pressure to which they are subject. In an extreme case, recorded by Chalk, the hypertrophied tongue had caused, by its weight, dislocation of the lower jaw.

The disease appears to be essentially a species of elephantiasis, consisting, as it does, of an overgrowth, especially of the lymphatic tissues of the organ. It is almost invariably an affection of infancy and early childhood. In Fairlie Clarke's table of forty-three cases, recorded by various observers, the disease was first noticed either at birth or before the age of six years in all but one; and in this instance the disease originated in mercurial glossitis and was therefore possibly not a true lymphangeioma.

Treatment.—The best and only reliable treatment is excision of as much of the enlarged organ as may be necessary for enabling it to be retained within the mouth. The operation may be performed by the knife, écraseur, or galvano-cautery. The écraseur is probably the best. A couple of broad curved needles should be made to perforate the tongue immediately in front of the proposed line of section, and the wire or whipcord should be looped over and behind them. The after-treatment will be the same as after excision of the tongue for cancer. *See* MACROGLOSSIA.

In mild cases benefit has accrued from direct pressure by strapping; and in a case of Teale's by pushing the tongue back within the mouth, and keeping it there by an elastic band under the chin. But such measures are of very uncertain benefit.

True hypertrophy must not be confounded with the protrusion of the tongue sometimes seen in idiots and in cases of sporadic cretinism.

Tongue-tie.—Undue shortness of the frænum linguæ is indeed a very rare affection. When it exists, the tongue cannot be protruded as far as the lower lip, and the act of sucking may be interfered with.

Treatment.—A snip of the frænum with blunt-pointed scissors is all the treatment required; the scissor-points being directed away from the under-surface of the tongue and towards the floor of the mouth, in order that the ranine artery may not by any chance be wounded. Before the application of the scissors the frænum should be stretched, either by the finger and thumb, or by means of the notched shield with which silver directors are usually provided.

Cases have been related in which the too free division of the frænum and subjacent structures has led to the sucking back of the anterior part of the tongue into the fauces, and consequent suffocation. It is difficult to believe that any such event could happen as the result of the operation, if properly performed. Similar accidents from undue length or absence of the frænum, or from malposition of the tongue, with defective development of the lower jaw and floor of the mouth, have been also recorded.

Acute Glossitis.—Acute inflammation of the tongue may arise from direct injury, especially when accompanied by the introduction of some irritating or septic matter, as from a wasp-sting, or from puncture by a foul knife, from exposure to cold, or from the undue administration of mercury. It may occur also as a sequela of the eruptive fevers.

At first œdematous and thickly coated, the tongue becomes swollen and acutely tender. Subsequently, it may become dry and red, or even black. Besides filling the mouth, or nearly so, on its own account, it is commonly pushed up to the palate by inflammatory swelling of the subjacent parts. Unable to protrude or even move it, the patient is also more or less incapable, in a severe case, of speaking or swallowing, while respiration may be also much impeded. If unrelieved, the tongue may protrude beyond the level of the teeth.

Acute glossitis may end by gradual resolution, or by more or less well-defined suppuration; the symptoms being at once relieved on the escape of pus from the tongue itself or from the tissues beneath. In very rare cases the inflammation may end in sloughing.

Treatment.—In a mild case of glossitis a saline purge should be given, followed by a draught containing gr. x.–xx. of chlorate of potash every four hours. The mouth should be frequently rinsed with a warm lotion of permanganate or chlorate of potash, or with a weak solution of carbolic acid (about 1 to 100).

If the swelling increase, the interior of the mouth should be carefully examined for any signs of localised suppuration; and a suspicion of fluctuation at any spot should be cleared up by puncture with a narrow abscess-knife, the operator having regard to the position of the main blood-vessels. If no sign of pus be detected, an incision of an inch or more in length should be made in the dorsum of the tongue, through the mucous membrane, on each side of the middle line; or the tongue may be punctured in several places. The incisions or punctures should be made sufficiently forward to be within reach in the event of undue bleeding. When the presence of pus is suspected, but where there is nothing to indicate its exact seat, a deep puncture may be made somewhere in the middle line either of the tongue or the anterior part of the floor of the mouth, and through this a probe-pointed steel director may be introduced for exploration. When the swelling is more especially in the sublingual tissues the exploratory puncture in the middle line may be made from without, between the chin and hyoid bone.

The more acute symptoms are usually relieved by the means just referred to; but the surgeon should be prepared, in a bad case, to perform laryngotomy or tracheotomy.

Chronic Superficial Glossitis.—*Glossy Tongue* (including so-called *dyspeptic ulcers*).—This is a very common disease; the morbid appearances presented by the tongue being due to repeated attacks of subacute inflammation, affecting the mucous membrane and submucous tissue. It is generally supposed to be, in most cases, of syphilitic origin; but we believe this to be a mistake, and that syphilis is accountable for only a minority of the cases observed. In the majority of cases of the disease, which is one chiefly of middle life, the predisposing causes are to be found in dyspeptic conditions, especially those which are the result of injudicious eating and drinking, while the disease is excited by local irritation—e.g. smoking, spirit-drinking, carious and foul teeth, and the like.

Sometimes, no sufficient cause can be discovered; but the disease will be always found to be aggravated by local irritation.

The appearances presented by the disease are very characteristic; the leading feature being an excessive smoothness or glossiness of the surface, as if all the papillary structures had been rubbed away. At one part the smooth surface of the tongue is red and as if raw; at another, not red but whitish, as if smeared with milk, or as if it had been touched with a solution of nitrate of silver. At another, there may be small, superficial, yellowish ulcers, or an irregular ulcerated surface, excessively tender to the touch or to anything hot or irritating. When at its worst the whole tongue may be swollen, and indented at the edges by the teeth. Here and there, remains of the proper papillary structure may be still visible.

The patient complains of much superficial pain and soreness, especially in the movements of the tongue in speaking or eating.

The microscopic characters of the disease are what might be anticipated from the naked-eye appearances. 'Expressed shortly, the changes consist in thinning of the epidermis, with destruction of the papillæ and other appendages; in thickening and increased vascularity of the corium, and infiltration of its superficial layers with nuclei or cells' (Butlin, *Med.-Chir. Trans.*, vol. lxi.).

Treatment.— Chronic superficial glossitis is a very intractable malady, and treatment should be directed rather to removing all the causes of an attack, and so preventing its recurrence, than to giving medicines with an expectation of quickly curing the disease by a specific. The mistaken notion that the disease is almost always syphilitic has had much to do, probably, with failures in treatment. The patient should live regularly and wholesomely, avoiding all spirituous liquors, and taking alcohol in any form with great moderation. He should not smoke; and if the teeth, natural or artificial, are not perfectly smooth and clean, he should have them made so as far as possible. Aperients (as blue pill and colocynth), with an occasional saline draught, should be taken, and any dyspeptic troubles should be treated.

The mouth should be rinsed occasionally with a weak carbolic lotion containing tincture of myrrh and eau-de-Cologne; and any ulcerated surface may be painted with a solution of sulphate of copper (gr. iij. to f℥j. of water), or chromic acid (grs. x. to f℥j. of water).

As a rule, the administration of iodide of potassium or of mercury will do no good, and may even do harm. But as it is not easy in all cases to distinguish simple superficial glossitis from that which has a syphilitic origin, these drugs should be tried in any doubtful or intractable case, not in ordinary routine fashion, but as supplementing the other measures referred to.

As in the case of all long-standing irritating affections of mucous membrane or of skin, chronic superficial glossitis may be followed by the formation of epithelial cancer. (See *Leucoplakia.*)

Leucoplakia. — *Ichthyosis*, *Psoriasis*, *Keratosis*, *Tylosis.*—This disease of the tongue, best termed *leucoplakia*, has attracted much attention during the last few years, chiefly on account of the fact, to which notice was first drawn by Hulke, that it not infrequently develops into epithelial cancer. The dorsum of the tongue is more or less covered, usually in a symmetrical fashion, by whitish patches, which, however, may vary much in size and appearance in different cases. In the milder cases, the tongue looks as if it had lost its papillæ, the surface being, in the part affected, more or less dry, smooth, and milky-white, with an appearance, often, of minute cross-hatching. In the least marked cases, indeed, there is little, if anything, to distinguish it from the effects produced by long-standing chronic superficial glossitis. The disease may, however, present appearances in different cases, varying from a mere 'milkiness' of the surface to a thick dead-white or yellowish covering, which, to the finger passed over it seems rough, or even prickly, and which reminds one, in its general aspect, of the sodden epidermis of the palm of a hand after long poulticing, or of a piece of rough and discoloured chamois leather. A similar appearance, but less marked, is very commonly seen on the mucous membrane of the cheek, especially just within the corners of the mouth, and extending from this part along the mucous membrane for a longer or shorter distance. The general appearance of the patches, especially in the milder cases, may vary in the same individual from time to time, probably in correspondence with the care taken to avoid all local irritation, as by smoking and drinking.

Differing so much as the cases do in their naked-eye characters, it is not astonishing that the microscopic appearances are found to differ also. Thus, in Hulke's

case of thick, tough, raised patches, to which alone (if ever) the term ichthyosis is applicable, the microscopic appearances were those of 'extreme hypertrophy of the filiform papillæ and their sheaths. These composite papillæ had an average diameter of 0·1 inch at their base and the average length of 0·25 of an inch. The epithelial sheaths of the secondary papillæ, instead of ending separately in brushes, cohered in solid masses' (Hulke, *Trans. Clin. Soc.*, vol. ii.). In cases of the mildest type, on the other hand, the microscopic appearances are indistinguishable from the effects of chronic superficial glossitis, and may be considered identical with them. In other cases, again, both mucous membrane and epithelium are thickened; but there is no extreme hypertrophic condition of the papillæ on the one hand, nor any marked effacement of them on the other (Goodhart; Sangster).

Unless the mouth be irritated, as, for example, by smoking and drinking, in which case the symptoms resemble those of chronic superficial glossitis, the disease may remain for many years without causing any notable trouble. Its importance, however, lies in the fact that after a variable number of years—it may be ten, twenty, or thirty, or more—the disease may develop into epithelioma, the latter being, in the author's experience, usually of the superficial, warty kind. In how many cases of leucoplakia epithelioma supervenes, it is impossible to say—possibly in only a small minority, as the milder forms of the disease are not rare, and, giving rise to no symptoms, would only come by accident under the notice of the surgeon.

With regard to the origin of the disease many causes have been assigned—syphilis, smoking, drinking, hot foods, and all other irritants. These, indeed, make the disease worse, and may act possibly as exciting causes; but it frequently exists without any such antecedents being discoverable. The disease is much more common in men than in women. *See* Psoriasis Buccalis.

Treatment.—The most important treatment lies in the careful avoidance of everything which may irritate the mouth or make it foul. The patient should abstain from smoking and from all spirits; he should live on plain wholesome food, with little or no wine or beer; care should be taken that no source of irritation is present in the shape of carious or sharp-edged teeth or in connection with artificial teeth. Mild cleansing or alkaline lotions may be used, if necessary. Any persistently ulcerated spot should be removed by the knife, or destroyed, if very limited in extent, by nitric acid. The pain produced by the latter is not so great as might be anticipated, and may be almost abolished by the previous application of a 20 per cent. solution of cocaine (T. Smith).

Aphthæ.—The tongue shares, with the inside of the lips and cheeks, a special liability, especially in infancy and early childhood, to the formation of small whitish spots or ulcers commonly termed *aphthæ*. Two varieties of this affection may be fairly differentiated one from the other—viz. (1) simple follicular or aphthous stomatitis, and (2) thrush.

(1) *Aphthous Stomatitis* is characterised by the appearance of small yellowish vesicles, which soon break and leave superficial ulcers, of about the size of a pin's head, with a whitish or yellowish surface and sharply cut edge with vivid red areola. Such ulcers, which may be single or multiple, are usually acutely tender, and cause much pain when, in the movements of the tongue in speaking or eating, they undergo friction against the teeth. Although most common in early life, follicular stomatitis in a mild form is not rare in adults, and, in both cases, is commonly associated with a furred tongue and other indications of a disordered condition of the digestive organs. In a severe case, the little ulcers may, some of them, become confluent and assume the form of so-called *ulcerative* stomatitis; but this condition is less common in the tongue than in the gums and inside of the cheeks, when it sometimes rather closely imitates the appearances seen in true cancrum oris. *See* Stomatitis.

Treatment.—Saline aperients, followed in an adult by the administration of dilute mineral acid in a bitter infusion, form the best constitutional treatment; and the mouth should be rinsed occasionally with a lotion of borax (gr. xx. ad f℥j. of water) or carbolic acid (1 to 100), and containing a little eau de Cologne.

Chlorate of potash is almost a specific for *ulcerative* stomatitis, and should be administered internally in gr. v.–x. doses, as well as applied locally in a saturated aqueous solution.

(2) *Thrush.*—The characteristic small whitish or yellowish spots in 'thrush' are much more numerous than in simple follicular stomatitis; the tongue and other parts affected looking as if thickly dotted over with tiny particles of curd, which in severe examples of the disease may coalesce and form patches of false membrane. The

white spots are firmly adherent to the mucous membrane, and when peeled off leave the surface red and sometimes abraded. There is some heat as well as tenderness in the parts affected.

Thrush is especially a disease of infancy (although it is met with sometimes in the course of wasting diseases of adults), and is almost invariably associated with disordered nutrition; the little patients being more or less emaciated, and frequently suffering from diarrhœa, with green and fetid motions. Although thrush depends essentially on disordered nutrition arising most commonly from improper or insufficient food, there is no doubt of its being immediately associated with the development in the diseased epithelium of a microscopic vegetable fungus (*oïdium albicans*), which, if it does not constitute the essential cause of the local disease, may be considered to aggravate its symptoms.

Treatment.— The predisposing causes of 'thrush'—insufficient or improper food, sour milk, want of cleanliness in regard to feeding-bottles and other vessels—and the diarrhœa which ensues as a consequence, all suggest the general treatment which is in most cases requisite. Local treatment is also important. Dr. West advises that the mouth should be carefully wiped out with a piece of soft rag dipped in a little warm water after every time food has been given, and that, afterwards, a lotion of borax (gr. xx.-ʒss. to fʒj. of water) should be applied. If the borax seem insufficient, a mild carbolic acid lotion (1 to 100 of water), or one containing permanganate or chlorate of potash, may be employed. In adults, aphthous ulceration of the tongue, whether associated or not with the presence of *oïdium albicans*, is a painful affection, and is usually met with in the last stages of wasting diseases, as cancer and tubercle. Various remedies are usually required for its treatment; sometimes one appearing to answer best and sometimes another. In addition to the means above-mentioned a lotion of sulphite of soda (ʒj. to fʒj. of water) may be tried; or a lotion containing glycerinum boracis and water in various proportions. In some cases, when the tongue is very dry, great comfort is given by painting it with a camel's-hair brush dipped in pure glycerine (Cotter).

Wandering Rash. — This very rare disease, the first account of which, in this country, we owe to Mr. Arthur Barker (*Pathological Soc. Trans.*, vol. xxxi.) is characterised by the appearance of small circlets or crescentic bands of light-coloured 'rash.' These extend rapidly, and wander from place to place centrifugally over the dorsum and occasionally the borders and under-surface of the tongue; what was only a round whitish or yellowish spot in the morning may have become a large ring in the afternoon, and have totally disappeared a few hours later. Itching and salivation sometimes accompany it, and form its leading symptoms. In some cases it causes scarcely any symptoms, and the patient may be unaware of its existence. Its resemblance in appearance to ringworm is very striking, but the disease appears, from Barker's observations, to be not parasitic.

With respect to prognosis, there appears to be nothing to fear beyond the discomfort arising from the itching; no serious sequelæ having been noticed, even in cases in which the disease has lasted for some years.

Treatment, whether local or constitutional, has little or no effect on its progress.

Pigmented Tongue. — Of pigmented tongues there are several varieties. In one of the most marked (*black tongue*) the disease appears in the form of an oval or circular patch placed in the middle line of the dorsum, and is caused by the deposit of some black material in the thick epithelial investment of the papillæ, especially the filiform, which may be at the same time abnormally elongated. The black patch may vary in size at different times; in some instances almost the whole of the dorsum being affected. The cause of the disease is unknown. It gives rise to no symptoms as a rule, and requires no treatment.

In another variety of black tongue the disease takes the form of small black dots and patches, most marked on the edges of the tongue and seated apparently rather in the corium than in the epithelial cells. Similar dots and patches may be seen on the tongue in Addison's disease. The possibility of black tongue being produced by an intentional or accidental application of colouring matter by the patient, should be borne in mind.

Xanthelasma of the tongue is very rare; but a well-marked case has been not long since reported by Dr. Wickham Legg, in which the disease appeared not only in some of the more usual situations, but also in the form of yellowish, slightly raised patches on the sides of the tongue.

Neuralgia. — Neuralgia, affecting the tongue chiefly or exclusively, is a rare disease. It does, however, occasionally

occur, and, like cases of the same affection in other parts, may be exceedingly obstinate under all treatment. Beyond the measures which would be tried as a matter of course, such as large doses of quinine and careful attention to anything wrong in the general health, may be recommended the local application of menthol (Butlin) or of solution of cocaine, four to twenty per cent., or the local injection of morphia, beginning with a small dose only (gr. $\frac{1}{8}$ or $\frac{1}{6}$), and cautiously increasing it if necessary.

If the disease does not yield to these measures, the operation of stretching or division of the gustatory nerve may be performed. *See* Gustatory Nerve.

Tubercle : Lupus. — Tuberculous or scrofulous ulceration of the tongue is a rare disease, although possibly less rare than is generally supposed, on account of its not being sufficiently distinguished from the much more common syphilitic and cancerous affections of the organ. It usually presents itself in the form of an œdematous, glazed, inflamed ulcer with yellowish surface, very tender, but not fissured or warty or sloughing, or suggesting the idea of much new-growth. In almost all cases the patient is the subject of other scrofulous manifestations. There is either scrofulous or lupoid ulceration in the throat, or suppuration of a like kind in the cervical glands, or the patient is the subject of advanced phthisis—laryngeal or pulmonary. The tip and edges of the tongue are favourite sites for the tuberculous ulcer, but it may attack any part of the organ.

Diagnosis.—The only form of syphilitic ulcer, with which the tuberculous is likely to be confounded, is the tertiary or gummatous; and from this the diagnosis is not very difficult, if the history and accompanying conditions are carefully considered. The tuberculous ulcer is usually much cleaner than the syphilitic; the glazed and raw surface being more like that of an ordinary inflamed but sluggish and irregular wound, produced by some injury. The acute tenderness of the ulcer is also characteristic, especially when it involves the tip or edges, and is more likely to lead to the disease being confounded with a cancerous than a syphilitic ulcer. The absence of other evidences of syphilis is also important, and last, but not least, as a diagnostic indication, is the failure of iodide of potassium to give any marked relief. Frequently, the early age of the patient affords help in diagnosis.

The diagnosis of tuberculous ulceration from cancer is not always easy; the pain and distress in both being often very great, and the failure of all remedies to give relief being about equally marked. But in the tuberculous tongue there is less evidence of infiltration by new-growth; its general aspect being rather that of an irregular inflamed *ulcer* than of *tumour*. There is comparatively little adhesion of the tongue to neighbouring parts, even when the disease has long existed; and although remedies give but little relief, the progress to evil in the scrofulous ulcer is much less rapid.

A valuable means of diagnosis may also be afforded by gently scraping the surface of the ulcer, and examining the specimen mixed with a drop of water under the microscope.

Treatment.—The general treatment of scrofulous disease in the tongue is identical with that which would be appropriate to tubercle in the larynx or lung. For local treatment see *Palliative treatment of Cancer of Tongue.* In a case in which the disease is well-defined and comparatively limited, erasion by means of a Volkmann's spoon, followed by the application of nitrate of silver or of iodoform, may be tried. Excision is sometimes, though rarely, advisable.

Lupus vulgaris affecting the tongue may be considered to be included in what has been said regarding tuberculous disease. So far as any diagnosis between the one form of strumous disease and the other is possible, it will be found in the presence or absence, at the same time, of lupus of the face or nasal passages or pharynx. The treatment is the same for both.

Syphilis.—Syphilis affecting the tongue may take the form of—(*a*) chancre; (*b*) condylomata or mucous patches, or superficial irregular ulceration; (*c*) tertiary syphilitic deposits (gummata) or ulceration.

(*a*) Chancre is exceedingly rare, and needs only to be mentioned.

(*b*) Condylomata and mucous patches are almost always accompanied by similar manifestations of syphilis in other parts of the mouth and elsewhere, as on the penis and about the anus. They require no special description. When not in the form of condylomata, secondary syphilitic ulceration of the tongue takes the form, usually, of an irregular whitish or yellowish superficially ulcerated or abraded surface, especially along the edges. The tonsils are usually ulcerated at the same time, and the corners of the mouth may be fissured.

With regard to treatment, it will suffice here to say that mercury should be cautiously administered either by the mouth

or by inunction. *See* INUNCTION; SYPHILIS. Much benefit will be produced also by local treatment, as by painting with a solution of chromic acid (gr. x. ad f℥j. of water) or a solution of the cyanide of mercury (gr. xv. to f℥j. of water).

Ulceration of the tongue produced by the injudicious administration of mercury may be confounded with syphilis, and is often associated with it. The foul breath, the spongy gums, the œdematous and indented tongue, with the history, will guide to a correct diagnosis; which will be confirmed by the good effects of a saline purge, with cleansing lotions, as of chlorate of potash (gr. x. ad f℥j. of water) or carbolic acid (1 part to 100 of water with a little eau de Cologne).

(*c*) Tertiary syphilis of the tongue usually takes the form of gummata, which may or may not be ulcerated or sloughing. When the surface is unbroken, the disease, in the form of tough nodules or tubercles, may be situate in any part of the tongue, but rather on the dorsum than the edges. These are very irregular both as to number and individual size, and are not commonly either very tender or painful. Sometimes, they are crowded together so as to give to the tongue a very irregular surface, with apparently deep furrows or fissures; but the latter are not necessarily ulcerated or even abraded. When no ulceration or abrasion is present, such a tongue may give the patient but little trouble; while at another time there may be considerable distress in consequence of some glossitis and superficial ulceration, with temporary enlargement of the tubercles and apparent deepening of the fissures. In another case, the gumma may slough or ulcerate, leaving a deep cavity with irregular walls and up-standing edges; the general appearance sometimes closely simulating malignant disease.

As a rule, the diagnosis between syphilis and epithelial cancer is not difficult. The best diagnostic signs of syphilis are—(*a*) the comparative absence of pain and of tenderness, especially on making firm pressure; (*b*) the tongue is not fixed by adhesions even in severe cases of syphilis; (*c*) tertiary syphilitic ulcers are usually in some part of the dorsum rather than on the edge, and are not usually single; the remainder of the tongue is also commonly more or less affected; (*d*) there is no marked salivation from reflex irritation; (*e*) a syphilitic tongue, likely to be confounded with cancer, should be *rapidly* and greatly benefited by the internal administration of iodide of potassium; (*f*) the presence or absence of any history of primary syphilis should be also duly (but not unduly) weighed in making a diagnosis.

Treatment.—The treatment of tertiary syphilis of the tongue lies in the internal administration of iodide of potassium, either by itself or combined with small doses of mercury. Calomel vapour-baths, if carefully given, are also useful; or mercury may be given by inunction. *See* INUNCTION; SYPHILIS. The local treatment is the same as that advised for secondary syphilitic ulceration. It frequently happens that a long-standing disease of the tongue, which is undoubtedly in its origin and even in appearance syphilitic, is really not syphilitic, and requires quite different treatment from that just mentioned. Tongues scarred and tuberculated by old syphilitic ulceration may never regain their normal texture, although the syphilitic element fades away by lapse of time, or is cured by treatment. Such tongues are easily irritated by injudicious eating and drinking into an extremely sore and troublesome condition, and the patient gets little or no benefit, and may even get harm, from the quantities of iodide of potassium or of mercury which are being constantly taken. Such cases require treatment identical with that mentioned under the head of *Chronic Superficial Glossitis*.

NON-MALIGNANT TUMOURS. — Tumours of the tongue (using the term in its usual sense) are almost always cancerous. But others are occasionally met with. Simple wart or papilloma, mucous, hydatid, and other cysts, fatty and fibrous tumours, keloid, enchondroma, and sarcoma have been all recorded. All are rare, and space permits here only mention of them.

NÆVUS.—Nævus of the tongue is a somewhat rare affection. It presents no difficulty in diagnosis; the general appearance and characters resembling very much those which are so familiar in the case of the skin. The purplish smooth swelling, dotted here and there with red, which disappears on pressure and quickly reappears when the pressure is removed, without hardness or pain or tenderness, can scarcely be mistaken for any other disease. As a rule, nævi give no trouble, and but rarely require any treatment; and unless they cause inconvenience by their size or bleed from injury by the teeth, they should not be interfered with, especially as they share, with similar growths in the skin, a tendency to wither as age advances.

Occasionally, it is necessary to remove a nævus, and, in this case, the knife or scissors may be employed if the tumour is small; the operator, after securing the tongue by a thread passed through its tip, cutting into the sound tissue around the nævus, and not, if it can be avoided, into the nævus itself. In cases of more extensive disease, removal by the écraseur is preferable, the operation being planned after much the same fashion as for other tumours. In some cases, the application of the actual cautery or galvano-cautery to the nævus, as in the case of some nævi of the skin and subcutaneous tissue, is advisable, in lieu of the more complete removal by the knife. Paquelin's cautery is convenient for the purpose; one of the more pointed instruments, at a dull-red heat, being introduced, here and there, for a few moments into the substance of the growth.

Cirsoid aneurism of the tongue is very rare. In a case recorded by Sir Joseph Fayrer, which bore a superficial resemblance to a large ranula, and which was subject on occasion to severe hæmorrhages, much benefit was obtained from the injection of a strong solution of tannic acid.

Warty Tongue. — *Sago Tongue.* — A rare but well-marked disease of the tongue is sometimes seen in which the organ is at one part warty or papillated; the individual projections, however, not looking like enlarged lingual papillæ, but having a gelatinous semi-transparent aspect, not unlike boiled sago-grains. The part of the tongue affected is generally thickened.

Unless, by chance, the tongue is bitten from its projecting between the teeth, no symptoms are perceptible by the patient, and the disease may be discovered only by accident.

The disease is probably, in its origin, nævoid; the peculiar appearances observable being caused by a degeneration of the nævus structure. No treatment is required.

Cancer.—Cancer of the tongue, which may be said to be always epitheliomatous, may begin either as a small lump or warty tubercle, or as a small ulcer or fissure, with hard edges, and tender on pressure. Unfortunately, it is only in a small minority of cases that the surgeon is called upon to diagnose the disease at a very early stage. Much more frequently, the disease is more advanced when the patient seeks relief, and is then in the form either of a warty or ulcerated mass, which projects slightly from the surface but is connected with it by a broad base, which dips down more or less deeply into the substance of the tongue; or, on the other hand, in the form of a well-defined ulcer, somewhat excavated, with hard edges, which seem infiltrated in the substance of the tongue. As the disease extends, it gradually encroaches on neighbouring parts, infiltrating not only the muscular substance of the tongue, but the mucous membrane and other structures which form the floor of the mouth, and even the gum and the lower law.

The mobility of the tongue is by degrees more and more interfered with, as it becomes bound down by the encroachments of the disease on neighbouring structures. Speech, mastication, and deglutition are all painful and difficult. Apart from any movement, moreover, the tongue is the seat of acute neuralgic pain, which radiates to other parts, especially to the ear and side of the head; while, by reflex excitation, the salivary and mucous glands are stimulated to secrete profusely. The lymphatic glands beneath the jaw are usually more or less enlarged and tender, when the disease in the mouth has begun to give rise to much pain and irritation; but in the early stages of the affection this symptom may not be present.

Diagnosis. — The diseases with which cancer of the tongue is most likely to be confounded are—(1) tertiary syphilis, (2) tuberculous ulcer, (3) simple ulcer from irritation.

(1) From syphilis, cancer is best distinguished, at an early stage, by its hard edge and excessive tenderness, the patient wincing on even moderate pressure; while, a little later, the tendency to adhesion of the tongue to neighbouring parts, the increasing pain of a neuralgic character, radiating to the jaw and side of the head, the extreme tenderness, with largely increased secretion of saliva, leave but little doubt as to diagnosis, even apart from the extent, very various in different cases, to which the infiltration by new-growth and the destruction by ulceration have extended. If the neighbouring lymph-glands are enlarged, there may be the less doubt regarding the nature of the disease; but the absence of such enlargement counts for very little at an early stage, and should be disregarded in making a diagnosis.

Absence of history of primary or secondary syphilis is, of course, to be counted as a diagnostic sign in favour of the malignant nature of the disease; but its presence should be reckoned as of slight value only in a case which, on other grounds, seems cancerous. A patient who has suffered

from syphilis is not *less* likely to have cancer than another.

(2) From the tuberculous ulcer, cancer may be best distinguished by the symptoms mentioned in connection with the former.

(3) A chronic simple ulcer, produced by irritation from a sharp tooth or artificial tooth-plate, or the like, may occasionally give rise to a suspicion of the presence of cancer. The absence of a hard edge or base will usually distinguish it; and, with proper care, the presence of anything in the mouth likely to cause such an ulcer will not be overlooked. Care should be taken, however, not to treat too lightly any apparently simple ulcer; inasmuch as a cancerous sore may, at its beginning, attract a patient's notice in consequence of friction, which to a healthy tongue would have been imperceptible.

In cases of doubtful diagnosis between cancerous and other ulcerations of the tongue, valuable help is sometimes got by gently scraping the surface of the ulcer, and examining what is obtained under the microscope. In the case of a non-cancerous ulcer, only elements will be found such as might be afforded by any simple ulcerating surface, 'pus and blood-corpuscles, débris of food, schizomycetes, and even epithelium. But the epithelium bears no resemblance to that derived from the cancerous ulcers. It is well formed, of more equal size, and regular shape—not granular, and the nuclei are exceedingly small in comparison with the large size of the cells.' On the other hand, 'the scrapings of cancerous ulcers contain always numerous epithelial cells, in addition to pus- and blood-corpuscles, and débris of food, and schizomycetes. But the epithelium differs widely from the healthy epithelium of the tongue. The cells vary much in shape and size, and often present singularly distorted forms; their nuclei are always much larger than those of normal cells, and sometimes there are several nuclei or even nucleated cells within the larger cells; while a greater or less quantity of granular material always occupies the interior of the cells. Not infrequently cell-nests or fragments of cell-nests may be observed' (Butlin).

The *microscopic appearances* of epithelioma of the tongue resemble very closely those seen in the like disease of other parts of the body. 'Processes of epithelium dip down from the epidermis into the subjacent textures. These processes, however numerous they are or large they may become, do not usually combine to form a continuous mass or solid block of epithelial cells, but become connected at short intervals by horizontal bars of cells, so as to enclose what look like areas of irregular form. These areas are really spaces, communicating freely between the anastomosing bands of epithelium, filled with the altered tissues of the tongue, infiltrated with leucocytes.' 'Cell-nests may be discovered without difficulty in almost every epithelioma of the tongue. Often large and well-formed, they rarely present the horny and finely-stratified appearance of similar structures seen in squamous carcinoma of the skin, but rather resemble the cell-nests which may be observed in the epidermis of the normal tongue' (Butlin).

The *duration of life* in cases of epithelioma of the tongue is very different in different instances. It may be measured sometimes by a few months, in other examples by many years. In a very few we may hope that the disease has been, by surgical operation, completely eradicated. When fatal, the disease almost always destroys by long continuance of pain, discharge, and interference with the swallowing of food; the end being hastened in many cases by hæmorrhage from vessels, of larger or smaller size, laid open in the course of the extending ulceration. Occasionally, a low form of septicæmic pneumonia, with partial destruction of lung-tissue, occurs—possibly the result of direct irritation of the lung by inhalation of matter from the foul discharging surface of the cancerous ulcer.

Treatment.—The question of treatment of cancer of the tongue resolves itself, in the first place, into whether the given case is one fit for surgical operation; and the reply may be briefly summed up by saying that the disease should be removed in all cases, in which complete removal is possible without undue danger to the life of the patient. There are many cases, too, in which it is advisable to remove the disease, even when it is not possible to be sure that the removal is *complete*. This point will be referred to hereafter. When possible, diseased lymph-glands should also, of course, be removed.

Palliative Treatment.—Many cases of cancer of the tongue are seen too late in the progress of the disease to permit the performance of any operation for its removal; and in some instances recurrence will occur *in situ*. The palliative treatment of all such cases is, therefore, most important, and although little can be done to delay the progress of the disease, very

much can be done often in the way of alleviating pain and distress.

(1) Very frequently it will be found, on examination, that the ragged and ulcerated surface of the cancer corresponds exactly in position with the neighbouring teeth, although the latter may be neither irregular nor carious. In such cases, great relief will be given by administering an anæsthetic and extracting all the teeth (sound or unsound) which touch, or in future are likely to touch, the cancerous mass.

(2) In cases in which the pain seems, from its character and distribution, to be caused by pressure on the gustatory nerve, great relief may be afforded by division of the latter in the manner recommended by Hilton or by C. H. Moore. *See* Gustatory Nerve.

(3) Among minor measures for the relief of pain may be mentioned the frequent cleansing of the mouth with lotions containing permanganate of potash, carbolic acid, or the like. Sometimes a lotion of citric acid (gr. x.–ʒss. to fʒj. of water) is serviceable, or the same remedy may be used in the form of small slices of lemon. Iodoform may be also occasionally dusted on the ulcerating surface.

(4) In some instances, acute pain at particular spots may be relieved by the application of the actual cautery, which acts, doubtless, by the destruction of fine nerve-filaments which are exposed in the course of the ulcerating process. For that purpose the cautery should be used at a dull-red heat, so that hæmorrhage may not be produced by the too quick destruction of the parts to which it is applied.

(5) Insufflation of the surface of the painful part with some such powder as the following has been lately strongly recommended by Butlin:—Borax, gr. iij. or gr. iv.; iodoform, gr. j.; morphia, gr. $\frac{1}{8}$ to gr. $\frac{1}{4}$.

(6) As a rule, the application of ice and of gentle pressure will suffice for moderate hæmorrhage from an ulcerated cancerous surface within the mouth, aided, if necessary, by some styptic, as perchloride of iron, carefully applied to the bleeding spot. It but rarely happens that ligature of the lingual artery is demanded.

The internal administration of opium and of other narcotics needs no detailed description. The surgeon must be guided by the special needs of each case.

W. Morrant Baker.

TONGUE, Operations for removal of the.—When the amount of disease is very small, and in the anterior part of the tongue, the method of removal is very simple. A strong thread should be passed through the tongue about an inch behind the tip, on the side opposite to that affected, and the little tumour or ulcer, having been seized by vulsellum forceps, may be cut out, with a good margin of healthy tissue, by the knife or strong curved scissors. If the operator prefer it, he may use the écraseur, taking care to pass one or more stout curved needles at a good distance behind the disease and in front of the écraseur, so as to ensure a free removal. In most cases, however, a less simple proceeding is required.

In choosing from among the various operations which have been recommended for removal of all but the smallest cancers of the tongue, the surgeon should adopt that which, in his opinion, will best enable him to remove the disease completely, without undue danger to the life of the patient.

Space admits here of a description only of those operations which are now usually practised.

(1) For the majority of cases the writer believes that the following method, which he suggested in the *Lancet*, April 10, 1880, is the best:—After the introduction of a suitable gag, and the removal of any sharp or jagged teeth which might be in the way of the operator, two threads are passed through the tongue about an inch behind the tip and half an inch on each side of the middle line. The tongue being now drawn forwards and upwards, the frænum and, as far as it may seem necessary, some of the muscular attachments of the tongue to the lower jaw in front are now snipped through, as advised by Sir James Paget, with strong, blunt-pointed scissors; and the scissors are then 'run' along the floor of the mouth at the side, beneath the mucous membrane, as far back as may seem requisite, keeping close to the lower jaw both for the avoidance of hæmorrhage and for the sake of being clear of the disease. The operator now with his forefinger clears the tongue in front and at the sides, and drawing it well forward again, and giving one thread to his assistant while he holds the other himself, he cuts steadily along the middle line of the tongue from the tip backwards, and farthest along the mucous membrane. On the withdrawal of the knife the finger is now again introduced, and it will be found quite easy to complete with it the median division of the tongue by a little tearing or splitting between the two halves. The only part which cannot be thus torn is the mucous membrane of the dorsum. Hence

the advice just given to divide this with the knife as far as may seem necessary for getting beyond the level of the disease. The écraseur is now slipped over the diseased half of the tongue. This is, of course, one of the most important parts of the operation; any want of care at this stage being shown afterwards by the narrow margin of healthy tissue, or by none at all, left attached to the diseased mass. The insertion of one or of two curved needles well behind the disease before the application of the écraseur in order to ensure the division of healthy tissue, is advisable, but, for the reasons previously given, must not be considered a sufficient safeguard in the absence of free separation of the tongue's attachments in front and at the sides. When one half of the tongue has been removed, the process is repeated on the other.

In a case in which the surgeon proposes to remove only half the tongue, the median section should be made before the attachments in front and on the diseased side are divided, as, of course, they need not be disturbed on the healthy side. The écraseur employed should be one curved 'on the flat,' and strong whipcord will be found more serviceable than the linked chain, which, from working only in one plane or nearly so, is much less readily looped far back.

In all cases in which, from the extent of the disease backward or in the floor of the mouth, any difficulty is anticipated in placing the loop of the écraseur well beyond the tumour, the cheek may be divided, with advantage, by an incision extending from the front border of the masseter to the angle of the mouth, as recommended by Gant and others.

Very commonly, at least when whipcord is employed, the main vessel and some other tissues, perhaps nerve-fibres, are pulled through the end of the écraseur after the softer substance of the tongue has been cut through. Under these circumstances, a double ligature should be passed with an aneurism needle, and the strand of vessels and nerves divided between the two knots, when the écraseur will, of course, at once come away, and the main vessels will be left on the face of the stump securely ligatured; or, if whipcord has been used, this may be cut through, and a single ligature applied to the small stump remaining.

After the removal of the tongue, wholly or in part, as the case may be, it should be carefully examined with reference to the question of how much healthy tissue has been removed with the cancer; and the floor of the mouth and stump of the tongue should be carefully examined also, with the same object in view. In freeing the tongue from the floor of the mouth, portions of mucous membrane, sublingual glands, and the like, are often loosened; and these can be readily dissected away when space has been gained by removal of the tongue. Lymphatic glands should also be searched for, especially in the submaxillary fossa. Should any be found, now or previously, an incision should be made through the skin and other parts over them, and they should be carefully enucleated.

It is often advisable, especially when the disease has advanced into the mucous membrane of the floor of the mouth, to extract three or four of the neighbouring teeth from the lower jaw; and, when the disease approaches or invades the gum, much valuable space may be gained (much more than would be imagined by one who has not done it) by cutting away also a portion of the alveolar border of the lower jaw.

In cases in which the tongue is adherent to neighbouring parts, the clearing of the diseased from the healthy tissues is the most important part of the operation; and nothing helps so much towards this end as a free median division of the tongue. The difficulties are at least halved by this procedure. If the disease is found to have been not quite completely removed, any nodules left may be carefully dissected out either entire, or sufficiently to enable a strong silk ligature to be passed beyond them, as in the case of lymphatic cancerous nodules high up in an axilla.

Notwithstanding every precaution, troublesome and even profuse hæmorrhage may occur during an operation for removal of the tongue. If the hæmorrhage is of alarming extent, or at least sufficient to fill the mouth so rapidly with blood as to make it impossible to see whence the bleeding comes, it is an excellent plan to pass the forefinger into the mouth, as far back as possible, and hook forward the base of the tongue, as if to press it against the inner surface of the lower jaw, behind the symphysis. This plan (suggested by Mr. Christopher Heath) has been found by the writer very serviceable on more than one occasion, the hæmorrhage being at once controlled, and the surgeon gaining time for seizing with forceps the base of the tongue (if not otherwise held), and for bringing the parts forward so as to be able to see and catch the bleeding vessel. At the same time, the head should be rolled over to one side, so as to give opportunity for escape to the blood which may have accumulated

in the back of the mouth. Difficulties in seizing a bleeding lingual artery usually arise from momentary forgetfulness, on the part of the surgeon, that the part whence the hæmorrhage comes, unless firmly held and drawn forwards, will be retracted out of easy reach at every attempt to nip the bleeding point with forceps.

(2) *Whitehead's Operation.*—The operation for removal of the tongue suggested by Mr. Walter Whitehead is performed by dividing the muscular and other attachments of the organ by scissors. A gag having been introduced, and the tongue steadily drawn forwards and upwards by means of a thread passed through its substance, the operator snips the frænum and mucous membrane of the floor of the mouth, and subsequently the muscular attachments of the tongue, by means of scissors, until all the attachments excepting the glosso-epiglottidean folds of mucous membrane have been divided. The latter are then finally cut through, after passing a thread through the tissues immediately in front of the epiglottis, which is retained *in situ*, for a day or two, as a means of drawing the stump forward, if required on account of hæmorrhage or of falling back of the epiglottis over the upper opening of the larynx.

This is, the writer believes, a satisfactory operation in cases in which the disease is not far enough advanced to have caused adhesions to neighbouring parts, and in which the surgeon can depend on having a good light and a skilled assistant, and in which the jaws can be opened to a width sufficient for obtaining a clear view of the tissues as they are successively divided throughout the whole course of the operation. But in such cases the operation previously described can also be easily and rapidly performed. The choice, therefore, of the one method over the other will depend very much on the liking of the surgeon for the scissors or the écraseur. In many cases, a preliminary division of the tongue along the middle line will be found very serviceable when the scissors are used; and when one-half of the tongue has been removed by the écraseur, so much space will have been gained, and all the tissues are so clearly within view, that a few snips with the scissors are, in some cases, all that is required for the removal of the second half and the completion of the operation.

In the performance of Whitehead's operation the details, as laid down by him, should be carefully attended to; a neglect of them having much to do with the troubles, as to hæmorrhage, which have been sometimes met with. One of the most important of these is the steady traction of the tongue out of the mouth, which should be unintermittent, and which not only brings each part well into view before division, but does much in restraining hæmorrhage.

In cases in which the tongue is adherent to neighbouring parts, so that it cannot be well drawn forwards, or in which the floor of the mouth is invaded by the disease; or in which a full view of the parts cannot be obtained, either from defective light or difficulty in opening the mouth, or restlessness of the patient from imperfect anæsthesia, the surgeon will do well to choose some other operation than cutting by scissors. Under the conditions referred to, an unfortunate snip of the lingual artery or one of its branches may lead to the filling of the mouth with blood, by which everything is obscured; while there may be inability to seize the bleeding vessel until the patient is faint from loss of blood, or has become half-suffocated by its entrance into the trachea.

There are no facts to warrant the conclusion that the wound left by the crushing action of the écraseur is less safe with regard to septicæmia than that left by the knife or scissors.

The plan of cutting down on the lingual artery (one or both) and applying a ligature to it, as a preliminary measure to removal of the tongue, is recommended by some surgeons. In most cases this is quite unnecessary.

Cases are sometimes met with in which the cancer has become closely adherent to the lower jaw, but in which the extent of the disease is not so great as to forbid an operation. In such instances a portion of the lower jaw may be removed; either a part of the alveolar border only, or a portion of the whole thickness of the horizontal ramus. Usually, in a case fit for operation, the anterior part of the jaw is the portion involved, and can be readily reached by making a vertical incision through the lower lip and down to the lower edge of the jaw, and then another cut at right angles to this (making with it either a ⊥ or ⌊ shape as may be required.) The flap or flaps are then dissected up from the bone, and the latter is deeply notched at two points with a saw, and the section completed with strong bone-forceps. The loose piece of bone, with the adherent mass of disease and more or less of the tongue, according to the extent of the cancer, is then removed. As all the parts are well within sight and reach, the knife, scissors, or écraseur may

be used, according to the fancy of the operator. The stump of the tongue should be firmly held during the division of the organ by means of a thread previously passed through it, so as to prevent it from falling back and interfering with respiration; the thread or a stout silver wire being afterwards fastened to the jaw or lower lip, and left in for a day or two.

(3) *Syme's Operation.*—This operation is performed by making a vertical median incision through the lower lip and chin down to the hyoid bone, and, after dissecting back the soft parts, dividing the lower jaw and separating the two halves, so as to expose the parts freely. The attachments of the tongue in front are then divided, and the organ removed by the knife. Unless the extent of the disease forbids it, the tongue should be divided along the middle line, as suggested by Buchanan of Glasgow, and only the diseased half removed. By these means one great source of danger after Syme's operation—the complete division of the muscles which attach the hyoid bone to the lower jaw—is avoided.

(4) *Regnoli's Operation.*—This operation is performed by making a semilunar incision immediately behind the horizontal ramus of the lower jaw, the horns of the incision extending nearly to the angles. An incision perpendicular to this is then made in the middle line from the centre of the first incision to the hyoid bone; and the two triangular flaps of integument thus outlined are dissected up, the surgeon taking care to avoid the facial arteries. The anterior bellies of the digastric muscles are now divided, and subsequently the attachments to the lower jaw of the genio-hyoids and genio-hyoglossi.

The mucous membrane of the floor of the mouth is now divided to an extent corresponding with the external wound; and, the tip of the tongue having been seized, the whole organ is drawn out through the incision and removed by dividing its attachments close to the hyoid bone.

This operation is now but seldom performed, as it possesses no advantage over the improved methods of removing the tongue through the open mouth, while it is a much more severe and troublesome proceeding.

(5) *Kocher's Operation.*—In this operation, as in Regnoli's, the tongue is removed through an infra-maxillary wound. An incision is made from a little above and behind the angle of the lower jaw, along the anterior border of the sterno-mastoid muscle to the level of the hyoid bone, then forwards to the latter, and is continued along the anterior belly of the digastric muscle. The flap having been turned up, the surgeon proceeds to tie the lingual artery, and to remove the lymphatic glands and other structures which lie in the neighbourhood. The tongue is then removed. It is recommended by those who practise this operation that, as a preliminary measure, tracheotomy should be performed, and that during the operation the pharynx should be plugged by a large sponge. The operation is a severe one, and its performance can only be justified by the results (as to non-recurrence of the cancer) being proved much better than after the less dangerous methods of operating.

The tongue is now but rarely removed by means of the galvanic wire or other form of actual cautery, on account of the greater amount of sloughing and the greater liability to secondary hæmorrhage which are entailed by this procedure.

After-treatment. — Immediately after the operation iodoform should be applied to the raw surface of the wound and adjacent parts; and, as soon as the patient has sufficiently recovered from the anæsthetic, he should be warned to let all saliva and 'discharge' escape from the mouth, and to refrain from any attempts at swallowing. The mouth should be rinsed frequently with a weak lotion of permanganate of potash or of carbolic acid (about one part to a hundred of water.) Small pieces of ice should be placed occasionally in the mouth, especially if there is any tendency to bleeding. The application of iodoform should be repeated daily if the mouth become foul.

If slight hæmorrhage recur after the operation, it will be found, as a rule, easily controllable by ice or by syringing the mouth with ice-cold water; or a piece of dry lint or sponge may be applied to the bleeding surface, and held firmly there for a few minutes by the finger of a nurse or assistant. If the hæmorrhage occur from a vessel of notable size, it should be, of course, seized with forceps and ligatured; and, in order to effect this, the *first* thing to be done is to seize the stump of the tongue with strong forceps and draw it forwards, so as to bring the bleeding vessel within sight and reach.

In almost all cases the patient should be fed for a few days through a tube. A No. 10 or 12 red-rubber or black elastic catheter, fitted with five or six inches of thin elastic tubing sufficiently large to admit the end of a glass funnel, is all the

apparatus required. The catheter can be easily introduced through the open mouth and passed to a point about half-way down the œsophagus, when the fluid nourishment, thus untainted by the 'discharge' from the mouth, can be poured into the funnel in any quantity that may be necessary. In the same way a dose of castor oil or saline aperient may be administered on the day following the operation.

Nutrient enemata and suppositories may, of course, be administered, if there is any insuperable objection to the use of the tube. W. Morrant Baker.

TONGUE-TIE. *See* Tongue, Diseases of the.

TONSILS, Diseases of the.—The tonsils are composed of lymphoid tissue, covered on the buccal side by a mucous membrane continuous with that of the pillars of the fauces. Externally, they rest upon the superior constrictors, which separate them from the internal carotid and ascending pharyngeal arteries; and they are in close relationship, posteriorly and above, with the pharyngeal orifices of the Eustachian tubes. The internal carotid artery lies from one-half to four-fifths of an inch behind and to the outer side, and is hence in little danger of injury during the puncture or abscission of the gland.

The physiological variations of the tonsil in size and aspect are very considerable. It may encroach sensibly upon the isthmus of the fauces, or may be so shrunken as to have the appearance of a shallow sulcus between the two pillars; and the surface may be almost smooth, or deeply honeycombed with crypts, the orifices of which occasionally present small pellets of retained secretion.

The principal diseases of the tonsils are acute and chronic inflammations, syphilitic and tubercular lesions, and tumours of various kinds.

Acute inflammation may assume two forms—the erythematous or catarrhal, and the phlegmonous.

Erythematous Tonsillitis is most common in early life, between the ages of five and twenty-five, and is especially prone to occur in rheumatic subjects. It is often epidemic, and may possibly be capable of spreading by infection.

The two chief causes are atmospheric contamination from bad drainage, and exposure to cold and damp. Erysipelas, measles, scarlet fever, syphilis, and belladonna-poisoning may also be associated with a symptomatic tonsillar erythema.

Symptoms.—The inflammation usually commences with a feeling of dryness and soreness of the mucous membrane of the tonsils and adjacent parts, associated with pain and a sense of stiffness of the parts on swallowing, and the expectoration of small quantities of viscid mucus. The affected gland is swollen, and at first red and dry in aspect, but may soon become covered with a thin pultaceous layer of epithelial débris, or studded with accumulations of pus in the glandular crypts ('follicular tonsillitis'), and the morbid condition may spread to the neighbouring parts. If the orifice of the Eustachian tube be reached, the complication is often indicated by a curious sense of irritation and tickling extending into the tympanum and external meatus, or, should the mischief go further, some dulness of hearing or even an active inflammation of the middle ear may supervene.

The constitutional symptoms bear no constant relation in degree to the local signs. More or less febrile disturbance is commonly present at the onset, and, where the affection is due to the inhalation of contaminated air, the nature of the evil may often be conjectured by the daily recurrence of profound mental depression, associated with a marked exacerbation of the local soreness and pain, on waking in the early morning; while food and pure air afford relief. Temporary albuminuria has been observed in some instances.

The disease, unless prolonged by the persistence of the cause, tends to subside in the course of the second week; but in unfavourable cases may pass into the phlegmonous form.

Treatment.—The occurrence of tonsillitis, especially in the follicular form, should always lead to a careful examination of the drainage of the house in which the patient resides, or of that in which he is occupied during hours of business. Should this be defective, the treatment of the symptoms will be of little service until the source of danger is removed.

Several remedies have been found useful as abortives at the onset of the disease. The chief of these are—(1) an emetic of ipecacuanha; (2) quinine in five-grain doses, repeated two or three times at intervals of a quarter of an hour; (3) salicylate of soda, in doses of fifteen grains, every three hours; (4) large and repeated doses of tincture of perchloride of iron (thirty to sixty minims); and (5) local application of bicarbonate of soda with the finger, or by insufflation five or six times in succession, at intervals of five minutes. If the affec-

tion pass on to the later stages, astringent gargles may be prescribed, the voice must be kept at rest, and the patient should be directed to breathe through the nose. Bland but nutritious food and pure air of equable temperature are important adjuncts to the medicinal and local measures.

Phlegmonous Tonsillitis (*Quinsy*).—The causes are those of the erythematous form, of which it is usually a sequel. In debilitated and overworked subjects it may develop under slight exciting causes.

Symptoms.—The condition begins as in the catarrhal affection, but the redness and swelling are more severe, and the inflammation usually becomes localised to a single gland. With the increase and diffusion of the inflammation are associated considerable pain and dysphagia, the respiration may be impeded, and the voice becomes changed. Tinnitus or partial deafness, spasmodic closure of the jaws, suffocative paroxysms, and enlargement of the submaxillary glands may appear as complications. There is tenderness on pressure externally opposite to the angle of the jaw, but any enlargement detected in this region is probably due to implication of the submaxillary lymphatic glands and not to the swelling of the tonsil itself.

Fever of variable degrees of intensity may accompany the local signs, and is generally associated with debility and mental depression.

When suppuration takes place the abscess may be single or multiple, and usually points inwards and forwards; but the pus may find its way towards the soft palate, or, in rare cases, may reach the suprahyoid region, or even show itself above the clavicle. The 'quinsy' of adults is commonly a suppurative inflammation of the areolar tissue of the soft palate or pharynx, rather than of the tonsil itself.

Treatment.— In the early stages, the treatment recommended for the erythematous affection may be sufficient. When abscess forms, the pus should be evacuated without delay by means of a bistoury guarded with a turn of strapping down to within half an inch of the point, and held with its cutting edge upwards and inwards (away from the internal carotid artery). Special instruments have been devised to add to the safety of the incision, but with ordinary care the armament of the pocket-case will be found quite sufficient.

The local application of cocaine may be of value as an alleviative in the acute stage of inflammation, and as an anæsthetic, before the incision of an abscess.

Hypertrophy of the Tonsils (*Chronic Tonsillitis.*)—The pure hypertrophy of the tonsils depends upon an increase of the lymphatic elements; but this condition is almost invariably associated with intercurrent attacks of subacute and chronic inflammation, which may lead to dilatation of the vessels and some induration of the connective tissue of the gland. It is nearly always bilateral, although mostly unequal in development on the two sides.

It is most common in strumous and lymphatic subjects, and is almost confined to the earlier years of life.

Symptoms.—The tonsils, usually as a sequel of repeated catarrhal inflammation, become enlarged, and project more or less into the isthmus of the fauces, in some cases even coming into contact with each other. The surface in the quiescent state is of a pale rose tint, but during an inflammatory access may be red and congested, and is often dotted with whitish granulations about the size of millet-seeds. The submaxillary lymphatic glands may be secondarily enlarged. Pain is usually slight or absent, but deglutition is impaired, the voice becomes altered, and, where the hypertrophy is considerable, the respiration may become so gravely embarrassed that sleep is repeatedly broken by suffocative paroxysms, the blood becomes imperfectly aërated, and the general nutrition suffers. In association with this, the aspect of the patient, if a child, may undergo a characteristic and remarkable change: the chest becomes contracted, the mouth is kept open to allow freer ingress of air to the lungs, and the countenance assumes a vacant and fatuous expression—a peculiarity which is increased when, as frequently occurs, the hearing becomes impaired through extension of the inflammatory processes to the Eustachian tubes.

The condition is usually associated with a predisposition to coryza and bronchial catarrh. Its course is very chronic, and it may linger on from childhood to puberty or even into early adult life.

Treatment.—The constitutional measures should be adapted in great measure to the diathesis. As a rule, cod-liver oil, pancreatic emulsion, and ferruginous tonics are the most efficacious medicines; but pure air, suitable exercise, and well-regulated, well-selected food are of still greater importance.

Locally, the use of astringent gargles or the direct application of powdered alum may be essayed. Should this fail and the condition demand more active treatment,

the enlarged gland may be pierced with a point of galvano-cautery, or the redundancy may be excised.

The ablation of the tonsil may be effected by a stroke of the bistoury, by the use of special instruments, or with the finger-nail. The so-called 'Borelli's operation,' avulsion by means of the finger-nail, is now practically abandoned, as liable to prove more painful and dangerous than any other method of removal. The use of the knife is still advocated by many surgeons. The most eligible instrument of the kind is a blunt-pointed bistoury, guarded by a turn of lint or strapping to within about three-quarters of an inch of the extremity; the cutting edge must be turned upwards and inwards, and manipulated while the gland is held with a pair of vulsellum-forceps. The guillotine, however, affords the safest and the most ready means of effecting the object. Many forms of this instrument have been devised, all answering the purpose more or less satisfactorily, but one of the best is that manufactured by Collin, which is provided with a kind of fork for transfixing and drawing inwards the gland at the moment of section. The operation is most easily effected when the surgeon stands behind the patient, whose head is to be well thrown back, but it may be performed with little less facility from the front.

The only danger to be feared in connexion with tonsillotomy is that of hæmorrhage. As a rule the loss of blood is very trifling in amount, but occasionally it is copious, and in one or two instances has even proved fatal. It may follow immediately upon the operation or occur after an interval of some hours, and is probably due to the implication of supplying vessels, that have become enlarged as a result of chronic hyperæmia of the gland; at any rate the flow is very rarely derived from the internal carotid artery, which can scarcely be wounded by any possibility with the guillotine, and only in the event of culpable neglect when the knife is employed. If severe, the bleeding may be arrested most conveniently by direct compression with a piece of lint, that has been soaked in a solution of perchloride of iron and wrapped around the handle of a spoon. The atrophy of the testicles, formerly supposed to be a possible consequence of the removal of the tonsils, is a contingency that need scarcely be taken into consideration. In the rare cases where such a condition has been observed after the operation, it has more probably been attributable to impaired nutrition induced by the disease, before the treatment was carried into effect. Excessive mental depression, which has been known to culminate in suicide, appears, however, to be a real danger, but is one for which it is not easy to find an explanation, unless we infer with Dr. Rubio the existence of a pharyngeal reflex, analogous in its nature and results to the well-known anal reflex.

Ulceration of the tonsils may be syphilitic, tubercular, or epitheliomatous in origin, or may develop symptomatically in the course of scarlet fever, diphtheria, &c.

Tonsillar Calculus consists of a concretion of phosphate and carbonate of lime, very similar in character to the tartar upon the teeth, and is found in the normal crypts of the gland. It may reach the size of a pea or small bean.

Tubercular Lesions.—Tuberculosis of the tonsil may appear in two forms, as (1) miliary granulations, which may follow an acute or chronic course; or as (2) an irregular ulcer of no great depth, characterised by the absence of induration, and the presence of tubercular matter in the borders and base of the sore. As a rule, neither condition is limited to the gland.

Syphilitic Lesions.—A few cases of hard chancre of the tonsil have been reported in recent years, but the complaint is very rare; secondary and tertiary lesions, however, in the form of mucous tubercles and gummatous ulcers, are amongst the most frequent manifestations of the disease. See *Syphilitic Stomatitis*, under Stomatitis; Syphilis.

Tumours.—*Hydatid cysts*, *fibromata*, and *myeloid* tumours have been met with in exceptional cases. *Sarcoma* is less uncommon, and generally takes the form of lympho-sarcoma. In nine cases collected by Mr. Butlin, the ages of the patients ranged between seventeen and fifty-three. In all, the disease had extended to the cervical glands, but only to those in immediate proximity to the growth; and in three instances in which post-mortem examinations were performed, a secondary affection of the viscera was demonstrated. Two new cases were added to the list by Mr. Clutton and Mr. Balding in 1884.

The removal of the growth by excision is a formidable operation, but has been undertaken with success. Out of seven published examples, death from hæmorrhage and exhaustion followed in one, cure is claimed in two, and in the rest a recurrence followed within a few months. The disease may sometimes be accessible from

the mouth with or without the division of the cheek, but in other cases it is necessary to expose the parts more fully by section of the inferior maxilla.

Epithelioma of the tonsil is seldom primary, but extends to the gland from adjacent parts. It may be scraped and cauterized with temporary advantage, and bold and extensive operations for removal of the disease by excision have recently been accomplished with success by Polaillon, Golding-Bird, and others.

The most frequent primary cancer of the part is *encephaloid*, while *scirrhus* is extremely rare. These affections have hitherto escaped the knife, but if seen at a sufficiently early stage might be treated in the same manner as sarcoma.

WILLIAM ANDERSON.

TOOTHACHE may be due to irritation of the tooth-pulp itself or to inflammatory conditions external to the tooth, though in immediate contiguity with it. It is important to discriminate between the two sets of causes, for the means for relief differ widely. Pain arising from a living pulp varies much in character; often it is very intermittent, coming on in darts, especially at the outset, and, even when continuous, it is subject to paroxysms of greater intensity. When severe, it is generally of throbbing character, and the tooth is very sensitive to changes of temperature; cold, however, occasionally is a relief, heat almost invariably an aggravation of the pain. There will be little tenderness on tapping the tooth, and none on pressing the gum over its roots.

Sometimes, the pain is of a neuralgic type and not felt in the offending tooth, so that its cause can only be discovered by careful examination of the teeth. It is aggravated by fatigue, relieved by tonics, stimulants, food, &c.

Hence, in any case of doubt, the teeth should be successively tested by the application, first, of a hot instrument, then of a large piece of wool dipped in cold water. If no sensation of pain results from these abrupt alternations of temperature, it is possible that the nerve is dead or dying, so that evidence of inflammation in the sockets should be sought by first smartly tapping the teeth in succession with the handle of an instrument of some weight, then pressing them home into their sockets, and, lastly, making firm pressure over the roots of each tooth. By such an examination, it will generally be possible to discover whether a tooth be the cause of pain or not, and to form an idea of its state if it be so.

If the pain be due to inflammation surrounding the tooth, the nerve will usually, though not quite invariably, be dead; there will be much tenderness elicited by tapping, or by pressure over the roots, and none by the test of heat and cold; if it has lasted long there will be swelling of the gums and more or less febrile disturbance. *See* GUM-BOIL. The cavity of decay should be cleared out, or, if it have been filled, the filling should be removed, so as to give free access to the pulp-cavity, and a little creasote, camphorated spirit, or oil of cloves is to be pumped down the roots; but the tooth must then be left perfectly open, so that pus or exudation can easily drain away. In the early stages, the gums over the roots should be painted with equal parts of tinctures of iodine and aconite; in the later stages deeply lanced.

If, on the other hand, we have to deal with a living pulp, and the pain have been of short duration and not very severe, the tooth should be closed up with a dressing of oil of cloves, creasote, or carbolic acid, confined by a pledget of wool dipped in a solution of gum mastic or sandrach. If the pain have been very severe, it is probable that there is a tiny drop of pus in the pulp-chamber pressing on the remains of the pulp; the pulp-chamber must then be carefully opened up and a dressing of the same nature applied, but, though this will give relief, the pulp is sure to die, and the best thing is to at once destroy it by an application of arsenious acid. This, however, should only be applied by those well accustomed to the manipulation of teeth, as disastrous results in the way of sloughing of the gum, necrosis of the neighbouring alveolus, &c., may follow upon the escape of any arsenic from the cavity. For the relief of pain a dead tooth should be left quite open, a live tooth carefully closed up.

Other less frequent causes of toothache are irregular calcifications of the pulp, exostosis of the roots, and the inflammation which attends the loosening of the teeth in old age; in a modified form this is, however, often met with in middle life, and when it occurs thus prematurely, it runs a more acute course, with more pain, suppuration, and ill smell, but, on the other hand, is more amenable to treatment. Another cause of obscure toothache is difficult eruption of teeth, especially of the wisdom teeth, which may ultimately be attended with violent inflammation of the superincumbent gum and surrounding parts. In many cases there is an absolute want of space, and no permanent relief will be got

without the extraction of the wisdom tooth, or, if this be impossible, of the tooth in front of it. In the vast majority of cases it is easy to discover the cause of pain due to morbid conditions of the teeth; but it occasionally is very difficult, especially when there are many teeth the condition of which is such that they are possible, though not probable, causes. It must not be forgotten that the gum will sometimes heal completely over a diseased root, or so nearly completely that only very careful search will discover any fistula.

Old-standing inflammations may also sometimes have involved the nerve-trunk, and so leave a legacy of pain even after their removal; this seems most prone to happen with lower wisdom teeth, the apices of whose roots are so very close to the inferior dental canal. CHARLES TOMES.

TOOTH-TUMOUR. *See* ODONTOMA.

TORSION.—This method of arresting hæmorrhage from large or small vessels was introduced by Amussat in 1829, and in this country was prominently brought forward by Mr. Bryant in 1868. To its originator it was suggested by the fact that 'torn vessels do not bleed.'

Numerous experiments upon living animals, upon dead arteries, and its practice in amputations in man, show that the effect of torsion is to rupture the internal and middle coats, as in ligature. The coats, moreover, are incurved, and being stripped from the external, are turned into the lumen of the vessel, so that the broken edges look towards the heart. Coagulation taking place around and—when the incurvation has been less complete—between the ruptured coats, prevents at once the escape of blood. The inflammatory process uniting the edges and the subsequent changes in the clot are the same as in ligation.

There are two ways of employing torsion: the 'free' and the 'limited.' In the 'free' the vessel is held by the forceps a short distance from the end, either parallel with or transverse to its axis, and twisted round and round. The objection raised to this plan, that the vessel is rotated through a great portion of its length and not completely twisted at any point, has no foundation, for it has been abundantly shown that only that part of the artery immediately above the forceps is twisted, and effectually so. This is the method now usually adopted. In the 'limited,' the vessel is first drawn out of its sheath and fixed by forceps three-fourths of an inch from the divided end, while with a second pair the extremity is seized and freely twisted. Special forceps must be used. They have flat, parallel, finely serrated blades secured by a sliding catch.

Torsion of large vessels—e.g. the femoral—is best performed in the following way. The artery is taken up by a pair of dissecting forceps and drawn forwards, the surrounding tissues being pushed back by a second pair till sufficient room is made for the application of torsion-forceps across the vessel, about one-eighth of an inch from the divided end. The whole width of the vessel must be grasped. The forceps are now rotated (or swung round) at right angles to the axis of the vessel, six complete revolutions being sufficient for the femoral, and four for smaller vessels. It is the practice of some surgeons to take up the vessel longitudinally, and rotate the forceps round in the hand; but this does not seem to secure such effectual torsion as the plan described above, for the whole width of the vessel is not included in the grasp of the forceps. When the torsion has been effective and complete, a loss of resistance will be felt, owing to the rupture of the inner coats, and whether one turn more or less secures this result is a matter of indifference.

It is well to allow the forceps to remain attached for a few minutes while the coagulum is forming, the other vessels being secured meantime. On removing the forceps, the twisted end uncoils a few turns and retracts into the sheath and the surrounding tissues, by which it should be well covered. The writer has in this way secured the first part of the axillary, and on several occasions the femoral. As to its safety, it is only necessary to quote Mr. Bryant, who gives 200 consecutive amputations at Guy's Hospital, in all of which the main artery was twisted, without a single case of secondary hæmorrhage.

In closing smaller vessels, it is only necessary to simply seize the end and give it several rapid twists.

Torsion is chiefly of value in securing the large vessels, and, when successful immediately after its application, there is no fear of secondary hæmorrhage unless unhealthy suppuration exist in the wound. It is the practice of the writer and of several other surgeons to secure the main vessels by torsion and the smaller by catgut.

CHARTERS JAMES SYMONDS.

TORTICOLLIS (Wry-Neck).—Deviation of the neck from the right direction is caused primarily by contraction of the

sterno-mastoid muscle, in most instances; other muscles may be associated with the sterno-mastoid, particularly the trapezius, the splenius, and the scaleni. The levator anguli also helps in approximating the head and shoulder.

The back of the head is drawn down towards the shoulder of the affected side, the face and chin being directed towards the opposite shoulder. The affected side of the neck is concave, and a very definite hollow may be made out below the mastoid process; across it is stretched the tight band of the sterno-mastoid. The tissues of the affected side of the face are, in a marked case, imperfectly developed, even to the inferior maxilla itself; the mouth and eyelids are drawn down, and the expression is changed and characteristic. On examining the lower half of the sterno-mastoid, the sternal and clavicular pieces may be found rigidly contracted and distinct.

The cause of the contraction of the muscle may be found—(1) in the muscle itself; (2) it may be due to the irritation of cervical caries, to an inflammatory attack of the vertebræ, periosteum, ligaments, muscles, nerves, or connective tissue of the neck, or to the presence of an inflamed or suppurating gland. In these cases, the contraction of the sterno-mastoid will be as a reflex act through the spinal-accessory or the second cervical nerve. Or, the contraction may be due to (3) some central irritation in the brain or spinal cord.

(1) When the cause of the contraction is in the muscle itself, it is generally the result of a tearing of bundles of its fibres during parturition, in which case a hard and tender ovoid lump may have been noticed in the course of the muscle or of one of its heads of origin within a few days or weeks of birth. The lump may be of the size and shape of a filbert or small walnut.

At one time it was thought that these sterno-mastoid tumours were of syphilitic origin, but any association they may have with such congenital taint is but accidental; the condition is due to a partial rupture of the muscle during parturition. Often the tumour is found after a difficult labour, but the writer has met with a case of such tumour, in which parturition had been so rapid and easy that neither midwife nor doctor had assisted. The tumour consists of torn muscle, blood, and inflammatory effusion. The mass becomes smaller by absorption, but the cicatricial patch in the muscle undergoes a steady contraction, until the ear may almost touch the shoulder. In the fat, short-necked infant, both the tumour and the early deformity of the neck may pass unnoticed; but as the neck grows the deviation becomes conspicuous, as may also be the arrested growth of the corresponding side of the face. The writer has recently been treating a young man, in whose case all the links in the clinical report were complete. The mother said that his had been a 'cross-birth;' that when he was a week or two old a 'lump' was noticed in the course of the muscle; the torticollis was complete.

(2) When the deformity is due to cervical caries, it is generally associated with obscure pains which radiate about the shoulders, neck, or scalp, according to the distribution of the sensory nerves whose trunks emerge at the carious region, and thus are compressed by inflammatory products. In the early stages the disease is apt to elude correct diagnosis, the 'stiffness of the neck' and other equivocal symptoms being frequently ascribed, at least by parents, to 'rheumatism.' If the patient be young or unintelligent, the neuralgic pains in the occipital and parietal regions may be spoken of as 'headache.' Stiffness of the neck is an important symptom; the patient cannot turn the head without at the same time wheeling round his shoulders and trunk, nor can he nod or shake the head freely. Pressure on the top of the head causes distress. *See* CARIES OF THE SPINE. It is of the utmost importance that an early diagnosis be made, the treatment demanding extreme gentleness, firmness, and a long-continued patient supervision. The writer has seen wry-neck suddenly caused by an acute attack of ostitis and periostitis of the cervical vertebræ, the result of a severe wetting of the head and neck of a child. The head was drawn down towards the right shoulder, and thus steadied against disturbance. Pressure upon the spinous processes or upon the top of the head gave intense pain. Such a case demands leeches, fomentations, and absolute rest in bed, the head being steadied between sand-pillows.

Wry-neck, due to the reflex contraction of muscles from peripheral irritation of inflamed tissue of the neck or glandular abscess, will disappear on the subsidence of the primary trouble, though exercises such as those sketched below may prove of advantage. For the deviation of the neck in infancy, gentle frictions and frequent adjustments of the head, as a precautionary measure, should be undertaken. But when such measures prove inefficient, as they most likely would in the case of the growing child, or the adult, or in the wry-neck

caused by vertebral caries long since passed away, tenotomy, under an anæsthetic, may be required. For this purpose a slender, blunt-pointed blade should be passed cautiously beneath that part of the muscle which shows most prominently at the root of the neck, when the head is brought towards the straight line. The puncture of the skin is made about half an inch above the clavicle with a sharp-pointed tenotome: and then with the blunt knife every resisting band must be severed. The skin-puncture is covered with a small compress of dry lint and a bandage, the head being left in the old position until the wound is sound. After section of one head of origin of the muscle, the other may be found in need of division; in this case two separate punctures of the skin are desirable. A few days after the tenotomy, frictions and shampooings of the neck should be begun, and the patient should be drilled in exercises to raise the head and depress the shoulder. He should carry a weight in the hand, and at the same time incline the head away, so as to stretch to the utmost the concave side of the neck. This stretching should be kept up at night by his lying with the affected side of the face upon a firm pillow. With this treatment, combined with massage, no mechanical apparatus need be required for the straightening of the neck, even in the adult. The operation is not entirely devoid of risk; troublesome bleeding may occur from the accidental and unavoidable wound of a blood-vessel, and should a venous tributary be stretched across the course of the knife, air may enter the circulation. In either case a firm compress should be adjusted. After the division of the contracted muscle, various secondary bands of shortened fibrous tissue will assert themselves; these will rarely need division with a knife, they will yield to drilling and manipulation.

(3) When the deformity is due to some central nervous irritation, the treatment is often unsatisfactory. The spasmodic contraction may be jerking, irregular and convulsive, and never cease during the waking of the patient. It is most common in young adults 'whose families have seemed prone to other cerebro-spinal affections' (Little). The treatment will comprise the administration of bromide of potassium and tonics; the employment of the mind; and the use of galvanism and massage. Tenotomy would afford but temporary relief, and even the stretching of the spinal accessory nerve, or the resection of a piece of it, does not always end the trouble. The nerve may be found either on its entrance to or emergence from the sterno-mastoid. In the former case an incision is made along the anterior border of the muscle, starting from the mastoid process, and descending for about two inches. The external jugular vein would have to be drawn forwards; and the head being still further inclined towards the shoulder of the affected side, in order to slacken the sterno-mastoid, the anterior border of the muscle would be slightly raised and everted, and the nerve running obliquely into its substance would be recognised. About half an inch of it should be taken away.

Neuro-mimetic contraction of the sterno-mastoid is most likely to be met with in girls; its onset may be sudden, and the symptoms over-acted.

Wry-neck from the contraction of an extensive cicatrix (as after a severe burn) is best dealt with by massage and exercises.

EDMUND OWEN.

TOURNIQUETS are instruments which are employed to arrest or diminish the flow of blood along the arteries to the limbs. There are two classes of tourniquets; the principle of one of them is to constrict the whole limb and to arrest the circulation through the collateral vessels as well as through the main vessel of a limb, whilst that of the other is the accurate limitation of the pressure to the main vessel, so that the flow of blood through it alone may be slowed or arrested.

Those of the first kind are used to prevent bleeding during the performance of operations on the limbs, or as a temporary means of checking bleeding from wounds of the limbs. For the latter purpose, in cases of emergency, the original plan, invented by Morel, may be employed; it is to tie a cord or a piece of bandage round the limb and pass a stick beneath the cord, and then to turn it round and round until the cord is twisted up and tightened sufficiently to arrest the circulation.

The elastic tourniquets of the present day act in a similar manner.

Esmarch's tourniquet is a strong elastic cord or tube, the bore of which is very small; a hook is attached to one end of it and a chain to the other. In using this, and all tourniquets which constrict the entire limb, the limb should be bandaged or raised, in order to favour the return of the venous blood, and then the cord should be rapidly stretched and wound round the limb, the two ends going in opposite directions and being finally secured by fastening

the hook to one of the rings. If applied slowly, the veins would be first compressed, and the limb consequently would become congested. Sometimes the ends of Esmarch's tourniquets do not meet just as required, and so they have to be carried once more round the limb, upon which they exert an undue constriction. *See* Esmarch's Bloodless Method.

Various modifications of this instrument have been introduced, with the object of remedying the defect alluded to above and of facilitating the removal of the tourniquet. Foulis' catch is one of these. It consists of a piece of vulcanite, about an inch and a quarter long, three-quarters of an inch broad, and half an inch deep; it is perforated along its longest axis by two holes, having a diameter of about an eighth of an inch; one of these communicates with the surface of the pad along its whole length by means of a slit; the elastic cord is threaded through the other hole. The pad is placed over the vessel, and the limb is encircled with the cord once or twice, and finally both ends, still on the stretch, are forced into the slit in the pad; when the ends of the cord are relaxed, the increased thickness which results serves to secure them firmly in the catch. Davy has recently introduced a catch which acts like the one just described, but it can be secured more firmly in position; its long axis is placed in the line of the vessel, and the elastic cord, which runs in the opposite direction, keeps it steady. Ward Cousins has substituted a buckle for the catch. His tourniquet consists of an elastic cord folded upon itself so as to form a loop, the ends of which are attached to the buckle. In place of the teeth of the common buckle, the one used has a plate with a serrated edge, which is not sharp enough to bite into the india-rubber, but is rough enough to get a good grip on to it. To apply the tourniquet, the cord should be stretched tightly round the limb, and should be secured by drawing the loop through the buckle.

All the tourniquets composed of an elastic cord are open to the objection that the cord produces severe constriction of the limb; this may be obviated by employing a stout elastic band with a piece of tape attached to each end, or with a buckle like that above described fixed to it about a foot and a half from one end; when applied, it may be secured by tying the tapes together into a bow, or by drawing the end of the india-rubber band through the buckle.

A field-tourniquet constricts the entire limb. It consists of a metal plate, to which a small pad is attached, and of a piece of stout tape. The plate has a slit at each side, through which the tape can be passed, and each lateral border of it has three teeth projecting from it. To apply the tourniquet, the tape should be placed beneath the limb, and each end of it should be passed through one of the slits in the plate above mentioned. By pulling on the ends of the tape the pad is pressed against the vessel, and the pressure can be kept up by fixing the ends of the tape into the projecting teeth on each side of the plate.

Petit's tourniquet may be employed either to constrict the entire limb, or, if a pad be placed over the main artery, to compress the latter and, at the same time, exert some general compression. The instrument consists of two plates, which can be separated from one another by means of a screw; a piece of stout tape is threaded into the plates in such a way that separation of the plates will draw on the ends of the tape. To apply the tourniquet, the plates should be placed in contact, and the tape should be buckled round the limb tightly enough to hold the instrument in position. By turning the screw, the plates may be separated, and the limb and main vessel compressed. Petit's and field-tourniquets are useful instruments to keep loosely applied to a limb from which hæmorrhage is anticipated, as either of them may be readily tightened up by a nurse.

The second class of tourniquets—viz. those which are intended to compress the main vessel of the limb alone, are chiefly used in the treatment of aneurisms. They are as follows:—

Signoroni's horse-shoe tourniquet is intended chiefly for the brachial artery. It consists of two stout steel arms, carrying pads at their extremities, which can be approximated or removed from one another by turning an endless screw placed at the hinge of the instrument.

Lister's (known also as Pancoast's) tourniquet is intended for compressing the aorta or common iliac in the treatment of aneurism of these vessels, or during amputation at the hip-joint. It consists of a large horseshoe-shaped piece of iron, carrying a pad at one end and perforated at the other by a female screw, through which a rod carrying a pad, and provided with a male screw, is introduced. The pad is screwed down on to the aorta at its bifurcation, which takes place at the level of the highest point of the crest of the ilium; the pad is so fixed on to the rod, which bears it, that the latter can be turned round without causing the pad tc revolve; and when

screwing the pad firmly home, it should be held on the vessel with the left hand whilst the screw is being turned by the right.

Skey's tourniquet is intended for compressing the common iliac or the brachial arteries. The whole instrument has an elliptical outline, and completely encircles the limb to which it is applied. It consists of two plates, which are connected together by quarter-circle steel bars, themselves composed of two pieces sliding one on the other, so that the size of the instrument can be reduced to the circumference of the limb to which it is applied. One of the plates above mentioned forms a pad, which should be placed behind the limb; in the other plate, a steel rod, having a pad, works in a similar manner to that described in Lister's tourniquet.

In the instruments above described, the pressure of the pad on to the vessel is maintained by the rigid force of a screw, and is accordingly most irksome if it be kept up for a long time, as is the case in the treatment of aneurisms. With the object of remedying this, Carte has, by a most ingenious contrivance, converted the rigid pressure of the screw into an elastic one; and so great is this improvement, that in the treatment of popliteal aneurisms by instrumental compression of the common and superficial femoral vessels, Carte's instrument should be used in preference to those already described.

Carte's compressors are adapted for compressing the common femoral artery in the groin and the superficial femoral at the apex of Scarpa's triangle. They possess two great advantages—(1) that the rod which carries the pad is fixed to the rest of the instrument by a ball-and-socket joint, which renders the pad less liable to shift from the artery during any slight movement of the patient; (2) that the pressure exerted by the instrument is an elastic one. In the old-fashioned compressors, the rod which carries the pad moves in the framework of the instrument by means of a screw. In Carte's compressor it moves up and down without a screw, but just above the supporting framework there are two plates; the lower of these is fixed to the framework, and, like the latter, allows the rod which bears the pad to move freely through it; the upper one only permits the rod to move through it by being screwed round. The two plates are joined together by a strong piece of elastic on each side. When the attempt is made to screw the pad down, the first effect is to separate the plates and put the elastic on the stretch; and it is only when the elastic is well stretched that the pad is pressed on to the vessel. If the pad be too tightly screwed down the elastic will be still more stretched, and so the pad will be allowed to rise a little from the limb and undue pressure will be relieved. Carte's larger instrument —viz. that for the groin—is fixed on to the pelvis by a broad and well-padded belt. The smaller instrument is very like Skey's tourniquet in shape, but its size cannot be altered as that one can.

Tuffnell's compressor consists of a truss-spring, with a pad which presses on the artery. It is fixed in position with straps, which also serve to press the pad more firmly on to the vessel. It is used for compressing the femoral artery.

Higginbottom's alveolar tourniquet is composed of two blades, with a pad at the end of each; its principle of action is like that of Signoroni's tourniquet. It is used to make pressure on bleeding tooth-sockets; this is accomplished by one of the blades within the mouth, whilst the other blade presses against the inferior border of the body of the lower jaw. A similar instrument is made for the upper jaw; one of its blades makes a wide sweep so as to fit on to the top of the head.

Weight-compressors are of two kinds. One consists of a conical bag with a truncated apex. The bag should be filled with shot and suspended over the vessel to be compressed, and steadied in position by the patient. The other (Watson's) consists of a weight, which is suspended from a Carte's elastic spring, and so adjusted that it rests upon the vessel. BILTON POLLARD.

TRACHEAL CATHETERISM.—The introduction of instruments through the mouth into the trachea was first attempted by Desault, who saw the immunity from evil following the accidental introduction of an œsophageal tube into the trachea, the tolerance with which the patient bore it, and the easy manner in which he respired through it. This took place toward the close of Desault's life, and he had few opportunities of practising the method. Efforts in the same direction were subsequently made by other surgeons, among whom was Bouchut, who practised what he termed *le tubage du larynx*, but who was so unfortunate as to be unable to record any case in which the life of the patient was saved by this method. Trendelenburg and Schrötter pass three-cornered vulcanite tubes into the larynx, in chronic cases, for purposes of dilatation. Since 1878 the writer has had

the opportunity of introducing tubes into the trachea through the mouth in a variety of cases, and the practice has been attended with favourable results.

It need scarcely be premised that, when it is practicable, a laryngoscopic examination ought to be made previous to passing the tracheal catheter. Some prefer to introduce the catheter by aid of the laryngoscopic mirror, while others are satisfied to be guided by the sensation of touch and an accurate anatomical knowledge of the parts. The catheters may be passed either with or without the aid of anæsthetics. Local anæsthesia, such as may be induced by the repeated painting of morphia solution on the outside of the larynx, or by the application of a solution of cocaine to the mucous membrane of the larynx, is of benefit in diminishing the sensitiveness of the parts, and preventing the troublesome expiratory efforts immediately following their introduction. Under chloroform, the introduction is attended by very little coughing, and a fresh whiff of the drug, inhaled through the tube, speedily allays any irritation which may have been set up. In a number of instances, the tubes have been passed by the writer without the aid of either local or general anæsthesia; both in cases where the larynx and trachea were in a normal physiological condition, the tubes having been passed in such instances in order to prevent blood from entering the trachea during operations about the mouth, and also in acute and chronic diseased conditions. In the former class of cases, when the patients were adults or were old enough to understand intelligently, the method of introducing the tube, and the sensations which its introduction gave rise to were explained to them, and they were invited to aid its introduction—first, by endeavouring to control coughing or retching; secondly, by being prepared to take a long inspiration at the moment of inserting the tube into the larynx; and thirdly, after the introduction of the tube, instead of persisting in violent expiratory efforts, to allow a deep inspiration to take place.

When the tube is about to be inserted, the patient's head is thrown well back, his mouth is opened, and if he be nervous a gag is introduced; in children this precaution is always taken. The tongue is then well drawn forward. The operator's left index-finger is introduced until it touches the epiglottis, which it depresses against the tongue. If the laryngoscopic mirror be used the epiglottis may be left free. The tracheal tube is made to pass over the index-finger, until it is engaged in the glottis, the patient being then instructed to take a long deep inspiration, and at the same moment the tube glides between the cords into the trachea. If the tube be made of hard rubber, the operation is now completed; if it consists of soft gum-elastic, the stylet used in introducing it is removed. The patient then gives vent to a series of prolonged expiratory efforts, which are generally greatly lessened after his first full inspiration. During the five minutes subsequent to its introduction, the cough may be very troublesome, but at the end of that period a tolerance has generally been established. A few inhalations of chloroform through the tube, at this stage, greatly mitigate the irritation.

There are considerable individual differences in the degree of toleration of the tube. In some diseased laryngeal conditions, the parts are by no means so sensitive as they are in health, and when once the tube is introduced, they are much more tolerant of its presence. The fact that the obstruction to the breathing has been overcome, gives the patient a sense of relief which causes him to regard the tube favourably. In one such case the patient was suffering from an advanced epitheliomatous affection of the larynx, and was in great distress from dyspnœa at the time he was first seen by the writer. After examining with the laryngoscope, a small-sized tracheal catheter was introduced while he stood in the theatre, its insertion being attended by very little coughing, and a few minutes afterwards he walked to his ward, steadying with his hand the extremity of the tube which projected from his mouth. It afforded him complete temporary relief, and enabled him to have a sound sleep, the first he had had for many days. In children the parts are soft and much more easily injured, and therefore the introduction of the tube must be undertaken with greater gentleness. There is also the difficulty to contend with, in the want of understanding on the part of the child; therefore the head requires to be held, and the gag to be introduced. A nurse is required to attend to the child afterwards, to prevent the tube from being removed.

In most cases it is better at first to insert a catheter of less calibre than the capacity of the larynx, as it will be admitted more readily, and subsequently a larger one may be inserted. In cases of dyspnœa, due to exudation about the glottis, the patient is able to breathe with freedom if the catheter be withdrawn at the end of

a few hours. The œdema is apt to return, however, and therefore it is better to retain the instrument in the trachea for ten or twelve hours. It may be withdrawn at the end of that period, and again inserted if the patient has any further respiratory difficulty. Not only can respiration be carried on through the catheter, but the patient has the power of expelling mucus or other secretion from the trachea beyond the distal extremity of the tube. He can swallow while the tube is in the larynx without any of the liquid gaining access to the trachea. When vomiting occurs, the ejected matters do not pass into the air-passages.

The catheter may be known to be in the respiratory passages from the sensation imparted by the tube passing over the first ring or two of the trachea; by the fact that there is a current of air flowing into the tube on inspiration and one passing out on expiration—the opposite being the case if it be in the œsophagus. A lighted taper or match will demonstrate these currents.

When the catheter is to be inserted to prevent blood from gaining access to the trachea during operations about the mouth or fauces, it should be mounted with a double fold of india-rubber tubing which fits firmly on the tube, and at the same time it should be sufficient to occlude the laryngeal orifice. This india-rubber ring may be about half an inch in length, and be placed about three inches from the proximal extremity of the tube. When this tube thus furnished is inserted into the trachea, the anæsthetic may be administered through it, the currents of air being distinctly audible to the chloroformist, who thus has a ready guide to the state of the respiration. The anæsthetic may be continuously administered during the whole time, without interfering with or stopping the operation. It answers the same purposes as Trendelenburg's tampon-canula, with the advantage of not complicating the major operation with tracheotomy or its after-results.

Tracheal catheters may be introduced in cases where the respiration is impeded by other than movable bodies, which might be pushed before the instruments further into the trachea. In cases of œdema glottidis and laryngeal stenosis, the presence of the catheter in the trachea for a few hours often gives great relief. If care be taken, the cords are not injured, the voice afterwards becoming quite restored. In cases of acute and severe laryngitis, tracheotomy is the better procedure. The introduction of the tube requires practice on the cadaver; when this can be accomplished on the dead body, it will be found easy to introduce it afterwards on the living.

William Macewen.

TRACHELORRHAPHY. *See* Emmet's Operation.

TRACHEOTOMY. — This operation may be defined as the artificial opening of the trachea, either to give entrance to air, or exit to foreign bodies; or for the purpose of gaining direct access to the windpipe for the removal of morbid growths. The operation is indicated in all cases where the free entrance of air to the lungs is interfered with, by a mechanical hindrance situated in the larynx or trachea.

Tracheotomy is now almost always preferred to Laryngotomy in cases where the impediment is likely to persist for any length of time. Thus, tracheotomy may be required in laryngeal diphtheria; in cancer and malignant disease of the larynx, both primary and secondary; in certain diseases affecting neighbouring parts, and causing pressure on or displacement of the trachea, such as goître, aneurism, or disease of the spine; for foreign bodies in the trachea or bronchi; and in some cases of laryngeal ulceration (for the purpose of giving rest to the cords), &c. In short, in all cases where life is threatened by a mechanical hindrance to respiration, which itself cannot be otherwise removed sufficiently rapidly, this operation is indicated. A consideration of the foregoing indications cannot fail to show that the operation must not, in any sense, be considered as a curative or therapeutic measure; it is but a means to an end, and the treatment, which may be appropriate to the various conditions calling for the operation, ought in no way to be suspended or interfered with after the operation has been performed.

The Operation.—*Seat of Incision.*—When the opening in the trachea is made above the level of the thyroid isthmus, the 'high operation' is spoken of; when the opening is below the isthmus, it is spoken of as the 'low operation.' For anatomical reasons, to be presently alluded to, the high operation should always be selected unless some contra-indication exists, especially in the case of children and short-necked persons. Many operations which are called tracheotomies would be more accurately described as crico-tracheotomies, for the reason that the cricoid cartilage participates in the incision.

Anatomy.—The trachea, owing to the large amount of soft cellular tissue by which

it is surrounded, is very movable. It is grasped between the lobes of the thyroid gland, and the isthmus which connects these lobes crosses its upper part, the whole gland being bound down upon the trachea by the deep layer of the cervical fascia. The isthmus of the gland (which is chiefly concerned in tracheotomy) varies much in size, being usually larger in females, and sometimes assuming very considerable proportions. In front of it is a large plexus of veins, which in all forms of pulmonary obstruction becomes gorged, and which, if cut during the operation, may cause troublesome hæmorrhage. The trachea runs downwards and backwards; it is therefore nearer the surface and more easily reached in the upper than in the lower part; hence the advantage of the high over the low operation. Moreover, besides its greater depth, the close proximity of the large vessels of the neck, as well as occasional abnormalities in their origin and course, render the low operation not only more difficult but more dangerous.

The *size of the trachea* varies; in young subjects it is disproportionately small, or, in other words, the larynx and trachea undergo special development after about the twelfth or fourteenth year of life. In twenty-four cases taken without selection, mostly from young subjects, male and female, the writer found the average diameter to be ·374 of an inch. The cases included one adult male, aged twenty, with a diameter of ·550; a boy, aged thirteen years, with ·475; and a girl, aged eleven years, with ·425. The average diameter of twenty cases, boys and girls of eight years and under, was ·356. These latter cases included an infant, aged ten weeks, with ·300; a boy, aged two years and two months, with ·275; a girl, aged three years and nine months, with ·500; also a girl, aged eight years, with ·500. Thus, the trachea varies in size with the growth and development of the child, rather than with its age. The above figures will give an idea of the size of the tube which may be required. In adults the differences in size are of less moment, as the trachea is larger in proportion to the body, and far larger than any tracheotomy-tube which can be required.

Various methods of operating have been proposed. Thus, a trocar and canula, suitably shaped, have been used by some surgeons, while others have tried the actual cautery; the ordinary plan of using a scalpel is the only method which will be described in this place. The surgeon will have first to decide whether an anæsthetic shall be administered or not. In a great many cases, especially in young children, an anæsthetic will be of the greatest service; if administered slowly and without constraining the patient too much, it never does harm. *See* Laryngotomy. If the patient is old enough, and has the courage to keep himself quiet, the anæsthetic may be dispensed with. The recumbent position is the most convenient for operating, with the head thrown back in order to make the trachea stand prominently forward. Then, with the index finger of the left hand the cricoid cartilage should be felt for and its exact position ascertained; in thin subjects there will be no difficulty, but in short, fleshy necks, especially if the thyroid gland or its isthmus is large, the cricoid cartilage is not always easy to make out.

An incision, having the cricoid about or a little above its centre, is now made in the median line of the neck, when the sterno-hyoid muscles, separated by a linear interval, will be seen through the superficial layer of the cervical fascia; the sterno-thyroid muscles are immediately beneath, also separated from each other by a narrow interval. The incision must next be carried through this interval, any veins which meanwhile present themselves being drawn aside. By keeping exactly in the median line, the danger of hæmorrhage is greatly lessened. After the muscles have been drawn aside by blunt hooks, the trachea will come into view; perhaps the thyroid isthmus, if very high or very large, may be found in front of the trachea. In the latter case it must be depressed by means of a blunt hook, after cutting through the fascia by which it is bound down to the trachea. Or the isthmus may be deliberately cut through, if it is seriously in the way and the case is an urgent one.

The trachea having been well exposed, the first three or four rings may be incised *from below upwards*. In young children, owing to the shortness of the neck, the space is very limited, and it will generally be found advantageous to include the cricoid cartilage in the incision, thus converting the operation into a crico-tracheotomy. It is very desirable that the opening should be as ample as possible, for besides facilitating the introduction of the tube, it gives better access to the trachea, and allows the surgeon to carry out his after-treatment with greater ease and certainty. The trachea having been incised, a dilator is introduced, and the opening kept patent. No further anæsthesia will be required; a

good deal of irritation and coughing usually ensues, by which mucus and any blood which may have penetrated are expelled.

The subsequent proceedings depend on the nature of the disease which has called for the operation, and will be discussed farther on *seriatim*. The introduction of the tube is usually accomplished without difficulty, provided a median and ample incision into the trachea has been made. As regards the *size* of the tube, it may be laid down that the largest tube which can be got into the trachea without violence, and the shortest which can be well retained, should be used.

The *shape* of the tube is of great moment. It has already been stated that the direction of the trachea is downwards and backwards. A quarter-circle tube is, therefore, obviously unsuited for the purpose. Some years ago the writer proposed, and has since extensively used, an 'angular tube;' this has been found to be comfortable to the patient, as well as free from the inconveniences which an ill-fitting quarter-circle tube so frequently gives rise to. In gauging the calibre, the inner tube must always be taken; the smallest diameter at any point determines the available size for breathing purposes; tapering tubes should always be avoided; the inner tube should project slightly beyond the outer. In a few urgent cases the patient ceases to breathe before the operation can be completed. When this occurs, the operator should complete the operation, put in the dilator, and having cleared away any mechanical impediments to respiration, should then practise artificial respiration. It is rare not to be able to re-establish respiration.

After-treatment. — This depends altogether on the nature of the lesion which has called for the operation. Undertaken for the removal of a foreign body, if not coughed out after the trachea is opened the foreign body must be searched for with suitably curved forceps, or a sling of bent silver wire, or a trachea-aspirator. Auscultation or the patient's sensations will probably indicate its position, and the surgeon will use the means which seem most appropriate to the individual case. After its withdrawal, the opening in the trachea need only be covered with wet lint, unless any secondary conditions in larynx, trachea, or lungs indicate that a tube should be worn. In the former case, the wound will probably heal in a few days; in the latter, recovery will be more gradual, and dependent on the nature and extent of the secondary lesions. *See* Foreign Bodies in the Air-Passages.

If the operation has been undertaken on account of respiratory obstruction due to papilloma in the larynx, a tube will have to be worn until the cause of the obstruction has been removed. If malignant growth have spread to the larynx or trachea, the tube will have to be worn indefinitely; the chief object of the after-treatment consisting in keeping the discharges as sweet as possible, and in facilitating their exit from the trachea.

This will be best accomplished by the application of disinfecting solutions or powders; among the former, glycerine of boracic acid, or of carbolic acid, or of alum will be found most useful; they may be applied through the tracheal opening with a soft brush or a feather; among the latter, iodoform blown in with an insufflator will be found efficacious. The use of a spray from time to time, the patient breathing it into the lung as much as possible, will help to ward off septic pneumonia, so fatal a complication in these cases. The occasional application to the eroded surfaces and adjoining part of a solution of cocaine will add much to the comfort of the patient, by diminishing pain and reflex irritability. In cases of paralysis of the laryngeal muscles; of injury to the larynx with secondary swelling or ecchymosis of the mucous and submucous tissues; of stricture following ulcerative processes, the tube will have to be worn until the condition causing the obstruction has passed or subsided. Besides keeping the tubes quite clean, no special after-treatment, as regards the tracheotomy wound, will be required. In all such cases great care must be used in selecting a well-fitting tube, or secondary ulceration may ensue.

It is in cases of diphtheria that after-treatment becomes of such special moment, not only because of the dangerous nature of this disease, but because children are the chief sufferers. If the purposes of the operation be kept in mind—viz. the admission of air into the lungs, and the removal of the false membrane (which is infective as well as obstructive)—the nature of the after-treatment will be obvious. Immediately after incising the trachea, while it is being held open by the dilator, and before the tube is put in, an effort must be made to clear out all membrane and retained secretions; for this purpose a good long feather answers admirably. After being soaked in a solution of sodium or potassium bicarbonate and glycerine (℥ij. and f℥j. respectively to half a pint of distilled water), this feather should be passed into the

trachea and twirled about so as to detach the membrane, that it may be coughed out; the feather may then be passed up into the larynx and through the glottis, and all membrane thoroughly cleaned out. This proceeding may have to be repeated several times. Besides the feathering, some of the potash solution may be sprayed into the wound; it will be found to moisten, dissolve, and detach secretions, and so aid their expulsion. In a few cases, even this does not suffice to clear the air-passages; then aspiration must be tried. This is most effectually accomplished with the writer's 'tracheal aspirator;' the plan, moreover, is free from danger. To suck a tracheotomy wound is worse than useless, for if the secretions are adherent they cannot be sucked out, and if they are loose they will be coughed out spontaneously. It is very necessary that the tubes be taken out and changed, the outer tube once in twenty-four hours, the inner tube every hour or two according to the amount and tenacity of the discharge.

It is a very useful practice to place all tracheotomised patients in a 'croup-bed'—that is to say, in a bed surrounded with thick curtains—and to keep the air warm and moist. For this purpose, Allen's croup-kettle, made at the suggestion of the writer, is the most simple and efficient means; by it the amount of heat, as well as of steam, can be nicely regulated; an excess of steam is injurious. One of the advantages of a 'croup-bed' is that the room can be thoroughly ventilated, without exposing the patient to any draught or change of temperature.

The *final removal of the tracheotomy tube* can only be thought of when the disease has been arrested or the foreign body removed. In malignant cases, in syphilitic disease, after injuries leading to cicatricial narrowing, a tube may have to be worn permanently. As a rule, in acute cases an attempt to dispense with the tube should be made about the fourth day, and repeated at longer or shorter intervals until the breathing through the natural channel can be re-established.

Complications.—These may be briefly described as *immediate* and *remote*. The former are more or less acute, coming on within a few hours or days of the operation, and may appropriately be called 'wound complications;' these include diphtheria of the wound, inflammatory œdema of the neck, and erysipelas. The latter are generally chronic, and include pharyngeal catarrh, laryngeal catarrh, irritative changes due to the presence of a tube, and ulceration due to an ill-fitting tube.

Immediate Complications.—Diphtheria of the tracheotomy wound is comparatively rare; a sloughy and unhealthy condition (which is sometimes mistaken for diphtheria) is very common. Trousseau, to obviate this tendency, recommended that 'during the first four days, the entire surface of the incision should be vigorously cauterised once a day; one may thus avoid a very redoubtable complication, the diphtheritic infection of the wound.' Should this really occur, active measures must be taken; the surface may be touched once or twice with a mixture of equal quantities of hydrochloric acid and of glycerine, whereby a simple will be substituted for a specific inflammation. The free use of the spray, and the application of glycerine of boracic acid, as previously recommended, are excellent prophylactic measures. Œdema of the neck is a much more frequent complication. To a small extent it occurs after all operations. Sometimes, owing to unusual difficulties in opening the trachea, the intermuscular planes are too freely opened up, and the cellulitis assumes dangerous proportions. It may or may not be complicated with erysipelas—that is to say, with involvement of the skin. Sometimes severe erysipelas occurs on the surface, without appearing to affect the deeper layers. In either case their occurrence adds to the gravity of the disease for which the operation has been undertaken. Treatment must be both local and general. As a local application, nothing answers so well as lactate of lead—one drachm of liq. plumbi to a fluid ounce of fresh milk—which should be brushed thickly over the inflamed parts, and be frequently renewed. Internally, quinine and iron should be given.

Remoter Complications. — Chronic pharyngitis, with or without enlargement of tonsils, not infrequently supervenes, in weakly subjects, on an attack of pharyngeal diphtheria or scald. The condition is chiefly of interest because it may interfere with the permanent removal of the tube. The most appropriate local treatment is alum, either in the form of a saturated spray, or with glycerine, which latter must be brushed on several times a day. Cod-liver oil and steel wine, alone or combined, should be given internally. Chronic laryngitis is another sequel, and one which often causes considerable delay in removing the tube; in these cases, there are stridor in

breathing, chiefly with inspiration, hoarseness of voice, and sometimes troublesome cough. Alum solution must be sprayed into the larynx, or glycerine of alum be applied with a laryngeal brush. Occasionally, it is advantageous to paint the vocal cords and neighbouring parts with a solution of nitrate of silver (10 to 20 grains to the fluid ounce of distilled water). This chronic laryngitis is sometimes kept up by, and may be due to, the irritation which the presence of a tube causes, even when the tube fits well, for some tracheæ are so hypersensitive that they never become habituated to the presence of the tube. In such cases every means must be adopted to lessen the irritation; the use of cocaine will prove of great value. Ulceration within the trachea, generally on the anterior wall, about the spot where the lower extremity of the tube impinges, was formerly a frequent complication after tracheotomy. Since M. Roger of Paris drew prominent attention to it, and to the part which ill-fitting tubes played in its production, ulceration has become much less frequent; the remedy for such cases is obvious. It must be stated, however, that complications are much less frequent in cases of injury or morbid growths requiring tracheotomy than in disease. *See* Tracheotomy Tubes.

Robert William Parker.

TRACHEOTOMY TUBES are employed to maintain a free passage for the entrance of air into the trachea, from an artificial opening in the neck, in cases where there is an obstruction to its entrance through the larynx. The tubes are made of either silver, india-rubber, vulcanite, or celluloid, and are fashioned according to numerous patterns.

There are several requisites in a good tracheotomy tube: it should be easy to introduce; it should be composed of two canulæ, one of which fits within the other, and projects a little beyond it at its deep extremity. The mucus which is so abundantly secreted in the trachea collects in successive layers within the tube, narrowing its calibre and impeding the passage of air through it. The mucus forms a coating of leathery consistence, which it is quite impossible to detach by means of a feather, and so it is frequently necessary to remove the canula in order to clear it away. If there were only one tube its removal might cause dyspnœa, and considerable difficulty might be experienced in replacing it; with the double tube this difficulty is overcome, for the patient can breathe through the outer tube whilst the inner one is being washed. The mucus adheres to the extremity of the tubes; so it is obvious that, if the inner tube were of the same length as the outer one, the mucus collected about the extremity of the latter would offer an obstruction, however clean the former were kept.

A good tracheotomy tube should inflict the least possible injury on the trachea; to ensure this, the portion of the tube within the trachea should lie exactly in the axis of that channel, so that the free extremity of the tube does not project against its walls. The tube should be capable of as little movement within the trachea as possible, and with this object it should be as large as can be got into the trachea without inflicting injury during its introduction. The shield, which is attached to the surface extremity of the tube in order to prevent it slipping into the trachea, should be movable, for, if it be rigidly fixed to the canula, any movements of the neck or of the trachea are liable to cause the canula to injure the mucous membrane. The inner canula ought to be capable of easy introduction and removal; if it fit tightly, there is some liability of injuring the trachea by pressing the outer tube against its posterior wall. This can be avoided if care be taken to support the outer tube by the fingers, whilst the inner one is pressed home with the thumbs, but, as the removal of the inner tube is often entrusted to nurses, it is desirable that it should slip in easily, without any forcible pressure.

Fuller's silver bivalve canula has been largely used. It is a quarter-circle tube, and is composed of two canulæ: the outer one is rigidly fixed to the shield, and is split down the middle so as to allow of its two halves being pressed together. This contrivance makes it easy to introduce the outer canula, but considerable force is required to push home the inner one, as it has to press the two valves apart and to dilate the opening in the trachea; in doing this, the sharp extremities of the outer canula will be pressed against the trachea, unless care be taken. Sankey has contrived a pair of forceps which still further facilitate the introduction of the outer canula; the blades of the forceps are passed through slits in the shield and made to grip the two valves and so compress them. Jessop has had the valves attached to the shield by means of a hinge, which allows of their being more easily separated; this modification lessens the pressure required to introduce the inner tube, and also facilitates the cleansing of the instrument.

The quarter-circle curve of these instruments is objectionable, as has been especially pointed out by R. W. Parker; he has shown that, when the tube is in the windpipe, the convex surface presses against the posterior wall of the trachea, whilst the front of the lower extremity of the tube tends to press on the anterior surface of the trachea, and set up ulceration at that site.

Durham's tracheotomy tubes are a great improvement on the quarter-circle canulæ. They are made of silver, and are only curved towards the lower end; they are provided with Roger's movable shields, and there is, further, a movable collar, to which the shield is attached, and which can be firmly clamped at any position along the straight portion of the tube. When in use, the portion of the tube beyond the curve should alone rest in the trachea, and to ensure this, the movable collar should be fixed at such a position as is required by the depth of the trachea from the surface. The shape of these tubes is such that a rigid inner canula could not be introduced, so the lower part of the latter is furnished with lobster-tail joints. A similarly jointed pilot, which projects with a blunt point just beyond the lower end of the outer tube, greatly facilitates the introduction of this instrument into the trachea.

Bryant's tracheotomy tube has a quarter-circle curve, but the intra-tracheal portion is freely movable with the trachea, owing to the canula being attached to the shield by a ball-and-socket joint.

R. W. Parker's tracheotomy tube is bent at an angle, which he has found, by examination on the subject, ensures its lying in the axis of the trachea. This is a most important modification, for by means of it the tendency of the tube to cause ulceration of the mucous membrane is reduced to a minimum. The tube is provided with an inner canula, which projects beyond the outer one; owing to the shape of this tube, a complete inner canula could not be introduced, so the latter is made without a posterior wall, except at the upper and lower extremities. The inner canula slips into position almost by its own weight, and can be firmly secured by a clip at the upper end. The instrument is provided with Roger's movable collar. It will be seen that this instrument possesses all the essential factors of a good tracheotomy tube.

Morrant Baker has introduced india-rubber tracheotomy tubes; they are made of vulcanised red india-rubber, and are sufficiently firm to withstand ordinary pressure, though not rigid enough to cause ulceration of the tracheal mucous membrane. These tubes are not intended to be used until twenty-four hours after the operation. Walsham has devised a pair of curved forceps, which can be passed along the tube and then opened so as to stretch it to the shape of the opening in the trachea, and thus facilitate its introduction.

Tracheotomy tubes should be securely tied into the trachea with a piece of tape. The tape should be threaded through a slit in one end of the shield, and the two ends of the tape should be carried behind the neck to the other side, where one end of the tape should be threaded through the slit in the other extremity of the shield, and then the two ends of the tape should be tied together at the side of the neck.

Difficulty is sometimes experienced in cleaning the inner canula; this is best done by pouring over it boiling water, to which some common salt has been added.

It is a difficult point to decide when a tracheotomy tube may be safely left out; some assistance may be gained by the employment of Lauer's ball-valve, which can be fitted to the orifice of the canula, or by using T. Smith's india-rubber valve, or Gresswell's tracheotomy tube, the free extremity of which is perforated with lateral holes, and is provided with a cap which can be screwed on so as to close the holes gradually more and more completely; as this is done the patient will breathe more through the glottis, and through a hole in the convex surface of the intra-tracheal portion of the tube. When, by any of these means, it is found that sufficient air can be inspired through the glottis, the tube may be removed. BILTON POLLARD.

TRANSFUSION. — Various methods of transfusion have been proposed, and a vast amount of useless ingenuity exercised on the invention of machinery for its performance; but since the accurate knowledge of a single, safe and certain method, which can be applied on an emergency, is of more value to the practitioner than the names of a dozen different plans with complicated apparatus, one method only will be described.

The writer proposes, therefore, merely to give the method of transfusion of which he has had actual experience, having recently performed the operation on two occasions for the late Dr. Mahomed, in each of which there was not the slightest difficulty in transfusing from 30 to 40 drachms of blood. The method is simple and certain, if care

be taken to follow the directions laid down. The apparatus used is that of Aveling, slightly modified in its size and structure by the writer. The instrument must be made of the purest rubber. It is like a miniature Higginson's syringe, with the exception that it has no valves. It consists of an oval ball made to hold two drachms. At either end of the ball and directly continuous with it is an india-rubber tube 8 inches in length, having an internal diameter of a No. 4 catheter. Two silver canulæ 2½ inches long, made conical in shape with rounded points, of the diameter of a No. 2 catheter at the apex, and of such a size at the base that the india-rubber tube will fit tightly over them, are provided.

The apparatus now consists of a simple tube with a dilatation in the centre, terminating in a canula at each extremity. This syringe, destitute of valves, is filled with a warm solution of salt and water. This filling is easily accomplished by squeezing the ball a dozen times or so in a bowl of salt solution. When filled, a bull-dog clip-forceps on the india-rubber tube, close to the canula, will prevent the escape of the water on transferring the syringe to position.

The arm of the giver of the blood is then compressed by three or four turns of a bandage high above the elbow. This makes the veins stand out prominently, and a suitable one about the bend of the elbow can be selected. The skin, being drawn a little to one side of the vein, is incised to the extent of ¾ of an inch, the incision going well into the subcutaneous tissue. On the skin being let fall back into its place, the vein shows clearly blue and distended in the incision. If it does not show clearly, it must be cleanly exposed by a little dissection of the surrounding subcutaneous tissue with the point of a director. The exposed vein is then temporarily covered over with a warm sponge, and the operator next exposes the vein in the arm of the recipient. This is not so easy, for, owing to the bloodless condition usually present, the veins are not so conspicuous. However, by pressure above them one of sufficient size can be selected. The exposing of the two veins completes the first stage of the operation.

The second stage consists in opening the veins, and in introducing the canulæ. A small table should be placed at the side of the bed, covered with a blanket. On this table the arm of both the giver and the recipient are laid, the giver being seated on a very low chair or stool. A portion of the vein of the receiver is now gently seized with a pair of forceps, and opened by dividing a part of the vein transversely just below the forceps. At the moment of doing this the little finger of the left hand, which is holding the forceps, should be pressed upon the vein, a little below the point at which it is opened. This controls the bleeding, and enables the operator to see exactly the little hole he has made in the vein. He is thus able to introduce the canula without difficulty. The hole made must be very small, so that, as the conical canula is passed up into the vein, it will fit tightly into the opening. The canula at the other end of the syringe is introduced in the opposite direction into the vein of the giver. An assistant is instructed to keep both canulæ in position with his hands.

The operator then proceeds to perform transfusion as follows. The clips having been removed from the tube at either end, the operator makes the necessary valve to prevent regurgitation by compressing with the finger and thumb of one hand the tube between the central ball and the giver. He then slowly squeezes the ball, with the effect of driving the water it contains gently into the vein of the recipient; then, having compressed the tube between the ball and the recipient, he removes the finger and thumb from off the tube on the opposite side, allowing the ball to expand with the blood coming into it from the arm of the giver. When the ball is full the manipulation just described is repeated, and the blood passes into the vein of the receiver. In this manner, each time the ball is compressed two drachms of blood are injected into the veins of the patient. Should the syringe appear to become blocked or work unsatisfactorily, it can be detached and washed out without removing the canula from the veins. Roussell's apparatus is strongly advocated by the inventor, but to those who have had experience of the two methods, there is no shadow of doubt that Aveling's apparatus is vastly superior. Roussell's plan is most unsurgical, and is merely an attempt to substitute the haphazard, blind puncture of a machine for the human fingers and eyesight, which alone are to be relied on in performing so delicate an operation as transfusion with ease, safety, and precision.

HARRISON CRIPPS.

TRAUMATIC ANEURISM. *See* ANEURISM.

TRAUMATIC FEVER.—The term traumatic fever has, up till the present

time, been vaguely employed to denote pyrexia of any kind following injuries of all sorts. Thus, it has been applied to all the kinds of pyrexia which commonly occur in surgical practice, and have therefore acquired the colloquial but misleading title of Surgical Fever. It is time that the term traumatic fever should be restricted to that class of cases in which pyrexia follows the infliction of a simple injury—i.e. one which, while causing a lesion of tissues, does not rupture the enveloping skin or mucous membrane, and, consequently, one which is not complicated by external septic influences, nor by the application of antiseptic substances to the wounded tissues. Even when the term is thus limited to such cases, we find that there are, clinically speaking, two conditions which each possess a distinctive form of pyrexia, and in which there is a difference in the detail of their causation. Thus, as a result of traumatism, we find that an injury involving fracture of a bone, with moderate rupture of the surrounding tissues, may under proper treatment be repaired without further adverse consequences; while another one, more violent perhaps, and possibly situated in the neighbourhood of large blood-vessels, will give rise to a series of changes, marked by congestion and œdema of the parts on the distal side of the injury. These two results of simple traumatism vary as much in the kind of pyrexia they produce as they do in their clinical features, and they will therefore be described as two distinct varieties of traumatic fever.

Symptomatology.—The general symptoms of traumatic fever, besides the pyrexia, are usually so slight as to escape notice in the large majority of cases, and, when they do occur, are practically summed up in those of headache and loss of appetite. These remarks apply rather to the first of the two varieties about to be described, since in the second the general symptoms are frequently prolonged and more severe.

The most important symptom, then, is the pyrexia, and this follows such a very definite course as to admit of the cases being grouped, clinically, into the two varieties. In the first variety, the temperature rises almost immediately after the single injury, reaching nearly its maximum within the first two hours, but gradually rising to that point during the first twenty-four hours. It then very slowly falls to normal in about a week. The intensity and duration of the pyrexia are both somewhat modified by the age of the patient, for, in individuals beyond middle age, the temperature rises to half the height it does in younger patients, and, moreover, lasts half as long.

In the second variety, instead of the temperature rising very suddenly nearly to its maximum, it rises rather more gradually (but still within five hours) to about half its ultimate height, and from this point it steadily rises for forty-eight hours, when it reaches its maximum. From this highest point, which averages 101° F., it falls till about the 120th hour after the accident, when it rises again to about 100°, and then falls to normal in three or four days. The second rise, just described, is peculiar to this class of cases, and the pyrexia is frequently continued for nearly a fortnight. Clinically, this variation in the pyrexia is accompanied by a very noteworthy difference in the condition of the limb. In the first variety, the limb is scarcely, if at all, swollen, and there is very little ecchymosis; but, in this second class there begins, soon after the accident, a gradual swelling of the limb, which reaches its height with the temperature, and, as noted above, the patient suffers from greater constitutional disturbance.

Pathology.—In both of the varieties of traumatic fever, just described, there is, in the very large majority of cases, one constant factor in the production of pyrexia, and that is, the fracture of a large bone, with the necessary accompaniment of some extravasation of blood and rupture of soft tissues. While admitting that the rupture of such important tissues as bone and muscle is nearly the determining factor in the production of the traumatic fever described as the first variety, it must be evident that, in the second class, we have a further effect on temperature superposed on that just described—an effect which is just as clearly due to the tension of the œdema of the parts around and below the fracture. In both varieties, then, we have pyrexia and the other symptoms of fever produced by a simple injury, and this, consequently, alone deserves the name 'traumatic.' In the present state of knowledge concerning the causation of fever (*see* Surgical Fever) in general, it is impossible here to do more than point out how much peripheral irritation of nerve-trunks there must be in the seat of a fracture, &c.

Prognosis.—Traumatic fever of itself is quite harmless, and never leaves any injurious sequelæ.

Treatment.—The treatment of traumatic fever is perhaps the least important,

if not the least interesting, side of the subject, for the whole treatment of a case resolves itself into preventing œdema and inflammatory changes at the seat of injury.

Nothing has been said above, purposely, concerning the delirium which sometimes occurs in cases of traumatic fever, for the reason that it can nearly always be traced to alcoholism, fat-embolism, &c., so as to leave pure traumatic delirium a matter requiring further investigation.

VICTOR HORSLEY.

TRENDELENBURG'S TRACHEA-TAMPON is an instrument which was devised to prevent the trickling of blood into the windpipe in operations about the jaws, palate, and pharynx, and also to facilitate the administration of the anæsthetic during such operations. It consists of a tracheotomy tube, which is surrounded by a hollow elastic collar at the part of the tube lying in the trachea; by means of a small syringe, this collar can be inflated and distended. When employing this instrument, the trachea should be opened in the usual manner and the tube introduced; the further administration of the anæsthetic should be carried on through the tube. Just before the operation is begun, the india-rubber collar should be inflated sufficiently to ensure its plugging the trachea completely. By means of this tube and tampon the gravitation of blood into the bronchi is prevented, and the anæsthetic can be given without in any way incommoding the operator. After the completion of the operation the tube may be removed, and, if necessary, an ordinary tracheotomy tube may be substituted for it. It is found in practice, however, that the inflation of the india-rubber collar is apt to produce irritation of the trachea and troublesome cough, and that a more satisfactory result can be attained by using an ordinary tracheotomy tube, and plugging the upper aperture of the larynx with a sponge, to which a string should be attached for safety. BILTON POLLARD.

TREPHINING. *See* SKULL, Fracture of the.

TRICHIASIS—Inversion of the Eyelashes. *See* EYELIDS, Diseases of the.

TRICHINOSIS. *See* MUSCLES, Affections of.

TRICHOPHYTON TONSURANS. *See* TINEA TONSURANS.

TRICHOREXIS NODOSA. *See* HAIR, Diseases of the.

TRISMUS NASCENTIUM. *See* TETANUS.

TROCARS are instruments used for puncturing and evacuating the contents of cavities; they are usually provided with canulæ or hollow ensheathing tubes, through which the contents of the cavities may be drained away when the trocar has been removed. The above description refers to the trocars in common use for tapping hydroceles of the tunica vaginalis, or for tapping the bladder through the rectum. The trocar is solid and spear-pointed, so that it makes a triangular and slightly contused wound, which, if small, heals readily enough, though, if large, it may not do so. To meet this objection, the large trocars which are used for puncturing ovarian cysts are made hollow, and have a sharp and bevelled extremity, so that the wound made is a semilunar cut, which will readily heal.

The older cyst-trocars were provided with a blunt ensheathing tube or canula, with a truncated end. After the cyst had been punctured, the canula was pushed on so as to guard the point of the cutting tube. More recently, the canula has been placed within the cutting tube, and its extremity has been made dome-shaped, and the sides just behind the extremity have been perforated with large holes. The advantage of the latter alteration is that, if the cyst-wall or a secondary cyst come in contact with the end of the instrument, it is not likely to obstruct all the apertures. Some trocars are provided with a cutting blade for a short distance behind the point, so that the deeper parts of the puncture may be enlarged, if it be desired. Others, again, are grooved on one side, so that the instruments may be used as directors as well as trocars. The following are some of the more common special trocars.

Spencer Wells's cyst-trocar is a hollow instrument with a pen-shaped cutting extremity and an outer ensheathing tube, which can be pushed on so as to guard the point. When the instrument is meant for tapping ovarian cysts, preparatory to their removal, it is provided with spring claws for seizing and holding the cyst-wall just beyond the punctured portion.

Fitch's cyst-trocar differs from the last in the puncturing sharp point of the trocar being on the outer tube instead of on the inner one, as in Sir Spencer Wells's original

instrument. Dr. Fitch has recently had the canula made dome-shaped, and perforated with large holes just behind the extremity.

Ponteau's trocar, for tapping the bladder *per rectum*, is a long, curved, sharp-pointed solid instrument carrying a simple canula, which is provided with a shield.

Cock's trocar, for the same purpose as the last, is composed of five pieces—a blunt pilot trocar, a sharp-pointed trocar, and three canulæ. The outside canula is first introduced into the rectum by means of the pilot trocar, and held firmly in position; the pilot is next withdrawn, and the sharp trocar substituted for it; the base of the bladder is then pierced in a direction towards the umbilicus and the trocar removed, leaving the canula in position. A second tube with an expanding extremity, adapted to retain the canula in position, is next introduced, and within the second tube a third is placed in order to keep the second in its place.

Pearse's trocar, for suprapubic puncture of the bladder, consists of a trocar and canula suitably curved for the purpose, and of a catheter which fits the canula accurately and extends a little beyond it; the outer end of the catheter turns downwards at a right angle, in order to convey the urine away through an india-rubber tube.

Harrison's trocar, for tapping the bladder from the perineum through an hypertrophied prostate, consists of a hollow straight trocar, through which the urine flows as soon as the point has penetrated about half an inch into the bladder. The canula is provided with a movable shield, which can be fixed in any position so as to suit the size of the prostate and the depth of the perineum; there is also an inner canula with a blunt expanding extremity, which prevents the instrument slipping out of the bladder.

Southey's trocars are fine instruments, provided with canulæ which are scarcely larger than the needle of a hypodermic syringe; the canulæ are perforated with four holes on each side, and their outer ends are made a little bulbous, in order to retain pieces of capillary india-rubber tubing through which the fluid removed may be drained away. The instruments are used for the gradual removal of ascitic fluid, and for draining away the serous effusion into the subcutaneous tissues, in unyielding cases of general dropsy.

The harpoon trocar, or *emporte-pièce*, is a hollow trocar with a spear-pointed end and an aperture just behind it, through which the harpoon may be projected and then withdrawn again within the tube. It is used to remove pieces of muscle in suspected cases of trichina disease, or in other cases where a little of the tissue is desired for microscopic examination.

BILTON POLLARD.

TRUSSES are appliances of various forms and of divers materials, which serve, in the case of reducible herniæ, to retain them within the abdominal cavity, and, in the case of irreducible herniæ, to prevent their increase and, ultimately, by pressure, to procure their complete reduction. A truss should exert an amount of pressure a little in excess of that required to retain completely the hernia, under all conditions and in all positions of the body.

Trusses are composed of different materials: elastic, as steel or vulcanite; inelastic, as leather, calico, or jean. Those formed of inelastic materials are not reliable, as they fail to exert a sufficient amount of pressure to keep the protrusion retained in any variety of posture; they are, however, occasionally serviceable in cases of large irreducible inguinal and umbilical herniæ. Those composed either of steel or vulcanite are alone capable of exerting the requisite amount of persistent, uniform, and pliant pressure.

Trusses should possess the qualities of lightness, pliancy, and adequate firmness; and these are best fulfilled by steel, which, after being pared from the sheet, should be carefully forged so as to render it more tough and ductile. The hammering of the steel at a blood-red heat, moreover, enables the artisan to give the truss the necessary thinning and tapering of the end opposite to the pad. Subsequently, the steel must be hardened and tempered. It is only by these means that the truss can be accurately adapted to the body of the wearer, clasping it at all points; firmly on the side of the hernia as far as the base of the sacrum, thence gradually lessening as it curves round the opposite iliac bone.

The basis of the truss is a narrow oval band of hardened and well-tempered steel, to the thicker end of which (in the case of a single truss) is firmly rivetted a slightly concave oblong head, which should not exceed two and a half inches in length, and an inch and three-quarters in its broadest diameter. The spring may be variously cranked so as to alter its pitch, thus allowing it to exert uniform and upward pressure according to the stoutness or thinness of the wearer. To the head is attached

a piece of cork, which forms the base of the pad, of the shape of a pear cut through, the narrow end being towards the shoulder. The pad, under ordinary circumstances, should be three and a half to four inches in length, an inch and a half to two inches and a half broad, and three-quarters of an inch in thickness. Over the inside of the spring and pad are laid three layers—one of glazed cotton and two of flannel; and, lastly, the whole is covered on the outside with calf and on the inside with chamois leather. To the outside of the steel head are affixed two studs, placed obliquely. To the upper one is attached the transverse cross strap; to the lower one, the under strap.

In the femoral form of truss the spring is weaker, the curve from the shoulder is more oblique, and the pad is smaller, and more hollowed on its outer side to prevent pressure on the femoral vein.

The under strap should always be worn, for it serves to maintain the truss in position, and prevents the pad from riding up during exercise. Air or water pads are sometimes substituted for cork, affording in some cases increased comfort to the wearer, but giving no additional security.

The form of truss best adapted for the large majority of herniæ is that known as the German serpent-spring truss, which more accurately than any other encircles the pelvis immediately below the crests of the ilia, affording at the same time gentle pressure when the body is at rest, and firm and increasing pressure when it is in action.

The truss, whether inguinal or femoral, should be adjusted high up behind, resting upon the base of the sacrum, immediately below the crests of the ilia; the pads terminating in front, in the inguinal form about one-sixth of an inch above the spine of the os pubis, and in the femoral form one-sixth of an inch to its outer side; the pressure of the pad being in the former case on the inner ring and the inguinal canal, and in the latter case on the femoral canal and the saphenous opening. The truss should be adjusted before the patient rises from bed, and be taken off after he has retired to rest. Irritation of the skin occasionally results from retention of perspiration, especially during hot weather; this is best obviated by washing the skin well every morning and, after careful drying, dusting it over with some powdered oxide of zinc.

The measurement for a truss, be it inguinal, femoral, or umbilical, should be taken in the following manner: A measured tape is to be drawn fairly tightly round the pelvis just below the crests of the ilia, and the two ends made to meet above the symphysis pubis, when the number in inches can be read off.

A truss should be applied as soon as the hernia is discovered, no age being too young for an instrument to be worn, even though the patient be only a few days old. The object of the truss is not only to retain the hernia within the abdomen, but, in a large number of cases—especially in those under ten years of age—to obtain a radical cure. The percentage of cures is necessarily difficult to ascertain, but, without doubt, the large majority of children do, sooner or later, become cured. When the frequency of hernia in early infancy is considered, and its comparative rareness in early adult life, as taken from the statistics of large educational establishments, it is fair to infer that the lesion has—temporarily, at any rate—been outgrown. In support of this it may be shown that in six years, at the City of London Truss Society, 6,268 boys up to the age of five years were supplied with trusses, while only 1,174 were relieved between the ages of eleven and fifteen years. In one large institution, containing over 800 boys, not one was the subject of hernia.

In infancy, the truss should be worn constantly, only being removed three or four times in the day for the sake of cleanliness. It is well to keep the parts well dried, and to absorb all moisture.

In adults, the truss may be taken off at night; but if there be any descent of the hernia, it should be kept constantly applied, and only removed night and morning for the purpose of washing. The truss should be adjusted when the patient is lying down, and care must be taken that the whole of the hernia is replaced before the truss is put on.

It is difficult to forecast the length of time required before a cure can be expected and the use of the truss discontinued; for the general deductions on this point the reader is referred to the article Hernia, Reducible.

In *inguinal hernia*, owing to the largeness of the rupture, the patency and approximation of the rings, and the difficulty of retention, it is often necessary to devise special instruments. Thus a hernia in the funicular portion of the tunica vaginalis is usually not kept up by an ordinary truss, and may require a rat-tail truss, which consists of a triangular prolongation of the soft part of the pad. A large, direct, inguinal hernia, again, can only be retained by a forked-tongue truss, to which, in addition to the rat-tail, is attached a soft transverse

portion crossing the pubes, and buckling to the shoulder of the opposite side.

In irreducible inguinal hernia a hinged-cup truss is usually needed, which not only supports the protrusion but, by its constant pressure, procures its reduction. This truss consists of a triangular rim-plate covered with chamois leather, attached by an oblique hinge to the lower part of an ordinary inguinal pad. If the hernia be a large entero-epiplocele, a suspensory bag of some strong inelastic material may be the only appliance which can be tolerated.

Besides these there have been many other trusses devised, and the ingenuity of the surgeon is often taxed to design proper and efficient trusses to meet the varying degrees of hernia.

In *femoral hernia*, if the ordinary truss does not answer its purpose, it is well to affix to the pad a thigh-belt with a triangular fulness to fit into Scarpa's triangle. In some large protrusions after herniotomy, it may be necessary to supplement the thigh-belt with an inguinal fulness to buckle to the shoulder of the opposite side. If the hernia be irreducible, which is very frequently the case, the pad should be more or less cupped so as to embrace the hernia, the cup being comparatively small, so as to afford persistent pressure.

Umbilical herniæ, a large percentage of which are irreducible, are best treated by a shallow, circular, concave plate, which not only compresses the hernia but, at the same time, supports the lower part of the abdomen. Nipple-shaped prolongations from the plate to fit into the umbilical aperture are unadvisable, as they tend by their wedge shape to gradually enlarge the opening. *See* Umbilical Hernia.

When the hernia is very large and irreducible, it often increases the patient's comfort to apply, first, a broad abdominal bandage, and over this to adjust the ordinary umbilical truss.

Although the circular spring truss, with its modifications, fulfils better than any form of truss all the requirements needed for the retention of herniæ generally, yet there are other forms which, under occasional conditions, supply important and practical advantages. Of these varieties the following are the more important :—

Salmon and Ody's truss consists of a semicircular spring, provided in front with an oval, slightly convex pad, which moves on a ball-and-socket joint, and having behind a circular flat pad to rest on the spine. It is adjusted round the pelvis *opposite to* the side of the hernia, and is usually worn without a cross strap or an under strap. It is especially useful in those classes of cases where the patients are thin and are therefore intolerant of the clasping pressure of ordinary trusses; it is also serviceable in incomplete and direct inguinal herniæ. The umbilical form of truss is often to be recommended in small umbilical and median ventral herniæ.

Coles's truss, like the preceding, has a semicircular spring with a circular pad behind, but to the front is affixed a pyriform convex pad, in the interior of which is concealed a broad spiral steel spring; so that, in addition to the general pressure of the spring, there is the local pressure of the spiral coil in the pad itself, which is increased as the truss is tightened. This form is useful in many cases of hernia, but chiefly in cases of direct inguinal herniæ, and of considerable bulging of the inguinal canal in incomplete hernia.

In *White's moc-main truss* the circular spring is superseded by a leather band. The pad is convex and thick, placed nearly vertically, and lying in a groove on its external surface is a spring and lever, on which is a stud. To this the under strap is attached, the tightening of which increases the pressure of the pad. This form of truss is chiefly of use in direct inguinal herniæ. It is comfortable to the patient, but is not very secure, as it fails to support the inner ring with firm and pliant pressure.

Wood's horse-shoe truss claims the merit of affording support to the canal and the pillars of the outer abdominal ring, without pressure upon the cord as it emerges between its pillars. The front pad, of horse-shoe shape, is made of boxwood, to the geometric centre of which is fixed the front end of the spring. A variety of this truss is provided with a spring and lever, and is stated to be useful in herniæ which are not retained by the simpler form of instrument.

Circular spring trusses are, by some instrument-makers, provided with sliding and with revolving pads, so as to be capable of adjustment to the various lengths and positions of the inguinal and femoral canals in different patients. The efficiency of these forms of trusses is, as a rule, in inverse ratio to the complexity of their mechanical arrangements.

These varieties, which represent the chief mechanical principles on which trusses are constructed, have undergone various modifications with the view either of increasing their efficiency or of lessening their discomfort to the wearers. They are so

numerous, that there are few towns of large size in England which have not given their names to one or other modification of the foregoing varieties of trusses.

JOHN LANGTON.

TUBERCLE has of late been classed among the 'infective granulomata,' a group which also includes syphilis (gumma), lupus, glanders (farcy-buds), leprosy, and actinomycosis, but the degree of its infective force, not yet distinctly formulated, is at all events greatly inferior to that of the other diseases placed in the same class.

Histology.—A tubercle is a non-vascular rounded nodule situated among vascular tissues, from which it generally so varies in colour as to present a clearly definite outline, and varying in size from a barely perceptible point to a lump half an inch or three-quarters of an inch in diameter. It appears under two forms. Miliary or grey tubercles, often also called grey granulatious, frequently multiple, rarely exceeding the size of a pin's head, are pearly, semi-translucent globules. The yellow or crude tubercle is produced from the former by a process of fatty degeneration commencing in the centre, while peripheral growth still continuing permits this form to attain the dimensions above mentioned. Larger masses, usually of more irregular form, are due to the coalescence of several smaller ones.

Examined under a power of 200–300, the grey tubercle is found to consist of three zones of cells, supported by a delicate reticulum. The periphery, which is without any definite outside or inside limit, consists of leucocytes or lymphoid elements. These are occasionally supported by a homogeneous or obscurely fibrillated network. Next, is a layer of large pellucid cells of the epithelioid type. The third zone consists of giant-cells usually branched; it is said that these branches are continuous with a fine reticulum, which permeates and supports the cells of the second zone. In some instances, the immediate centre is occupied by an irregularly granulated material, probably the débris of one or more deceased giant-cells. In all this there is, be it observed, no distinctive or specific element; but since the year 1865, when Villemin, followed by Wilson Fox, Cohnheim, Sanderson, and others, produced artificial tuberculosis by inoculation, the possibly infective nature of the disease in the human subject has been suspected. After Pasteur's description of septic and of certain pathogenic micro-organisms, many attempts were made to discover a like generator of tubercle, but all more or less unsuccessfully until, in 1882, Koch, by using a specially prepared solution of methylene-blue, was enabled to demonstrate the existence, within the giant-cells, of a living organism which he calls *bacillus tuberculosis*. This organism is a rod, generally straight, but sometimes slightly curved, $\frac{1}{7000}$th of a line (2–6 mm.) long, and in breadth one-fifth or one-sixth of its length —i.e. about $\frac{1}{40000}$th of a line broad. Its chief habitat is the interior of the giant-cells and the interspaces among the large epithelioid cells of the second zone of tubercles; its movements, if any, are extremely sluggish.

Course and Termination.—Very occasionally, tubercle undergoes a change into an imperfect fibroid tissue, due apparently to an exaggeration of the reticulum; and though, even when thus altered, it generally suffers fatty degeneration, it does sometimes remain as a hard cicatrix-like nodule. Also, in a few instances calcification takes place. But the course of tubercle, so usual as almost to deserve the term normal, is caseation and softening. The latter is commonly called 'breaking down.' When a grey granulation has attained a certain size, the older central parts, which are those farthest removed from nutritive sources, begin to soften into a fatty, irregularly granulated material, which imparts to the hitherto pearly grey nodule a yellowish opaque colour (yellow or crude tubercle). Sometimes, this is preceded or closely accompanied throughout the nodule by caseation; or, after the central parts have thus broken down, the more peripheral portions may become caseous, previous to yielding to the more completely destructive process. The resulting mass is a fatty pultaceous semi-solid.

As these degenerative processes approach or reach the outer zone of the growth, so does the neighbouring tissue inflame. Thus, the healthy or relatively healthy surface next to the mass of disease suppurates, and there is an attempt to throw off the tubercle into a tube or hollow viscus if it have been on a surface, or into a cavity of new-formation if it have been parenchymatous. In the former case a tuberculous ulcer, in the latter a tuberculous abscess or *vomica* results, the floor or the lining membrane of which might be (in a few rare instances is) healthy, but that the softened or caseated tubercle has a great tendency to infiltrate the immediate neighbourhood, or to induce round about

the deposit of fresh tubercular matter, in the form of miliary tubercle, scattered in the tissue surrounding cavities or ulcers of considerable age. Thus, the floor or walls of such excavations very generally consist, in part, of rapidly forming and quickly retrograding tubercular matter, which, continually invading more and more tissue at the circumference and breaking down at the centre, constantly enlarges both the area of tuberculous deposit and of ulcer or abscess. The gravity or the deadly nature of such processes depends chiefly on the locality of its occurrence; but not altogether so, for, when tubercle has gained a habitat in some part of the body, it has a tendency to spread to other portions by means of the lymphatics or the veins, which may carry some of the *materies morbi* from less to more important parts.

Clinically, tuberculosis is divided into acute and chronic; the former is often widely spread—that is, a number of different organs become simultaneously or in very rapid succession infested with tubercles, which, if the patient survive long enough, quickly break down.

Acute general tuberculosis, or tubercles, may attack with almost equal rapidity one organ only, or at least so predominantly that the affection of any other viscus is quite secondary, both in sequence and importance—*acute pulmonary* or *acute hepatic*, or otherwise specified *tuberculosis*.

Occasionally an organ, unessential to life, may be suffering for months from chronic or subacute tuberculosis, when some more important part, as, for instance, the lungs, the cerebral meninges, or the brain itself, may become rapidly involved, death very quickly resulting—*acute secondary invasion or infection of tubercle*.

Local tuberculosis is, as a general rule, chronic. It may affect internal organs, as the lung, liver, brain, kidneys, or it may attack the lymphatic glands primarily, skin (lupus), Peyer's and the solitary intestinal glands, the tonsils, the adenoid tissues at the back of the pharynx, the bladder, prostate, and ureters; also, as is generally believed, the synovial membranes of joints and the bones. (On the tuberculosis of these two latter more will be said in the sequel.) The ovaries, the mammæ, the thyroid, and the muscles (voluntary), are singularly, but not entirely, exempt. Wherever it may arise, tubercle goes through the phases above described, unless its mere presence in some organ of great vital importance excite fatal irritation or inflammation.

Etiology.—The course of tuberculosis, especially as exemplified in phthisis, gave rise many years ago to the opinion that it was in many instances of an infective character. The discovery by Koch of the bacillus tuberculosis, which, after eight generations of pure cultivation, diffused in distilled water and injected into animal tissues, can produce both local and general tuberculosis, has rendered that opinion still more prevalent; while more recent experiments, carried out with all the precautions now known to be necessary, have negatived former results, which seemed to show that indifferent substances, such as glass-beads, setons, &c., introduced into, and left a certain time within the body, resulted in the production of tubercles. Furthermore, animals made to inhale tubercular matter diffused in their atmosphere as spray, develop tubercle, chiefly of the lung. So stringent do these facts appear to many minds, that they consider inevitable the conclusion that tubercle is due to infection by bacillus tuberculosis, and that it can arise in no other way. As, however, in the human subject, entrance of tubercle by inoculation or infection through the skin is unknown, it is by such believers assumed that the tubercle bacillus always finds its entry in man by way of the lungs or of the alimentary canal; in the former case by breathing the same air as phthisical patients, in the latter by eating meat infected by the very common bovine tuberculosis. They point out that such bacillus, if it survive, need not of necessity find its ultimate lodgment at the point it first strikes, but that, taken up by the blood or lymph, it may pass with either circulation to the next most vulnerable point, such as a lymphatic gland, a serous membrane, or some not quite healthy viscus. They furthermore affirm that everyone exposed to the above sources of infection does not of necessity become tuberculous, because the bacillus seems incapable, or capable only with extreme difficulty, of thriving on or in healthy tissues, but that the soil must be to a certain extent prepared by some morbid condition, the chief of which is a low or chronic inflammation, or perhaps that state of ill-nutrition of the tissues which forms the definition of scrofula. *See* Scrofula.

But it must also be stated that many pathologists hesitate to accept this theory, being perhaps put somewhat on their guard by its very ease and apparent simplicity, as well as by the fashion of the hour to find bacilli in so many morbid processes. They point to the fact that the diseases known to

be connected with the development of living germs, such as pyæmia, splenic fever, &c., run a course much more acute, and in other ways differing from local tuberculosis; that most tubercles, in parts having no access to the outward air, show a great paucity of bacilli, and in many those organisms are not discoverable at all; that there is much difficulty in accounting for the existence of a bacillus in healthy animal fluids while travelling from the first spot of implantation to, let us say, the cerebral meninges; that the acknowledged necessity for some antecedent morbid process to prepare a *locus vivendi* for the bacillus, into which, by means of such navigation, it may find its way, is not easy to accept; also, that many facts of heredity are not reconcilable with the dogma that tuberculosis can only be produced by reception, from without, of a *contagium vivum*.

The writer thinks it best to place these arguments on either side in juxtaposition, without himself offering any opinion, but, nevertheless, must say a few words on a prevalent tendency to confuse scrofulous with tuberculous inflammation. The two things are distinct. Irritation of teething or of a slight scalp-eruption may produce a lymphadenitis of the neck, which, lasting a long time, becomes evidently scrofulous, but which may subside, or which may become the site of tubercle, but is not, until so infected, tuberculous. So also a joint or a bone may, after some slight injury, assume a scrofulous inflammation. The tissues are rendered no doubt fit for, but may never receive, tubercle, and until they do so the inflammation is strumous, not tuberculous. When they do so the condition is tubercle, not of a bone or of a synovial membrane, but of an inflammatory product. The nodules, named by Rindfleisch 'new lymphatic follicles' (*see* Scrofula), have often been mistaken for tubercles. When either the grey granulation or the tubercle bacillus has been found in such a tissue, still nearly healthy or only very recently diseased, and not until then, will primary tuberculosis of those parts be established.

The *treatment* of tubercle depends in very great part on its situation. Tubercle of the viscera in the three great cavities belongs to the physician. Tubercle of the throat, lymphatic glands, of the prostate and bladder, is described under their respective headings. General directions for treatment can include little but management of a diathesis, and is identical, or nearly so, with that of scrofula, save that residence in sufficiently warm, dry, and above all, equable climates, is of the highest value. High altitudes are also greatly advocated, and next in efficacy is sea air. Whatever may be believed concerning the bacillus tuberculosis, there is, at all events, sufficient probability in the hypothesis and the alleged discovery, to render imperative that we carefully avoid exposing predisposed persons to the emanations of phthisis or of other tubercular diseases. We may even go further, and sequestrate such individuals—especially if for family reasons the life be valuable—from any prolonged contact with tuberculous persons.

The possible spread of tubercle from some less important part to a vital organ calls forth the question of early removal, when feasible, of all tuberculous parts. The subject is too recent to be discussed; it can only be suggested here as a surgical problem of the immediate future.

Richard Barwell.

TUBERCULOSIS, Surgical. — Local surgical disease, characterised pathologically by the presence of tubercle in any of its forms, the clinical course of which coincides with the morbid changes known to occur in tubercular deposits.

The subjects of scrofula and tubercle have been treated of under their respective headings; this article is intended to serve as a brief exposition of the views on local tuberculosis which the labours of German pathologists, especially Volkmann and König, have done so much to generalise. A lengthened general introduction to the local affections treated of below would therefore be superfluous, but it is necessary to make a few remarks on the connection of surgical tuberculosis with scrofula, the etiological importance of trauma and inflammation, and the relation of local to general tuberculosis.

Volkmann suggests that the tubercular nature of an affection is indubitable when (1) inoculation gives positive results, (2) the bacillus tuberculosis is demonstrable, and (3) the tissues exhibit the typical structure. These three confirmatory conditions are, however, not to be looked for in every case, since inoculation sometimes fails from accident, or incapacity for infection of the animal chosen; (2) the bacilli are in some cases, in chronic ones especially, very limited in number; and (3) in some acutely progressing cases the structure is not characteristic, although the bacilli may be abundant. Under these circumstances, two of the conditions should suffice, especial prominence being given to the inoculation test.

All recent investigations tend to support the infectious nature of tubercular processes, and, moreover, to strengthen the dependence of this property on the bacillus of Koch. Considering the wide distribution of the infecting organism, it is necessary to endeavour to gain some notion of the reason why some of those exposed to infection suffer from tubercular diseases while others go free. In the present state of knowledge, this is explicable only on the supposition that healthy vital tissue is an unfit nidus for the development of the virus. Some change must occur before the organism can develop itself, and induce the characteristic process and appearances due to its presence. The condition most favourable to this development is a local or general depression of the vital processes, leading to inflammatory changes, and it is here that the connecting link between scrofula and tubercle has been sought. The scrofulous diathesis has been said to consist in a tendency to processes, essentially of an inflammatory type, marked by the characteristics of chronicity, a tendency to the development of granulation-tissue and to caseation. Thus, under the head of scrofula are described characteristics both of a general diathesis and of local affections. Attempts have been made to explain the peculiarities of the inflammations occurring by special structural arrangements, which find mention in the article on Scrofula.

When we endeavour, however, to separate the local processes due to scrofula and tuberculosis respectively, we find ourselves landed amongst innumerable difficulties. Most pathologists will, no doubt, admit that the majority of such processes belong to the province of tubercle; indeed, in some organs —notably the testis—the name tubercular testis is rapidly superseding, if it has not already altogether done so, that of scrofulous testis. Again, in the case of so-called scrofulous glands, authors (Allbutt and Teale) who do not call them tubercular, allow their capacity to produce tubercular disease on inoculation. The writer thinks it will not be long before this change in terminology occurs in most other so-called scrofulous diseases. Are we then to regard scrofulous and tubercular diseases as identical? Here we are met by the difficulty, well put by Volkmann, that a healthy blooming individual may present all the general characteristics of the scrofulous diathesis, but no local affection as evidence of tubercle. It would seem best, then, to restrict the term scrofulous as indicating a diathesis characterised by the personal peculiarities described in the article on Scrofula, and, while not denying the possibility of simple inflammations in scrofulous subjects, to refer all those inflammations which have been described, as undergoing the changes already mentioned—changes ordinarily occurring in tubercle—to the category of tuberculosis.

Traumatism, as a causative agency, finds an explanation in the induction of a precedent inflammation. The slightness of the violence exerted, often noted, is perhaps of importance as not occasioning a very acute process, a condition unsuited to the development of the organism (Volkmann). Allied to trauma as a cause, is overuse of a part, as exampled in tubercular disease of a joint, freely used from its position and the occupation of the patient—e.g. elbow in a mason. The ultimate tubercular nature of many joint cases, commencing during the course of an acute exanthem, may perhaps be similarly explained; the inflammatory infiltration offering a suitable nidus or *locus minoris resistantiæ*.

Another point of extreme importance, from a prognostic point of view, is the possibility of these local affections acting as infecting centres for the production of a general tuberculosis. The mode by which the primary infection occurs, as far as our knowledge will allow us to presume, is commonly from the alimentary or respiratory tracts, possibly, in rare cases, from a broken cutaneous surface. A primary infection having taken place, the modes of extension or generalisation may be shortly enumerated, as a consideration of these gives some indications as to surgical treatment, and also explains the comparatively good prognosis in cases of external tuberculosis. They are—

1. By wide extension of the original deposit in the surrounding tissue, or direct extension along mucous or serous surfaces.

2. By extension through the lymphatic system, such extension being usually limited by the lymphatic glands. If the tuberculosis spread beyond these it may reach the thoracic duct (Ponfick), and so the virus may be poured directly into the general circulation. Volkmann remarks that the function of the lymphatic glands as stop-gates, or even possibly destroyers of the poison, has not yet been sufficiently recognised.

3. Infection of a serous sac, either by direct extension, or by rupture of a neighbouring suppurating or caseating deposit. The danger in the latter case depends on the size of the sac, its lymphatic connec-

tions, and possible lining with granulations, —forming a barrier against further diffusion.

4. The entrance of tubercular matter into canals or cavities lined with mucous membrane, where stagnation is possible or actual length renders long contact inevitable.

5. Entrance of tubercular matter into veins by extension, or rupture of neighbouring deposits (Weigert); or by septic changes in tubercular wounds, leading to breaking down and distribution of the venous thrombi (König).

Consideration of these modes of extension explains the comparatively favourable position of a patient suffering from tuberculosis of the skin, bones, joints, or glands; for, in addition to the fact that the affected organs are less important in the vital economy, the danger of generalisation from them is manifestly less than in tuberculosis of the respiratory, alimentary, or genito-urinary tracts. As to the frequency with which general or secondary infection occurs, it is difficult to speak with certainty; but in relation to this subject, a point much insisted on by Volkmann is of great importance—viz. that in many cases the primary deposits are multiple, although only one causes appreciable symptoms. A familiar instance in support of this is the multiple nature of the lesions in tubercular dactylitis. That a large number of cases die of tubercular phthisis was long ago pointed out by Billroth, and has since been confirmed by many authorities, but it is not possible to give any reliable percentage of cases in which the pulmonary disease was evidently secondary. A certain number of cases, particularly of tuberculosis of joints, die of acute general tuberculosis; but here a point emphasized by König must be regarded with attention—namely, that in all the instances in which this occurred among his cases, the patient had been recently operated on, and the wound had become septic. The writer has seen similar cases. These considerations, therefore, would seem opposed to the theory of removing a local infecting centre as a general rule, except in such a case as the testis, where removal may prevent direct extension, by continuity of surface, through so important a tract as the genito-urinary.

As has been already pointed out, the danger of general infection is not great, and when the disease is limited to external parts, the interference with the vital functions is not sufficient to make the outlook a correspondingly bad one to that in cases where internal organs are affected. The local prognosis is of more importance; and here it may be broadly stated that complete removal ensures local cure, but the possible presence of other deposits may prevent the cure from being complete. A number of secondary considerations will affect the question—as the surroundings of the patient, the extent of the disease, and the general condition; the nature of the process as to its tendency to granulation, caseation, or suppuration; the age—youth, as in other diseases, being on the patient's side, and markedly so both in the possibility of spontaneous cure, less rapid destruction, and in the relative infrequency of concomitant pulmonary phthisis. Lastly, as to spontaneous cure: under favourable circumstances this is always possible, but, as in all other diseases of a similar nature, recurrences may readily take place from fresh activity of the process in and around the latent deposit.

Tubercular Disease of Bone.—The deposit of tubercle in bone may form a part of an acute general miliary tuberculosis, or it may be a distinct local affection. In the latter case it may of course serve as an infecting centre, but more commonly its prejudicial consequences are the result of direct extension.

Miliary tuberculosis of bone, as a part of an acute general condition, may be dismissed with mere mention, since it is uncommon and devoid of clinical interest. Recognition of the frequency of local tuberculosis amongst chronic bone-affections is, however, perhaps the most important result of recent investigation of tubercle from a surgical standpoint. The disease is characterised by definite appearances, situation, and course of extension, which allow a fixed boundary to be placed between it and other forms of bone-affection, such as acute infectious osteomyelitis, simple chronic inflammations, or those due to syphilis. Subsequent description will, however, identify the affection more or less completely with that often spoken of as scrofulous.

Situation.—No bones or parts of bones are exempt from the possibility of tubercular disease, but the special seat of predilection is the cancellous structure of the articular ends of the long bones and of the short bones. Deposits are common in the bodies of the vertebræ, the os calcis, the olecranon, the condyles of the humerus, and the neck and internal condyle of the femur. Observation tends to free the head of the tibia from the unenviable distinction of being the head-quarters of this disease. The shafts of the long bones and the flat

bones may be affected, the most typical examples of the former occurrence being met with in tubercular dactylitis; while deposits are common in the acetabulum, and far from rare in the glenoid cavity of the scapula and the skull.

Appearances. — The morbid processes vary according to the structure of the bone affected, and will be considered here first as they are met with in cancellous, then in compact bone.

Localised Tubercular Ostitis.—In cancellous bone the disease commences as an ostitis affecting limited areas, which may vary in extent from the dimensions of a pea to that of a hazel-nut. The deposits may be single or multiple; in the latter case two or more may coalesce by extension. The process is primarily rarefying in character, the bony trabeculæ being thinned by absorption of the walls of the Haversian canals, soft granulation-tissue, containing histologically perfect reticular tubercle, taking the place of the harder element. The ultimate termination may vary considerably: the bone-tissue may be converted into a mass of granulations without suppuration (caries sicca); the process may proceed irregularly, small islets of bone being cut off and necrosing (caries necrotica); a sequestrum of some size may be formed, or caseation or suppuration may occur. In the case of the caries assuming the dry form, secondary ossification and sclerosis may occur; if caseation or suppuration supervene, the area may become encapsuled by a layer of sclerosed bone.

In the majority of cases progressive changes occur, the tendency being to extend peripherally—in the joint ends preferably towards the articular cavity—the cartilage being undermined and perforated by the granulations. Perforation may, however, take place beyond the articular margin, in rare and favourable cases even beyond the attachment of the joint-capsule. The two latter occurrences are the less frequent, from the fact that extension towards the compact tissue is usually accompanied by subperiosteal bone-formation, which renders perforation a slower and more difficult process. They are of radical importance with regard to the possible implication of the joint, and the limited or diffuse nature of the local joint-affection. This subperiosteal bone-formation accounts for the actual enlargement of the bone-ends occasionally met with. Prior to perforation, and even when that has occurred, a satisfactory view of the affected area can only be obtained by section of the bone-end. The appearance will then vary according to the special form the process has assumed.

Circular defects or burrowing tracks may be met with, either single or multiple; in the case of dry caries, often the latter; these may be situated near the centre or peripherally. In recent cases they may consist of soft grey or reddish-grey granulation-tissue, often with evident tubercles at the periphery, and surrounded by an area of hyperæmic bone. If caseation has occurred, the tint will be yellower, and, when the granulations have been cleared out, in recent cases the walls will be softened, in old cases more or less sclerosed. In all cases, molecules of bone exist in the granulations; in caries necrotica, palpable sequestra are present; in other instances, the whole of the centre of the area originally affected forms a sequestrum permeated with tubercular granulations, and lying in a cavity lined with similar tissue more or less firmly connected thereby to the sclerosed wall or surrounding bone. In other cases the cavity will contain broken-down caseous material and pus. If the process has extended directly down to the cartilage, the latter will be more or less extensively detached, perhaps perforated; if perforation has occurred beyond an articular margin, more or less irregular disposed periosteal bone will surround it. In rare cases, the bone may be secondarily affected by extension of the tubercular process from the soft parts, as seen in cases of lupus of the face extending down to the bones. Where the affection of the bone is recent, tubercles may be found deposited in the marrow of the cancelli, without any change in the trabeculæ (Volkmann).

Besides the forms of necrosis already adverted to, a third occurs. Here, a considerable area necroses as a result of a somewhat more acute tubercular infiltration. This may occur in the pelvis, ribs, skull, or notably in the articular ends. When met with in the articular ends, the sequestra are often of a typical wedge shape (suggesting to König a possible embolic origin, the whole area becoming infected by bacilli spreading from the original embolus into the arterioles), of a yellow colour, permeated by tubercular granulations, and separated from the surrounding healthy bone by a layer of tubercular granulations to which they are attached, and which preserve the bone from wider affection. In the skull and pelvis they are irregular in outline; in the case of the former, the sequestra are

similar in character, but are peculiar in affecting both tables of the skull to an equal extent.

Diffuse Tubercular Osteomyelitis.— This is a much less common and more serious disease than that above described. The tubercular infiltration may affect the whole medullary cavity. It usually commences at a cancellous end, but, deviating from the common course, extends centrally. The medullary cavity becomes filled with soft, breaking-down, tubercular granulations; the compact tissue is much thinned. Local prognosis in these cases is very bad.

Tuberculosis of the Shafts of the Long Bones.— This affection, implicating the compact tissue from the first, is less common than the form first described. The disease is commonest in the metacarpal and metatarsal bones and their phalanges; more rarely it occurs in the femur and tibia. It is a disease of childhood, characterised by chronic enlargement of the bones, due to the following process. Deposition of tubercle takes place both in the medullary cavity and periosteum; this leads to the development of granulation-tissue in the canal, and of irregular spongy nodes containing tubercle beneath the periosteum. The true compact tissue is gradually thinned, while, later, a layer of hard bone is sometimes developed beneath the periosteum on the surface of the osteophytic nodes. The process sometimes subsides spontaneously, and subsequent absorption of the new bone removes all trace of its occurrence; more commonly, however, considerable shortening remains from arrest of growth.

Effects of Bone-Tuberculosis.— The extreme importance of the process is derived from the formidable nature of the complications due to extension. Here we find the origin of an overwhelming percentage of the cases of joint-tuberculosis; while bones bordering on the large cavities may, when so affected, lead, by extension of the process, to meningitis, pleurisy, or peritonitis, with all the attendant dangers of infecting a large lymphatic sac. No more fertile source exists of cold abscesses, especially in their most formidable form—the spinal abscesses; and, lastly, no disease of bone so commonly leads to lasting deformity from loss of substance, as is met with in spinal caries and pathological displacements of joints.

Signs of Tubercular Disease of Bone. These are chronic in nature, often most insidious; in many cases the first sign met with is due to some complication. An important early symptom is pain, which may be characterised by the deep boring character and nocturnal exacerbation common in central bone-cases, but this may be absent. Later, local thickening and tenderness, followed by œdema, redness, and suppuration, may occur; the suppuration may sometimes be superficial, but is generally in direct communication with the osseous deposit. When the suppuration has pointed, a chronic fistula is usually established, lined with tubercular granulations, discharging thin unhealthy pus. On probing, the sensation will vary with the form of caries present; the commonest result is to feel the bone covered with granulations, and often small sequestra, giving a gritty feeling, may be embedded in these. Such fistulæ are extremely chronic, and rarely heal without treatment.

In many cases, however, where the joint-ends are affected, joint-symptoms, as local tenderness or pain on some particular movement, with more or less effusion, are often the first signs; such synovitis at an early stage is often simple, thus differing widely from that met with when perforation has occurred, and when a well-marked joint-tuberculosis is the result. In disease of the vertebral bodies, neuralgic pain, deformity, or abscess may be the first sign, and abscess or neuralgia may be the first signs of pelvic disease. Tubercular necrosis of the vault of the skull is most common in the frontal and parietal bones; it may be heralded by cerebral symptoms from pressure due to inflammatory effusion within the skull; in other cases a large, lax, cold abscess forms. Necrosis of a rib, again, is often first evidenced by abscess or empyema. In the case of the long bones, increased epiphysial growth may result from the abnormal vascularity, or, later, dislocations may occur from actual loss of substance.

In tubercular dactylitis, a chronic fusiform enlargement of a metacarpal or metatarsal bone or phalanx may take place, often without pain. Several bones are often implicated. The disease may, after a time, recede, leaving slight evidence of its occurrence, but, usually, arrest of growth leaves permanent shortening in cases of recovery. If it progress, the skin and surrounding tendon-sheaths become implicated, reddening occurs and suppuration; the disease often leads to spontaneous fracture. A marked characteristic is the limitation of the disease to the diaphysis. Its occurrence is limited to childhood.

Diagnosis.—The presence of tubercle in other organs, a tubercular history, or the special personal characters are often of value. The less acute nature of the process, and its tendency to spread in the direction of the epiphysis (dactylitis excepted), contrast strongly with the extremely acute invasion and tendency to spread in the diaphysis, characterising acute osteomyelitis. In the later stages, the different character of the sequestrum, its yellow colour and permeation with granulations, contrast quite as markedly with the hard white sequestrum of osteomyelitis. In the case of more chronic simple ostitis or caries the diagnosis is more difficult, and must depend on the general aspects of the case and a microscopical examination. The history, and the result of treatment, should settle the question of syphilis in any given case; but difficulty may arise in some cases of dactylitis and necrosis—in the latter, the tendency to sclerosis in syphilitic affections should be borne in mind.

Prognosis.—This depends greatly on the situation of the disease, and the direction in which extension may have taken place, greatly also on the dry or suppurating character of the original deposit, which will impress a corresponding character on any further processes it may give rise to by extension. Local cure may follow complete removal, or may occur spontaneously; in the latter case, usually leaving some permanent deformity (angular curvature, shortening, &c.). In no case, however, where spontaneous cure is supposed to have occurred, is the patient free from danger of subsequent recurrence from the lighting up of a fresh inflammation at the latent spot.

Treatment. — The general treatment differs in no way from that followed in other cases of tuberculosis. As to local treatment, the first indication is rest, and, where extremely chronic symptoms exist, counter-irritation may be of use. The first indication is usually fulfilled by the use of splints; for the second, blisters or, rarely, the actual cautery may be applied.

When signs of progressive disease exist in the neighbourhood of a joint, no time should be lost in trephining or chiselling the bone, so as to afford a free exit, and divert the course of extension from the direction of the joint. Any cavity thus opened should be freely scraped out with a sharp spoon, or the wall chiselled away, and the cavity may be dressed with iodoform. Where a sequestrum exists it should be removed, and the walls of the cavity treated in like manner. The question of excision and amputation are treated of in the next section on joints.

Tubercular Disease of Joints.—These affections are broadly divided into two classes: 1. Where articular disease is secondary to tubercular ostitis of the joint-ends. 2. Where primary tuberculosis of the synovial membrane occurs.

1. *Arthritis secondary to Tubercular Ostitis.*—This may depend on extension of any of the forms of bone-disease above described, the nature of the primary process impressing itself on the secondary joint-mischief. If the primary disease is of the dry or fungous form, or if one of the wedge-shaped sequestra is present, suppuration does not necessarily occur; if, on the other hand, caseation or suppuration of the primary deposit has taken place, a local or general suppuration of the joint-cavity is the invariable consequence. The perforation leading to infection of the articular cavity may, as already mentioned, take place either through the articular cartilage or through the bone beyond its margin, but internal to the line of attachment of the ligaments. This point of infection is of considerable importance, since, if it be beyond the margin of the articular cartilage, inflammation of the periosteum and structures in immediate contact with it may have led to adhesions, so disposed as to ensure the general joint-cavity from infection. If, on the other hand, the perforation be subchondral, a general infection of the articular cavity is the result. The possibility of such a local infection must always be taken into consideration in examining the tissues for tubercle, for it may exist here alone and in very limited extent, although considerable inflammatory change may have occurred in the synovial membrane generally. The bone-deposits may be single or multiple, confined to one bone, or affecting both bones entering into articulation. The appearance of these deposits has been already described under the heading of *Tubercle in Bone*; it will be only necessary to describe here the condition of the remaining joint-structures.

The cartilages are always secondarily affected, playing a passive part. In cases where perforation is subchondral an opening may exist, the edges of which are bevelled off from the osseous aspect to a thin margin, or the whole sheet of cartilage may be separated, hanging in shreds, or readily tearing off the subjacent granulations. When perforation has occurred beyond the margin of the cartilage, the latter may still be loosened, as the result

of a subarticular ostitis or caries; in other cases it is absorbed from its free surface by the granulating synovial membrane. In the latter case, it may retain its attachment until total absorption occurs by a process of gradual thinning. In examining the subchondral osseous granulations in such cases, especially the latter variety, it will be found that they are very frequently simple in nature, the tubercular process being limited to the original deposit and the immediate neighbourhood of its perforation.

The synovial membrane is thickened, in the more chronic cases enormously so, both by the development of a species of false membrane on its surface and by infiltration of its deeper layers; it is of a greyish or brownish-grey tint, studded thickly with lighter-coloured spots, softened and pulpy in consistence. On examination, it is found to contain enormous numbers of typical reticular tubercles and long areas or stretches of tubercular tissue, suggesting to König the idea of invasion of the lymphatic spaces; in addition, numerous isolated giant cells are met with, dispersed through the small-celled infiltration. In old cases, a similar infiltration may have invaded the ligaments, though for the most part the infiltration in these is of a simple inflammatory nature; this latter usually extends into the pararticular structures, binding down the skin and destroying its normal mobility. The subsequent contraction of this pararticular infiltration causes the white anæmic condition of skin which led to the adoption of the name of white swelling. The infiltration and softening of the ligaments allows the occurrence of spontaneous dislocation. The joint-cavity may be more or less obliterated or cut up into sections by adhesions, or it may contain a varying amount of thin cheesy pus. Such pus may come to the surface and point externally; in other cases, abscesses form in a localised cavity or on the external surface of the joint-capsule. These pararticular abscesses are usually the result of caseation and suppuration in the infiltration of the soft parts above described; in rare cases, they may result from the perforation of tubercular deposits in the articular ends, beyond the attachment of the ligaments.

In other cases where, as already mentioned, the process of infection has been limited by prior adhesions, the tubercular changes may be limited to a small area, while the other changes in the joint are of a simple nature; and, where the course is chronic, these may be entirely atrophic in character, so that, in place of the large fusiform pulpy joint, a thin skeleton-like joint may be present, the atrophy of the soft structures leading to the idea that the bone-ends are considerably enlarged. Actual localised enlargement may exist when periosteal new bone-formation has occurred. In old suppurating cases, again, a very considerable new bone-formation may exist, generally within the joint-capsule. The muscles of the limbs undergo fatty degeneration and atrophy from disuse; this may sometimes be masked by the existence of extensive tracts of suppuration in the deep planes of the limb. Pathological dislocations of the joints are common, either from shortening and malformation due to absorption; from separation of portions of bone, as in the case of the head of the femur where the neck is implicated or a part of the acetabulum is necrosed; or by the pushing out of the head of a bone from a joint-cavity by redundant granulations, as may occur in the case of the femur and acetabulum.

2. *Primary Synovial Tuberculosis.*—This may take on several forms; the affection of the synovial membrane may be local or general, and the tendency may be to serous or suppurative inflammation.

In its severest form, we have the most typical example of white swelling, and the appearances do not in any way differ from those described in the last section, except in the absence of osseous deposits, and the fact that the tuberculosis of the joint is usually general.

In the serous forms, less thickening of the synovial and subsynovial tissues occur, and the disease is characterised by considerable distension of the joint, the fluid being clear or containing flakes of lymph or melon-seed bodies. In these cases the membrane may be studded with very numerous tubercles. In the late stages, the thickening may increase and become considerable.

Lastly, a nodular form (König, Riedel), is sometimes met with. It is rare, commonest in the knee. This variety is characterised, in some cases, by the development of a single tubercular tumour in the fibrous layer of the synovial membrane, which may reach the size of a pigeon's egg; in other cases the individual tumours are smaller, and may be numerous. The tubercles lie in the fibrous layer of the membrane, surrounded by small-celled growth and young connective tissue, the nodules are of a pinkish-grey colour, speckled with points, or a pure grey colour, and the normal

synovial epithelium covers them. The joint usually contains fluid in considerable quantity, often melon-seed bodies.

The relative frequency of primary osseous or synovial cases is difficult to determine accurately, but all authors agree in regarding the bone cases as largely preponderating. The proportion varies in different joints and at different ages, synovial cases being relatively more frequent in childhood. König gives the following percentages. All joints—synovial cases, 20 per cent.; hip—synovial cases, 6 per cent; knee, 33 per cent.; elbow, 20 per cent. He also gives the following statistics as to the influence of age in the cases observed in his *Klinik*:—

3–14 . .	Bone cases,	50 . . .	Synovial,	21
14–30 . .	„	„	64 . . .	„	18
30 & over	„	„	39 . . .	„	12

Symptoms.—The local signs will vary according to which of the pathological varieties exists, and they will be so described; but it must be at the same time stated that the different forms may, in their different stages, so much resemble each other that it is often impossible to decide whether the case be primarily a bone or synovial one, without an opportunity be afforded by operation for internal examination.

Primary Bone Cases.—The early symptoms are often extremely insidious. Local pain may exist, and, later, tenderness on pressure or on some particular movements, indicated by limping or interference with free movement of the joint. Local thickening of the bone may be present, or effusion into the joint (as already mentioned, possibly simple) may occur. This effusion may become absorbed with rest, and later will reappear, often with acute local and constitutional signs, indicative of suppuration and infection of the joint. In cases where no adhesions exist, this infection leads to general thickening and pulpy degeneration, with the development of a typical fusiform white swelling. In cases where adhesions exist, a local abscess only may form, with atrophic changes around. Where the original bone-mischief is of the dry or fungating form, suppuration may never occur, the disease being characterised at first by moderate swelling and loss of function, later by deformity due to absorption of bone-ends subsequent to their conversion into granulation-tissue, and extreme wasting of the muscles surrounding the joint. The most typical examples of this disease occur in the hip and shoulder.

Primary Synovial Cases.—Here we have the typical white swelling. The disease usually commences insidiously, at other times with an effusion following a slight trauma. In the case of a joint in the extremities, the typical fusiform swelling now develops, being emphasised by the wasting of the limb above and below the joint. The swelling is doughy and pulpy to the touch, completely effacing all the natural prominences and depressions around the joint; the limb takes up the position characteristic to the joint affected, considerable abnormal mobility from stretching and softening of the ligaments develops, while the normal movements are limited by intra-articular adhesions and the infiltration around the joint. As the cartilages become affected, muscular rigidity prevents passive movement, and the usual night-startings occur. The changes may progress slowly, contraction of the pararticular infiltration giving the skin a white and anæmic look. Abscesses may form in or on the surface of the joint; these are sometimes small and acute, oftener of considerable extent, and of the typical cold variety. It is difficult sometimes to discover any connection between them and the joint. In the later stages these abscesses open, often after burrowing considerably, and long fistulæ, lined with tubercular granulations, remain in connection with a deformed articulation. Such cases may go on for years, at times improving, then relapsing, until finally the last stage is reached. The lymphatic glands above the joints are often enlarged and tubercular, this change being more common in the upper than the lower extremity (Volkmann).

Cases of tubercular hydrops are characterised by the insidious invasion of the effusion, and later by the chronic nature of the thickening of the synovial membrane which persists. The cases of local tumour or nodular thickening are also usually accompanied by considerable effusions. Cases of hydrops may terminate in typical white swellings.

Diagnosis from other joint-affections will be made by the presence of the characteristic diathesis, possibly by signs of tuberculosis in other organs, and by the special course of the case and its pathological peculiarities. The question of primary bone or synovial affection must be made on the lines indicated in the description of the symptoms. The occurrence of local tubercular tumours is to be borne in mind in cases of tumour of the great sac of the knee-joint.

Prognosis.—The general prognosis will depend on the presence of contemporary tubercular disease elsewhere, the general condition of the patient, his surroundings, and his age, becoming proportionately worse with increase in years.

The local prognosis varies with the joint affected, as to its size, accessibility, the possibility of removing the morbid tissue completely, and the nature of the process as to suppuration. The prognosis is best in dry caries, when the joint may heal spontaneously without suppuration. Where moderate localised bone-mischief exists, capable of complete removal, and probably accompanied by limited affection of the joint only, the prognosis is much better than in extensive synovial disease, where complete extirpation of the tubercular tissue is difficult or impossible. Extensive abscesses are bad, and the presence of a sequestrum is also bad prognostically, as necessitating suppuration or opening of the joint. As to the result after spontaneous cure or after operation, in all cases the mobility will be seriously interfered with; in many, complete fibrous ankylosis takes place, and in spontaneous cures considerable deformity is the rule. In all cases, however favourable their course, the possibility of a relighting up of the mischief at the seat of the old deposit is always to be remembered.

Treatment.—The treatment of tubercular joints, in its main principles, differs little from that of other joint-affections, but several points of detail are of extreme importance, and will be shortly adverted to.

The general treatment differs in no particular from that of other tuberculous affections; the special point in the local management is to ensure perfect rest to the articulation, while the patient is confined as little as possible. Rest is, as a rule, best ensured by the application of plaster of Paris splints, except in the case of the hip, where Thomas's splint is more convenient and comfortable. It should be continued for some time after the apparent subsidence of the joint-mischief; interference with mobility must be put up with. In no case should any very active efforts be made to restore free movement, as free manipulations are commonly followed by inflammation and possible relighting up of the tubercular process. This rule especially holds good in the later stages of the disease, even if it has been quiescent for some time; if considerable deformity exist, it is preferable to perform osteotomy of the shaft of the bone in the neighbourhood than to interfere with the joint itself. Thus, contractions of the hip, not amenable to gradual extension or moderate manipulation and, possibly, tenotomy, should be treated by subtrochanteric division of the femur, those of the knee by division of the femur above the condyles.

Counter-irritation, except in the form of iodine paint, is rarely to be made use of. Treatment by rest is especially successful in cases of dry caries, and here, as in cases of synovial disease, the greatest care should be exercised to maintain it, as thereby suppuration is most certainly prevented.

In the majority of cases, however, rest fails to fulfil its object, and here further treatment is necessary, and the relative merits of arthrectomy, excision, and amputation come under consideration. The question of excision or amputation has been considered in the general articles on these subjects, and needs no lengthened mention here; the only special point, that of removing a local infecting centre by amputation, has been alluded to in the general section of this article. The facts there detailed are opposed to the practice.

A few remarks must be made on the special application of arthrectomy and excision.

The main points to be noted in excising tubercular joints are: 1st. The necessity of completely excising the infected synovial tissue, since, if any portion of this or infected granulations remain, the wound becomes re-infected, and the prospect of cure is little better than before the operation. To do this effectively, the incisions must be free, and the scissors are preferable to the sharp spoon, as rather more than the actual granulation-tissue is thus removed. 2nd. To examine the bones with extreme care so as to discover, if possible, the original deposit, and thoroughly to extirpate it by means of the gouge or chisel. As to the employment of excision, it may be said to be applicable only to the hip-joint, and perhaps the elbow, before fourteen years of age; later, it may be performed under the same rules as in other forms of disease.

Below fourteen years of age, except in the hip, and in many cases over, arthrectomy is generally to be preferred. The advantages claimed for the procedure are the following:—No bone being removed, no loss of length follows; the epiphysis not being interfered with, growth is not arrested; the joint in some cases, as the knee, retains its normal outline; it may be employed in some cases where from extent of disease

excision is impossible, and amputation formidable from the amount of limb which must be removed; and lastly, it allows the possibility of a secondary excision or amputation if it should be deemed necessary. In arthrectomy, as in excision, too great pains cannot be taken to completely extirpate the infected tissues, and on the completeness of this the final result mainly depends.

It is usually followed by fibrous ankylosis in varying degrees of completeness. In the after-treatment, it must be borne in mind that deformity occurs as readily as after excision, if a sharp eye be not kept upon the patient. The best dressing, after either excision or arthrectomy, is iodoform. In many cases, either operation is often followed by the persistence of sinuses from reinfection of the wound, most probably due to incomplete removal; such patients may be fit subjects for amputation, or may succumb to some other form of tuberculosis or to amyloid disease.

A more troublesome form of disease to treat is perhaps the so-called hydrops tuberculosis. This disease is not so generally recognised in this country as on the Continent, where the active treatment employed has allowed the surgeon special opportunities of examining these joints at a much earlier date than they come under notice here. In addition to rest and pressure, the first active local measure will be to tap the joint, with a view to relieving tension, preventing injurious stretching of the ligaments, and also obtaining more exact information as to the condition of the synovial membrane. This having been done, considerable difference of opinion exists as to further operative measures. The plan usually followed is to continue the local treatment by rest and support, but Continental surgeons consider that when a diagnosis is established, more active measures are needed. König incises the joint freely, extirpates the infected synovial membrane accessible from the openings, and actively rubs in iodoform to any part of it which cannot be got at with the knife. Volkmann makes such incisions as to allow complete extirpation of the membrane. The partial operation has met with some success in the hands of König; but, as it seems in great measure to depend on the local action of iodoform on the diseased structures left, the writer would suggest in such cases to try the effect of injecting an emulsion of iodoform and glycerine, similar to that used by Mikulicz for spinal abscesses. The mixture consists of glycerine with 10 per cent. of crystallised iodoform shaken up in it. About f℥j. of such a mixture might be safely injected into a joint, since Billroth has injected as much as 100 grammes (containing 150 grains of iodoform) into a spinal abscess without bad result. The mixture must be well diffused by pressure. The success of this treatment in tubercular abscesses, in the hands of Billroth and Mikulicz, would seem to offer a fair probability of good results in joints where the disease is general and no adhesions exist.

The local tubercular tumours have also been removed by incision; this would seem the right treatment, as otherwise the whole joint may become affected by extension.

Tuberculosis of Tendon Sheaths and Bursæ.—Tuberculosis of the sheaths of the tendons may be primary; in the majority of cases it is secondary to disease of the bones or joints. When secondary, it is diffuse, the sheath being lined with fungous granulations, and sooner or later containing pus. When primary, the same condition may exist; in other cases, the deposits are localised in a similar manner to that noticed in the nodular form of tubercular synovitis.

Signs.—An elongated pulpy swelling in the line of a tendon, most commonly met with in the foot, and as a primary condition in connection with the tendo Achillis. At a later date suppuration occurs, and, if not incised, spontaneous opening takes place, with the development of chronic fungating fistulæ. The process may, when the tendon is in the immediate neighbourhood of a joint, affect the articulation by direct extension. More or less widespread local extension is common.

A similar condition may, rarely, affect the bursæ; in other cases, a bursal hydrops, similar in its pathological condition to the joint-hydrops, occurs.

The *prognosis* is not good. Such cases are extremely difficult to heal, and the danger of extension is considerable.

The *treatment* is as complete extirpation as possible with the scissors, and iodoform dressing.

Tuberculosis of Wounds.—Considering the ease with which an acute tuberculosis is produced in animals by inoculation, it seems strange that examples of a similar nature have not been observed in man. Infection, due to cohabitation with a tuberculous person, has been commonly suspected and seen to occur, and although often complicated by the question of occurrence in persons of the same heredity,

taken with similar observations made on animals it is of extreme importance. Evidence of direct inoculation and transference of tuberculosis in man has, however, only been offered during the past few months. The source of such cases would naturally be sought by surgeons among external wounds, and although it has been suggested that infection of internal organs has followed affections of the skin, possibly primarily tubercular in nature, in no case has any proof of the fact been furnished. Secondary tuberculosis of wounds, from extension of existing deposits in continuity with them, is of every-day occurrence; but this never appears to occur if the diseased tissue be wholly removed at the time the wound is made. That this is the case, is rendered the more probable from the fact that none of the chief workers on this subject have ever noted tubercular changes in an amputation wound, when the operation to remove the diseased structures was undoubtedly carried through healthy tissues. This is the more anomalous, since, as a *locus minoris resistentiæ* in a tubercular patient, one would expect to see, at any rate in some cases, the wound take on a tubercular character. During the past year, however, a small number of cases has been published by various observers in Germany bearing on this question. Three (König 1, Kraske 2), are examples of tuberculosis of osteotomy-wounds in young patients, ostensibly in sound health, who were exposed to the possibility of infection by residence with phthisical patients. These cases, however, though of interest, are not convincing, since the two reported by Kraske were osteotomies for deformity, resulting from ostensible osteomyelitis, and, distinct as the signs may have been, considering possible error in diagnosis, they can only be regarded as possibilities. König himself, while putting the third case on record, thinks it of interest rather than as a proof.

Two other observations (Karg, Riehl), have been obtained from another source, one which would have been regarded as likely to offer some valuable information—viz. the hands of those employed in making post-mortem examinations on tubercular subjects. Both patients had so-called post-mortem or butcher's tubercle on the hands and, secondary to this, affection of the lymphatics of the arm. The diagnosis was founded on the histological structure and the presence of bacilli. In neither case is any mention made of inoculation experiments, but, in one, cultivation failed. A third observation (Tscherning) was made in the case of an attendant on a phthisical patient, who wounded her finger, the wound showing signs of tubercular infection spreading to the tendon-sheath and the lymphatics. Examination of the structures again allowed the diagnosis to be made from the structure and presence of bacilli, even in the axillary glands. These cases can of course only be regarded as an elementary contribution to the question; but the importance of the subject warrants their mention. The one striking feature is the local nature of the infection, standing in sharp contrast to the general tuberculosis observed in animals under similar circumstances.

Tubercular Ulceration. — Closely allied to the above subject are those of tuberculosis of the skin and mucous membranes. For some time, the superficial eczema and skin-inflammations observed in so-called strumous children have been regarded as specific in character, while the nature of the process set up in lymphatic glands secondarily affected has led to the supposition that they may be tubercular. The question has become included in the range of practical pathology by the discovery of tubercle bacilli in such a case (Volkmann). The tubercular nature of lupus has long been a contested point; but strong affirmative evidence has lately been adduced in the positive results of inoculation experiments, the discovery of bacilli, the local structure, the co-existence of tubercular disease of other organs, and the cases of general tuberculosis occurring secondarily to it lately recorded by Besnier, Doutrelepont, and Leloir. The observation of Besnier derives special interest from the fact that general infection seemed to follow operative interference. The possibility of the contemporaneous existence of lupus and other tubercular disease is only to be excluded by more extended observation.

Besides lupus, deeper tubercular ulcerations spreading from caseating and suppurating subcutaneous nodules, and from and around lymphatic glands in which similar changes have occurred, are met with; the former are rare, the latter not uncommon.

Tubercular ulcerations, again, are met with in all the exposed mucous membranes; those about the mouth, pharynx, and larynx will be treated of under those headings. An internal ulceration of mucous membrane, of much interest to the surgeon, is that occurring in the bladder. It is nearly always secondary, a typical example of infection by direct extension either from the

testis or kidney. It may be met with in two forms, resembling those seen in the skin—as ulcerations limited in extent, circular in outline, and extremely shallow; or as deep extensive ulcerations, with considerable infiltration of their base. Besides these, the bladder may be the seat of miliary tuberculosis in the acute general variety.

The clinical appearances and characters of these ulcerations will be met with in the special sections. The only points to be referred to here are their resistance to any treatment short of complete extirpation, their liability to recur, and their tendency to attack certain localities.

Tuberculosis of Lymphatic Glands.—This is one of the most common forms of local tuberculosis. It is usually secondary, the result of direct infection from the lymphatics; but cases of primary tuberculosis, occurring by way of the blood-stream, are also described. The possible function of the lymphatic glands as safeguards to the system from general infection is, to a certain extent, illustrated by the situations in which tubercular glands are found. Thus, the most common situations are the neck, the infection coming by way of the lymphatics of the nose, mouth, fauces, and pharynx—parts constantly exposed to danger of infection from without—the bronchial glands and the mesenteric glands, also at the root of the respiratory and alimentary systems respectively; less commonly the glands of the extremities, and here more frequently in the upper than the lower, for what reason it is difficult to determine, since bone and joint cases, their most probable primary source, are equally frequent in either. In the case of the neck, it must be noted that in many instances no primary point of infection can be discovered.

When infection occurs by way of the lymphatics, the glandular affection is local; in cases of general glandular tuberculosis the infection occurs by the blood-stream. The glands present some peculiarities in this case, which will be discussed later.

Section of a tubercular gland reveals appearances dependent on the stage of the process. In the earlier stages, the surface will be of a pinkish or pale grey colour; in some cases, whiter or more opaque spots are visible on minute inspection, or when a magnifying-glass is employed. At this time only moderate swelling will exist, and the gland is still soft. Later, a series of changes occurs. The most common is caseation; this occurs at a number of spots, which tend to coalesce, the gland becoming harder with the development of this process. Section of such a gland may exhibit a number of yellowish areas; when the process is advanced these may be extensive. With the advance of caseation a small-celled new-formation is thrown out around the gland, amalgamating the surrounding tissues with the capsule, blocking up the hilus, and extending along the lymphatic vessels. Where a number of glands are affected, they are in this way amalgamated into one mass, the skin covering them becoming gradually adherent by the extension of the process. Meanwhile, the central portion breaks down, softening extends towards the surface, and a discharge of purulent matter, composed of caseous detritus, shrunken gland-cells, and pus-cells takes place. In other cases the suppuration occurs in the periglandular infiltration, and, when it opens, a tubercular ulcer is formed with the exposed gland lying at the bottom. In such cases healing is slow, occurring only when the whole of the infected gland has been cast off. In place of suppuration, calcification sometimes occurs in the caseating glands, especially in the mesenteric. Caseation, however, is not an invariable sequence; in some cases a fibroid induration develops.

On microscopic examination, such glands exhibit well-marked reticular tubercle; the process commences most commonly in the centre of the gland, and the elements are furnished by hyperplasia of existing gland-structure. Giant-cells are developed between the gland-cells, but in large numbers in the lymphatic vessels, leading to the suggestion, by Mr. Treves, that they are lymph-coagula. Bacilli frequently are not to be found, but they exist in a considerable number of the earlier cases. In Dr. Kidd's cases of phthisis, he found bacilli in glands in six out of thirteen cases; he suggests that the indurated condition of such glands may have something to do with the apparent absence of the organism in the late stages.

In cases of infection by the blood-circulation, tubercles often exist in unaltered gland-tissue.

Signs.—A chronic enlargement of the glands commonly in connection with a primary lesion, the common situation of which has been indicated in the preceding paragraph. The enlarged glands may at first be discrete and free, but, when they have gained an at all considerable volume, they become matted together, lose their distinct outline, and become adherent to surrounding structures. Later, the skin may become implicated, and softening may

result in formation of abscess and fistula. The course may be extremely chronic.

Diagnosis.—The only point of importance is the possible confusion with lymphadenoma. The following particulars are of weight: in both cases a constitutional diathesis exists, the types of which differ, the anæmic appearance, deficiency of red blood corpuscles, rise of temperature, general distribution of the enlarged glands, enlargement of the spleen, and possible hyperplasia in the position of tracts of lymphatic tissue in lymphadenoma, contrasting with the tubercular type, tubercular history, possible concomitant tubercular lesions, and limited distribution in the case of tubercle. Local differences are also well-marked. Individual tubercular glands do not reach so large a size, nor are the collections so large as in lymphadenoma; they tend to suppurate, and are, at any rate, usually surrounded by considerable inflammatory infiltration, neither of which characteristics is met with in lymphadenoma.

Prognosis.—General infection is rare, for reasons already stated. Local prognosis is unsatisfactory; the course is chronic, and recurrences are always possible. If the glands be let run their course, considerable deformity often results.

Treatment.—The constitutional treatment is that of tubercular affections in general; the internal administration of arsenic is sometimes followed by improvement.

Local treatment varies with the stage. The only radical treatment of use is complete extirpation with the capsule. Incision and scraping are likely to be followed by recurrence. Operations should only be undertaken when the glands are not numerous or widespread, and then with a view to obviating the disfigurement likely to accompany ultimate changes, not with the object of removing a local centre. The wounds are best treated with iodoform.

When suppuration and inflammatory infiltration have occurred, the use of the sharp spoon may be inevitable from the implication of surrounding structures. The wounds here should also be dressed with iodoform, all granulations and the mouths of sinuses having been removed.

G. H. Makins.

TUMOURS, Non-malignant. — The simple translation of the word tumour is swelling, and yet the adage that whilst tumours are swellings, swellings are not necessarily tumours, proves that the words 'tumour' and 'swelling' are not convertible, and that, in its technical application, a tumour is something more than, or something different from, a mere visible swelling.

A tumour may be regarded as having *negative* as well as *positive* characters. Of the former, it may be observed that a tumour is not such a swelling as results directly from injury; nor from inflammation, whether of a general or specific form, or involving only some definite structures. Neither is a tumour produced by displacement of an organ, or malformation of any part; nor is it a collection of fluid in a naturally existing cavity, nor a distended condition of some part of a vessel or canal. Hence, traumatic hæmatoma, abscesses, adenitis, gummata, synovitis, hernia, meningocele, hydrocele of the tunica vaginalis, and aneurism, are not tumours in an exact use of the term; although such expressions as 'hernial tumour' are often conventionally employed, as denoting that such a swelling resembles a tumour in some one or more of its positive characters, which are persistency of the swelling, an inherent power of continued growth, and an incapacity either of spontaneous cure or of dispersion by remedial agents of any kind.

In structure, a non-malignant tumour, such as lipoma, adenoma, or exostosis, is of the nature of a localised hypertrophy of a tissue naturally existing in the part. Physically, such tumours may be either subcutaneous swellings, smooth on the surface and more or less closely connected to the tissue or organ in which they are developed, or outgrowths. As regards consistency, they may be either solid, fluid, or mixed, and, if solid at first, they may become cystic, or if fluid at first, the containing cyst may be filled by the growth of an intra-cystic solid tumour.

In the endeavour to define the term non-malignant as applied to certain tumours, it must be observed that this term is a purely clinical expression, and refers to their life-history and to the effects they produce upon the owners. With this in mind, the structure or composition of any tumour may, for the moment, be left out of consideration, and the simplest course will be to state the converse of the signs of malignancy. Innocent tumours do not, when the growth is left to run its course, with unerring certainty destroy the patient's life; indeed, the true state of the case is that, as a rule, a non-malignant tumour exercises no prejudicial influence on the health of a patient. They possess no power of infecting neighbouring parts by an advancing infiltration of the adjacent tissues,

nor of the viscera and distant parts by a subtle deposit of germs of the parent growth, which, in the likeness of the original growth, become new tumours—secondary growths, as they are termed. On the contrary, non-malignant tumours remain always localised even when multiple. Malignant tumours have a distinct proneness to ulcerate; this character is entirely foreign to non-malignant tumours, the skin over which has the same liability to ulceration as, and scarcely more than, any other part. Malignant tumours evince a very constant tendency to recur after removal, in the site of the original growth—a tendency which continues, however frequently the local affection may have been extirpated. Non-malignant tumours are seldom reproduced, and one is tempted to say never, if the whole of the visible growth has been removed.

Cause.—It must be admitted that the usually accepted explanations for the occurrence of tumours are very meagre, and that, in truth, we know very little indeed of any cause based on well-ascertained facts. Developmental errors afford an explanation in congenital hygroma and some dermoid cysts. An excess of formative material in some instances, or a localised hypertrophy in others, may supply a reason for many of the connective-tissue tumours, whilst localised irritation may offer an explanation for the frequency with which tumours are found in similar sites.

The results of obstruction of the duct of a sebaceous follicle may serve to point out how some cysts are formed, whilst the distension of some minute space explains others; and changes, perhaps inflammatory, or possibly degenerative, may explain the growth of a large cyst or a cystic tumour from a small body like a Graafian follicle. For the majority of tumours there seems no satisfactory explanation, nor can we go further than the statement that tumours 'are the result of some inexplicable error in nutrition in the part they affect, and are dependent in the same measure as are the natural tissues on the blood for the appropriate materials of their nutrition.'

Pathology.—A distinctive feature in the histology of a non-malignant tumour is its resemblance to some one or more of the adult tissues of the body, and it has become a pathological axiom that the more complex, the more highly-developed the tissues of a tumour are—the more, in a word, it approaches the type of one of the fully organised normal adult tissues, whether it be fat, gland, or bone—the more surely is its non-malignancy proclaimed; and whilst there are the greatest differences in the frequency with which the various forms of tumour occur, yet instances of all recognised tissues being found in growths are well-established.

It must not, however, be taken for granted that, from the structure of a tumour alone, its malignancy or non-malignancy can be asserted; for quite certainly sarcomatous elements—i.e. such as resemble some fœtal structure—are found in tumours whose general composition is that of one of the non-malignant group, and whose clinical features clearly require that it should be considered innocent. True it is, nevertheless, that, in some instances, features denoting malignancy may be superadded to a growth which, at its commencement, appeared of a simple nature; and, having in view the general similarity that exists between the cells seen in the course of the processes of inflammation (especially those existing during the developmental period) and some typical cells of sarcomatous tissue, surprise cannot be felt that, occasionally, a malignant invasion of an innocent tumour occurs, or that an injured or inflamed part becomes the seat of a malignant growth.

Upon naked-eye inspection, most of the tumours under notice will be seen to be invested with a capsule, which is commonly intimately blended with the growth, but loosely connected to the surrounding structures. Some of the solid tumours are lobed, whilst the cystic may show pouches. As a rule, non-malignant tumours grow much more slowly than the malignant, yet in nearly all tumours periods of active increase occur, and some of the forms of non-malignant tumours attain a great size, notably lipomata; others, again, as the myo-fibromata of the uterus, shrink and may almost disappear coincidently with the cessation of the menstrual function. Degenerative changes, such as calcification, sometimes are noticed, whilst in other forms there is a great liability to the formation of cysts, the result of a process of softening or a mucoid change ending in the formation of definite cavities. In the case of cysts, which at first may seem quite 'barren,' a sort of germinating process begins, and from some portion of the wall a solid intracystic growth sprouts up, frequently going on to fill up and occupy the whole cavity of the cyst or cysts. Whilst some forms of tumours, particularly those formed of erectile tissue, are congenital or commence in the early period of life, some, like exostoses, grow whilst the bony framework is

growing; others again, like the adenoid tumours of the breast or the myo-fibromata, occur chiefly during the period of functional activity of a particular organ, whilst, again, others—for instance, the prostatic adenomata—mark the declining period of life. Putting on one side growths which are more or less peculiar to either sex, on the whole women seem to grow tumours more frequently than do men.

Symptoms and Diagnosis.—The symptoms of an external tumour are objective—due to the presence of a swelling. The diagnosis of a 'new growth' tumour from a swelling which has been defined to have no claim to the technical term of *tumour*, involves an inquiry into history, mode of origin, and physical characters. In most forms of non-malignant tumours, after careful inquiry and examination, a diagnosis is simple, in many it is palpable; occasionally, the history and physical characters are irreconcilable. In such a case, it is nearly always prudent to give preference to the physical symptoms. Again, in a few instances, the physical conditions of a swelling may allow of a diagnosis of some two or three affections; here the probability of the swelling being one of them on the score of frequency should be allowed to prevail. From the circumstances that a simple tumour is nearly always encapsuled, and can be more or less readily displaced from its ordinary position, whilst in an inflamed part everything feels fixed and adherent, it is seldom that an abscess is mistaken for a tumour; yet an error in the opposite direction has equally to be avoided. One must not assume that because a swelling is inflamed, therefore it cannot be a tumour; an innocent tumour, especially when there is some fluid in it, is very prone to attacks of inflammation. In these circumstances, as indeed may be advisable in others, aspiration of the swelling or the extraction of a small portion of tissue, and its examination under the microscope, will often allow of an exact diagnosis being made.

As between a malignant and a non-malignant tumour, the diagnosis turns upon many considerations, but the characters and relations of the tumour are the most reliable. A non-malignant tumour is, as a rule, both more superficially placed, better defined, and more isolated from surrounding parts; the integument is less often implicated in the growth; its rate of increase is much less rapid; whilst the actual period for which a tumour has existed is, if one of years, often well-nigh conclusive evidence of its harmless nature. As it is only in the later stages that a malignant tumour visibly affects the health, too much importance must not be attached to this question, nevertheless loss of weight is a common symptom in all malignant tumours.

Treatment.—Dealing with solid tumours first, it is clear that, for the large proportion, the only treatment is the radical one of extirpation. It would be out of place to describe how this should be done, or to go into any of the subsidiary details connected with the operative procedure, whether relating to patients or their wounds; on this subject all that is requisite being to point out the circumstances which either call for an operation or render it unadvisable, as well as to indicate those tumours that can be more appropriately treated by other means.

As a rule, in non-malignant tumours, surgical interference is a question of expediency, since neither life nor even health is often threatened; where they are, as for instance in ovarian tumours, the risk of a capital operation is justly permitted, otherwise the risk involved by the proposed operation should be measured before deciding in favour of it. Subject to these provisions, the removal of a tumour is to be recommended when it is unsightly or distinctly inconvenient from its position or its size, or is painful, or is obviously growing. In some forms of tumour, the possibility of a cancerous or malignant change supervening should influence the decision in favour of operating. In the absence of any of those conditions, an operation is not to be pressed upon a patient.

On the other hand, when by the removal of a tumour an injury, likely to be attended with permanently harmful results to the patient, may be inflicted upon some structure—such, for instance, as the division of a portion or the whole of a nerve in dissecting out a neuroma, or the laying open a large joint in taking away an exostosis—then in these and similar cases an operation must, as a rule, be refused.

Erectile tumours for the most part only require for their cure that the blood in the dilated vessels should undergo coagulation. This may often be accomplished by electrolysis, styptic injections or setons, or possibly even by compression or ligation of the afferent trunk-arteries. Of the electrolytic treatment of tumours, the writer would venture to express the opinion that it is deserving of a more extended trial than it has as yet obtained.

Completely fluid tumours, particularly those pellucid cysts called hygromata, may

be occasionally cured by repeated aspiration, or, this failing, by the injection of Morton's fluid into the cyst; or a seton may be passed through it. But this is liable to lead to a tedious as well as painful suppurative process, and it should not therefore be inconsiderately put into practice. These measures again may be employed when excision of the cyst is impracticable, but, when it is easily removable, that procedure is the best for most fluid tumours, as well as for those tumours which are partly solid and partly fluid.

ALFRED WILLETT.

TUMOURS OF BONE may be either simple or malignant; the latter are by far the most important, forming about one-half of all the tumours which have their origin in the osseous system.

Taking the simple tumours first, we may refer the reader to the article on EXOSTOSIS for a description of these bony outgrowths or osteomata.

FIBROMATA OF BONE are, comparatively speaking, rare, except in connection with the jaws. *See* JAWS, Diseases of the. They also occasionally spring from the base of the skull, and may hang down into the naso-pharyngeal space. When polypoid in form, such a tumour may be very easily snared by a loop of wire passed through the nose and slipped over the growth by a finger in the mouth. For fuller details as to the tumours in this space, *see* NASO-PHARYNGEAL GROWTHS. In the long bones, the simple fibroma arises from the periosteum, and pushes aside the adjacent tissues, but does not invade them like the sarcomata. Nor does it in any way destroy the bone to the surface of which it is attached. It is very rarely met with, and can only be diagnosed from a periosteal sarcoma by the length of time that it has existed, by its uniform consistence, smooth surface, and perfect freedom from pain. If a reliable history can be obtained which proves beyond a doubt that it has been of an excessively slow growth, the proper treatment will be to remove it from the bone without interfering with the integrity of the shaft. It must, however, always be remembered that it has a very close affinity to the spindle-celled periosteal sarcoma, for which the limb must be removed at a considerable distance from the growth. Some of the periosteal sarcomata, having a large admixture of fibrous tissue, and being in consequence exceedingly dense and firm in structure, resemble very closely the fibromata. These have been called fibro-sarcomata, and are more fully described in the latter part of the article SARCOMA.

ENCHONDROMATA OF BONE, when purely cartilaginous, are simple tumours which do not return after their complete removal. If such a tumour shows the characteristics of a malignant growth, it is almost certain that the cartilage is mixed with other embryonic tissues, and is practically a chondrifying sarcoma. An enchondroma in most cases, closely resembles hyaline cartilage, which presents itself in a more or less embryonic form; but it may have a varying amount of fibrous tissue in its matrix, and in this way simulate fibrous cartilage. Calcification and ossification may also take place, and, in the latter instance, partly convert the tumour into an osseous growth. An extreme example of this change is seen in the cancellous exostosis (*see* EXOSTOSIS), which is generally covered by a layer of cartilage, and increases in size by the ossification of its cartilaginous cap. Fatty and myxomatous tissue are also not uncommonly present, especially in the larger tumours (chondro-myxoma). These changes may convert different parts of the growth into a soft and diffluent mass, and even produce distinct cystic cavities. Since the microscope has been more generally used for the minute and thorough examination of all new-growths, it has been found that, even where the tumour appears to the naked eye to be almost entirely composed of cartilage, a certain admixture of the other embryonic tissues may be discovered. It is also known that a sarcoma of bone may, in part, be converted into cartilage. Putting these two facts together, most surgeons believe that, where an enchondroma returns after removal, or is widely disseminated in the glands and viscera, the case is not one of simple enchondroma, but a mixture of two growths, both starting from embryonic tissue, or more probably a sarcoma in which a part of the embryonic tissue has become cartilaginous—i.e. a chondrifying sarcoma. In former days it was very probable that the sarcomatous element would be overlooked, when the tumour appeared to be almost entirely composed of cartilage.

Situation.—The pure enchondromata of bone are most commonly found arising from the phalanges or metacarpal bones. They are then frequently multiple, so that a patient may have one hand distorted by several of these tumours. Both hands and both feet may be similarly affected, but it is far more common in the former than in the latter. Though often multiple

these enchondromata are generally small, but their size is quite sufficient to very seriously interfere with the functions of the hand or foot. These small multiple enchondromata usually arise in the medullary cavities of the smaller bones just named, so that a complete shell or plates of bone are generally found upon the surface. A cartilaginous tumour arising on the other and larger bones is always single, and may assume enormous proportions. The scapula and pelvis are common sites for these growths, so also are the adjoining parts of the femur and tibia; but scarcely any bone in the skeleton can be said to be free from the possible development of an enchondroma. In these cases they generally grow from the periosteum, and are consequently attached in many cases only to the surface of the bone; but the latter may be partially absorbed by pressure. Many of those enormous tumours which are described in our surgical literature as enchondromata would, in the present day, be classified as sarcomata, for the reasons that have been already stated at the commencement of this article.

Age.—The multiple tumours of the hands may occur either during childhood or in the young adult, but the majority arise before the age of puberty. With regard to the single and larger growths, they are generally seen at a somewhat later period of life, but it is difficult to form any decided opinion as to the usual limits of age, on account of the uncertain nature of the tumour in most of the recorded cases.

Diagnosis.—A cartilaginous tumour is globular in outline, with a slightly lobulated surface, but this is nevertheless perfectly smooth in each of its larger and smaller subdivisions. Its consistence may vary from a very dense and solid growth to one which, with some confidence, may be thought to be in part cystic. The outline can be very clearly felt, being distinctly circumscribed, and, as there is no infiltration of the surrounding tissues, the skin and muscles may be made or seen to move without traction upon the tumour; in its simplest form it merely pushes aside the overlying and adjacent structures, without invading them in its growth. As a general rule, it is perfectly painless, unless some nerve be accidentally stretched or pressed upon. There is consequently no inconvenience complained of except from its weight and size. It is exceedingly indolent and slow in its growth, occupying many years in attaining any great size. Rapidly growing enchondromata have been described and thought to be a malignant type of cartilaginous tumour, from the fact that they sometimes returned after removal either in the site of operation or in the glands and viscera; but, as has been before explained, it is very doubtful whether they are not sarcomata in which chondrification had taken place.

The enchondromata of the hand, whether multiple or single, do not, as a rule give rise to any difficulty in diagnosis. The age at which they occur, the particular bones affected, their central position in these bones, their slow growth and freedom from pain and tenderness, combine to make the diagnosis tolerably easy. The consistence may vary considerably in different parts, so that a deceptive sense of fluctuation may at times be detected; but although in such instances the bone has evidently been perforated by the growth, osseous plates will be found in some parts of its surface, and the general impression will be that of an elastic central growth rather than a fluid tumour. In its early stages it might possibly for a time be confused with a so-called 'strumous phalanx,' which is also most commonly seen in childhood. The metacarpal bone may be affected in a similar manner by a strumous ostitis. But in the latter cases some signs of inflammatory infiltration would be felt in the superficial structures, and tenderness on pressure. The enchondroma, though globular in its general outline, has usually small rounded projections on its surface; but the skin and superficial structures are never infiltrated and adherent to the parts beneath, as in the strumous disease of the phalanx and metacarpal bone. As time goes on and suppuration takes place, some shortening of the bone is produced and the swelling diminishes in size, whereas the enchondroma steadily increases without any signs of inflammation or suppuration.

Syphilitic disease of the phalanges, which is seen in young children, is generally distinguished by the fusiform enlargement of the whole bone without any tendency to suppurate, and by the history and other signs of syphilis. It has never the globular outline of an enchondroma, nor its elastic sensation on pressure. The tumour also only occupies a part of the bone, and generally one of its extremities.

The larger enchondromata, which occur in other parts of the skeleton, may give rise to greater difficulty, for although we may be able to say that a given tumour contains cartilage, yet we cannot always feel confident that this is the particular tissue which controls the sequel of the case. As has been

already pointed out, the cartilage may be in part ossified, but this and other simple changes are of less consequence than the possibility of the presence of sarcomatous elements in its structure. The real difficulty in these cases will lie between the simple periosteal enchondroma and the chondrifying periosteal sarcoma. The history will generally be the most important point in the decision of this question.

The rapidity of growth in the case of the enchondroma is commonly measured by years; whereas, in the sarcoma, months, or even weeks, produce a visible alteration in the size of the tumour. Pain is also frequently complained of in the sarcoma, and in some cases is a very conspicuous feature, keeping the patient awake at night for many hours; an enchondroma, on the other hand, is, as a general rule, quite free from this distressing symptom, and only gives rise to inconvenience from its size.

In an enchondroma there should be no infiltration of the surrounding parts, so that the tissues ought to move smoothly and easily over the tumour, whereas in the malignant growth the reverse is generally the case.

The *treatment* of a simple enchondroma depends somewhat on the part that is involved and the inconvenience which it causes. In the hand, the tumour may sometimes be removed without the loss of the bone, but it can only be done where the growth has not converted the shaft into a mere shell. The writer of this article excised an enchondroma from one of the metacarpal bones, which had grown from its medullary cavity but projected only on the flexor aspect, leaving the cortex of the shaft on the dorsum perfectly free. The tumour was removed from the flexor side, and the thin strip of cortical bone left *in situ*. The patient recovered with the perfect use of his hand, and no recurrence took place. But, as a general rule, the bone is so disorganised that the whole of it has to be taken away. Amputation of the finger with its metacarpal bone, if the latter be involved, is therefore the usual method of giving relief where an operation is required. It must, however, be remembered in these cartilaginous tumours of the hand that the growth is, after all, benign, and that it generally ceases to increase before it has attained a large size. Consequently, when it does not interfere with the usefulness of the hand, it may be wiser not to remove a part of so much importance as a whole finger with its metacarpal bone, unless the patient is himself exceedingly anxious to have it done on account of the deformity. On the other hand, if a finger is already disabled by such a tumour, it had better be removed.

It is difficult to lay down any rules for the large single enchondromata which grow from the long and flat bones, such as the femur and scapula, for they differ very much in their importance. One that is slowly but steadily increasing should be removed, for it may in time assume such a size as would, from the magnitude of any subsequent operation, of itself endanger life, and one can scarcely estimate the inconvenience and disability to which it may eventually give rise. An exploratory incision may be made to see if it can be removed from the bone to which it is attached. In some cases, it may be taken away without destroying more than a limited portion of the bone from which it grows; in others, the shaft of a long bone may be so injured as to necessitate the amputation of the limb. An enchondroma of moderate size, attached to one of the larger bones and perfectly stationary in its growth, may, for a time at least, be left without interference, particularly if its removal would entail some loss of function in the part to which it is fixed. But the patient should be cautioned as to the possibility of its increase, and the necessity in that case of again consulting his medical adviser. When, however, a tumour appears on examination to be an enchondroma, but yet has increased very rapidly in size and shown other signs of being malignant, it should be treated like a sarcoma, and the limb be removed at once well above the seat of the disease.

Sarcomata of Bone.—General articles on Sarcoma and Malignant Tumours affecting all the tissues and organs, but not especially referring to bone, are given elsewhere. Although this subject has been discussed in the manner indicated above, yet it is thought desirable to give more fully in this article an account of the sarcomata in their special relation to bone, for they are by far the most important of the tumours which start in the osseous system. It will not be necessary to again describe the structure of the different varieties of these tumours.

Cause.—The theories as to the etiology of these growths have been very fully discussed under Malignant Tumours, and it is here only necessary to emphasise a fact of some clinical importance—that a very large proportion of the sarcomata of bone are traced by the patients to some definite injury, such as a blow, a kick, or a fall.

Central and Peripheral Sarcomata.—These may start from the centre or from the surface of a bone, and it is exceedingly difficult in some of the flat bones, such as the skull, scapula, and ilium, to say where the tumour commenced. But in the long bones there is not, as a rule, any difficulty in distinguishing between the two, even during life. The parosteal tumours, or those which are connected with the outer layer of the periosteum, will not be included in the periosteal or peripheral tumours of bone, as it is probable that they only secondarily invade or become attached to the periosteum. The periosteal or peripheral sarcomata develop generally from the osteogenetic layer of the periosteum, and are especially prone to be in part calcified or ossified. The bone itself upon which they are seated may be normal or itself invaded by extension through the Haversian canals.

Mr. Butlin has ably pleaded against the use of the word 'osteoid' in relation to these changes of structure in the periosteal sarcomata. We have no space here to produce his arguments against the term 'osteoid,' which 'implies the presence of a substance like bone, yet not bone.' Suffice it to say that ossifying, calcifying, or chondrifying sarcoma is distinctly more correct, and at the same time more nearly expresses the changes that may occur in the periosteal growths. An equal objection may be taken to the word 'osteosarcoma,' which has been used with very various meanings. After removal, these tumours, which spring from the periosteum, have in most instances a distinct radiation from the bone upon which they are placed. The columns or lines appear to be produced by the calcification and ossification round the small vessels which run from the periosteum at right angles to the bone. As the tumour increases in size, the periosteum is farther removed from the bone, so that the area in which this radiation and subsequent ossification or calcification may occur becomes larger, and occupies a greater part of the new-growth. But bone is never found in the capsule or outer part of the tumour. The central sarcoma starts in the medullary canal, and gradually approaches the surface by destruction and expansion of the bone within which it grows. As it reaches the surface, the periosteum, irritated by its presence, produces new bone to encapsule the growth; so that, as it increases in size, a shell of new bone is still found upon its exterior. This is the distinguishing feature both in a clinical and a naked eye examination of the difference between the central and peripheral tumours of bone. This encapsulating shell of bone is, however, rarely complete, and may only be represented by a few osseous plates.

The microscopical and naked eye appearances of the different varieties of Sarcoma will be found under the article of that name, and need not be repeated here. The round-celled, spindle-celled, mixed-celled, and myeloid sarcoma, which is the classification there adopted, may each of them attack the various parts of the human skeleton. The last one only of the group is confined, almost entirely, to the tumours arising from the gums and the cancellous parts of the bones, whilst the other varieties may be found equally in the central and peripheral sarcomata. From a perusal of the article just alluded to, the reader will find that other subdivisions might be made according to the secondary changes to which many of them are liable. It is here only necessary to mention those which are of practical and clinical importance. One form, in which there is often a large development of bone, has been already mentioned in describing the periosteal sarcoma. Cartilage may also be found, and is especially referred to under *Enchondroma.* The cystic and vascular conditions which are sometimes found are of still greater importance, as they are liable to be misunderstood. These tumours are all of them, but especially the central sarcomata, liable to degenerative changes. They may be in part cystic, myxomatous, or fatty, and the possibility of these conditions being present must not be forgotten in an examination of any particular case, as it will give rise to different degrees of density in various parts of the growth. The central sarcomata are also often exceedingly vascular, a circumstance which at one time leads to hæmorrhages into its substance, and at another to distinct pulsation. In an analysis of 165 cases of sarcoma of the long bones by Gross (*American Journal of Medical Science*, July and Oct., 1879), it appears that pulsation was noticed in twenty per cent. of those that were central; whilst in the flat bones, such as the skull and innominate bones, it has been very frequently observed in both the central and peripheral tumours. But of all the sarcomata of bone, it is perhaps most common in those cases in which several bones are simultaneously affected.

The malignancy of these sarcomata is shown by their tendency to return locally after removal, by the occasional invasion of the lymphatic glands, and by the frequent occurrence of deposits of the same growth

in distant viscera, especially the lungs. But they differ very much in the degree of malignancy which the various forms present when arising from bone. Some sarcomata invariably return locally or appear elsewhere, no matter how early in the course of the disease or how far removed from the seat of the tumour the operation is performed. On the other hand, the myeloid sarcomata so seldom return after removal that some surgeons look upon them as benign growths, and have even urged that they should be merely scooped out from the bone in which they are embedded. But of their occasional recurrence, especially after this latter operation, there can be no doubt, so that they must still be looked upon as malignant tumours. The following table, taken from Gross's article on 'Sarcoma of the Long Bones,' already quoted, shows this point extremely well. It will be seen by this analysis, which is based upon a study of 165 cases, that the periosteal growths are much more malignant than the central sarcomata, and that these again each differ considerably amongst themselves; so that the periosteal spindle-celled sarcoma appears at the head of the list as the most malignant of all, and the central myeloid at the other end of the list, as the most innocent or least malignant of all sarcomata arising in bone:—

Variety of Sarcoma	Infection of adjacent tissues, as shown on dissection after removal	Local recurrence after operation	Infection of glands	General infection
	per cent.	per cent.	per cent.	per cent.
Periosteal spindle-celled	44	60	—	100·
„ round-celled	50	50	7·69	66·66
„ osteoid (?ossifying)	40	41	6·25	65·62
Central round-celled	66	25	8·33	33·33
„ spindle-celled	18	20	—	23·07
„ giant-celled	12	8	—	22·72

The invasion of the lymphatic glands is not by any means a common occurrence, and would seem, from its rarity, to be due in most cases to the chance position of the primary growth. Thus, it is much more common when the tumour arises in the bones of the pelvis or skull than when it starts in any of the long bones. In the pelvis it is probably due to the direct implication of the glands, which are so numerous in this region, and, when once any gland is involved in the infection of the adjacent tissues, the disease may easily be carried on to the others. In the skull several tumours may simultaneously arise, or many of the bones and viscera be affected by the same growth. The blood-vessels in such cases must be looked upon as the medium through which the disease is disseminated. Indeed, there is but little doubt that this is the ordinary way in which the viscera become the seat of the secondary tumours. The lungs are far more frequently affected than any of the other organs, a fact which strongly supports this view of the means by which general infection of the system is produced. As is shown by the table quoted above, the percentage in which this general dissemination of the disease occurs is much higher in each variety of sarcoma than that of the local recurrence after operation.

Although most commonly seated in the articular extremity of a long bone, the joint is very rarely invaded. The bone may be almost completely destroyed, forming a mere shell around the growth, or represented by a few bony plates upon its surface, but the cartilage still opposes a barrier to its entrance into the joint. Cases are, however, recorded in which the tumour has passed through the joint, and invaded the opposite bone entering into the articulation. In the periosteal sarcomata the invasion usually takes place through the synovial membrane, but in this case also it is a very rare occurrence.

The *favourite seat* of both the central and periosteal sarcomata, if we exclude the jaws, which have been considered in another article, is the articular extremities of the long bones, and one epiphysis is more likely to be attacked than the other. For example, it is much more common for a sarcoma to arise in the lower end of the femur and the upper end of the tibia than in any other parts of these two bones. To quote again from Gross's admirable article, it will be seen that out of 165 cases which he analysed,

The femur	was the seat of the disease in	67	instances
The tibia	" "	46	"
The humerus	" "	25	"
The fibula	" "	13	"
The ulna	" "	7	"
The radius	" "	6	"
The ulna and radius were	" "	1	instance

Thus the bones of the lower extremity are far more frequently affected than those of the upper, the femur, tibia, and fibula being the seat of the disease in 76 per cent. of all his cases.

It is interesting also to note, in an analysis of the histological structure of the tumours in these same cases, that the myeloid or giant-celled sarcomata formed about 42 per cent. of the entire number, and that the central tumours collectively exceeded the periosteal by about 18 per cent. We have already shown that the central are less malignant than the periosteal sarcomata, and that, of the central growths, the giant-celled are the least likely to show any malignant tendency.

Symptoms and Diagnosis.—The sarcomata of bone occur chiefly at an early age, by far the larger proportion developing before the thirtieth year. Their favourite situation has been already discussed. The external contour of these growths will vary with the position and nature of the tumour. The central are generally spherical in outline, wherever they may be situated, whilst the periosteal sarcomata are long and fusiform in the shaft, and pyriform at the extremities of a bone, with the base directed towards the articulation. This gradual diffusion along the shaft is very characteristic of a peripheral sarcoma. The periosteal tumour may be situated at first only on one side of a bone, although, as a rule, it quickly surrounds it in its further growth. The central will have a distinct bony capsule or numerous bony plates upon its surface, and, if the tumour be soft and cystic, will often yield a sensation of 'egg-shell crackling.' The periosteal growth will be smooth or tuberous, with no bony plates upon its exterior.

In either case, the density and resistance to pressure will probably vary in different parts, the tumour being in some cases exceedingly firm and in others so soft as to give rise to a doubtful sense of fluctuation. But the growths may also be uniformly hard or soft throughout, or even in part distinctly cystic. Pulsation is of fairly frequent occurrence in the central tumours of the long bones, and is also found in some of the multiple periosteal growths of the flat ones. If pulsation is felt in the articular extremity of a long bone, it may fairly be assumed that the case is one of central sarcoma. It has happened to the writer to have to treat a case of pulsation over an area of about half an inch in diameter on the inner surface of the head of the tibia, in which there was no expansion of the bone and no tumour to be detected. In submitting this case to operation, the whole of the interior of the head of the tibia was found excavated and replaced by a soft, almost fluid, and highly vascular pulp. This, on careful examination, proved to be a myeloid sarcoma. The size to which these tumours may grow varies enormously, and no opinion can be formed as to their nature from this circumstance alone. Some, while still quite small, will have produced general infection of the system; whilst others, which have assumed gigantic dimensions, may yet not return after complete removal. Spontaneous fracture may occur in either the central or peripheral form of growth, and in some cases is the first indication of the disease. If no swelling has been previously present, it very quickly appears on the occurrence of the fracture. In those periosteal cases in which calcification or ossification takes place, this accident is not likely to happen, but in the softer tumours, which extend through the Haversian canals, eroding the bone, it is as prone to occur as in the central sarcomata. Pain is almost always a prominent symptom, and is sometimes very severe, making life so intolerable that, on that account alone, the removal of the part affected may seem desirable. It is perhaps less frequent in the myeloid tumours, but in the other forms of sarcomata of bone it is almost invariably present, in more or less severity, throughout the course of the disease. Pain is, indeed, often the first symptom which attracts the patient's attention to the presence of a swelling, and should always be looked upon as of gravest import when it cannot be traced to the distribution of any definite nerve-trunk. In the latter case a simple tumour might, from its accidental position and pressure, be the origin of the pain.

The rapidity with which the sarcomata of bone increase in size, and the duration of life without operation vary enormously. It is, however, upon this symptom that the diagnosis chiefly rests, and it would be, in most cases, impossible to distinguish the sarcomata from the simple tumours of bone, without knowing the length of time that the swelling had existed. As a rule, the rate of increase is, in the former, measured

by months or even weeks, and in the latter by years. In some instances there may be a kind of pause in the rapidity with which the disease advances, but, generally, the increase is uninterrupted in its progress till death occurs, in from one year to eighteen months in the case of the more rapidly growing tumours, whilst in the more chronic forms life may be prolonged for two or even several years.

The diagnosis of a sarcoma from an innocent tumour of bone is generally easily formed from the history of its rapid growth, from its varying consistence in different parts, from the constant presence of pain, and from the well-known fact that it is of much more frequent occurrence than any other kind of growth in bone. Some difficulty will occasionally arise when the tumour is exceedingly firm, of considerable size, with a clearly defined margin and a lobulated surface. If of slow growth, such a tumour would naturally be considered to be a simple enchondroma; when, however, it has been rapidly increasing in size, the probability will be in favour of a sarcoma which is chondrifying; and if it be seated in the articular extremity of a long bone, such as the lower end of the femur, the probability will approach a certainty, as may be gathered from the remarks in the preceding paragraphs.

In very rare and exceptional cases, some forms of inflammation of bone may be mistaken for sarcoma, especially as a hectic temperature is not unknown in some instances of the latter affection. The soft tissues in the rapidly-growing variety of sarcoma may also be hot, œdematous, and infiltrated, as if from inflammation. The converse also takes place, in which the inflammatory affection is of such a chronic type as to simulate very closely the early stage of a central sarcoma of bone. Mistakes of this kind have been made, and could not, apparently, have been avoided. They have mostly been described under the name of 'necrosis without suppuration,' to which and its clinical distinction from sarcoma a reference will be found in the concluding paragraph of the article on Sarcoma. In any doubtful case the tumour should certainly be incised, and, if necessary, the bone trephined, so that no time may be lost in excluding or confirming the presence of a malignant tumour. There should be no difficulty in distinguishing a sarcoma of the articular extremity of a bone from disease of the neighbouring joint; for, even in the rare cases of invasion of the articulation by the new-growth, to which allusion has been previously made, the occurrence only takes place in the later stages of the disease, when the diagnosis will probably have been already made. In the case of the tumour, the joint will not be uniformly enlarged nor form the centre of the swelling; its freedom of movement will not be much, if at all, impaired; no pain or grating will accompany its action, and no improvement will be produced by the perfect rest obtained from a splint, but, on the contrary, the tumour will continue to increase in size.

Pulsating tumours of bone will be found discussed under Osteo-aneurism, but there is very little evidence to show that there is any other growth in bone giving rise to pulsation, except the sarcomata which have been already described. From an ordinary aneurism in the groin or popliteal space, the diagnosis may at times be attended with considerable difficulty. The points, however, of importance would be the situation of the tumour, which might be out of the line of the vessel supposed to be affected, the incorporation of the growth with the bone upon or within which it is placed, the presence in many cases of bony plates upon its surface, the ill-defined outline in the periosteal form of growth, and the less impulsive character of the pulsation as contrasted with that of an aneurism. The arterial pulse below—as, for example, at the ankle—will be altered or possibly absent in the case of aneurism, whereas, in the pulsating sarcoma, it will be of the same size and character as that of the corresponding artery of the opposite limb. On compressing the artery above, the tumour also cannot be much diminished in size by pressure, whereas the aneurism may be partially emptied, and the solid growth may be more easily felt and appreciated. That it is, at times, exceedingly difficult to distinguish between the two in the situations mentioned above, is evidenced by the fact that arteries have been ligatured by the most experienced surgeons for tumours supposed to be aneurisms, which have subsequently proved to be pulsating sarcomata.

Treatment.—Amputation at the earliest possible moment, whenever it is possible, is undoubtedly the proper treatment to pursue. The only question of importance is the site of operation. Even in those cases where we know that the growth will almost certainly return elsewhere, the limb should still be removed if the patient is suffering any pain. And there are very few cases in which pain is not experienced, which steadily increases in severity, and may be entirely

relieved by operation. The best plan will be to take the individual bones *seriatim* and to discuss the operation which the writer thinks most suitable for the sarcomata which affect them.

In the case of the *tibia* and *fibula*, which may be taken together, much will depend upon whether a decided opinion can be formed as to the central or peripheral origin of the growth. The periosteal sarcomata should be very widely removed, as they have a great tendency to infiltrate the surrounding tissues. Consequently, when it is quite clear that the growth is a periosteal one, there should be no hesitation in amputating through the lower third of the thigh or through the knee-joint, unless there is plenty of room between the tumour and the part immediately involved in amputation below the knee. If a periosteal growth involve only the lower part of the tibia or fibula, either of the two latter operations would be feasible, provided there is a very large margin of healthy tissue between the flaps and the tumour. There is no reason to suppose that the tumour would be likely to return in the stump of the tibia in the amputation below the knee if these conditions be observed; in fact, experience rather proves that the disease more frequently returns elsewhere. But there are very few cases of sarcomata in this position which, when they come under observation, have not made such rapid progress as to require the higher operation; and, as a general rule, an amputation through the lower third of the thigh should be preferred to one below the knee. If, however, the case is one of periosteal sarcoma in the upper end of the tibia or fibula, an amputation through the middle of the thigh would probably be indicated, as there would scarcely be room to form healthy flaps in an amputation through the lower third of the femur.

The central sarcomata will allow of more lenient treatment, on account of their malignancy being of a less marked character. An amputation may therefore almost certainly be performed below the knee in a case of central sarcoma involving the lower ends of tibia or fibula, but the sawn surface should be carefully examined, for fear of any extension of growth along the medullary cavity. If this be found, it would be best to complete the operation by removing the upper end of tibia and fibula—in fact, by amputating through the knee-joint. For a central sarcoma of the upper end of tibia or fibula, amputation through the lower third of the thigh would probably be sufficient, if there were plenty of room for the flaps. In the middle of the shaft, the central sarcoma is likely to be of the round or spindle-celled variety, which is more malignant than the myeloid. It would, therefore, be wiser to give more space between the growth and the site of operation. As regards the enucleation of a central sarcoma from the bone in which it is situated, it is, in the writer's opinion, a very doubtful policy. In most cases, the bone is reduced to a mere shell after the removal of the growth, and, even if successful, so far as the tumour is concerned, enucleation would be unlikely to leave a leg capable of bearing any weight in walking. There is also another danger, which occurred to the writer of this article. The tumour will very probably encroach so much upon the neighbouring joint that, after its removal, the cartilage only may be left between the cavity in the bone and that of the joint. In the case referred to, amputation had to be performed a week or two after the first operation on account of a secondary synovitis, and, when the limb was removed, the condition described above was found. The patient made an excellent recovery, and has had no recurrence of the disease up to the present time, which is two years since the removal of the limb. Resection of a central sarcoma of the fibula, with the part of the bone affected, has been successfully accomplished by Langenbeck, and might certainly be attempted if the disease were not too far advanced; but the tibia could scarcely be so treated, although in the case of a myeloid sarcoma the disease would probably not return.

If there is any doubt as to the nature of the growth and the consequent site of operation, it would be best to make an incision into the centre of the tumour, when its endosteal or peripheral origin would be decided, and the amputation selected on the lines indicated above.

In the *femur* there is much less choice of operation, but the same rules which have been already mentioned will guide the surgeon aright. The periosteal sarcoma of the lower articular extremity of the femur will require an amputation as far removed from the seat of the tumour as is consistent with safety to the patient's life. If it has already spread along the shaft, the limb should be removed just below the trochanters. If the disease be seated in the centre of the femur, nothing less than amputation at the hip-joint ought to be entertained, but the mortality after this operation is exceedingly high. It is right, therefore, considering the immediate danger to life,

that the nature of the case should be fully explained to the patient or his friends, so that they may judge whether the risk is worth running in view of the very probable return of the disease, to which a glance at the foregoing table will recall the reader's attention. What difference the various later modifications of amputation at the hip-joint will make in the immediate risk to life, future experience must prove. In the ordinary flap operation, the soft tissues are retained. Furneaux Jordan's method, which is so suitable for cases in which excision of the hip has been unsuccessful, is also objectionable in periosteal sarcomata for the same reason. Cutting short flaps from without inwards, and retaining as little of the deeper tissues as possible, would probably be the best for the patient, so far as recurrence of the growth is concerned. The immediate risk to life from shock might then be avoided by sawing through the trochanters instead of disarticulating at the hip, provided of course the growth did not extend too far along the shaft of the femur to make this modification of the operation undesirable. For a periosteal sarcoma of the upper extremity of the femur no operation ought, in the writer's opinion, to be undertaken. The patient would almost certainly succumb to the direct effects of the treatment, if the operation were sufficiently extensive to take away the parts infiltrated by the disease. The sarcoma would also probably return in the stump before the wound had closed, and little or nothing would have been gained by the operation.

The central tumours may be treated, as in the case of the tibia and fibula, with greater leniency, particularly if there is reason to suppose that the case is one of myeloid sarcoma. A much larger proportion of the central growths are limited to the lower epiphysis of the femur than is the case in the periosteal sarcomata. They are, also, much less likely to be diffused in the surrounding tissues, so that an amputation through the middle of the thigh will, in most cases, be sufficient for a central tumour of the lower epiphysis. The sawn surface of the femur must be carefully examined, and if there be any doubt as to the possible extension of the disease along the medullary canal, another section must be made till a perfectly healthy part is reached. For a central tumour of the middle of the shaft, amputation through the trochanters or a disarticulation at the hip might be performed; the decision, as to which would be the best operation, being made according to the special features of the case.

For a central tumour in the upper end of the femur, disarticulation at the hip-joint should certainly be undertaken, if there be any chance of the patient surviving the immediate risks of the operation. This would give by far the best prospect of permanent recovery from the disease; but if, from any special reason, this was thought undesirable, resection of the head, neck, and great trochanter might be attempted. The immediate risk to life would probably not be so great, but the subsequent progress of the case would be much more exhausting to the patient's strength than in excision for disease of hip, and recurrence of the growth would be more likely to take place than after amputation. Still, if the disease were not too far advanced, it would certainly be right to give the patient this last chance, in the case of a central sarcoma of the upper epiphysis of the femur. It is well to bear in mind that the hæmorrhage in such an operation would probably be very considerable, if one may judge from the records of cases of resection for sarcomata in other bones.

In the *forearm* the same distinction should be made between the central and peripheral tumours, the latter requiring amputation through the elbow or just above the condyles of the humerus, according to the position and extent of the primary growth. In some of the rapidly growing periosteal tumours, the disease extends very quickly along the muscles and their sheaths. Where this appears to be probable, from the infiltrating nature of the growth and its rapid increase in size, the amputation should be done at the junction of the middle and lower third of the arm, above the humeral attachments of the muscles of the forearm. The central sarcomata are almost entirely limited to the lower third of the radius and ulna, and may in many cases be removed by enucleation or resection. In the case of the ulna, the latter operation is particularly favourable, as it may be done without opening the wrist-joint. Should there be a doubt as to its central or peripheral origin, an incision ought to be made and the finger introduced, for if it proved to be a central sarcoma, but yet too extensive for enucleation or resection, amputation might still be performed through the upper third of the forearm, if the soft parts were not already infiltrated.

In the *humerus*, disarticulation of the shoulder-joint will probably be required for

both forms of disease. The periosteal, which is nearly always situated in the shaft of the bone, must be treated in this manner on account of the principles already enunciated in speaking of the other bones; and the central, which, with very few exceptions, has its origin in the upper epiphysis, most frequently requires this operation from the large size and extensive nature which a central sarcoma so rapidly assumes in this position. Resection of the upper end of the humerus has been performed with a large portion of the shaft, but hitherto, so far as the writer has been able to learn, without success. In the amputation, the skin only should be retained, especially in the periosteal cases, as there can be no object in keeping the deltoid. The outer half of the clavicle and a portion or the whole of the scapula have also been removed at the same time, where these parts were involved in the disease.

Portions of the *pelvis* may at times, in quite the early stage of the disease, be capable of removal, but the possibility of doing this will always be exceptionally rare. The same may be said of the *clavicle* and *sternum*. The *scapula* has been more frequently attacked by the surgeon's knife for sarcoma. The inferior segment, when that alone is involved, may be very rapidly and successfully removed; but the excision of the whole scapula, with the arm and outer portion of clavicle, is a very formidable operation, comparable in its results with disarticulation at the hip. The new growth is also almost certain to reappear in the lungs.

The *prognosis* of the sarcomata of bone may be gathered from what has been previously said as to their malignancy. But, after the tumour has been removed and examined, a much safer opinion can be given as to the probable result. It would be wiser, therefore, to withhold any definite opinion till the necessary operation has been performed.

If the tumour proves to be a myeloid sarcoma and has been very freely removed, every hope of a permanently successful result may be entertained. But if it has only been enucleated or resected, a definite opinion, with our present knowledge and experience, must still be withheld for a time. Should it return, amputation may yet be performed with every hope of permanent success. The other central tumours, although more favourable than the periosteal, are not so benign as the myeloid. According to Gross, if calcareous or osseous deposits are found in *any* of the central sarcomata, they are much more likely to recur. If, after removal, the periosteal nature of the tumour is confirmed, the prognosis becomes much more grave, as the majority return either locally or by general dissemination; in the spindle-celled variety, metastasis occurred in Gross's cases in the proportion of 100 per cent.

Cystic Tumours of Bone may be divided into four classes—

(1) Those which are connected with the teeth, and which will be found described under Jaws, Diseases of the.

(2) Those which are due to some other and more important growth. They are here only an accidental formation, and must not be considered apart from the disease in which they arise. For example, they are found in the enchondromata, especially in the myxomatous variety. Cavities, containing serous and bloody fluid, are also not uncommon in the central sarcomata, and were often described in former days under the name of 'spina ventosa.' The large majority of cystic tumours of bone occur under one or other of these two headings, and the reader must refer to the preceding pages for an account of their origin.

(3) Simple cysts of bone must be exceptionally rare. They have, however, been described, but not in recent times, so that, until a modern microscopical examination has been made of such a tumour, we cannot feel sure that some new growth is not, after all, the cause of the cystic development.

(4) *Hydatids* may also, although very rarely, produce cystic cavities in bone. Several specimens are preserved in the museums of St. Thomas's and Guy's Hospitals. The bone becomes thin and expanded, and gives rise to the symptoms of a central cystic tumour. If this can be tapped, a diagnosis may be made by a microscopical and chemical examination of the fluid that is withdrawn. *See* Hydatids. But, from the histories of some of the recorded cases, it would appear that a fracture, occurring spontaneously and from some very trivial cause, is sometimes the first indication of the disease, and an operation, which has been undertaken for the resection of the fractured ends of the bone, has demonstrated the nature of the case by the escape of hydatids through the wound.

The treatment, that must be adopted for hydatids of bone, will vary with the amount of absorption and destruction of the osseous tissue. If a mere shell is all that is left of one of the longer bones, it may be necessary to amputate. But in the flat bones, and in

those cases of the longer bones in which such extensive destruction has not taken place, the hydatids and the cyst-wall may be carefully removed and scraped away, and the wound left to fill by granulation.

Pulsating Tumours of Bone.—It is probable that nearly all the pulsatile tumours of bone are central sarcomata, for an account of which see preceding pages. This question is also discussed under Osteo-Aneurism, where another condition, which must, however, be exceedingly rare, is described as producing pulsation in bone.

Carcinoma of Bone, as a primary disease, is almost unknown; in fact, it is believed by many to be impossible, as there are no epithelial tissues from which it could arise. Secondary growths are not uncommon, especially after scirrhus of the breast. In these cases, carcinoma may develop in the cancellous tissue of almost any of the bones, and may give rise to spontaneous fracture, or only be discovered *post mortem* in the bodies of the vertebræ.

Epithelioma rarely gives rise to secondary growths in bone, but often enough involves and partially destroys it by direct extension from the primary growth, as in the lip and tongue. Cancer of bone must therefore be looked for under *Sarcoma of Bone*. H. H. Clutton.

TYLOSIS.—Tylosis or tyloma is the name given to an hypertrophy of the epidermis. It consists of a horny mass, which may be of any size. It occurs chiefly on the palms and soles, but it may develop on any part of the body exposed to constant friction or pressure. Thus, on the hand it may be caused by gymnastic exercises, cricket, rowing, or any occupation calling for the excessive use of the part, and on the feet, at times, the unequal pressure of the shoe produces a thick and horny mass, causing great pain and inconvenience in walking.

Treatment.—Similar to that for hard corn. *See* Corns. Malcolm Morris.

TYMPANUM, Affections of the.—*See* Ear, Middle, Diseases of the.

U

ULCERATION. — *Definition.*—A pathological process in which the affected tissues undergo softening and molecular death, and are cast off, partly in a minutely disintegrated, and partly in a liquid state forming a discharge or ichor. The molecular death, minute disintegration, and liquefaction of the affected tissues distinguish ulceration from sloughing and gangrene, in which the tissues die *en masse*, and, retaining their cohesion, are thrown off in the form of a slough or sphacelus. The above definition of ulceration chiefly applies to the process as it occurs in the skin and mucous membrane, or morbid growths in connection with these structures, and in the deeper tissues when exposed in an open wound.

Causes.—The process of ulceration is preceded by the infiltration of the affected part with morbid products, which may be either of inflammatory origin, or due to the less understood departure from normal nutrition that occurs in the formation of new growths. The causes of ulceration, therefore, looked at broadly, resolve themselves into the causes of inflammation and of new growths. These will be found fully discussed, so far as they are known, in the articles on these subjects. As regards ulcers of the integuments, however, with which this article is chiefly concerned, there are certain well-recognised causes, whether inflammatory or other, which will need special mention. These may be divided into the predisposing and the exciting.

1. The predisposing causes are — (*a*) *Certain constitutional conditions of the system*, such as exist in struma and syphilis, in some fevers, in the old, and in the badly nourished and cachectic generally. (*b*) *An alteration or defect in the circulation of blood through the part*: for example, a feeble circulation, such as often exists in the lower limbs of old people; a deficient supply of blood, such as occurs in scar-tissue or in consequence of atheromatous or other degeneration of arteries; and an excessive supply of blood, such as occurs in chronically congested and inflamed parts, and in limbs the subject of varicose veins. (*c*) *An alteration or defect in the nerve-supply of the part*, such as ensues upon division or other injury of a nerve-trunk, or disease or injury of the nerve-centres – a familiar example of this predisposing cause, when

combined with the exciting one of pressure, is seen in the bed-sores which occur after injuries of the cord in fractures of the spine. (*d*) *The infiltration of the tissue with certain morbid growths*, as lupus or epithelioma.

2. The exciting causes may often be very slight—indeed, so slight as to escape notice. They may be divided into—(*a*) *Direct injury of the part*, as from cuts and blows of all kinds, continued pressure, chafing or rubbing the part, the application of irritating ointments, or chemical agents as acids or alkalies, and burns and scalds. (*b*) *Irritation produced by the presence of foreign bodies in the part*, such as a thorn, bullet, &c., or of extravasated and putrid secretions, as urine, fæces, bile, synovial fluid, &c. (*c*) *Inoculation with certain specific poisons*, as those of soft chancre, hospital gangrene, &c. (*d*) *The presence of certain morbid growths*, as lupus, epithelioma, &c.

Pathology.—The process of ulceration may perhaps be best studied as it occurs in the skin, as the result of inflammation. The part is hot, red, and swollen. The cuticle in the centre of the inflamed spot softens, and is separated or rubbed off. The sore thus left gradually enlarges in depth and extent, by the melting away as it were of the inflamed tissues surrounding it; and an ulcer is produced, exuding an ichorous and sanious discharge. Under appropriate treatment, the surrounding inflammation now subsides, the destructive process ceases, the surface of the ulcer becomes covered with a number of minute red points called granulations, the discharge assumes the characters of healthy pus, and the ulcer gradually contracts and skins over from the margins, till finally the raw surface is covered, and a scar or cicatrix remains at the seat of the former wound.

The minute changes which occur in the course of the phenonema above described are as follows:—The tissues at the focus of inflammation, where stasis has already occurred, become infiltrated with serous exudation and leucocytes which have escaped from the blood-vessels. This leads to the increased proliferation of the cells of the cuticle, which are pushed forward before they have had time to assume their horny characters; and the cuticle thus softened readily separates, leaving the dermis raw and exposed. The infiltrated tissues are now softened and disintegrated by the pressure of the leucocytes, which, in their turn, also undergo degeneration, and are cast off along with the liquefied and minutely disintegrated tissues, forming a discharge or ichor. Thus the ulcer spreads in depth and extent. But if now the cause of the ulceration is removed, the circulation in the surrounding blood-vessels resumes its healthy characters, the abnormal exudation of serum and leucocytes ceases, and whilst the exposed surface of the infiltrated tissue still degenerates into pus, loops of delicate blood-vessels grow out from the neighbouring capillaries, permeate the deeper layers of the infiltrated tissues, and become surrounded with small round cells, formed either from the leucocytes or the cells of the original tissue. These cells are united by a homogeneous intercellular substance, and, together with the capillary loops, constitute the granulations, or more correctly speaking the granulation-tissue. Under healthy conditions, the growth of the granulation-tissue proceeds more rapidly than its superficial degeneration into pus, and so the ulcer is filled up. New epithelium is now formed from the old epithelium at the margin of the ulcer, and gradually spreads over the surface of the granulations till the ulcer is finally skinned over. Islets of epithelium are sometimes seen springing up on the surface of the granulations, unconnected with the epithelium of the margins; but it is probable that this only occurs when portions of the papillary layer, with cells of the rete Malpighii, have escaped the ulcerative destruction. The granulation-tissue is developed into fibrous tissue; this slowly contracts, obliterating many of the blood-vessels, and reducing the size of the ulcer; till at length a smooth, white, fibrous cicatrix, devoid of papillæ, sweat-ducts, hair-follicles, and lymphatics, and but poorly supplied with blood-vessels, alone remains to indicate the seat of the recent sore.

In the ulcerative process by which a portion of gangrenous tissue is separated from the living, the same pathological changes ensue, and are fully described under GANGRENE.

When ulceration occurs in a morbid growth, as in epithelioma, the process of ulceration is essentially similar; the tissues are softened and disintegrated by the pressure of the infiltrating cells, and are cast off in the form of a discharge or ichor. In this case, however, the process is not the result of inflammation; the infiltrating cells are not leucocytes, but those of the morbid growth; and the process is one of continued destruction, showing, as a rule, no tendency towards repair.

The *treatment* of ulceration is given in detail under the various ULCERS.

W. J. WALSHAM.

ULCERS.—When the process of ulceration, whether the result of inflammation or of the breaking down of a morbid growth, involves the free surface of either the skin or mucous membrane, a loss of substance ensues, and the open sore thus left is called an ulcer. An ulcer, however, is not always produced by the process of ulceration alone, but frequently by the processes of ulceration and gangrene combined; as when a portion of skin from an injury or other cause dies, and the gangrenous piece is thrown off by the process of ulceration. The term ulcer, moreover, is often applied to any open granulating wound, left either as the result of an injury or of a surgical operation. The process by which an ulcer is produced has already been discussed under ULCERATION. It now remains to describe the various forms of ulcers that are met with in surgical practice, with their diagnosis and treatment.

Varieties of Ulcers.—The names by which ulcers are known have been derived either from the local condition of the ulcer itself or from its specific cause. Thus, when the process of ulceration, however produced, has ceased, and the surface of the sore has become covered by healthy granulations, the ulcer is said to be *healthy* or *healing*; when from any cause, as the too prolonged use of emollient applications, the granulations become pale and watery, it is spoken of as *œdematous* or *weak*; or if, from obstruction to the venous circulation in consequence of excessive contraction of the surrounding tissues (as, for example, in ulcers following burns), the granulations become protuberant and turgid, it is termed *exuberant* or *fungous*. When an ulcer is attended by signs of acute or sub-acute inflammation, it is called *inflammatory* or *inflamed*, the former term being generally applied to an ulcer having an acute inflammatory origin, and presenting signs of inflammation from the first; whilst the latter is used to indicate that the inflammation is a mere accidental condition, the result of local irritation, engrafted on any form of ulcer whatever its previous characters. If the inflammation is very acute, and the ulceration is accompanied by sloughing or by very rapid destruction of the tissues, the ulcer is spoken of as *sloughing* or *phagedænic*. If, on the other hand, the inflammation is of a chronic character, and the edges and surroundings of the ulcer become thickened and infiltrated with inflammatory products, it is termed *callous* or *indolent*. An ulcer, moreover, whatever its other characters, is often styled *varicose* when associated with or dependent upon a varicose condition of the veins of the leg; *eczematous* if surrounded with an eruption of eczema; *hæmorrhagic* when subject to bleeding; *painful*, *neuralgic*, or *irritable* when attended with excessive pain; and *cold* when occurring on the extremities of old people with a feeble circulation. Again, as the result of certain constitutional dyscrasiæ, ulcers present well-marked characters, and are named after the affections producing them. Such are the *gouty*, the *scorbutic*, the *strumous*, and the *syphilitic*; whilst ulcers due to the breaking down of morbid growths are denominated *lupoid*, *rodent*, *sarcomatous*, *epitheliomatous*, *carcinomatous*, according to the nature of the growth preceding them.

The characters, diagnosis, and treatment of most of the above-mentioned ulcers will next be given in detail. In studying them, however, it should be borne in mind that, in actual practice, many minor shades of difference in the local condition of ulcers are constantly met with, and that it may be, therefore, difficult or sometimes impossible to assign to any given ulcer an exact place in a nosological table. The local characters of an ulcer, moreover, are subject to continual changes; an ulcer which at one time is callous may at another be inflamed, and at another sloughing. Further, ulcers of specific origin may have their characteristic features so obscured by inflammatory or other local complications, that it may not be until these have been subdued by rest and appropriate treatment that the diagnosis can be determined.

I. ULCERS WHOSE CHARACTERS DEPEND UPON THEIR LOCAL CONDITION.—*The Healing, Healthy, or Simple Ulcer.*—The situation, and at first the size and shape of this, must necessarily depend upon the original ulcer of which it is the healing form. The edges are neither raised nor depressed, inverted nor everted, but smooth and shelving, the healthy surrounding skin shading off into a thin bluish-white and glistening film, which extends over and is finally lost on the circumferential granulations. The base, unless the ulcer has been very deep, is level, or but slightly depressed below the surface of the surrounding parts, and is covered with small, pointed, florid granulations, not painful, and not readily bleeding when lightly touched. The discharge is small in quantity, and consists of laudable pus.

Treatment.—The ulcer, as the name implies, is a healing one, and the less it is meddled with the better. Rest, and a light dressing of wet lint to protect it from fric-

tion or other source of irritation, and the gentle cleansing of the surrounding skin at each dressing, are all that are required. When the wound is very large, healing may be hastened by skin-grafting. *See* Grafting. Dr. Hamilton of Aberdeen has recently proposed grafting with small portions of sponge, as a means of promoting the filling up of deep and healthy ulcers. The writer has seen this method tried in several instances at St. Bartholomew's Hospital, but the results were not satisfactory. The granulations grew into the sponge in the way described by Dr. Hamilton, but the wound did not skin over, and the portions of sponge, filled with granulations and consequently adherent to the wound, remained in this state for many months; and it was not until infinite trouble had been taken in picking out the sponge with forceps, from time to time, that the ulcers were at last induced to heal. Cicatrisation was certainly considerably delayed in these cases.

The Exuberant or Fungous Ulcer is characterised, as its name implies, by the overgrowth of its granulations, a condition due to obstructed venous return, and hence frequently met with after burns and other injuries followed by the undue contraction of the surrounding tissues. The granulations, which rise up above the surface and often considerably overhang the edges of the ulcer, are turgid and congested, of a dark red colour, redundant, and closely packed together; they readily bleed, and are covered with a purulent discharge. The edges and surrounding skin are healthy.

Treatment. — Solid nitrate of silver should be applied occasionally until the surface of the ulcer has been reduced to the level of the surrounding parts, and the sore then treated as described under *Healing Ulcer.*

The Œdematous or Weak Ulcer, like the exuberant or fungous variety, is characterised by the uprising of the granulations above the surface of the surrounding skin; but instead of being turgid and dark red from excess of venous blood, the granulations are pale, flabby, bulbous, semi-translucent, watery, and œdematous. They are soft, easily broken, and readily slough, and are covered with a profuse and watery discharge. The edges of the ulcer are smooth, flat, or slightly rounded, and the surrounding parts are healthy. This ulcer generally occurs in connection with scrofulous bones and joints; but any ulcer may become œdematous if healing is delayed, especially where poultices or other relaxing applications have been too long continued.

Treatment.—Equably applied pressure to the surface of the ulcer, painting the granulations with a strong solution of nitrate of silver, or destroying them by solid nitrate of silver and afterwards applying astringent lotions, is the local treatment generally required. It should be combined with the internal use of tonics, cod-liver oil, and a generous diet.

The Inflammatory Ulcer.—All ulcers due to inflammation might, during their formation, with propriety be styled inflammatory; but the term has been restricted to those in which inflammation of the surrounding integuments is the most marked phenomenon. Such ulcers generally depend upon some constitutional derangement, such as may be induced by gout, excessive drinking, &c., and are usually accompanied by more or less fever. Any ulcer, however, when subject to neglect and local irritation, may become inflamed, but these are more often, for the purpose of distinction, styled 'inflamed ulcers.' The inflammatory ulcer is commonly met with in the lower third of the leg, and is of an irregular shape. Its edges are ragged and shreddy, or abrupt and sharp-cut. Its base is very little depressed, void of granulations, dry, raw, and livid red, or bathed in a serous and often profuse and blood-stained discharge, mixed with débris of breaking-down tissues; or, when the inflammation is more intense, covered with a yellow slough. See *Sloughing Ulcer.* The surrounding skin is hot, red, painful, and œdematous. When inflammation attacks a previously granulating ulcer, the granulations become florid and swollen, and generally slough, whilst the ulcerative process, if the ulcer itself is previously healthy or stationary, is again set up.

Treatment.—Rest in the recumbent posture, with elevation of the limb, the removal of all sources of local irritation, the application of cold in the form of the lead and opium lotion, or, better, of warmth in the form of poultices and soothing fomentations, is the local treatment necessary; whilst the general health should be attended to by gentle aperients, restricted diet, and tonics.

The Sloughing Ulcer is perhaps most frequently met with in connection with venereal disease. *See* Chancre; Syphilis. But any ulcer when neglected or subjected to local irritation, especially in feeble and cachectic subjects, may become acutely inflamed and slough, spreading with great rapidity. The edges then appear undermined, inverted, of a dusky red colour, the

redness extending some distance in the skin around. The base is covered by an ash-grey pultaceous or black slough, and, if this is removed, appears red, raw, and void of granulations. The ulceration is generally attended with much local pain and sharp constitutional fever.

Treatment.—The patient should rest in the recumbent position, with the part elevated, and hot poultices or fomentations be applied till the sloughs have separated. Internally, opium should be freely administered, as it not only allays the pain, but appears to have a controlling action upon the inflammatory process. The bowels should be regulated, and the patient confined to a light but nourishing diet. When the ulcer is foul, disinfecting lotions or charcoal poultices must be freely used.

The Phagedænic Ulcer, owing to improved sanitation, better hospital management, and the more scientific treatment of wounds, is, like the sloughing ulcer, seldom seen at the present day except in connection with venereal disease. *See* PHAGEDÆNA; SYPHILIS. The two processes of sloughing and phagedæna are often present in the same ulcer, which is then spoken of as the sloughing phagedænic ulcer, or simply as sloughing phagedæna. Bad hygienic conditions generally, intemperance, want of sufficient and proper nourishment, uncleanliness and neglect of venereal sores, and possibly direct contagion from a phagedænic wound by means of infected dressings, sponges, &c., may be regarded as the chief predisposing and exciting causes of an ulcer becoming phagedænic. The pathological process is similar to that which occurs in other forms of ulceration, but the softening and disintegration of the tissues proceed with much greater rapidity, and are generally accompanied with severe constitutional disturbance. The edges of the ulcer when well established, present an irregular, eaten-out appearance; they are swollen, and of a dark purplish-red colour, fading off into a dusky red, and in places undermined and inverted. The surface is devoid of granulations, and is covered by a dark, blood-stained, ichorous discharge, often intermixed with sloughs. The ulcer spreads with fearful rapidity, and, if not arrested, an entire organ, as the penis or the whole of the vulva, may be destroyed, or a large vessel, as the femoral in the phagedænic bubo, may be opened, and the patient die of a sudden gush of hæmorrhage. On the arrest of the morbid process, the ulcer assumes the ordinary granulating appearance and heals in the usual way.

The *treatment* must be both local and constitutional. The ulcer should be thoroughly dried with pellets of cotton-wool or blotting paper, and the surface completely destroyed by fuming nitric acid. The patient should be placed under an anæsthetic, and the acid applied with a glass rod or brush. In less severe cases, boro-glyceride or carbolic acid in the form of a lotion may be sufficient. At St. Bartholomew's Hospital, the writer has seen the best results from the continuous use of the warm bath. In the case of phagedæna of the penis or vulva, the patient is placed sitting in the bath, the water being maintained at a uniform temperature for many hours. The constitutional treatment consists in the administration of full doses of opium, tonics such as iron and quinine, ammonia and bark, and stimulants in amounts varying according to the condition of the pulse, tongue, temperature, &c.; whilst thorough ventilation of the room is absolutely necessary.

The Irritable or Painful Ulcer.—This name is applied to a small, superficial, and very painful ulcer, commonly situated about the ankle, and occurring chiefly in women beyond the middle period of life. The pain, which is the chief characteristic, is sometimes excessive, even preventing sleep, and is thought by some to depend on the exposure of the peripheral terminations of nerve-fibres in the wound. The edges are perpendicular, irregular, somewhat raised, but vary considerably in appearance; the base is either sloughy or of a livid red, the granulations are shrunken or turgid and bleed when touched, whilst small blood-clots are sometimes dotted over the surface. The skin is, for some distance, congested and of a purplish red, and is often left discoloured and slightly thickened after the healing of the ulcer.

Treatment.—The general health should be improved by saline laxatives combined with quinine or iron, and the pain subdued and sleep obtained by small doses of opium. Locally, rest, elevation of the limb, and the application of the lead and opium lotion, will generally suffice. These means failing, the surface of the sore should be thoroughly cauterised with the solid nitrate of silver. In rare instances, it may be necessary to attempt the subcutaneous division of the nerves by passing a tenotome under the most painful spot, in the way described by Hilton.

The description of this ulcer does not apply to the painful fissure or ulcer of the rectum, which is fully treated of under FISSURE OF THE ANUS.

The Chronic, Callous, Indolent, or Atonic Ulcer.—This ulcer is seldom seen except among the labouring poor, in whom it is frequently found on the front and side of the lower third of the leg. It is very chronic and indolent in its course, often existing for many months or years. It is generally unattended with pain, and when small may cause but little inconvenience. It is usually oval or circular in shape, sometimes irregular, and of moderate dimensions; though not infrequently, when subject to long neglect, it extends round the greater part or the whole of the circumference of the leg. The edges of the ulcer are smooth, steep, and rounded, white, callous, and bloodless, quite insensible when touched, and often elevated above the surface. The base is smooth, and covered with a thin sanious or serous discharge, whilst granulations are either absent, or are minute, pale, flabby, and ill-formed. When of long duration, the ulcer is often adherent to the fascia beneath, or even to the periosteum or bone, and the surrounding parts are chronically congested, thickened, and infiltrated; the skin is scaly and pigmented, and the veins are not uncommonly varicose.

Treatment.—The key to the treatment of these ulcers lies in restoring the circulation through the callous walls, by promoting the absorption of the inflammatory products with which they are infiltrated. This is best done by pressure. Before commencing treatment by pressure, however, any transient attack of inflammation should be subdued, the ulcer, if foul, cleansed by carbolic lotions or linseed-meal poultices, and, under any circumstances, the callous edges macerated and softened by poultices or other emollient dressings. Where a week's rest in bed can be taken previously to beginning the pressure, the cure will be greatly expedited. Having brought the ulcer into a suitable condition, pressure may be applied either by a Martin's bandage, or by strapping after the method of Baynton.

A Martin's india-rubber bandage is best used without any dressing. It should be put on before the patient gets up in the morning, evenly and loosely, so that when the feet are placed on the ground it tightens from the natural swelling of the leg. It should be taken off at night, sponged with cold water, and hung up to dry, while the leg should be well cleansed, and a dressing of lint, soaked in a weak carbolic lotion and covered with oil silk, applied to the ulcer for the night. Ointment should not be used, as grease destroys the rubber of the bandage. Baynton's method consists in carefully and evenly strapping the limb with strips of adhesive plaster, beginning a little below and terminating two or three inches above the ulcer, and then applying a roller bandage from the foot to the knee. The strips of strapping should be perforated opposite the ulcers to allow of the escape of the discharge, and should not be disturbed for a week. The bandage should be re-applied daily, or at least every two days. The writer, when the ulcer is very deep, carefully packs it with very small pieces of lint soaked in black wash till the level of the skin is reached, before applying the strapping, and has found this modification very useful.

When the surface of the ulcer is only slightly depressed, good results have also been obtained by applying to its surface portions of sheet lead, cut to the size of the ulcer and secured to it by strapping and a bandage. Where the ulcer is very obstinate, the edges may have to be pared down, or incisions made through them to the deep fascia, or a blister applied over the ulcer, as recommended by Syme, before beginning the pressure treatment. When very large, and extending completely round the leg, the question of amputation will have to be considered. A callous ulcer, if converted into the healthy condition by the above means, may, when large, be treated by skin-grafting as already described. An ulcer subjected to constant movement, as when situated over the tendo Achillis, must be placed at rest by applying a suitable splint to the leg.

The Varicose Ulcer.—This term is applied to any ulcer dependent upon, or associated with, a varicose condition of the veins. Such ulcers are usually situated on the lower third of the leg, and are generally of the inflamed, irritable, or callous variety. The ulcer will therefore not require further description, and the pathology and treatment of the varicose condition of the veins will be referred to in the article on that subject.

The Eczematous Ulcer is one which is surrounded by an eczematous condition of the skin. The eczema may be either induced by the irritating discharge from the ulcer, or the ulcer may be due to the breaking down of the centre of the eczematous patch, which is then generally the result of a varicose condition of the veins. In either case, the ulcer itself may be of any of the forms already described.

II. Ulcers whose Characters depend upon their Specific Origin.—*The*

Gouty Ulcer.—The small superficial ulcerations of the skin, which are sometimes met with over gouty deposits, have been called by Sir James Paget gouty ulcers. They are characterised by their situation over evidently gouty parts, and by the discharge leaving, as it dries, a chalk-like deposit consisting of urate of soda.

The Scorbutic Ulcer.—Scurvy does not appear to be a specific cause of ulceration, but, when it occurs in a person the subject of an ulcer, the same semi-fibrous material is formed on the surface of the sore as gives rise to the spongy gums, petechiæ, and other local manifestations of the disease. The edges of the ulcer, whatever its previous condition, become swollen and tumid; whilst its surface assumes a characteristic appearance, being 'covered by a spongy, dark-coloured, strongly adherent, fetid crust, whose removal is attended with free bleeding, and is followed by a rapid reproduction of the same material.'

The *treatment* should first be directed to the correction of the constitutional condition, and the ulcer then dealt with according to its local condition.

Strumous Ulcers are most frequently met with in the neck in the course of the lymphatic glands, in connection with strumous bones and joints, on the cheeks and scalp, and occasionally in other situations. They are produced by the softening and breaking down of enlarged lymphatic glands, by the bursting of subcutaneous strumous abscesses, and by the ulceration of the pale, pink, low, flattened elevations, known as strumous tubercles. The ulcers are generally multiple, often confluent, frequently forming an irregular indolent sore in the course of chains of lymphatic glands. Their edges are irregular, of a pale pink or bluish colour, often thin and undermined, but occasionally thickened. Their base is covered by œdematous, pale, often protruding granulations, having a marked tendency to bleed when touched, and exuding a thin, yellowish-green, scanty discharge. Enlarged glands and the cicatrices of former ulcers are frequently present in their near neighbourhood, or, in the case of ulceration of the neck, on the opposite side. The presence of these cicatrices is very diagnostic of this variety of ulcer. They are usually of a pale pink colour, or white when less recent, and slightly raised above the surface of the surrounding skin, which is puckered and variously drawn in towards them, forming cracks and crannies in which particles of dirt are apt to lodge. The cicatrices sometimes assume the form of irregularly shaped bands, giving the part a peculiar trellis-like appearance. Their appearance in connection with strumous bones and joints is described under those diseases.

Treatment.—Cod-liver oil, or maltine, syrup of the phosphate or iodide of iron in drachm doses, sulphide of calcium in doses varying from one-sixth to half a grain according to the age of the patient, together with an unstimulating diet and residence at the seaside, are amongst the constitutional measures which should be adopted. Locally, red oxide of mercury ointment, or lactate of lead made by pouring Goulard water into milk, will often be of service; but, if intractable, the edges and surface of the sore should be destroyed by nitrate of silver, or pared away, and the base scraped with a Volkmann's spoon. The cicatrices may sometimes be dispersed by repeated applications of blistering fluid, or, if this fails, it may be of advantage to excise them.

Syphilitic Ulcers.—Two forms of ulcer occurring in the course of constitutional syphilis are here described, the superficial and the deep. The primary syphilitic ulcer is described under Chancre.

A. *The superficial ulcers* are generally due to syphilitic ecthyma or rupia, or to the breaking down of syphilitic tubercles, and have often associated with them patches of these eruptions on various parts of the body. Any superficial ulcer, moreover, occurring in the course of syphilis, may take on the syphilitic characters to be immediately described. They are generally multiple, and are more common on the trunk than on the extremities. They are usually circular, or crescentic, or of a horse-shoe shape, often spreading by their convex margin whilst healing on their concave. Their edges are sharp-cut, neither inverted nor everted, raised nor depressed, and unattended by induration. Their bases are but slightly depressed, of a dark red colour, and often covered by a yellow slough or an ecthymatous or rupial scab. The surrounding skin is healthy, though an areola of dusky redness may immediately encircle them. On healing, they leave a bluish-white, semi-translucent, slightly depressed cicatrix, which is apt to break down on slight provocation. Several of these ulcers frequently coalesce, giving rise to a serpiginous or annular form of ulceration, which is very characteristic of syphilis.

B. *The deep ulcers* are nearly always due to the breaking down of gummata. They may occur in any part of the body,

but are most frequently met with in the lower extremities, in the neighbourhood of the large joints, and about the palate and fauces. They begin as deep-seated swellings, which at first are hard and painless, and unattended with signs of inflammation; then central softening occurs, the skin over them becomes inflamed and gives way, a slough separates, and the ulcers are produced. The ulcers are circular or oval in shape, of moderate dimensions, surrounded by a dusky red areola, but by only slight induration; they are generally painless; their edges are sharp-cut, steep, often slightly overhanging or scooped out, and of a dull red colour. The centre of the ulcer is at first occupied by a yellow slough, intermixed with shreds of the breaking-down tissues. On its separation, the base appears considerably below the surrounding skin, but rapidly fills up with granulations under appropriate treatment, the resulting cicatrix remaining slightly depressed, of a smooth, polished, and white appearance, while the skin immediately around is more or less pigmented. Two or more ulcers are frequently present at the same time, one perhaps open and discharging, another in a stage less advanced, whilst there may be several gummata around not yet broken down; and cicatrices of former ulcers are often to be found in the near neighbourhood, or perhaps in a different part of the body.

Treatment. — Iodide of potassium in full doses, combined with quinine, bark, &c., should be administered internally; whilst locally a poultice should be applied till the scab or slough has separated; and afterwards, the red oxide of mercury ointment, or the black wash, or iodoform powder should be used. Where the gummata are not broken down they should on no account be opened, as, even after softening has occurred, they may completely clear up under the influence of the iodide. Inflammation, if present, should be subdued previously to beginning the specific treatment. *See* Syphilis.

Lupoid Ulcers are such as are produced by the softening and breaking down of lupoid tubercles. Lupoid ulcers are most commonly met with on the face, especially about the alæ of the nose. When first formed, their characters, with regard to shape, size, and number, will depend upon those of the lupoid tubercles that precede them. But as the ulcers extend they become confluent, and, spreading superficially, may destroy large portions of skin. They sometimes extend deeply as well, eroding the cartilages and even the bones, and producing great deformity. The edges of the ulcer are slightly elevated, irregular, eaten out or sharp-cut, and neither inverted nor everted; the base is slightly depressed and raw, granulations being either absent or spongy and prominent, or it may be covered by a scab of hardened secretion. Tubercles that have not yet undergone softening may be seen in the skin around, whilst depressed white cicatrices, produced by the healing of former ulcers, are often present in the near neighbourhood.

Diagnosis.—Lupoid ulcers have to be distinguished from impetigo, from tertiary syphilitic, strumous, and rodent ulcers, and from epithelioma. When the lupoid ulcer is covered with scabs, it may bear a resemblance to impetigo; but the latter affection may be distinguished by its beginning as a pustular eruption, by the absence of tubercles around, by its evanescent character, by the thick yellow characteristic crusts, and by the absence, on removing them, of the ulcerated and spongy surface beneath, as seen in lupus. From ulcers occurring in the course of tubercular syphilides (the so-called syphilitic lupus), it is often very difficult to make a diagnosis. The age at which the disease began, its history and duration, the presence or absence of concomitant signs of syphilis, and the effect of antisyphilitic remedies will help in the determination of the point. The age of the patient is an important factor in distinguishing lupus from rodent ulcer and epithelioma, as both of these latter affections are very rare before fifty. Both may further be distinguished from lupus by the absence of tubercles around, by being single, and by showing generally no tendency to contract and heal. In epithelioma, moreover, the edges are indurated and everted, and the glands are enlarged at an early date of the disease.

Treatment.—The lupous tissue should be thoroughly destroyed either by scraping the surface of the ulcer with a Volkmann's or Morris's spoon till healthy tissue is reached, or by cauterising the parts with the actual or galvanic cautery. Internally, cod-liver oil and arsenic will be found the most useful remedies. *See* Lupus.

Rodent Ulcer, although now almost universally regarded as a form of carcinoma, is here described separately, as, whatever its pathological relations, its clinical characters differ in many marked respects from those of ordinary carcinoma. Thus it is much slower in its growth, in some cases having been known to be in progress for

upwards of thirty years. It does not become disseminated, nor, like epithelioma, affect the neighbouring lymphatic glands; nor does it return after complete removal. The patients often enjoy excellent general health throughout its course, attain old age, and appear, except for its local ravages, to be none the worse for its presence. Still, like carcinoma, it is progressively destructive, spreading by infiltration of the surrounding tissues, and sparing neither cartilage, bone, nor other tissue in its neighbourhood; and finally, like it, destroying life. *See* Carcinoma.

Symptoms.—Rodent ulcer is a disease of advanced life, seldom occurring under the age of fifty. Its favourite seat is the face, especially about the internal and external canthus of the eyelids and the alæ of the nose, and the scalp. It generally begins as a warty elevation of the skin, of a reddish-brown colour. This, after undergoing several desquamations, finally breaks down into an ulcer. The ulcer is generally single; its edges are irregular, sinuous, a little raised, and but very slightly if at all indurated. The skin around is supple and healthy; the base is slightly depressed, void of granulations, glazed, sometimes furrowed, and of a whitish or pale pink colour; the discharge is scanty and generally thin, though sometimes, especially when astringent lotions have been applied, it may harden, forming variously coloured crusts. Imperfect attempts at cicatrisation are sometimes seen, but no contraction of the part follows, and the ulceration soon again proceeds. It may continue superficial, but spread widely, or it may extend deeply, eating away and destroying everything—muscles, cartilages, bones—in its vicinity, and producing horrible deformity. Thus, a deep, gaping chasm, sometimes involving a part or the whole of one side of the face, may be left; the globe of the eye, perhaps, being destroyed, and the nasal cavities laid open to view. Or the cranium may be perforated, and the dura mater or even the brain exposed.

Diagnosis.—Rodent ulcer may sometimes have to be distinguished from epithelioma, lupus, or syphilis. From epithelioma it may be diagnosed by the absence of induration around, the non-involvement of the lymphatic glands, and its slower growth; but often in their early stages it may be impossible to distinguish these affections. From lupus it may be known by the absence of tubercles around and of cicatricial scarring, and by its beginning in the old, whereas lupus begins in the young. From syphilis it may be known by the rate of growth, the absence of concomitant signs of the latter affection, and the effect of remedies.

Pathology.—When the edges of the ulcer are examined microscopically, they are found to be infiltrated with a new growth; but the ulceration follows so quickly on the infiltration that, except just beyond the edge of the ulcer, the tissues are healthy. The cells are smaller than those of epithelioma, but are contained in alveolar spaces like those of carcinoma. Cell-nests, but ill-formed and not traceable to ingrowths of the epithelium, are said to have been here and there discovered. The manner in which the growth begins has not for certainty been ascertained, but it appears, from recent researches, to start as a proliferation of the sweat-glands or hair-follicles.

Treatment.—Early and wide extirpation by means of the knife should always be undertaken, and if any doubt exists as to whether the whole of the disease has been removed, the parts should be further destroyed by caustic or by the actual or galvanic cautery. When extensive ravages have occurred, much may still often be accomplished by the knife; and although a fearful chasm may be left—the globe of the eye perhaps extirpated, and the greater part of one side of the face cut away—if the whole of the disease has been removed, the parts may then, to a great extent, granulate up, and the deformity be in some measure obviated by the patient wearing a vulcanite mask, shaped to the lost features and coloured to the complexion.

Epitheliomatous Ulcer.—The general pathology of epithelioma is given under Carcinoma. The epithelial ulcer may begin as a crack or fissure at the junction of the skin and mucous membrane, or as a wart or pimple on the skin, or it may occur in the seat of an old scar, or in an ulcer that has continued open and discharging for a long period. It is characterised by its irregular, sinuous, raised, everted, and indurated edges; by its indurated base, which is generally raised, and covered with a scab or with warty or proliferating and cauliflower-like granulations; by its thin, ichorous, and sometimes sanious discharge; by the evident infiltration of the surrounding tissues with the new growth; and, after it has existed some time, by the enlargement of the neighbouring lymphatic glands. As the ulcer progresses it gradually invades the surrounding tissues, destroying fat, muscle, cartilage, and bone; the enlarged lymphatic glands soften and break down,

the skin over them gives way, and a secondary ulcer, with characters similar to those of the primary, is produced. Remoter glands may next become affected, but the disease, unlike the other forms of carcinoma, does not, as a rule, become disseminated through internal organs.

Diagnosis.—The induration of the edges and base of the ulcer, the advanced age of the patient, the rapid growth of the disease, the warty or proliferating character of the granulations, the evident presence of a new growth, and the infiltration of the lymphatic glands, are signs which will serve to distinguish an epitheliomatous ulcer from the other forms above described. A microscopical examination of a scraping of the growth will often assist in the diagnosis.

Treatment.—Free and early extirpation is the only treatment of any avail, and should always be resorted to when there is a fair probability of getting away the whole of the disease. A moderate enlargement of the neighbouring lymphatic glands does not, in the writer's opinion, contra-indicate the operation, and any such glands should, if consistent with safety, always be removed at the same time.

W. J. Walsham.

ULNA, Dislocation of the. — The upper extremity of this bone has, in very rare cases, been found dislocated backwards, whilst the radius retained its normal position. The writer has once had an opportunity of examining this dislocation. The forearm was semiflexed and strongly pronated, and the olecranon formed an unmistakable prominence behind the elbow. The hand inclined to the ulnar side, and the measurement from the internal condyle to the pisiform bone was half an inch shorter than the same measurement on the other arm. Movements caused great pain, but the head of the radius could be felt in its normal relation to the humerus, on attempting supination. This dislocation is sometimes associated with partial displacement of the radius forwards. Under chloroform, extension from the ulnar side is not likely to fail; but in a case reported by Waterman, straightening of the arm was found necessary, whilst, in one related by Pirrie, sudden flexion combined with pressure on the olecranon proved successful after extension by assistants. (Dislocations at the lower radio-ulnar joint, which some authors describe as dislocations of the lower end of the ulna, will be found under Wrist).

R. Clement Lucas.

ULNA, Fractures of the.—The *olecranon* may be fractured by falls on the elbow—its most common cause; by direct violence, as by a blow; and, as recorded instances appear to show, occasionally by the action of the triceps. The size of the portion detached varies from a thin plate to the whole of the process. The fragment is drawn up at the back of the joint, sometimes slightly, sometimes for an inch and a half, so that an interval—much increased when the arm is bent—can be readily felt; it can be moved from side to side, and the power of extending the forearm is much impaired. The joint is more or less distended with fluid. Union is generally ligamentous.

Treatment.—The arm must be placed in the extended position on a splint—best applied to the anterior aspect—and the inflammatory swelling usually present must be reduced by rest, position, and cold lotion. As soon as practicable, an attempt should be made to bring the fragment down towards the remainder of the bone. This may be done, either by a figure-of-eight bandage passing above the fragment and round the forearm; or, by placing two pieces of narrow bandage lengthwise, one on the inner and one on the outer side of the joint, crossing them with two or three turns of bandage above and below the elbow, and then tying the upper and the lower ends of each together. These methods, however, are not very efficient, and they, moreover, tend to produce swelling of the joint by constriction. A better plan is to use a loop of narrow elastic bandage, the middle of which arches over the fragment, while its two ends are fastened, one to the inner and the other to the outer border of the splint, at a convenient distance below the elbow, to secure the requisite amount of downward tension; or the fragments may be wired together, as recommended by Sir J. Lister. This operation, however, although it is no doubt free from any considerable risk, is, in the opinion of the great majority of surgeons, not warranted by the necessities of the case, since short ligamentous union, attended with only very slight impairment of the functions of the limb, can be obtained without operative interference. Some surgeons trust entirely to the natural contraction of healing, and keep the elbow bent and the forearm in a sling, with very good results.

Fracture of the *coronoid process*, though a very rare accident, and one which has often been diagnosed when it did not exist, has several times been verified on dissection. Generally, it is produced by falls on the

hand, and is associated with dislocation of the forearm backwards. The injury may be recognised by the fact that dislocation is reduced by slight force, but recurs when extension ceases. Possibly, the detached pieces may be felt in front of the elbow, and crepitus may be present. The brachialis anticus, however, is attached to the base of the process, so as to overlap it towards its apex in such a way that wide separation, unless the muscle itself is torn away, can hardly occur.

Treatment.—The forearm should be flexed upon the chest and confined in a sling. For the management of relapsing dislocation of the elbow, *see* Elbow-Joint, Dislocations of the.

Fracture of the *shaft of the ulna* alone is rare, and is always the result of direct violence. The upper third is so strong that it seldom gives way, but the middle and lower portions are sometimes broken in falls over some projecting object or by a blow. There is usually but little displacement; the injury, however, is plainly indicated by mobility, detected by fixing the upper, and pressing the lower fragment towards the radius, or by moving the pieces on each other, by crepitus, and by irregularity of the bone when its subcutaneous ridge is traced down.

Treatment.—As the bone is well supported by the radius, and displacement is usually slight, it is sufficient to apply a pair of straight splints, one on the dorsal and one on the palmar aspect of the limb, and to place the forearm in a sling in the semiprone position; or gutta-percha or leather splints moulded on the limb, or a light case of plaster of Paris may be used, instead of the straight splints. But should there be any tendency of the lower fragment to start towards the radius, it is better to use the straight splints, with the addition of a narrow pad carefully adjusted over the space between the bones; and the forearm should be placed in a position of supination. The splints may be discontinued at the end of the month; the arm, however, being kept a few days longer in a sling. Passive movement for supination and pronation should at the same time be carefully employed.

Howard Marsh.

ULNAR ARTERY.—I. *In the Forearm.*—The artery commences one inch below the elbow—i.e. opposite the neck of the radius—passing obliquely inwards for a short distance, it then runs down the forearm parallel to a line drawn from the front of the internal condyle of the humerus to the outer side of the pisiform bone.

In the *upper* half the artery passes between the superficial and deep layers of muscles; it has superficial to it skin, superficial fascia with the internal cutaneous nerve and ulnar veins, deep fascia, pronator radii teres, flexor carpi radialis, palmaris longus and flexor sublimis muscles; the median nerve crosses it three-quarters of an inch below its commencement, passing from within outwards. The artery rests on the flexor profundus digitorum. In the *lower* half of the forearm the artery is covered only by cutaneous structures, and it rests on the same muscle; it has the flexor carpi ulnaris tendon to its inner side, serving as a guide, and the flexor sublimis externally; the ulnar nerve lies on its inner side.

Ligation.—1. In the middle of the forearm the artery is reached by an incision, two inches long, in the guiding line of the artery. Cut through the cutaneous structures; in opening the deep fascia, recognise the outer tendinous edge of the flexor carpi ulnaris, enter between the sublimis externally and this tendon internally, and find the ulnar nerve or artery. If between the ulnaris tendon internally and the sublimis externally the nerve is seen, the artery, with its veins, will be to its radial side.

2. In the lower third the artery is exposed by an incision commencing in the guiding line two inches above the wrist, and ending half an inch above the pisiform bone. The outer edge of the ulnar tendon again serves as a guide, especially after the cutaneous incision is made. It is drawn inwards, when the artery is found lying beneath a process of the deep fascia, with the ulnar nerve to its inside, the flexor sublimis to its outside, and, behind, the flexor profundus digitorum.

II. *In the Hand.*—The ulnar artery passes from the outer side of the pisiform bone across the palm of the hand, just below the crease of the thumb muscles—the line of life—forming with the superficialis volæ from the radial, the superficial palmar arch. When the ulnar artery is clear of the pisiform bone, it sends down a deep branch to complete the deep palmar arch by joining with the radial trunk. The superficial palmar arch sends downwards digital arteries towards the clefts between the fingers, where, opposite the heads of the metacarpal bones, each vessel divides to supply the fingers, passing along their lateral aspects. The arch lies beneath the palmar fascia, and upon the median nerve and the sublimis tendons. The deep arch lies upon the bases of the metacarpal bones.

James Cantlie.

UMBILICAL FISTULA may result from one of three causes, the first two of which are congenital. (1) It may result from non-closure of the urachus, or (2) from continued patency of the omphalo-mesenteric duct. (3) It may arise from the opening of an abscess in some part of the abdominal cavity.

1. The urachus, which forms in early fœtal life a tubular communication between the bladder and the allantoid vesicle, and should become closed long before birth, remains occasionally patent, and it then gives passage to small quantities of urine, and has been known to remain unclosed until late in life. Besides the flow of urine from within, materials from without sometimes pass into the channel, and are then liable to become nuclei, around which concretions and deposits from the urine will collect and give rise to considerable trouble and inconvenience. In general, the permanence of such opening is marked by the occasional and inconstant issue of urine, and as a consequence of this, some eczematous eruption may be found at and around the navel. Spontaneous closure may take place after birth, but when it does not, and when the inconvenience and suffering is sufficient to render operative measures necessary for the closure of the opening, a light touch of the actual (or Paquelin's) cautery, or of a galvano-caustic wire, followed by careful strapping together of the granulating surfaces, is all that is requisite to effect their union. In some instances a mass of granulations is seen to arise from the umbilicus and to constitute a tumour, which attains in some instances a length of nearly an inch; and in the centre of this there may often be seen a small channel, from which issues a frequent discharge of fluid, having the characters of urine. The granulations are merely a result of irritation, and are directly due to the permanence of this condition. A ligature, tied firmly round its base, will strangulate the tumour, and the treatment above recommended will close the canal if it still persists.

2. Although very rarely, instances are occasionally met with, in which there remains a congenital communication between the umbilicus and some part of the intestinal tube by means of the omphalo-mesenteric duct, which, though often obliterated, can not infrequently be detected at post-mortem examinations as a diverticulum running upwards from the lower part of the ileum, and attached at the umbilicus. Through this canal, when patent, discharges having a fæcal odour will exude, and sometimes even small quantities of the ingesta can be detected in the fluid that issues. The treatment recommended above may be applied in such cases, or the edges may be pared and brought together by stitches.

3. By far the most usual cause, however, of this form of fistula, occurs in children with a tendency to a tubercular diathesis, and is due to the opening of an abscess at the umbilicus, which, in most instances, is the result of suppuration in the glands of the mesentery, either from breaking down of tubercular deposits, or secondary to some inflammation or ulceration of the intestines. This form, therefore, is never of congenital origin, and the discharge is more distinctly purulent, and when mixed, as it not infrequently is, with fæcal matter, points to the existence of a communication with the cavity of the intestine. There would seem to be a natural tendency for such accumulations of matter to make their way towards, and to present at, the umbilicus, although no good anatomical reason can be given for their taking this direction. When once the abscess has burst, the sinus which follows is lined with healthy granulations, and can be traced for some distance into the abdomen by means of a probe, and the external aperture is occasionally large enough to admit the tip of the little finger. The presence of bile in the discharges may indicate a connection with the liver or its ducts, but no such communication has ever been demonstrated by dissection. These fistulæ are very difficult to close; sometimes they will heal spontaneously after a considerable lapse of time, if the patient is kept quiet in bed; in other instances they will heal after adoption of some such methods as are mentioned above; but it is often necessary that the sinus should be laid open, and this is best done by passing down a probe-pointed bistoury as far as is deemed safe and cutting outwards, the wound being dressed antiseptically, and allowed to heal from its deepest part. See *Fæcal Fistula*, under FÆCAL ABSCESS.

JOHN H. MORGAN.

UMBILICAL HERNIA. — Ruptures at the umbilical cicatrix are of three kinds: 1. The congenital. 2. The infantile. 3. The adult form.

1. *The congenital.* These herniæ are very rare, and exist at the time of birth. They are due to an arrest of fœtal development, whereby the abdominal cavity remains imperfectly closed in the region of the umbilicus. Some of these herniæ are

of enormous size, and contain nearly all the abdominal viscera. They occur in monsters, and are associated with other deformities not consistent with life. As a rule, the protrusion is small, and is in the substance of the cord. The tissues of the cord are stretched over the sac, with which these herniæ are always provided, and the umbilical vessels are separated by it. The rupture appears as a rounded or conical swelling at the point of attachment of the umbilical cord to the abdomen. The coverings of the hernia may be so thin that the contained gut can be seen through them. Or the coverings may be absent, or may become ruptured soon after birth, and allow the viscera to escape. The contents are usually small intestine, and very often the cæcum. In some instances, the hernia and its contents have unwittingly been cut across in dividing the cord at birth. In many instances the hernia has undergone spontaneous cure. In any case the rupture should be reduced, and retained by broad strips of strapping passed round the abdomen.

2. The infantile form is very common. It depends upon yielding of an imperfectly consolidated umbilical cicatrix, and is most frequently met with during the first year of life. The swelling is usually small, and gives no trouble. So far as the writer is aware, it is never the seat of strangulation. Beyond certain moderate limits the hernia shows no tendency to increase. If left alone these ruptures will, in nearly every instance, undergo spontaneous cure. If any treatment be required, the hernia should be reduced, and the edges of the hernial orifice carefully held together by the forefinger and thumb. The margins of the opening should then be maintained in this position by means of strips of strapping passed across the abdomen. There is a form of treatment which is to be condemned, if on no other ground than that it prevents the cure of the rupture, and tends to perpetuate it indefinitely. It takes the form of an elastic belt, to the inner aspect of which a small button or nodule is affixed. This button is supposed to fit into the hernial orifice, and while it occupies that position it merely keeps the abnormal orifice patent, and prevents its closure. Fortunately, the button soon slips out of place, and no harm is done, except such as may be occasioned by the wearing of a tight abdominal band.

3. The adult form. The umbilical hernia of adults may—as a rare circumstance—have persisted from infancy. The great majority, however, are newly formed in adult life. This hernia is more common in women that in men, is most common in those who are obese and have large and pendulous abdomens, and especially in women who have borne many children. The average size of the rupture is about that of the closed fist. It may, however, attain large dimensions. As it increases in size it becomes pendulous, and may in time reach the groin. The hernia is always provided with a sac. The tumour is often irregularly lobulated, and its coverings are frequently very thin. The contents of the protrusion are most usually the great omentum, the transverse colon, the small intestine. It may contain the stomach, and even the cæcum. It often presents what is known as an omental sac.

This hernia is often irreducible in whole or in part. It is sometimes inflamed; it is but rarely strangulated; it is peculiarly prone to become obstructed or incarcerated. When reducible, it should be retained by a suitable abdominal belt. The introduction of a small pad of cork in the front of these belts is objectionable. The pad occupies the hernial orifice, and tends to maintain, if not to increase, its dimensions. When irreducible, the rupture should be protected and supported by a proper belt, the precise arrangement of which will vary according to the size and outline of the rupture, and the condition of the abdominal walls.

When the hernia is strangulated, it may often be reduced by taxis, the pressure being applied in a direction directly backwards. When herniotomy is required, a vertical incision of about two inches in length is made in the middle line at the upper part of the tumour. One half of this incision should fall upon the tumour, and the other half upon the abdominal parietes. The risk of cutting into the sac is much diminished by making the incision from below upwards, thus commencing it upon the tumour. The stricture will be at the opening in the parietes; and it should be divided by cutting directly upwards in the middle line. When possible, the rupture should be reduced without opening the sac. After the hernia has been reduced, the edges of the hernial orifice should be carefully brought together by several points of catgut suture. The sac may then be excised close to the hernial aperture, and its cut edges neatly brought together by sutures which maintain its serous surfaces in contact. When the hernial orifice is very large, it may be necessary to use harelippins to effect a closure. In such a case the pins should be removed at the end of forty-eight hours. FREDERICK TREVES.

UMBILICUS or NAVEL.—The umbilicus is more frequently spoken of as an anatomical point, than as the seat of any peculiar diseases. It is situate in the middle line of the abdomen, a little below midway between the ensiform cartilage and the symphysis pubis, and marks the point of separation of the two recti, which admits the entrance of the contents of the umbilical cord, and forms the point of their attachment subsequently to fœtal life. These are the umbilical arteries and vein, and the urachus, which are enclosed, within the abdomen, in a fold of the parietal peritoneum. It corresponds in situation to the body of the third lumbar vertebra, and the spot at which the aorta is most easily compressed is about an inch below and a little to the left of the umbilicus. It is below the umbilicus that the usual incision in the median line commences in laparotomy for intestinal obstruction, or in operations for the removal of tumours of the uterus or ovaries; and the cases are rare in which it needs to be carried above this spot, but when this has become necessary, the abdominal walls should be divided with blunt-pointed scissors, and the incision be carried round, but never through, the umbilicus. Other operations, either for removal of tumours of abdominal organs, or for other purposes, may commence above the umbilicus, but the same rule must apply in extending them downwards. In a healthy state, the rudiments of the cord dwindle after birth, and a firm cicatrix is formed; but it sometimes happens that when a ligature has been placed on the cord, the portion nearest to the infant does not wither, and is converted into a granulating mass which requires a fresh ligature to be placed round its base, or the application of a piece of solid nitrate of silver, before it dwindles to its normal condition. *See* Umbilical Fistula.

Hæmorrhage sometimes occurs in newly-born infants from careless ligature of the cord, or from the ligatured portion being torn off before the vessels are properly closed. This is seldom of much consequence, and is to be arrested by replacing the ligature. But a much more formidable hæmorrhage, or rather a constant oozing of blood from the granulating surface of the navel, sometimes takes place soon after birth, and this is either due to the hæmorrhagic diathesis, or it is found to be associated with a congenital malformation of the cystic or hepatic biliary ducts, or to the absence of a gall-bladder. Such bleeding is not restrained by styptics or even by ligature, owing to the absence of any coagulating power in the blood; and although when associated with these deformities, there is invariably a fatal termination, yet it is necessary to check the hæmorrhage, which can only be done by passing harelippins through the integuments, and constricting the parts with a piece of silk tied round their ends. The condition often occurs in several children of the same parents. Fatal cases of pyæmia in infants, with multiple abscesses and destructive inflammation of various joints, have sometimes been ascribed to inflammation of the umbilical vein.

In very stout persons a deep transverse depression often exists, running across the abdomen and completely obscuring the navel from view. This furrow frequently becomes the seat of a troublesome eczematous eruption, which goes on to ulceration if the affection is not speedily relieved. The variety is known as eczema intertrigo, and is one which is especially liable to affect fat subjects. It arises from decomposing secretions (sweat, &c.), being confined in moist and warm situations, and is characterised by an angry erythematous blush, associated with sodden epidermis and fetid exudation. The treatment consists in thoroughly separating the parts and cleansing with oatmeal and warm water, after which rags soaked in an astringent lead lotion should be applied for some hours, and finally a desiccant powder should be dusted on and some soft absorbent material employed to separate the parts. A saline aperient should be given at the same time.

Other forms of ulceration may affect this region, particularly those occurring in the third stage of syphilis, and a Hunterian chancre may sometimes be detected. Psoriasis, whether simple or syphilitic, causes great irritation, when by reason of folds of fat there is accumulation of acid secretion on surfaces denuded of epithelium. So too scabies finds a convenient nidus in this situation, and will often give rise to the greatest discomfort. Epithelial cancer is seen sometimes to arise idiopathically from the umbilicus, and commences as a superficial ulcer, resembling an excoriation and dipping into the pit of the navel or occupying the summit of the prominent button at the bottom.

Umbilical hernia or ruptured navel occurs in infants and is very common. The contained viscus, which is usually part of the small intestine, but which may be the stomach, omentum, large intestine, or bladder, pushes forward a portion of the parietal

peritoneum through the lax tissues which surround the umbilical vessels at their attachment in the linea alba. The coverings are therefore very thin and the diagnostic symptoms are those of hernia generally (*see* Hernia). A small round tumour is present, easily reduced by the pressure of the fingers, and the sharp tendinous edges of the aperture can then be felt. It seldom becomes large, except when conjoined, as it sometimes may be, with a ventral hernia, produced through non-closure of the recti above or below the navel. In all cases it has a tendency to natural cure, so much so that umbilical hernia is almost unknown in youth, and the only remedy which the surgeon is called upon to prescribe is a flat pad of cork, or of metal, covered with wash-leather, and secured by strapping or by an elastic band which laces behind. Some surgeons have, however, thought fit to operate in these cases.

The form of umbilical hernia which occurs in adult life is a protrusion which arises at one side of the navel proper, generally in the middle line above it, and is found in elderly persons, more commonly in stout females. The viscus, whether intestine or omentum, pushes forward the fibrous structures which are relaxed in consequence either of frequent pregnancies or of general fatty degeneration. It has a tendency to increase in size, and is not unfrequently irreducible, owing to the formation of adhesions. When this form of hernia becomes the seat of strangulation operative interference is not always called for, as the symptoms will often subside after the active use of enemata, &c.; but when it becomes imperative to use the knife the issue is frequently unfavourable, on account of the general unhealthy condition of such patients. A carefully constructed truss must be constantly worn. John H. Morgan.

UNREDUCED DISLOCATIONS. *See* Dislocations.

UNUNITED FRACTURE. — True ununited fractures are rare; but some delay in the process of union, especially where the fracture has been inefficiently treated, is not uncommonly met with. No hard and fast line can be drawn between the two classes of cases: the union of such a bone as the femur may be delayed many months—in one recorded case for as many as twenty-two—and yet eventually take place without operative treatment. It is difficult, therefore, to say at what exact time a case of delayed union becomes one of ununited fracture. Whatever induces delay in the union of a fracture may also, if the same conditions continue to exist, lead to permanent non-union.

The great majority of cases of ununited fracture depend on some *local* cause. The fracture has been badly set, the fragments have never been in good apposition, with perhaps some foreign body, some piece of muscle or other soft tissue, between them: or, originally together, the splints over them have been too tightly or too loosely applied, producing in the former case obstruction to the circulation and consequent delay in the deposit of reparative material, allowing in the latter harmful mobility. An over-anxious surgeon, who is perpetually meddling with a fracture, may get delay or even non-union for his pains; and restlessness and intractability, on the part of the patient, will predispose to the same result. Injury to the nutrient artery, or to the main vein of a limb, with resulting phlebitis and thrombosis, may be mentioned amongst the local causes of delayed and non-union, as also may disease of the fractured bone itself. Of this, necrosis is the most common example, and it is nearly always in cases of compound fracture that it is met with, either following comminution of the bone or detachment of its periosteum. In very rare instances, small detached portions of bone, embedded in the callus, necrose at a later period and cause disunion. In the London museums are five preparations showing non-union from mollities ossium, one from atrophy, one from fragilitas ossium, and one, in a lion's bone, from rickets. Cases of non-union are mentioned by Norris, in which bones affected with chronic abscess, hydatid cyst, and nodes, have given way at the seat of disease. The too early removal of splints, especially in oblique fractures of the lower extremity, where the weight of the body is thus prematurely brought to bear on imperfectly ossified callus, may lead to the absorption of that already laid down, or prevent its further development. Sometimes, a congenital ununited fracture is met with.

Most *constitutional* causes, such as fevers, scurvy, syphilis, privation, sudden changes of diet—e.g. deprivation of accustomed alcohol—pregnancy, lactation, hæmorrhages, delay rather than permanently arrest the union of a broken bone. Alkaline urine, with an excess of phosphates, is found sometimes to be present where no other cause for the non-union can be ascertained to exist, or it may accompany one

of the above conditions. What influence the nervous system exercises over the union of fractures is uncertain. Cases of natural union in paralytic limbs have been recorded; but in one case of fracture of the lumbar spine, in which both the arm and the leg were broken, only the humerus united. Spontaneous fractures of ataxia reunite readily and rapidly, with an enormous formation of callus. The bones of lunatics seem to be more brittle than normal and break easily, but, unless there is some disease such as mollities ossium, they unite with readiness. Experiment has shown that division of the nerves of a limb has the effect of making the callus of a fracture, on that side, larger and harder than in one on the opposite side.

It is usual to classify cases of non-union under three heads: fibrous union, false joint, and absolute non-union. Fractures of certain bones—the patella, olecranon, neck of the femur (when intracapsular) and coronoid process—so usually unite by fibrous tissue, that, when in this condition, they can hardly be regarded as instances of ununited fracture.

Fibrous or ligamentous union, as it is sometimes called, may be effected by one or more bands, usually the former. The fibrous tissue appears to be the result of an arrest of the process of union, just when ossification should commence. Sometimes masses of bone are embedded in it; these are either comminuted fragments which have become encysted, or the result of limited ossification from separate centres. The neighbouring periosteum is often thickened, and other fibrous bands connecting the fragments may be formed by atrophied muscular tissue or interosseous membrane. The ends of the bone, in cases of long standing, are usually coated with fibrous tissue, somewhat atrophied, rounded off, and pointed; in other cases they are found enlarged and sclerosed, with, perhaps, irregular masses of callus around them. The medullary canal is usually filled in with an osseous or soft fibrous deposit, but may be patent from atrophy. In cases of *false joint* the ends of the bone are often expanded, eburnated, or covered with fibrous, cartilaginous, or fibro-cartilaginous material, one, perhaps, convex, fitting into the concavity of the other, and surrounded either by a proper fibrous capsule—a sort of unossified provisional callus—or by a capsule formed by the neighbouring soft parts. The interior of this capsule may be smooth or fasciculated, is often moistened by a synovia-like secretion, and sometimes contains loose bodies or has soft outgrowths projecting into its cavity. When the ends are more widely separated, a bursal sac, which does not enclose them, may be interposed. It is only in rare instances that the surgeon has to do with *absolute non-union*. The bones in such a case are atrophied; the limb generally shrunken, wasted, and useless; movement of the fragments is very free, and not imparted from one to the other.

The *diagnosis* of ununited fracture is easy. If in the lower limb, the patient either cannot walk at all, or, if able to do so, is aware of a sensation of 'giving' at the seat of fracture when the weight of the body is brought to bear on it. In the upper limb, the arm is more or less useless and perhaps flail-like; if the forearm is affected, there will probably be loss of the power of pronation and supination. There is frequently deformity at the seat of non-union, and the surgeon can, by manipulation, move one fragment on the other. The extent of this movement will depend much on the displacement of the fragments, the interval separating, and the consequent length of the uniting material between them. Very rarely, the fragments are so interlocked that there is but little impairment of the function of the part. Whether a case is one of fibrous union or of false joint must often remain a matter of doubt. Fibrous union is the more common, allows, perhaps, of greater movement, and is unattended by the crepitus that occasionally is met with in cases of false joint. If manipulation causes much pain, the uniting medium is said to be probably fibro-cartilaginous. In such cases union is probably only delayed, and they have a good prognosis.

Treatment.—It should be remembered that the union of some fractures is necessarily slow—e.g. where there is much displacement or great obliquity of the fragments; in such cases, patience and perseverance in the original treatment will probably be all that is required. Whenever any of the causes of delayed union enumerated above are present, the surgeon must at once direct his attention to its removal. A patient with scurvy must have fresh vegetables, fresh meat, and lime-juice; one with syphilis a course of mercury, iron, or potassium iodide, according as one or the other is indicated; one who is cachectic, weak, has undergone privation, or suffered from hæmorrhage, a generous diet and tonics; one accustomed to stimulants, beer and wine; a suckling woman must wean her child; a pregnant one may be assured

that, after delivery, her fracture will probably unite; a phosphatic and alkaline condition of the urine is best treated by a liberal diet and dilute mineral acids. Some of the local causes of delayed union, such as injury to the nutrient artery, are beyond the surgeon's control, but most can be avoided by careful treatment. If crepitus is elicited when the fracture is set, it is improbable that any foreign body, muscle, or other piece of soft tissue is between the fragments. Efficient application of splints and careful after-treatment should prevent either undue mobility or too rigid confinement of the fracture; if this has been oblique or there has been much displacement, extra time must elapse before the support afforded by splints is finally dispensed with. Necrosed pieces of bone, if not separating naturally, must be removed by operation. In neglected cases of fracture, where the delayed union is simply due to separation of the fragments, the surgeon, if the injury be at all recent, may by the use of continuous extension be able to a great extent to rectify the malposition, and so bring the parts into a more favourable condition for union or, failing to obtain this, for any operation that may be needed.

If delayed union follows treatment by splints and absolute rest in bed, the patient should be allowed to get up and go about in the open air with his fracture put up in a plaster of Paris, silicate of potash, leather, or pasteboard splint. In this way, the ends of the bone being rubbed together, the parts are excited to greater action and union may result. If the patient has already—from the first—been treated by the plaster of Paris bandage or some such immovable apparatus, it may be that a change to splints and rest in bed will procure consolidation. Frictions, shampooing, stimulating embrocations, or even blisters or issues over the seat of fracture, may also be tried. Mercury—even in non-syphilitic subjects—is sometimes given empirically. If after a reasonable time no union results, the case must be regarded as one of ununited fracture, and more severe measures will be necessary. Amongst the many operations that have been devised are the following:—

Dieffenbach's operation of drilling the bones and inserting ivory pegs into them. The pegs may be cut off level with the bone and allowed to remain, and often give rise to no irritation, or they may be removed at a subsequent operation. Some surgeons have used copper nails for the same purpose. *The introduction of gilt steel needles* into the bones under antiseptic precautions, has in Germany met with a good result. The needles are ten or twelve in number, and are retained for fifteen days.

Irritation of the unossified callus by *acupuncture*, or *subcutaneous incision* by means of a narrow-bladed tenotome, has also been practised. In performing such an operation, it must be remembered that large vessels—even the main artery of the limb—may be close, if not actually adherent to the fragments. *The passage of a seton*, silk or silver wire, between the ends of the bones is attended with the same danger of injuring important vessels or nerves: in some cases, where it is impossible to pass the seton between, it may be passed in the immediate neighbourhood of the fragments. *Drilling the bones* may be practised in many ways. The ends may be perforated in one or more places and the drills withdrawn; they may be left *in situ*, or, in suitable cases, passed right through from one fragment into the other, so as to hold them together. In such cases, the apertures should be made by a circular drill, and into these circular openings other drills, triangular on section, should be introduced, so that there may be thus provided an escape for the discharges. This operation has been practised by Sir J. Lister for ununited fracture of the neck of the femur. External incision may usually be dispensed with; if the bones be at all deeply situated, the insertion of long hare-lip pins may sufficiently mark out their limits and be a guide during the operation.

If, in addition to failure of bony union, there be irremediable displacement of the fragments, in itself sufficient to spoil the utility of the limb (e.g. great inversion of the foot, in a case of fractured leg), such simple operations as the foregoing must give way to the more severe measure of *resection*; and removal of more bone than just the ends of the fragments may be necessary to correct the malposition. Before, however, the displacement is put down as irremediable, it must be clearly seen that it is not due to or kept up by contracted tendons. If it were, tenotomy might make one of the milder operations feasible. Resection will also be needed when, although there is little displacement, other measures have failed, and probably in nearly all cases of false joint. It is now usually combined with wiring the fragments, the wire either being cut off close, hammered down, and left; or being twisted a known number of times, made to project from the wound, and subsequently removed. Since the in-

troduction of antiseptics, this operation is not to be regarded as of much danger when practised on most of the long bones. In the case of the femur, where a large deep wound is made, and much manipulation is perhaps necessary to bring the fragments together, the amount of discharge following the operation is usually so great as rapidly to soak through the dressings and make it a matter of some difficulty to keep the wound thoroughly aseptic; no such trouble is experienced with the other bones. Such resections are not nearly so dangerous as ordinary compound fractures in the same situations. The wound is made with a clean sharp instrument, with antiseptic precautions from the very first, the soft tissues are less injured, and the condition of the bone and medullary canal is usually, from previous pathological changes, such as to render them more tolerant of injury than when in their natural healthy state.

In performing resection it is well to render the limb bloodless, either by elevation or the application of Esmarch's bandage. As a rule only a single incision, if possible passing through a muscular interspace, will be required; but in the forearm, if both bones are implicated, two will be necessary; and sometimes, when the fragments of such a bone as the femur overlap much, and are deeply situated, it will facilitate matters if a separate incision is made on to each of them; the more dependent wound will be useful for drainage. The fragments may be drilled obliquely, or the wire passed through their whole thickness. The former is the easier, but more likely to split the bone; on this account, too, the saw is to be preferred to the cutting pliers for the actual resection. All periosteum should be preserved. In cases where both bones of the forearm or leg are ununited, the two upper or the two lower fragments may be found joined to each other. It is very essential in the forearm to separate and keep them apart, and to remove any redundant callus that might subsequently interfere with the movements of pronation or supination. The after-treatment of cases where resection has been practised resembles that of an ordinary compound fracture.

Nüssbaum's *transplantation of bone*, with antiseptic precautions, may be mentioned as another method of treatment. *See Bone-grafting* under GRAFTING.

Amputation should only be resorted to as a last resource, when other operations have failed and the limb is a useless encumbrance.

Mechanical appliances are most commonly used in ununited fracture of the femur; they may also be advisable for cases where, although resection and wiring has failed, the limb is still, with such a support, more useful than a stump would be, or when the patient objects to or is a bad subject for operation.

The *prognosis* after operations for ununited fracture is better when non-union is due to a local, than when it is due to a constitutional, cause; better, when irregular masses of callus show there has been an attempt at ossification, than when there is no such evidence; and better, when the bones are enlarged and sclerosed, than when they are atrophied.

GEORGE ROBERTSON TURNER.

URÆMIA. — This is a convenient clinical term used to indicate a condition in which peculiar phenomena, chiefly nervous, are exhibited as the result of the retention in the blood of matters usually eliminated by the kidney. These phenomena may either present themselves suddenly with great vividness and be followed by speedy recovery or death; or may come into being slowly, remain but slightly pronounced for a considerable time, and then quietly pass away with complete convalescence; or, on the other hand, become gradually exaggerated until they finally terminate in death. We speak accordingly of acute uræmia and chronic uræmia. The commonest cause for both of these conditions is one or other form of Bright's disease, but they may also be produced by mechanical obstruction, of one variety or another, to the flow of urine from healthy kidneys. In this way, the impaction of stones in the ureter or the pressure on the latter by a tumour may give rise to retention in the blood of those matters capable of producing uræmic symptoms, simply by throwing them back upon the kidney and embarrassing its free action.

The *symptoms* of uræmia are either suddenly developed in most pronounced forms without any warning, or are preceded by certain premonitions of a less distinct character. Among the latter may be mentioned slowing of the pulse and headache of a fixed kind, often referred to the back of the eyes or occiput; heaviness and mental inactivity are also noticed. The patient may also vomit once or twice in the morning without any evidence of dyspepsia, the vomited matter being watery and smelling of ammonia, or may have attacks of diarrhœa, or, again, may complain of dimness

of vision from time to time, which passes off completely. These premonitory symptoms, if they belong to uræmia, are usually followed, sooner or later, by acute evidence of the state of the blood. The most common is convulsions. These are of an epileptic character, and are usually accompanied by complete loss of consciousness, though not always. There is also biting of the tongue and foaming at the mouth. In the majority of cases, coma follows upon these fits and is usually deep, but coma may also appear without any previous nerve-explosion.

Uræmic convulsions may be single, but are more frequently repeated again and again, at shorter or longer intervals. During the stage of coma, the pulse is often quickened, the temperature rises, the teeth are ground, and there are twitchings of the muscles, and the fæces and urine are passed involuntarily. The pupils at the time are usually dilated and do not contract to light, but in some cases they have been found to be contracted or only of normal diameter. The face is usually pale all the time. In the intervals between the attacks the patient may appear quite well, and may recover vision completely, but often the sight of one eye at least remains impaired and the headache persists. The impairment of vision may be due to functional cerebral disturbance, which leaves no change in the eye appreciable by the ophthalmoscope, or may be due to actual changes in the retina, the result of the kidney-disease which leads to the uræmic symptoms. Of these organic changes in the fundus of the eye several are described. Dr. Gowers speaks of—(1) an œdematous swelling of the retina; (2) white patches of degeneration; (3) hæmorrhagic patches; (4) optic neuritis; (5) atrophy of the optic nerve and retina following the latter. Uræmic deafness is also occasionally noticed as a transient symptom, but is not so common as the ocular phenomena just mentioned.

The chronic condition of uræmia differs from the acute in that the fits are not so frequent and violent, and if there is any coma subsequently it is not so deep. Muscular twitchings, headache, itching of the skin, and morning sickness are, however, persistent. If the matters vomited are tested they are found to be of low specific gravity, and of alkaline reaction due to the presence of ammonia. Asthmatic attacks and hiccup are also noticed. The sleep is bad and disturbed by distressing dreams, and vision is frequently deranged.

All this assemblage of symptoms has long been recognised as depending upon the retention of excrementitious matters in the blood, but the exact nature of the latter and their mode of action have been the subject of much debate. Without going into the details of the controversies on these points, which have been ably handled by Dr. Ralfe, it may be pointed out that one of the earliest views with regard to the causation of uræmic phenomena was that of Christison—that it was due to the accumulation of urea in the blood. This was very soon abandoned in favour of the theory that it was not the urea itself, but the ammonium carbonate derived from its decomposition, which gave rise to the well-known symptoms. But this theory, too, was found to be unsatisfactory, as also that which laid the evil to the credit of an excessive quantity of potassium salts in the blood. Further, it was suggested that uræmic nerve-explosions were due simply to the mechanical effect of œdema of the brain, combined with anæmia brought about by the associated renal disease; but this theory again has not met with general acceptance. From a review of the whole subject, in the light of the most recent investigations, it appears probable, as Dr. Ralfe points out, that so-called uræmic phenomena are not caused by the toxic effects of one substance alone, but by the presence in the tissues of numerous other decomposition-products such as kreatin, leucin, and extractives, which have accumulated there and have actually brought about an alteration in their chemical constitution. He further lays stress upon the fact that in uræmia there is a considerable amount of acid unexcreted, and consequently diminished alkalinity of the blood. The reduced power of oxidation which accompanies this change must react powerfully on the tissues already loaded with decomposition-products, and especially on the nervous system.

The *diagnosis* of uræmia from epilepsy is often not easy unless the history of the case be known, and especially the state of the urine. But, as a rule, the turgidity of the vessels of the face and asphyxial symptoms are less marked in uræmia. From apoplexy the condition is distinguished by the absence of paralysis. In cases of opium-poisoning the coma is continuous; uræmic coma is often interrupted; the pupils, too, are not contracted, as a rule, in the latter condition, and the face is pale, while the breathing is not stertorous and is quiet.

ARTHUR E. BARKER.

UREA, one of the chief results of tissue-metabolism, is consequently found in

those organs and tissues where change is most active, always excepting muscle. Its occurrence and the means of recognising it in urine are the subjects of the following article, but may be fittingly prefaced by a few general observations.

Chemical Composition.—Urea is a prismatically crystalline substance, which, soluble in water, insoluble in alcohol, is easily decomposed by heat, fermentation, &c. On the other hand, it may easily be artificially made, so that its composition is now perfectly understood to be that of an amide, the amide of carbonic oxide, thus $CO\begin{matrix}NH_2\\NH_2\end{matrix}$, which (in the process of fermentation, &c.) is saturated with two molecules of water, the result being its metamorphosis into carbonate of ammonia. It is worth while digressing for a moment to point out here that this katalytic process, of such great practical moment in the surgery of the urinary organs, may follow as a result of three distinct conditions, one of which at least, however, is impossible (so far as we know), *intra vitam*—(1) Prolonged heating in the presence of water; (2) by the action of alkalies (this is comparable to No. (1)—viz. hydration); (3) by far the most important, the action of the so-called micrococcus ureæ, or possibly a product of its growth. *See* Septic Diseases, Classification of. It is interesting to note, what has been known for some time now, that this mode of decomposing urea is attended with slight result unless there are phosphates present. This is evidenced by the great difference in behaviour between a pure solution of urea and normal urine.

Relation to Tissue-change.—Urea being a product of metabolism, it now behoves us to consider its origin and practical import, since such must form a valuable aid to diagnosis, other things being equal. In the first place, it is quite fallacious to rest any opinion on an excess or deficit over or below the 'normal' amount passed, unless the two preliminary points—(1) the ingestion of nitrogen as food; (2) the amount of tissue-waste produced by exercise in various ways, pyrexia, &c., be fairly estimated and known. Forewarned in this way, the relation of the amount of urea passed, to the actual degree of tissue-change on the one hand, and the secretory power of the kidneys on the other, (*see* Urine) is a determinable fact within certain limits. The normal amount of urea passed by a healthy adult male in twenty-four hours varies from 30 to 35 grammes—i.e. from 450 to 525 grains. This amount is, of course, the *average* quantity from day to day, and is the total quantity excreted in the twenty-four hours. It must not be imagined that the excretion is regular, for examination of the urine at varying periods, between meals and directly after meals, shows that the amount of nitrogen got rid of is doubled according to the period examined.

The well-known increase due to pyrexial processes, &c. (Ringer), need not be referred to here, and for its relation to the excretion of uric acid, *see* Urine.

Quantitative Estimation.—The possibility of decomposing urea, uric acid, kreatin, &c., the nitrogenous constituents of the urine, by the action of an alkaline hypobromite or hypochlorite, enables the quantitative estimation of the amount of nitrogen excreted to be a comparatively simple matter now; the cumbersome and extremely uncertain method of Liebig being now superseded by the more accurate and more complete process of observing the total quantity of nitrogen in the urine.

The method requires little detailed description. A measured quantity (5 c.c.) of the urine is placed in a small tube or glass bottle, and this is then carefully lowered into a larger bottle, into which 25 c.c. of freshly prepared solution of hypobromite of soda have been previously poured. Without mixing the urine and hypobromite solution, this bottle is then firmly corked with an india-rubber stopper, through the centre of which passes a glass tube. Now, the mixing of the urine with the hypobromite will cause the katalytic destruction of the nitrogenous bodies contained in that fluid, and so produce the evolution of a definite volume of nitrogen. This gas, being led off by the tube perforating the india-rubber cork, can be measured by displacing water in a tube to which it is connected. By previous analysis of known substances this tube can be graduated at once, not merely in divisions which show the amount of nitrogen evolved, but also how much urea that amount of nitrogen represents, in percentages of the total urine. Perhaps the best (being the simplest and accurate) apparatus is that of Gerrard. To repeat: the amount of nitrogen given off by this means, and measured (as is customarily the case) in percentages of urea, represents not only the urea present, but also other bodies referred to above. In regard to the amount of uric acid passed, and its correlatives, carbamic acid and ammonia, it has recently been proposed to estimate these (when in mixture) by the use of sodium hypochlorite followed by sodium hypobromite.

Thus (Fenton): take two equal portions (*a*) and (*b*) of the solution, and from (*a*) measure the amount of nitrogen evolved by action of the hypobromite. Call this amount V_1. Treat the other portion (*b*) with the hypochlorite, and let V_2 = volume of nitrogen obtained. Act on the residue of this experiment with the hypobromite, and let V_3 = the volume of N. produced. And if

x = vol. of nitrogen due to urea,
y = " " ammonia,
z = " " carbamic acid,

then $x + y + z = V_1$,

$$\frac{x}{z} + y = V_2,$$

$$z = V_3.$$

After discounting the ordinary fallacies mentioned above as attendant on the deduction drawn from the amount of nitrogen excreted in the twenty-four hours, it is perhaps scarcely necessary to state that since the separation of urea by the kidneys, in normal physiological action, is now well known to be a direct process carried on by the epithelium of the convoluted tubules, it is obvious that we have a definite means of ascertaining the secretory power—i.e. the state of the kidneys—and therefore can form some idea of the ability of a patient to successfully sustain a severe operation. This point is, of course, of especial importance when such an operation is performed on the urinary tract. *See* URETHRAL FEVER.

VICTOR HORSLEY.

URETHRA, Diseases of the.—These include urethritis, with its consequences—warts, gleet, peri-urethral abscess, inflamed follicles, stricture, neuralgia, syphilitic, chancrous, and tubercular ulcers. Many of these affections have been described under the articles CHANCRE; GLEET; GONORRHŒA; STRICTURE OF THE URETHRA; SYPHILIS; URETHRAL FEVER.

URETHRITIS, following coitus with women suffering from leucorrhœa or other non-gonorrhœal muco-purulent discharge, is a milder affection than gonorrhœa, though probably often closely resembling that disease. But urethritis is not exclusively due to contagion. It may be caused by injury, by gout, or by tubercular disease. Nevertheless, all these forms are, in comparison with gonorrhœal urethritis, rare affections. Excessive beer-drinking in young men, and, in children, the irritation of worms in the intestines, are stated to sometimes cause slight urethritis. Again, certain vegetables—e.g. asparagus—and turpentine and cantharides are accused of exciting a mild urethritis, besides specially irritating the kidneys. Occasionally also, a very mild urethritis accompanies the early macular eruption of syphilis; it is always very limited, and subsides spontaneously.

In *traumatic urethritis*, the signs of irritation follow the passage of the calculus or other foreign body without delay. Soreness is felt at the first micturition after the injury has been inflicted; swelling and discharge are evident, at latest, twenty-four hours after the occurrence. Like other forms of urethritis, the traumatic variety may be followed by inflammation of the prostate, testicles, bladder, or kidney. Orchitis is, probably, the most frequent form of this secondary inflammation.

In *gouty urethritis*, the inflammation usually begins, and irritation is generally first felt at the membranous and prostatic portions, not near the meatus as in gonorrhœa, and causes greatly increased frequency of micturition. This irritability of the bladder, coming on at once and out of proportion to the amount of inflammation of the rest of the passage, is very characteristic of the gouty form. Patients who suffer from it have had also symptoms of gout elsewhere, or pass uric acid crystals. They are usually of full habit, over forty years of age, and addicted to the pleasures of the table. Too much reliance must not be placed on the gouty symptoms, inasmuch as gonorrhœa is not uncommon in men of the habits just mentioned. Gouty urethritis affects both sexes, though much more common in men. The inflammation may be as severe as it is in well-marked cases of gonorrhœa, pus being secreted freely; or it may give rise to the complications of the bladder, testis, joints, and eye which attend or follow gonorrhœal urethritis. The leading distinctions of gouty urethritis are—the history or presence of gout elsewhere, the usually scanty discharge, notwithstanding the great amount of scalding in the perineum and irritation of the bladder felt by the patient. Further, the symptoms are generally dispelled by remedies appropriate to gout. The termination of gouty urethritis is nearly always by resolution. If it is followed by prostatitis or epididymitis, abscess may form, and septic infection may possibly succeed, with its various consequences.

A very obstinate form of urethritis, probably allied to gout, is occasionally met with—the *eczematous*. In the cases which the writer has seen at the Lock Hospital and elsewhere, the patients have been between forty and fifty, of full habit, beer-drinkers, and suffering from eczema on the skin. In

these cases the surface of the glans around the meatus was bright red and very tender. The interior of the urethra for two or three inches, in one case as far as the membranous portion, was also bright red, but did not bleed readily when the endoscope or the bougie was passed along. There was a scanty, milk-white discharge, and the patient complained of constant burning pain along the urethra. Passage of urine or of instruments increased the pain greatly for the time. No further change appeared to take place in this obstinate affection; relief was given by cold water injections, or by the cold irrigation-coil round the penis, and benefit was derived from arsenic, alkalies, and careful diet.

Tubercular urethritis is at first an indolent affection, due to the slow ulceration of the tubercular products in the mucous membrane. The affection, though it may occur at any part of the urethra, is much more widely developed in the mucous membrane of the neck of the bladder. The discharge is scanty, often somewhat bloody. Soreness in the urethra during micturition is very slight, being generally little heeded in comparison with the severe burning pain and spasm of the neck of the bladder which accompany or follow every act of micturition. Should a sound be passed, intense pain is felt as the instrument reaches the ulcerated surfaces, which lie most commonly about the prostate, and before the bladder is entered. The extreme, unassuagable irritability of the bladder is characteristic, becoming in the end constant torment. The mucus secreted by the cystitis that spreads generally over the surface of the bladder sets up decomposition and produces ammoniacal, putrid urine, which irritates still more the ulcerated surfaces and excites the frequent spasm. Tubercular disease in time spreads to the body of the prostate, the vesiculæ seminales, and the epididymes, and thus gives corroborative evidence of the nature of the urethritis.

The terminations of tubercular disease may be cicatrisation of the ulcers, when the contraction of the cicatrix may produce stricture in rare cases; but, usually, death is caused by the tubercular disease spreading to the bladder and kidneys, causing death by their destruction, or by developing acute tuberculosis of the lungs or other viscera.

The *treatment* of traumatic urethritis consists in the first onset of allaying irritation by salines, diluent drinks, low diet, and aperients. When severe, the patient must rest in bed; should spasm and irritability of the bladder come on, 5 to 10 minims of tincture of belladonna should be given in camphor water every four or six hours, with careful watching of the effect of the drug on the patient. Warm poultices and fomentations of the perineum are beneficial; and, if abscess form there, its contents must be immediately let out. Should urinary fever with partial suppression of urine set in, the treatment proper to that affection must be adopted. Usually, the slighter forms of traumatic urethritis subside in a few days, if the exciting cause be removed or not applied a second time; but it may be a serious and dangerous affection.

In treating the gouty urethritis, more benefit can be obtained by attacking the general condition than by treating the local affection. Free purging, with mercurial and other cholagogues, and citrate or bicarbonate of potash with colchicum, in frequent moderate doses, are needful. These measures, with low diet and continued abstinence from food likely to excite gout, aided by hot baths and other sudorifics, usually arrest the irritation quickly. Care in avoiding all but very moderate exercise, and the support of the testicles in a suspensory bandage are requisite to prevent the urethritis from causing prostatitis or epididymitis. The gleet left by the urethritis is obstinate, being mainly secreted in the prostatic portion of the canal and from its ducts. Local treatment and counter-irritation usually aggravate the discharge; better results are gained by persevering with the treatment for gout, and, when that condition is quiet, by administering ℥v. to x. of copaiba or 15 to 20 grains of cubebs, or some similar remedy, three times a day. Obstinate cases are often thoroughly cured by a course of saline waters, such as those of Homburg or Plombières, Bath, Carlsbad, or Töplitz.

In tubercular urethritis, the treatment is mainly that useful to combat the tubercular disease—rest, warmth, dry sunny climates, nourishing food, cod-liver oil, and iron. The spasm and pain often require large doses of belladonna and morphia in suppositories and by the mouth. If cystitis supervene, washing out with a solution of boric acid of half the saturated strength gives relief for a time; but drainage through a perineal opening is necessary to prevent the accumulation of urine in the bladder, when the cystitis is marked and the patient worn by pain and spasm.

Neuralgia of the Urethra.—This term is given to a painful affection of the urethra,

occurring when no disease can be detected in that part of the urinary apparatus.

The *causes* of the affection are very numerous, and may be divided into two groups: those referred to general disturbance of the nervous system and those connected with reflex irritation set up by local disorder of neighbouring parts. It is most frequent in the male sex and during the middle period of life; but it is not unknown in women and children. It may follow excessive coitus, masturbation, and repeated sexual emotion, or accompany neuralgia of other parts of the body. A superabundance of phosphates or of uric acid in the urine is also a frequent cause. Of causes of a reflex kind are—disease of the kidney, constipation, flatulent dyspepsia, fissure of the anus, piles, uterine disease; of causes more closely connected with the urethra are congenital narrowness of the meatus urinarius, enlarged prostate, stone or atony of the bladder. Lastly, in some cases none of these causes can be detected to explain the painful condition of the urethra.

The *symptoms* of this affection are—increased frequency of micturition, smarting pain, and difficulty in voiding urine; sometimes also a sense of heat and itching at the tip of the penis; aching pain beginning in the penis and radiating to the pubes, groins, loins, buttocks, and thighs. This is a not infrequent form, often recurring and ultimately almost continuous. In some persons the physical pain is accompanied by mental despondency, irritable temper, or dread of society.

The course of the affection is very capricious, irregular, and intermittent. It often assumes a certain periodicity, or comes and goes without obvious cause. The disorder thus affords long intervals of freedom from pain, to return when the general condition has been disturbed by some of the diathetic causes already mentioned. Sometimes, the passage of a small quantity of highly acid urine will bring on an attack of neuralgia, which copious draughts of simple diuretics, water, barley-water, or weak gin and water will speedily allay.

The *diagnosis* is formed chiefly from the obstinacy and severity of the pain with complete remissions, the absence of congestion of the mucous membrane and of discharge, and the existence of some of the causes of neuralgia already mentioned. Not infrequently the diagnosis is reached by the simple process of exclusion.

The *treatment* resolves itself into removal of any local disease which excites the neuralgia, if that be curable; and the palliation by anodynes, regimen and diet, of those, such as renal or prostatic disease, which are incurable. The phosphatic diathesis is remedied by tonics, mineral acids, fresh air and exercise, and sufficient amount of animal food. There should be also prohibition of coffee or strong tea, as those beverages are prone to cause precipitation of the phosphates and consequent painful micturition. To these measures, in obstinate cases, may be added a change of climate from a cold damp one to a warm sunny one. A course of saline aperient waters at Kreuznach, Harrogate, Carlsbad, and other baths is useful; or, if this be not procurable, free purging by saline aperients, when excess of uric acid depends or accompanies defective action of the liver, is often effective in procuring a cure.

For local treatment, the most efficacious remedy is the repeated passage of bougies and sounds. Usually, this operation is much dreaded by the patient, and causes him at first considerable pain of a hot, burning character. But if great gentleness be exercised and small pliant bougies be employed until the urethra has lost its hyperæsthetic condition, the suffering is only momentary, while the diminution of the constant irritation encourages the patient to submit to a repetition of the operation. When the passage has grown accustomed to bougies, full-sized steel sounds, well heated and oiled, may be passed twice or thrice a week until the neuralgia is considerably abated. Recourse may then be had to cold injections, cold hip-baths and other local stimulants of the circulation through the genitals. Repeated blisters to the perineum, produced by painting an area of half an inch square along the raphé with blistering fluid, are valuable when there is any tendency to prostatic congestion; but, to do good, blisters must be persevered with for several weeks.

Warts, as little pedunculated or sessile projections, identical with those seen in the furrow behind the glans or on the glans and inner surface of the prepuce, are a not uncommon affection of the mucous membrane. They are situated usually in the first inch beyond the meatus, though sometimes they can be seen by the endoscope growing at a greater depth from the surface. It is probable that true warts are not found more than three inches from the meatus. Again, they occur in persons who have a proclivity to them—that is, have warts on the glans or prepuce as well, or who have had them in boyhood on the hands or elsewhere. Urethral warts are always consequences of

gonorrhœa, and do not arise without the stimulus of acute irritation. In structure they are simple papillomata, and vary in size from that of a pin's point to that of a small pea. So long as they remain in the urethra, they give rise to itching and tickling there and secrete discharge. They are easily removed by touching them with an astringent solution or by snipping them off, when they are within reach. Those which are seen only with the endoscope, are destroyed by touching them with a solution of nitrate of silver of twenty grains to the ounce of water.

Peri-urethral Abscesses are also nearly always a consequence of gonorrhœa, and may begin at any part of the canal. Most frequently they develop just within the meatus, between the under surface of the urethra and the frænum preputii further on, or at a point about three inches from the meatus. They begin either by inflammation of a closed follicle, or as abscesses having no communication with the urethra, and spread both towards the skin and towards the mucous membrane. They may open on both surfaces, but most commonly do so externally. When forming beneath the frænum, they are often of slow growth and form a prominent swelling on either side of it. When they have broken, the pus escapes, but the cavity is slow to heal, and the pus collects again and again, to be discharged from time to time through a minute aperture. Should the abscess force its way to the urethra, it usually also opens on to the skin and thus produces a urethral fistula. If the abscess have formed in the part behind the bulb, the depth of the situation causes the abscess to be long in reaching the surface, and it may percolate between the layers of the superficial fascia to the scrotum or at the side of the crus penis for a considerable distance, before it makes its escape.

If the deeper abscesses break into the urethra, a troublesome purulent discharge remains, and the cavity of the abscess fills from time to time and may obstruct the flow of urine along the urethra.

The *treatment* consists in early puncture, and the maintenance of a free outlet for the pus until the cavity is closed by granulation. If there be a fistula, this usually closes in a short time, provided there be no obstruction, by stricture or otherwise, to the passage of urine by the urethra. Hence, the urethra must be searched for contractions, and any that are present be widened by treatment. The little obstinate pouches of matter, which lie on either side of the frænum in the furrow, are best treated by a free incision, and plugging the interior of the cavity with iodoform lint to ensure drainage and granulation.

Berkeley Hill.

URETHRA, Foreign Bodies in the.—Foreign bodies found in the urethra have either entered that canal directly from the external urinary meatus, or have passed into it after a long or short residence in the bladder. Calculi of purely renal or vesical origin arrested in the urethra are not referred to here, but are fully discussed under Stone in the Urethra. Foreign matters obtain entrance into the bladder and thence into the urethra, either through injuries which cause penetrating wounds or in consequence of disease. As the result of direct injury, shot, pieces of clothing, or fragments of bone are met with, while portions of bone, the contents of dermoid cysts, fruit-stones, and other fæcal matters from the intestines, are consequences of disease. *See* Foreign Bodies in the Bladder.

Most usually, the urethral foreign body has been introduced directly from without, through the external meatus, and is a portion of bougie or catheter which has become detached while the instrument has been lying in the canal; but straws, pieces of pencil, quills, penholders, pebbles, fruit-stones, pins and needles, are not infrequently passed into the urethra, and allowed to pass beyond reach of recovery. Such bodies are introduced by patients themselves for the treatment of real or supposed disease, or as a means of inducing improper excitement of the sexual organs. Sometimes they are passed in by others from curiosity or mischievously, when the sufferer is asleep or drunken.

The discomfort occasioned in the urethra varies with the nature of the foreign body. It may cause retention of urine with all its troubles and dangers, or inflammation of the urethra, with considerable constitutional disturbance, may result. Sometimes little immediate discomfort is experienced, the foreign body becomes impacted and gradually is encrusted with urinary salts. The diagnosis is made by first examining the urethra externally through the penis and perineum, and with the finger in the rectum. Afterwards, a small sound may be introduced into the urethra, and the nature and position of the foreign body more accurately ascertained. Care must be taken, in making this examination, not to push the body further down the urethra or into the bladder. Much ingenuity has been expended upon the invention of urethral

forceps for the extraction of foreign bodies, and there are numerous varieties, but the best is, perhaps, that one known as the simple, long urethral forceps. The long urethral scoop or curette is a useful instrument, and a loop of silver wire may be made to do good service.

Treatment.—If the foreign body is engaged in the penile portion of the urethra, its further progress towards the bladder should at once be arrested by tying a piece of elastic drainage-tube, or an india-rubber catheter firmly round the base of the penis. Here it may be remarked, that all foreign bodies which are elongated and therefore possess distinct ends, when once engaged in the urethra, will naturally pass inwards or outwards according as the end which offers least resistance is directed outwards or inwards. Thus the end of a broken catheter will tend to pass rapidly into the bladder, owing to the action of the muscular fibres of the urethra, because the rounded non-resisting end is towards the bladder and the rough resisting end is directed outwards. Round, smooth, urinary calculi, drops of urine, semen, and pus, are all expelled outwardly. If the patient has plenty of urine in his bladder at the moment of the introduction of the foreign body, the urethra may be injected with olive oil, the meatus pinched between the finger and thumb, and the patient directed to make a full stream of urine forcibly, when, upon the meatus being released, the foreign body may fortunately be expelled. If, however, it is not expelled, the surgeon may attempt to manipulate the body through the walls of the urethra, and so squeeze it out.

If this plan is not successful, the urethral forceps or scoop must be carefully tried. Their use is usually very distressing to the patient, and sometimes an anæsthetic has to be employed. The patient must lie on his back, and the surgeon should steady the foreign body and prevent its being passed further down the urethra by pressing behind the body upon the urethra, either in the penis or perineum, or with his finger in the rectum. The forceps may then be passed down to the foreign body, and a careful attempt made to extract it. Sometimes the surgeon will succeed with the urethral scoop or curette, when he has failed with the forceps. If the foreign body be a piece of gum elastic bougie or catheter, and a small gum catheter can be passed by its side into the bladder, it will often be well to tie this catheter in for a few days, in the hope that on its withdrawal the vagrant piece of catheter will come away also, having become glued to the inlying catheter. This method should only be tried when an attempt with the forceps has failed. The knife can rarely be required to cut down upon a foreign body in the urethra. Such a proceeding is, however, occasionally justifiable, and it is most proper to do so if the body is engaged behind an organic stricture of the urethra. In such a case, after the body has been removed, the stricture should be thoroughly divided internally or dilated, otherwise a fistula will almost certainly result. In cutting down upon a foreign body, care should always be taken to draw the skin of the penis well forwards; after the operation the incisions into the skin and into the urethra will not correspond, and the parts will rapidly heal.

Occasionally, foreign bodies of a peculiar character will be met with in the urethra, which will tax the manipulative skill of the surgeon. Hairpins and shawlpins have sometimes called for exceptional ingenuity. A hairpin is usually introduced with the bent portion towards the bladder. Directly the pin has passed from the patient's grasp, the legs of the pin spring apart and the ends become firmly fixed into the urethra. In such a case a metal tube (a piece of silver catheter) may be passed down to the pin, the legs of which are firmly pinched together through the urethral walls, and slipped into the metal tube, which is then withdrawn, bringing away with it the pin safely. Another plan of dealing with such a case is to hold the penis forcibly against the abdomen, and with the finger in the rectum the ends of the pin may be made to protrude through the walls of the urethra and skin of the penis. One leg of the pin may then be cut off close to the skin and the the rest of the pin twisted out. A shawl- or large-headed pin may be treated in much the same way, supposing the head of the pin to have been passed in first, towards the bladder. The point may be pressed out through the urethra and skin, and then brought well down towards the patient's anus; the head of the pin can then be pushed up to the external meatus and the whole pin removed.

In the performance of lithotrity, the jaws of a lithotrite loaded with débris may become fixed in the urethra. If this is due to stricture, a small tenotome may be introduced under the skin, the stricture divided subcutaneously, and the lithotrite withdrawn, or the blades of the lithotrite may be cut down upon, then protruded, cleared of all débris, approximated, and withdrawn by the natural passage. G. Buckston Browne.

URETHRA, Injuries of the.—These are caused by falls, kicks, blows on the perineum or penis, by gunshot wounds, cuts, by twisting the penis during erection, or blows given to relieve chordee, by the tying of strings tightly round the penis, and by the impaction of calculi or the passage of foreign bodies (such as catheters) along the canal. The consequences are bruises, lacerations, incisions, sloughing and loss of substance; afterwards, as results of this loss of substance, firm fibrous stricture or complete obliteration of the urethra for a short distance.

Of perineal injuries, a frequent cause is falling when walking along the joists of an unplanked floor. The legs slip between the joists, and the perineum is violently struck against one of them. By this accident the bulbous or membranous portion of the urethra may be simply bruised, lacerated along its floor, or so completely divided that its continuity is lost.

When the perineum is struck the amount of hæmorrhage is often considerable. As the skin is seldom divided, the blood, escaping into the cellular tissue, causes swelling of the perineum and scrotum; the skin of which quickly turns purple or black. There is much pain and general shock, and there may be inability to void urine from the compression of the extravasated blood on the urethra. If the urethra be torn as well as bruised, blood, usually in small quantity, escapes from the meatus urinarius. Occasionally, the flow of blood from the urethra is dangerously copious. After this accident, if the neck of the bladder as well as the urethra be injured—a complication that is more common when the injury to the urethra is secondary to fracture of the pubic bones—the urine escapes from the bladder at once, not waiting until the patient attempts to micturate before it invades the cellular tissue of the perineum, scrotum, and integuments of the abdominal wall. When the urethra alone has been lacerated, the bladder retains its contents until the patient passes urine; then several consequences may follow. The urethra may be blocked by coagula, and the urine consequently be driven through the tear in the urethra, and extravasation take place. Or urine is voided through the meatus in great part, a small quantity only escaping into the cellular tissue, at once exciting irritation there. The contact of urine with the wounded surfaces materially increases the patient's sufferings. A stinging pain is felt, and great anxiety and prostration ensue, which continue until an outlet is made by sloughing and abscess, when the urine escapes through the gaps caused in this manner. Finally, the urine continues to escape through these artificial channels, which contract to fistulæ, the perineum is thickened by numerous tough scars, and the urethra is tightly contracted by fibrous stricture. Not infrequently the patient is exhausted by pain and irritation, and dies before the process of repair and cicatrisation begins. The diagnostic sign of bruise of the urethra is the immediate escape of blood by the meatus urinarius; that of laceration of its walls, a pricking, stinging pain, felt when the patient proceeds to pass urine. This act is often involuntarily performed immediately after the accident, through the fright and shock caused by the injury.

The *treatment* of cases of injury to the perineum by falls or blows is regulated by the amount of injury the urethra has received. If it is only bruised, but no aperture is made in its wall, the patient must be kept in bed, opiates and restoratives being given as needful. Cold evaporating lotions, ice-bladders, and leeches should be applied to the perineum if the rupture of the vascular structures of this region (erectile tissue, transverse perineal arteries, artery to the bulb), cause rapid swelling from extravasated blood. If these methods fail to check the swelling, a catheter must be passed to the bladder and tied in, while firm pressure is made against the perineum with a padded crutch fixed by bracing it firmly to the thighs above the knees. The catheter should be a silver one, No. 10 or 12 of the English scale, because the point of such an instrument can be most readily guided along the roof of the urethra, the part least likely to be injured. If, though the hæmorrhage be not excessive, retention from coagula blocking the urethra comes on, a catheter should be tied in and retained for a week, to give time for the wound in the urethra to heal sufficiently to prevent urine escaping into the cellular tissue, after the catheter is withdrawn.

When besides the free escape of blood *per urethram*, there is complaint of pricking pain, with more or less difficulty in voiding urine, while the swelling increases steadily, an attempt should be made at once to pass a silver catheter to the bladder. If it reach the bladder, the further steps for opening the perineum are followed with greater confidence. But, if the bladder be not reached, the instrument should be passed as far as it will go along the urethra, and an incision be made

at the point where its beak is arrested. The incision must always be carried scrupulously along the middle line to give free escape to the urine, to avoid wounding important blood-vessels, and to increase the probability of reaching the urethra behind the injury. If this is found, and a guide can be carried along it to the bladder, a tube must be passed to it and tied in. When the bleeding is small, a flexible tube of india-rubber or of 'gum-elastic' may be carried through the wound to the neck of the bladder, to bring away the urine as fast as it reaches the bladder from the kidneys. If there be free hæmorrhage after the perineal incision is made, which is a very uncommon event, the flexible tube may be replaced by one of hard rubber or a stiff lithotomy tube with a petticoat or Brown's tampon, and the wound plugged round the tube for a few hours till the bleeding stops. Every wandering collection of urine in the cellular tissue of the scrotum, groins, or abdominal wall should be opened by incisions, and allowed to drain into warm boric acid dressings.

If, after the perineum has been opened in the middle line, the urethra be not readily found, it is best to desist from further search for the canal until the lapse of a week has allowed the swelling to subside. The gap in the urethra by which the urine escapes will be then found with ease, and the remainder of the passage to the bladder traced. This direction for delay implies, of course, that there is no retention, that the urine escapes through the laceration in the urethra, and by the incision in the perineum to the surface. When retention is present, the distended hinder portion and neck of the bladder are not usually difficult to discover. If, nevertheless, the opening cannot be made out, the bladder must be punctured *per rectum* and a catheter tied in through the puncture.

Great cleanliness is necessary, and support by nutritious food and opium must be given freely.

The urethra is sometimes lacerated in attempts to relieve chordee by resting the erect organ against the edge of a table and striking it a sharp blow. The distended corpus spongiosum is ruptured, and occasionally the urethra also, when free hæmorrhage *per urethram* takes place. The consequences are often abscess in the corpus spongiosum, and fibrous stricture of the urethra at the site of the injury.

Another mode of damaging the urethra is to tie a string tightly round the penis or to slip a ring over the glans, thereby causing swelling and sloughing of the constricted part and fistula.

Among foreign bodies which injure the urethra the most common are metallic catheters or sounds, used by surgeons or by the patients themselves in attempts to treat stricture; the lacerations are called 'false passages.' They are usually single; but occasionally there may be two or three such false routes. The urethra is perforated most commonly in the floor or at the left side of the passage; and the perforation is made in front of the stricture or at the bulbous portion, before the triangular ligament is reached. The false passage passes backwards between the urethra and rectum. Sometimes it enters the urethra again behind the stricture; though more frequently it penetrates into the rectum. If left alone, these passages will sometimes close; but more often they remain permanently open, and render the patient liable to abscess or urinary fever, if a catheter be pushed into them on any occasion.

Calculi while drifting from the bladder to the meatus may become lodged in the irregularly shaped prostatic portion, or in the narrowest portion of the urethra, the last three inches. There they may cause ulceration and abscess, and even work their way out of the body by this means. In the prostate they nearly always remain as permanent causes of pain, irritation, and suppuration. In the penile urethra, the immediate effect of their impaction is usually retention of urine; and in attempts to relieve this obstruction or to withdraw the calculus, the urethra is often seriously injured. If the calculus is tightly fixed in the penile portion, it may be successfully removed through a longitudinal incision made over it, which incision should be at once sewn up, and the urine drawn by catheter from the bladder while the wound unites. If the stone be not fixed it may be pushed back to the bladder, where it may be crushed or extracted by lithotomy. *See* Stone in the Urethra.

A great variety of articles have been pushed or let slip into the urethra, such as hairpins, pen-holders, catheters, &c. Sharp-pointed articles like hairpins can be extracted by bending the urethra over the point of the pin until it projects through the skin. It can then be seized and withdrawn. If the foreign body to be extracted lie in the membranous portion of the urethra, a finger should be kept in the rectum during these manipulations, to prevent the body from slipping into the bladder. *See* Urethra, Foreign Bodies in the. Berkeley Hill.

URETHRA, FEMALE, Affections of the.—The female urethra, measuring about one and a half inches in length, extends downwards and forwards from the neck of the bladder to terminate externally in the opening known as the *meatus urinarius*, situated in the middle line immediately in front of the vaginal orifice. The canal, which lies more or less completely embedded in the anterior vaginal wall, is narrowest at its external orifice, and admits throughout of great distension—a fact of considerable importance in relation to the diagnosis and treatment of certain affections of the bladder.

Artificial dilatation of the urethra for diagnostic purposes may be readily effected by the use of graduated bougies or specula, or even by means of the finger alone in certain instances. Experience has shown that *rapid* dilatation, carefully performed, is on the whole preferable to the more gradual methods of procedure, as being less likely to be followed by incontinence of urine.

I. Malformations.—1. *Congenital* defects due to imperfect development are of very rare occurrence, and are commonly co-existent with some malformation of the adjoining parts. The following may be mentioned as well-recognised conditions: (1) total absence of the urethra; (2) defect of its external portion (hypospadias); (3) defect of its internal portion; (4) atresia of the canal.

2. *Acquired* conditions, affecting the calibre of the canal or its direction, may arise from various causes.

Dilatation of the urethra in whole or in part, due to a relaxed state of its walls, may result from displacements of the canal, accompanied by inflammatory thickening of its lining mucous membrane (conditions usually traceable to child-bearing); or may be consequent upon mechanical causes, as stricture, or the presence of neoplasms, calculi, &c. The *symptoms* vary according to the extent and the exact seat of the dilatation, while further depending upon the state of the mucous membrane, which, when inflamed or prolapsed, will give rise to frequent and painful micturition.

Dilatation of the *lower third* of the canal often causes no functional derangement whatever, unless ulceration or inflammation exist.

When there is dilatation of the *upper third* of the urethra, the patient is usually subject to partial incontinence of a most distressing character.

In dilatation of the *middle third* (*sacculation, urethrocele*), there is recognisable a pouched swelling in the anterior vaginal wall, into which a catheter can be passed. Micturition is frequent, and accompanied by straining efforts consequent upon reflex tenesmus excited by the retention of decomposing urine in the pouch, of which the involuntary escape on exertion usually renders the patient's condition one of extreme discomfort.

Treatment.—An inflamed or relaxed state of the mucous membrane *in the neighbourhood of the meatus* may be remedied by the use of astringents, such as tannic acid or alum. Should these fail, redundancy of the prolapsed mucous membrane may be dealt with by applying the fine point of the thermo-cautery to a narrow strip on each side, parallel to the axis of the canal, so as to avoid stricture of the meatus from subsequent contraction of the cauterised tissue. Or, if necessary, a narrow V-shaped portion of mucous membrane may be excised, and the edges adapted by fine sutures.

Dilatation of the *upper third* of the canal must be treated simply by the use of a suitable anteversion pessary.

The surgical treatment of *urethrocele* consists in excising an elliptical portion of the anterior vaginal wall, so as to completely open the cavity of the pouch, the lining membrane of which is to be carefully dissected off as far as the aperture communicating with the urethral canal. The freshened surfaces are then thoroughly coapted by deep sutures of fine silver wire, so passed as to include the margins of the opening in the floor of the urethra. These should be left undisturbed for eight or nine days, a catheter being meanwhile retained in the bladder for the first four or five days after operation.

Stricture.—A much less common affection in women than in men. It may occasionally be met with as the result of inflammation or ulceration due to specific disease, or consequent upon the use of caustics. Cicatrices in the vaginal wall, resulting from injuries during childbirth, may also give rise to contractions of the canal, which, again, may become permanently narrowed from disuse in cases of long-standing vesico-vaginal fistula.

The chief *symptoms* caused by stricture are frequency and difficulty of micturition.

Treatment.—Stricture of the *meatus*, the most common form of contraction, may be either divided or forcibly dilated.

methods o treatment equally applicable to strictures of inflammatory origin seated higher up in the canal. In cases of contraction of the entire urethra, gradual dilatation by bougies should be practised.

Displacement of the urethra in an *upward* direction may be caused by the presence of a pelvic tumour pushing the bladder up out of the pelvis. *Downward* displacement, to a greater or less extent, invariably accompanies prolapse of the bladder (cystocele). Incontinence of urine or difficulty of micturition, according to the degree of displacement, results from this condition.

Treatment must aim at the rectification of the prolapse.

II. Foreign Bodies in the urethra may either come from *within*, as calculi or substances which have entered the bladder by perforation of its wall (fœtal remains, hydatids, fæcal concretions, gall-stones, &c.), or may have been introduced or have penetrated from *without*. In any case the chief *symptoms* are retention with pain and tenesmus. Injury to the wall of the urethra may cause hæmorrhage, and be followed by peri-urethral inflammation.

Treatment.—Extraction of the foreign body is to be effected with the help of fine forceps or with a wire loop, guided by a finger in the vagina. Care must be taken to avoid laceration of the parts.

III. Urethritis. — *Inflammation of the Lining Membrane of the Urethra.*—The *acute* form is commonly, although not necessarily always, of specific origin. In such cases its onset is usually sudden, being preceded or accompanied by inflammation of the vagina and vulva. The prominent *symptom* is urgent and painful micturition (scalding), occasionally followed by hæmorrhage from the meatus. The urethral discharge may be revealed by pressure along the course of the canal in the vagina.

Treatment consists of the use of local baths, with the employment of sedative vaginal suppositories. Free purgation, followed by the administration of salines with hyoscyamus, usually answers well. In *subacute* cases the cautious injection of a solution of nitrate of silver or sulphate of zinc may be tried. In *chronic* cases the passage twice a week of a full-sized bougie has been recommended.

The existence of a *fissure* in the immediate neighbourhood of the neck of the bladder resulting from a urethritis may be the cause of great discomfort, tenesmus, and pain both during and after micturition. The endoscope is essential for its discovery and treatment, which can be effected either by the application of nitrate of silver fused on a fine probe, or by incision as practised in fissure of the anus.

IV. Fistula.—For *complete* or *urethro-vaginal* fistula, *see* Vaginal Fistulæ. *Incomplete internal* urethral fistula may be met with as a blind sinus extending downwards from the floor of the canal, as the consequence of a peri-urethral abscess. Its existence can be detected by the passage of a probe *per urethram*, while the finger presses upon the anterior vaginal wall.

The *symptoms* to which it gives rise are pain and frequency of micturition, with vesical tenesmus; there is usually a constant sense of heat and discomfort about the part, and occasional traces of pus occur in the urine.

Treatment.—The sinus should be converted into a *complete* urethro-vaginal fistula, which may be subsequently closed by operation if it be found necessary to interfere surgically.

V. New Growths.—Of these the most common form is that known as *vascular growth of the meatus* or *urethral caruncle*. *See* Vulva, Affections of the.

Varices of the urethral veins, analogous to rectal hæmorrhoids, most commonly affect the floor of the canal, and may occasionally cause obstruction to the flow of urine. The occurrence of submucous rupture of an over-distended vessel will lead to the formation of a urethral *hæmatoma*. *Treatment* should be directed to the relief of the impeded circulation.

Cysts of glandular origin are not common, but may be met with at any age. If polypoid in shape, they may cause obstruction.

Fibrous growths are of rare occurrence. They are met with embedded in the urethral wall; or as projecting polypi, usually seated in the neighbourhood of the meatus.

Sarcoma urethræ has been described, but the affection is an extremely rare one.

Epithelioma of the female urethra, whether of primary origin or secondary by extension, is also of very uncommon occurrence.

The *symptoms* caused by urethral neoplasms are pain and difficulty in micturition, sometimes amounting to complete retention, partly due to spasm. Dyspareunia and a train of nervous symptoms are occasionally traceable to their presence. The more vascular growths may give rise to hæmorrhage.

A growth presenting at the meatus will be readily detected; when seated further up in the canal, its presence may be recognised by pressure of the finger along the course of the urethra in the vagina. Dilatation of the meatus and the introduction of the urethral speculum will facilitate the investigation of its nature.

Treatment.—Extirpation of *non-malignant* growths is to be effected by caustics, or by means of the ligature, by torsion, or by excision. The curette, the écraseur, or the galvano-cautery may be advantageously employed, care being taken in any case to effectually remove the whole of the new growth. W. A. Meredith.

URETHRAL FEVER, or the pyrexia frequently following mechanical treatment applied to the lower urinary tract, is a condition which, in all probability, is due to direct disturbance of the central nervous system—i.e. the spinal cord and the medulla oblongata—and which presents all the symptoms of an acute specific fever.

Etiology and Causation. — Urethral fever, as its name signifies, is dependent for its origin on certain conditions of the urethra. If the mucous membrane of that passage is irritated by some means or other, there follows a rise of temperature, rapid or gradual according to circumstances detailed below, the pyrexial rise being accompanied by a shivering fit or cold stage not long before the temperature reaches its maximum. As may readily be observed, the symptom of shivering or shuddering is sometimes seen in healthy persons in whom the urethra is perfectly normal, but irritated by the mere flow of urine, as in the simple act of micturition. But, further than this, the symptom of pyrexia may also be observed, in a very mild degree, as a result of stimulating the normal urethra. An artificial fever is thus sometimes seen, clinically, to follow the passage of a catheter for some trifling inability to pass water, owing to reflex spasm, &c.

What occurs thus in health, is repeated on a wider scale and with far greater intensity in disease. Since, however, every degree of constitutional disturbance can be found between the slight shivering, &c., observable in healthy people and the most severe or fulminating variety of the pathological pyrexia, we have good ground for believing that the two things possess a common cause; and this is to be found in the fact of there being, in each instance, a disturbance of the central nervous system by irritation of the periphery. We can scarcely do more here than refer to the articles on Rigor, Surgical Fever, and Neurotic Fever, for an explanation of the manner in which nerve-irritation may be supposed to evoke such symptoms, and will pass on to examine the scanty etiological facts which help to explain several differences in the clinical histories of cases of this affection.

It was shown by Fergusson that urethral fever occurred most severely in those patients who had not been previously catheterised, and that where instruments had been freely used, constitutional disturbance was very exceptional. This partly expressed the facts of the case, since about forty per cent. of the cases, in which the severest form of urethral fever occurs, are those which have undergone no previous treatment whatever. The principal factor, however, in the causation of urethral fever appears to be the age of the stricture. Thus, the average age of the stricture in cases of fulminating urethral fever is less than eighteen months, whereas in the milder forms it is as much as eight years, and in 'apyretic' cases much older still. The simplest explanation of these facts is that we have, in urethral fever, to do with a fever which is essentially neurotic in origin. *See* Neurotic Fever. In a recent stricture, the nerve-fibrils and nerve-endings (already hypersensitive from the specific inflammation of the surrounding tissues) are capable of transmitting a severe shock to the spinal cord, &c.; while in an old stricture, we may very justly assume this peripheral nerve-supply to be considerably damaged by the shrinking of the stricture-cicatrix, so as to make it more or less insensitive to mechanical irritation.

A very important element in the causation of urethral fever is the mode of instrumentation which evokes the pyrexia. To put this question most briefly, we may say that laceration is more productive of fever than is incision. Thus, it occurs more frequently in cases which have been subjected to catheterism and rupture of the stricture, than in those where division has been effected with a urethrotome. A predisposing cause of great influence is that of malarial fever, as pointed out by Fayrer. If a patient with stricture have previously suffered from some form or other of malarial fever, he is practically certain to be the victim of urethral fever if his stricture is treated mechanically, unless certain prophylactic measures are taken. See *Treatment* below. Other predisposing factors are to be found in other causes of depression

affecting the nerve-centres—e.g. exposure to cold, alcoholism, &c.

Pathology.—Whether or not the process of urethral fever is primarily a neurosis set up by peripheral irritation, cannot yet be decided (*see* Surgical Fever); but this much at least may be said, that, whether true or not, this is a very good working theory, and treatment based upon it is safe and efficacious. The foregoing applies simply to those cases where a pyrexia, of varying degree, directly follows (as will be described presently) interference with the urethra, and where no complication from affection of other organs—e.g. kidneys, &c.—exists. But the operation of dilating a stricture is sometimes capable of producing intense congestion of the kidney, and frequently partial or complete suppression of urine. This effect on the secretory power of the kidneys finds a parallel in the rigor and pyrexia, being due to reflex disturbance of the spinal cord, &c.; and since this very awkward and frequently fatal complication possesses a like pathology to the pyrexia, &c., it may be partly averted in a similar way. As the result of a preliminary investigation, it may be stated that the actual change in the kidney-excretion in an ordinary case of urethral fever is very small, as regards the amount of water and of nitrogen. For the pathology of cases of suppression of urine the reader is referred to the article on that subject.

Post-mortem Appearances. — Urethral fever is very rarely fatal, and when it is so the result is owing to causes not yet explained, but connected with the sudden arrest of the renal secretion. Usually, after death the kidneys are found congested and the seat of old cirrhotic disease (interstitial), but nothing organic has yet been detected in the central nervous system.

Symptomatology.—Urethral fever presents itself clinically in two well-marked groups: one which may well be called fulminating, from the fact of its sending the temperature up to 105° F. within four hours, and another in which the rise of temperature is relatively slow, and often preceded by a depression due to shock. A distinct class of urethral fever, and one which scarcely merits the name, is that which is met with in the cases, referred to above, of suppression of urine after operation. Finally, there has been described lately a combination of these conditions and others, to which the name of catheter fever has been given.

(1) Fulminating Urethral Fever.—In this the most violent form, the temperature rises rapidly in four hours, on the average to 104°–105° F., and accompanying the rise of the pyrexia there are usually one or two severe rigors before it reaches its acme. The temperature commences to fall for two hours as quickly as it rose, but after that interval its descent is more gradual, and it reaches the normal again in about twenty to twenty-four hours. During its onset the patient feels sick and often has a violent headache, while during the rigor he suffers from the symptoms of that condition (*see* Rigor), but usually, soon after the temperature begins to fall the unpleasant symptoms gradually disappear.

(2) The second variety of urethral fever is characterised by a gradual rise to 101°–102° F., in about twenty-two to twenty-four hours, having been preceded for eight to ten hours by a fall below the normal level. The final fall of temperature from the acme is nearly equal in time to the actual rise—viz. about twelve hours, so that the whole course is of about thirty-three to thirty-six hours' duration. Rigors occur at the usual point in the rise of temperature, but are not so frequent as in the first variety, and the constitutional symptoms are not so severe.

(3) Urethral fever, occurring in cases which are attended with suppression of urine, must not be regarded as belonging to the same category of 'fevers' as the two first described, for the reason that the condition of the patient is not a simple one. In fact, it is impossible at present to distinguish what of the rise is due to the operative measures, and what to commencing interstitial nephritis, &c. As a rule, the temperature curve is that of continued fever, varying from 100°–102° F., and falling gradually for twenty-four to forty-eight hours before death, when it is frequently subnormal. The curve resembles that of traumatic fever far more than that of typical urethral fever.

(4) Catheter Fever.—Under this term, Sir Andrew Clark has drawn attention to the way in which urethral fever is frequently followed by septic infection. He divides the clinical history of these cases into four stages—(1) Reflex irritation of the nervous system (*see* foregoing remarks); (2) disturbance of general metabolism, especially in the kidney; (3) septic infection begotten autogenetically or deuterogenetically—i.e. inside or outside the body; (4) the effect in the vessels of the urinary tract upon the metabolic processes, produced by suddenly drawing off the water from a distended bladder.

In this article, the relation of urethral fever to subsequent fatal septic processes is not touched upon, on account of the fact that at the time when pure urethral fever is started by instrumentation, the introduction of septic material, which may or may not develop in two or three days in the bladder, is very likely to happen. Cases in which it does so are referred to under NEPHRITIS; PYELONEPHRITIS.

Between the varieties just described (excepting 'catheter fever') of fever following instrumentation of the lower urinary tract, there are transition cases which bridge over the intervals between the groups formed out of averages, minute differences of detail in treatment, constitution of the patient, &c., obviously affording reason for the multiplication of forms.

Prognosis.—Favourable, if secretion by the kidney is found to be undisturbed. Extremely unfavourable, in proportion to its development, if the secretion of urine is checked or diminished, with excessive blood-staining. More or less unfavourable if the temperature is not normal again in forty-eight hours, since a continuation of the pyrexia will then suggest the extreme probability of nephritis having been lit up.

Treatment.—The most successful treatment of urethral fever is that which is based on the neurotic theory. It has been known for a long time that quinine and morphia, administered prophylactically, prevent the development of fevers arising from many causes, and among others urethral fever especially. Before, therefore, a patient is operated upon for stricture, &c., he should be treated for two to three days with Quiniæ sulph. gr. iij., and Liq. morph. ℥v. every six hours. A quarter of an hour before the operation he should be given ¼ to ½ gr. of morphia hypodermically, and be placed under ether for the operation.

During the operation he should be warmly clad, especially about the lower extremities, which are to be covered with drawers, socks, blanket, &c. In the event of a rigor, treatment indicated in the article on that symptom is to be followed.

Hot baths are of little use except in cases of SUPPRESSION OF URINE.

VICTOR HORSLEY.

URETHROPLASTY: shaping of the urethra. This term is used to denote operations for closing fistulæ or openings in the urethra. These operations may be practised in the perineal part, in the scrotal, or in the penile part of the urethra. They are most frequently needed to close gaps in the last portion, that being the common situation of the destructive action of sloughing sores, or the result of arrest of development during fœtal life. In the perineum, when obstinate fistulæ remain open, the tissues are nearly always greatly indurated and of low vital power; so that failure to get union of the margins of a fistula after bringing them together is very common, and several attempts must often be made before success is attained.

In all these operations, great attention to detail and most careful management are requisite. It is absolutely necessary that no urine shall percolate over the wound during the healing process. To ensure the preservation of the fresh wound from defilement with urine, the patient should be of an age when he may be readily taught to empty the bladder himself by a catheter, to be introduced every time urine is voided and before every evacuation of the bowels. This plan of preventing access of urine to the wound is much preferable to that of the retained catheter, by the sides of which the urine is apt to escape, when the instrument has been worn for more than two days. During the first twenty-four hours the catheter may be tied in, to allow the patient to recover his self-possession after the anæsthetic and for the soreness to diminish. But thenceforth the urine should be drawn every four hours by the patient himself. Should the patient be too young to be trusted with the catheter, it must be regularly drawn for him by a nurse, trained beforehand to use the catheter on the patient himself. While the catheter is worn, it should be plugged or its end connected with a foot or so of india-rubber tubing, so that the urine may be led away from the neighbourhood of the wound. It is also essential to success that the edges of tissue to be united shall be kept in close apposition without strain, that the circulation of blood through them may be free and continuous. If the circulation is hindered, either by dissecting too thin a flap of skin and thus dividing the nutrient blood-vessels, or by constricting them afterwards with tightly drawn sutures, the flaps do not unite, but slough away, leaving the opening larger than before.

Before operating, the patient must be prepared by invigorating his health with rest, attention to digestion, stay at the seaside or in fresh country air, regular use of hip-baths, and thorough dilatation of a stricture if there be one in the urethra. Any impediment to the outflow of the urine, until the wound is firmly consolidated,

would drive the urine against the scars of the united edges and cause them to give way. When the patient is freed from irritation of all kinds, the operation may be undertaken.

When the fistula is situated in the perineum, before the incisions are made, a No. 20 or No. 22 (No. 12 English scale) flexible catheter may be passed to the bladder and tied in, being plugged after the urine has been withdrawn. Then, the track of the fistula should be thoroughly cleared of the old cicatricial membrane that lines it with a sharp scalpel, and the surfaces be brought into apposition as nearly as possible along their whole length, from the urethra to the skin, by the quill suture or the button suture. The edges should be closely united by fine catgut or silk stitches set near together. If there be tension on the stitches through the induration of the parts, the skin may be loosened by incisions carried parallel with, but at a distance from, the line of the closing edges. These parallel cuts ultimately close by granulations. The line of sutures may be protected with a coating of collodion, and then dressed with iodoform and iodoform wool.

In the scrotal portion incisions may be more freely practised; the edges, besides being thoroughly pared, should be dissected away in thick flaps, and their raw surfaces held in apposition over the gap by wire and button or clamp sutures, while their edges are closely joined with numerous fine sutures of silk. The sealing with collodion and the preliminary introduction of the catheter should be practised in these cases also.

In penile fistulæ or congenital defects of the urethra, the thinness of the tissues that can be used for closing the aperture requires very delicate handling and careful adjustment, lest the flaps that are formed by dissection be strained or so injured that they throw out no reparative material at their points of junction. Not infrequently only part of the gap is closed at the first operation, the remainder being united by one or more repetitions of the paring and stitching process. Should this be necessary, sufficient time—two or three months at least—should be given between each operation to enable the parts already joined to establish the circulation through a plentiful system of blood-vessels. If the second operation is undertaken too speedily, the flaps, being ill-supplied with nutrient vessels, will slough and probably undo some of the union already obtained.

Several operations have been devised for closing the gaps, but many of them are liable to the objection of producing a troublesome stricture. In those plans where the raw surface of the flaps is turned inwards at the part to be covered, this inner surface is slow to heal, and does so by granulation, cicatrisation, and contraction. The contraction must be kept open by sounds; the passage of which excites irritation and excoriation from time to time. This objection attaches to both of Nélaton's methods. By one of his plans the edges of the aperture are first pared, and then, transverse incisions through the skin having been made half an inch or more distant from the fistula—one in front, the other behind it—the knife is slipped underneath the skin, to separate it from the subjacent tissue, for half an inch all round the aperture. The skin which is thus freed is lifted away from the penis, and the edges of the fistula are drawn together by a pin and twisted suture. If the catheter be regularly employed and all urine drawn through it, the granulations growing from the large under-surface close the fistula in the urethra, and the gap in the skin unites quickly if not irritated by percolation of urine. The danger here is that the knife may be carried too close to the surface of the skin, and by dividing its blood-vessels, cause it to slough after the operation. Nélaton was also successful with another plan, by which, after paring the orifice, he dissected the skin freely around it by introducing the knife under the skin through two lateral incisions, parallel to and at some distance from the raphé; this done, he stitched up the orifice of the fistula in the area of skin separated from the cellular tissue, and passed a slip of india-rubber underneath it, to protect the joined edges from urine during their granulation, the urethral fistula being closed in the same way as in the first method.

The orifice which terminates the urethra before the operation is often extremely narrow; and before closing the gap, care must be taken to pare away the edges freely, to ensure a sufficiently wide passage at this point afterwards.

Legros Clark and others have devised, and used with success, methods by which flaps of skin dissected from the penis around the aperture have been securely adjusted over it, and union obtained. When the orifice is small, all these plans are successful, but when a large gap is to be covered, as in cases of hypospadias, they usually fail. Success has often followed the first attempt, if the precaution is taken to make a

perineal aperture in the urethra behind the fistula, through which the urine may be drained from the bladder until the plastic operations have thoroughly closed the fistula in front. When this repair is complete, the urine may be withdrawn through the natural channel, and the perineal outlet closes spontaneously.

In cases where the urethra is open quite or nearly to the peno-scrotal angle, the method devised by Anger of Paris has been successfully employed by the writer. In these cases, there is the additional complication of curvature of the penis during erection. Fibrous bands, placed across the corpus spongiosum near the urethra, prevent proper dilatation of the erectile tissue, so that the glans is bent during erection towards the scrotum instead of being directed upwards. In attempting a cure of such a case, it is necessary first to divide the fibrous bands which draw down the glans during erection, and when the wound thus made has healed, to proceed to the prolongation of the defective urethra. If the organ be examined, a furrow will be traced along the mesial line from the actual termination of the urethra to the apex of the glans. This is the roof of the urethra, in which, at the proper situation, the furrow is deepened to form the fossa navicularis. On each side of this furrow the loose skin of the penis is raised into a narrow ridge—each ridge being half of the raphé of the perfect organ. Anger, in order to provide a suitable surface for the continuation of the urethra, and also to prevent the formation of a cicatricial stricture, so cut his flaps that one was turned inwards, with its epidermic surface towards the urethra, its raw surface having been turned outwards. This raw surface was again covered by a second flap brought over it from the other side, and attached closely to it by rows of stitches applied on each side of the urethra, as will be presently described. By this contrivance a surface of skin, not raw tissue, was turned towards the urethra, and a large raw surface exposed and applied to a similar raw surface, to which it united by granulation. Great security against failure of union was thus obtained, and an epithelial lining provided for the urethra.

In carrying out this method, the penis is steadied on a large sound, No. 25 or 26, after the margins of the urethral orifice in front of the scrotum have been pared freely. One incision is made across the penis through the skin opposite to the glans penis, and, parallel to it, another three-quarters of an inch behind the orifice of the urethra. Between these transverse cuts two flaps are formed: one by an incision carried along the penis close to the raphé at the side of the furrow, and dissected outwards for half or two-thirds of an inch. This will form the outer flap when in position. Next, a parallel longitudinal cut is carried along the penis between the transverse ones, but two-thirds of an inch away from the mesial line. A flap is then formed by dissecting up the skin towards the raphé. When this flap is formed, it is turned over the sound, so that its epidermic surface lies against the metal. Its corners are then fixed by two points of fine catgut or silk suture to the raw surface of the penis, at each end of the root of the covering flap first formed. The two flaps are compared and, if needful, trimmed to fit nicely, especially at the posterior end, where they overlie the urethral orifice. The upper flap being then held back, a close row of fine silver wire sutures is carried through the free edge of the inner flap and the cellular tissue of the penis close to the root of the upper or covering flap, so as to attach the inner flap closely in its place, the ends of the wire being led out through the upper flap at its root and left loose. The upper flap is then applied to the inner one, and the wires tightened by running over them split shot or short lengths of lead-tubing, which can be pinched round the wires. The ends of the flaps are carefully stitched to the scrotum behind the margins of the orifice, and also at the end near the glans at each side of the sound.

Finally, the free edge of the upper flap is fixed in place by some points of interrupted suture along its free border. This done, the edges are freely painted with collodion; the sound is withdrawn and replaced by a flexible catheter, which is worn for the first twenty-four hours, after which time it should be taken out and the urine drawn off at regular short intervals during granulation. The parts must be kept well covered with iodoform and wetted with cold boracic acid lotion, to prevent erection during sleep. Erection may also be hindered by large doses of bromide or of bromide and chloral hydrate. The bowels must be kept quiet by opium, and the patient remain as still as possible in bed. At the end of the fourth or fifth day the sutures should be examined, and any that are cutting their way out removed at once, their punctures being drawn well together by collodion. In the course of seven or nine days the remainder of the sutures are removed, and at the end of a fortnight the

patient is able to sit up in bed and gradually resume his active habits. The catheter should be used for emptying the bladder for three or four weeks. *See* Hypospadias.

Berkeley Hill.

URETHROTOMY. — (Cutting the strictured part of the Urethra.) — The cases of stricture for which urethrotomy is most suitable are the following: strictures of the meatus urinarius; strictures of the penile portion of the urethra in front of the peno-scrotal angle, particularly narrow bands or 'bridle' strictures; strictures of the bulbous portion when composed of thick masses of fibrous tissue; and strictures of ordinary density, if dilatation by the passage of bougies or sounds excite irritation and febrile reaction in the patient.

In persons who suffer from rigors after a sound or bougie has been passed, complete division under anæsthetics commonly causes no rise of temperature and quells the irritation at once, if the precautions to be afterwards described are taken. Strictures which contract rapidly when enlarged by gradual dilatation are best treated by cutting; so also are strictures complicated with urinary fistulæ. Again, in young persons whose disease has not existed long enough to alter the condition of the kidneys, cutting is admissible for a stricture that should be simply dilated in an elderly man whose kidneys have undergone considerable degeneration. The young man desires to lead a more active life than he whose kidneys have been seriously diminished in excretive power can possibly do. Again, urethrotomy affords a longer interval of freedom from contraction than does any other plan of widening a stricture; and if the after-management of the stricture be regularly carried out—a necessity in all cases, whatever be the plan of treating the stricture—the patient may enjoy many years of freedom from disturbance of the urinary organs.

The patients for whom urethrotomy is not necessary or not suitable, are those whose contractions, being of only short duration, are formed by areas of inflammatory congestion rather than by development of fibrous tissue; such contractions are usually dispersed by gradual dilatation. Strictures also do not need urethrotomy which give way readily under gradual dilatation and do not contract again during the process, nor return rapidly after a sufficient width has been restored to the urethra. The result in such case is satisfactory, and obtained with less inconvenience by interrupted dilatation than by cutting.

Several methods are followed for treating strictures by cutting. They may be arranged in two groups—those which attack the stricture from within the urethra—*internal urethrotomy*; those which attack it from the surface of the body—*external urethrotomy*.

Internal Urethrotomy may be performed by instruments which cut the stricture as the knife advances along a guide towards the bladder, from before backwards; or, by one where the knife, protected by a shield, is first carried through the stricture, and then exposes its sharp edge to the stricture as the instrument is withdrawn from behind forwards. By cutting from before backwards narrower strictures can be divided than by the second method, where the instrument most generally employed for this purpose—Civiale's—cannot be used until the stricture is widened sufficiently to allow the knife and its shield to pass. The requisites of a urethrotome for cutting from before backwards are—(1) a guide through the stricture to the bladder, (2) a sharp edge, which, passed along the urethra under a shield, can be protruded by the operator at any part and as deeply as he desires to cut; (3) means for steadying and tightening the fibres to be divided before the knife is passed across them. The last requirement is an essential condition of a good urethrotome, in consequence of the toughness of the fibres themselves and the mobility of the parts in which they are formed; conditions that render proper division of them extremely difficult unless the part to be cut is kept taut while the sharp edge is carried across it. The edge of the knife also cannot be too sharp to divide the dense tissue of a stricture.

In the experience of the writer, Maisonneuve's urethrotome, as improved by Teevan, meets these requirements tolerably well. In the Maisonneuve-Teevan urethrotome, the guide consists of a fine, hollow staff, which can be passed through very narrow strictures by means of a filiform guide-bougie, to the end of which it can be screwed after the bougie has reached the bladder. Along the hollow staff a stylet is run, carrying in front of it a triangular shield, which, fine at the apex, widens gradually to three-quarters of an inch at the base. This inclined edge is pushed to the stricture at the upper surface of the urethra, tightening and steadying it before the triangular knife, which can be protruded beyond the shield, attacks the unyielding

fibres. When the opposing fibres are sufficiently divided, the shield travels onward to the bladder; and, in withdrawal, its wide base catches against any insufficiently divided fibres against which the knife's sharp base can be brought, and thereby ensures their thorough section.

Another urethrotome that complies with these requirements is the 'Wedge-Dilator' of the writer. It is composed of the following parts:—First, a narrow split sound, calibre of No. 8 of the millimetrical scale (No. 2 English), that can be guided through narrow tortuous strictures by being attached to a filiform guide-bougie, previously passed to the bladder. Second, a wedge that runs in dovetail grooves between the halves of the split sound. In this wedge is concealed a knife that can be protruded between the halves of the split sound, when the stricture-tissue prevents their separation sufficiently to allow the wedge to pass on. The wedge, pushed up to the situation of the stricture, in separating the halves of the split sound tightens and steadies the stricture thoroughly, while the knife divides it to the width required by the wedge to pass along. If a wedge be chosen that will expand the urethra to its full natural capacity, the cut made by the knife divides the stricture to that extent, but does not pass beyond the stricture into the vascular erectile tissue external to it. The knife can be applied either to the upper or under surface of the stricture as may be preferred.

Instruments which cut from behind forwards—i.e. after the knife in its shield has passed behind the stricture—steady the fibres to be cut by pulling forwards the parts which attach the urethra to the pelvis, as the bulbous end of the urethrotome is drawn out. The stricture is pulled on by the instrument until the cut gives free passage to the bulbous shield and knife, separated from each other. But reliance cannot be placed on the simple straining of these attachments to ensure perfect division of the stricture-tissue. A Civiale's, or any other urethrotome which cuts from behind forwards, is very apt to wriggle its way through a stricture without properly severing its fibres; and, to meet this difficulty, the knife is often carried more deeply than is otherwise necessary. There is another objection of greater importance to the method of cutting from behind forward. It is this: if an incision be made through a thin layer of fibrous stricture-tissue into the erectile tissue, in the belief that a tight stricture with a thick layer of fibrous tissue exists, there is greater danger of free hæmorrhage, and of septic absorption through the vascular tissue thus laid open. This risk is less when cutting from before backwards, and the writer prefers to begin at the meatus urinarius and divide only such obstructions as prevent the progress of the wedge-dilator in its advance towards the bladder, thus avoiding the risk of cutting into the erectile tissue.

Most of the instruments used for cutting from behind forwards consist of a straight or slightly curved staff, terminated by a bulb or 'swell.' This swell is the shield containing the knife. By means of a contrivance at the handle, the distance to which the cutting edge is thrown forwards from the shield can be regulated. The operator first passes the urethrotome through the stricture, then drawing the instrument outwards, exposes the knife at the posterior limit of the stricture, and with a slightly sawing motion cuts his way along the stricture. In doing this, he places the forefinger of his other hand against the skin lying over the stricture, and judges of the completeness of the division partly by the cessation of resistance to the progress of the knife, and also by the sensation which the near approach of the knife to the finger gives him. The success of the operation and the avoidance of dangerous complications depend greatly on the precision with which the fibrous tissue is divided and the normal vascular or erectile tissue outside it is untouched. Hence, by whatever method the cut be made, the operation is one requiring great nicety of manipulation and caution on the part of the operator.

Certain complications may follow internal urethrotomy if incision be carried beyond the fibrous tissue. Among them are perineal abscess, extravasation of urine, copious hæmorrhage, orchitis, acute suppurative nephritis, and septicæmia. But if the operation is confined to cases suitable for this method of treatment, and the necessary precautions are taken, the occurrence of dangerous complications is very rare. Before the patient is subjected to urethrotomy, his general condition must be free from febrile disturbance. The kidneys must be working properly; this is shown by the urine being acid, not much loaded with mucus, free from albumen or almost so, and containing urea in the proportion of not less than two and a half or two per cent. The urethra must not discharge pus; any urethritis that may be present must be cured before the operation is performed.

To ensure favourable results, the after-treatment is also of great importance. The writer's present custom, which he has followed for several years, is, after incising the strictures, to test the width of the canal by passing a wedge of the size of No. 27 of the millimetrical scale after the knife, and then to withdraw, by a No. 24 silver catheter, any urine that may be in the bladder. No catheter is tied in the urethra, and the patient is ordered to refrain from micturition for seven or eight hours, or as long as the call is not urgent. The secretion of urine for some hours after the operation is small because, to prevent vomiting from the anæsthetic, the patient has fasted for five hours before the operation, and after it takes only a few spoonfuls of ice or iced milk for a like period. In six or eight hours the wound is protected by firm clot and plastic fibrin. When the bladder must be emptied, the patient is put into a hot hip-bath, and passes urine while in the bath. The urine is thus voided without spasm of the perineal muscles; and the incision, protected by clot and fibrin, is not torn open and exposed to the stream of urine. If the urine flow off without disturbing the protecting clot, very little if any pain is felt during micturition and no reaction ensues. If pain has been felt, it is well to repeat the hot bath at the second act of micturition.

The nurse should be directed to take the temperature of the patient before he passes urine, and at half an hour and an hour afterwards. In the cases of reaction after micturition, the thermometer will show a slight rise before the patient feels any malaise, chill, or shiver. Immediately a rise is detected, a soothing draught or antipyretic should be given, such as twenty minims of tincture of opium in an ounce of brandy and a little hot water, into which five or eight grains of quinine are put. The temperature must be carefully noted every two hours, and an important elevation combated by repetitions of the quinine at intervals of three hours. But, if precautions are taken to prepare the patient for operation and to avoid strain of the urethra in micturition during the first twenty-four hours, reaction seldom occurs, and the temperature keeps below 99° F. throughout.

It is indispensable that the patient lie in bed continuously for at least ten days, and keep his room for fourteen days. He must not even get up to the night-stool for the first three days after the operation. To conform to this condition the more easily, the bowels should be well cleared before the operation and the patient lightly fed afterwards, that the bowels may not need to be cleared for three or four days. At the end of this time a dose of castor-oil or blue pill and draught of sulphate of magnesia may be taken, to ensure defæcation taking place promptly and without straining. On the eighth or ninth day a bougie, No. 24 or 25, should be slowly and gently passed through the stricture, no instrument having been introduced after the operation until then. This period of rest to the incision is of the highest importance to avoid pain, bleeding, and suppuration of the wound. If the wound heal by suppuration, the after-contraction is always much more speedy than when it heals by simple union. On the tenth or eleventh day, the patient may be taught to pass the bougie himself by letting him push it slowly and gently to the bladder. A repetition of this lesson on the thirteenth day usually suffices, and the patient is allowed to get about at the end of the fortnight. If pain and soreness attend the passage of the bougie, the temperature must be carefully watched, as was done after the operation. On the approach of pyrexia, warm baths, fomentations, &c., must be employed to allay local irritation, while the febrifuge draught is again prescribed. Before leaving the surgeon's care, the patient must be impressed with the necessity for regularly passing the bougie at intervals increasing in length from twice weekly to once in three months or once in six or twelve months, according to the rapidity with which signs of shrinkage come on.

Dangerous Complications. — Copious hæmorrhage is most frequent immediately after the incision, if the knife have cut more than the stricture itself; but it may occur at the end of a week after incision, even before a bougie has been passed. In such cases the knife has been carried too deeply, and the erectile tissue has been wounded. It is rarely dangerous, and is controlled by passing through the stricture a lithotomy tube or one made of hard rubber, around which the urethra can be compressed, and the bleeding vessels closed till a coagulum is formed, when the compressing apparatus may be removed. When the bleeding point is at the bulbous portion of the canal, a crutch, invented by Otis of New York, can be fastened to the knees and ankles, and made to press strongly on the perineum. Renal congestion, denoted by rigors, diminished secretion of urine, &c., may follow the incision itself, or may occur if a bougie be incautiously thrust through the granulating

area of the wound. The most common consequence of too hasty a use of the bougie is epididymitis. Nephritis and septicæmia are treated in the manner appropriate to these affections when arising from other causes. Perineal abscess and extravasation of urine require early drainage and great cleanliness in dressing. It must be again repeated that, when sufficient care has been taken in the preparation of the patient and in the performance of the operation, these complications do not occur.

For widening very narrow, tortuous strictures, along which a bougie or catheter can be passed only part of the way, or when the presence of a narrow anterior stricture hampers the surgeon in the treatment of a second deeply placed one, Lund of Manchester has invented a useful instrument. A grooved and very narrow director projects for two and a half inches beyond a cylinder of the size of No. 20 of the millimetrical scale. This director is passed as far as it will go through the stricture, and then a stylet, carrying a little knife that projects one-twentieth of an inch above the director, is thrust forwards from the cylinder by a thumb-spring in the handle. This cuts the anterior stricture sufficiently to allow an instrument to traverse it and approach the deeper one with freedom. This plan is occasionally a useful resource; but it needs great care and nicety in execution, that the instrument may not enter a false passage, and incise that instead of the urethra.

When the stricture is very dense and of long standing, the bladder is sometimes so affected with chronic cystitis that nothing except the restoration of free evacuation will cure it. But the trickling of pus, often of ammoniacal urine also, over the fresh wound of the incision excites irritation and suppuration therein, with unfortunate effect on the stricture. A procedure revived by Reginald Harrison of Liverpool is very useful in these cases—drainage of the bladder through a perineal opening into the urethra behind the stricture—so that no urine, pus, or mucus shall pass over the stricture-incision until it has had time to heal.

External Urethrotomy, dividing the stricture from without, is practised upon a guide passed through the stricture to the bladder—Syme's operation. When it is not possible to pass a staff to the bladder, the stricture may be reached by opening the urethra in front of it, laying bare its mouth and passing fine directors through it, on which the knife which divides the fibrous tissue can be guided along the urethra—Wheelhouse's operation. Lastly, it may be dealt with by opening the urethra behind the stricture—Guthrie's perineal section—and cutting forwards through the stricture to a sound passed down to its anterior end.

The cases for which external division is appropriate are those in which the perineum is thickened and hardened by inflammation or cicatrices, and the urine escapes, wholly or in part, from the dilated urethra behind the stricture through one or more fistulæ. The very rare cases, also, in which repeated patient trials fail to introduce an instrument along the urethra to the bladder, must be treated by a perineal opening.

Syme's operation; or that in which a grooved staff can be passed through the stricture to the bladder. The staff used in these cases has at the last three inches—the curved part—the calibre of No. 8 of the millimetrical scale (No. 2 English). This part is grooved on the convexity; beyond the grooved part to the handle, the staff enlarges by an abrupt shoulder to No. 18 or 20 (No. 10 to 12 English), and the groove is prolonged by a notch through the shoulder, but no farther. This staff is passed into the bladder, and the patient is put in the lithotomy position. The surgeon sits down opposite the perineum, and, with the left forefinger inserted into the rectum, feels for the curve of the staff in the perineum, and also that its position in the urethra is correct. An assistant holds the staff steadily, pushing its convexity downwards towards the surface, that it may be the more easily met by the knife. The surgeon then introduces the point of a scalpel, the cutting edge being held forwards, through the skin and fat at a point one inch in front of the anus and exactly in the mesial line of the body. The left forefinger then explores the incision for the staff; if felt, the finger is held steadily against the staff while the scalpel is slid along the nail till its point penetrates the urethra, which is usually not indurated at this part, and rests against the staff in its groove, the edge of the knife being forwards as before. The knife, steadied by the left forefinger behind it, is then carried forwards, the point scraping along the groove of the staff until the shoulder of the staff is reached. The whole of the indurated tissue of the stricture being cut, the knife is laid down and a small gorget with a narrow tapering point, fine enough to run in the groove of the staff, is passed through the wound to the bladder. When this is reached by the gorget, the staff is withdrawn and a flexible or celluloid catheter, No. 20 or 22

(No. 12 English), is passed along the urethra from the meatus, and, guided by the gorget, traverses the incised part of the urethra, and easily reaches the bladder. The gorget is removed, the catheter secured, and the bladder emptied. The catheter is worn three days, then withdrawn, and a No. 24 or 25 steel sound is passed every third or fourth day until the perineal cut has closed. Fistulæ, if tortuous or containing collections of pus, must be incised, that the matter collected in them may drain off freely. Usually, when urine is no longer forced into them by the efforts of the patient to empty the bladder, fistulæ close up readily.

It is necessary that the patient be aided in his recovery by rest in bed, good food, sea air, &c., as the bodily condition is often much exhausted by irritation of the stricture and the abscesses which formed before the operation was performed.

A stricture divided externally will, if neglected, shrink again as certainly as it does after any other method of treatment. Hence the patient must be trained to use a maintaining bougie regularly after he is dismissed from the surgeon's care.

External urethrotomy by opening the urethra in front of the stricture, now generally practised by *Wheelhouse's method*, is a very valuable one in the rare cases when, though urine escapes along the urethra, no instrument can be passed through the stricture. The patient is put into the lithotomy position; a straight staff, grooved on one side, with its beak turned up as a blunt hook at the other side, is passed along the urethra to the stricture, and held steadily with the groove directed towards the surface. The operator feels for the tip of the staff, and, making in the mesial line an incision an inch long through the integuments, exposes the tip of the staff at the bottom or posterior end of this incision. He then completes the division of the urethra for the length of the incision, by running his knife along the staff. The sides of the incision are seized with hooked forceps and held asunder by assistants, and the staff is turned round, that its hook may catch in the upper end of the incision. The interior of the urethra is carefully sponged and the mouth of the stricture sought for. It is usually discovered easily, and a fine probe-pointed director may be carried through the stricture to the bladder. On this director the stricture may be cut towards the bladder with a long narrow knife or tenotome. When the passage has been thus widened, a small tapering gorget, of which the beak fits into the groove of the director, is carried to the bladder. The director is withdrawn, the hooked staff and forceps are removed, and a flexible catheter, passed along the urethra, is guided to the bladder by the gorget and fixed in place. The remaining treatment is that employed in Syme's method.

Perineal Section of the membranous portion of the urethra must be done when no guide can be carried to the bladder. By this operation access is obtained through a cellular interval between the last portion of the rectum and the bulb of the urethra. Here, in the mesial line of the body, no important structures intervene between the urethra and the surface. The patient is directed to hold his urine, if possible, for some hours before the operation, that the bladder may be charged and its neck and the distended membranous portion of the urethra found more easily at the time of operation. The surgeon has at hand a bistoury, probes, probe-pointed directors, artery-forceps, sharp and blunt hooks, No. 20 (12 English scale) silver catheter, tapering gorget, sponges, tapes, &c. The patient is put into the lithotomy position, and the surgeon begins by passing the left forefinger into the rectum to ascertain the precise position of the bowel, and to draw it slightly backwards. A puncture through the skin, half an inch in front of the anus and precisely in the middle line of the body, is made with a small sharp-pointed bistoury, the edge being turned forwards, and an incision is carried directly forwards for an inch and a half. When the skin of the perineum is much indurated, a short transverse cut may be made also to give freedom to the further steps of the operation. With this exception, the line of the cut must be carefully kept in the mesial line throughout, or the urethra may be missed and much mischief done. The left forefinger being still in the rectum, the incision is deepened to one inch. If the patient cough or strain, the urethra may often be distinguished when distended by the escape of urine into it from the bladder; in this state its puncture is easy. If the urethra remain collapsed, the point of the knife is thrust backwards a little and the patency of the urethra tested by a probe, and by the left forefinger exploring the wound. If urine escape through the puncture, difficulty is at an end. A director is passed to the bladder and along it the tapering gorget, over which the urine escapes copiously. The track to the bladder being thus assured, the stricture may be dealt with.

A catheter is passed along the urethra from the meatus to the contracted part, and then the gristly tissue is cut cautiously, in a forward direction from the incision, until the catheter can be brought to the surface of the gorget, by which it is at once guided into the bladder, where it may be tied in and the gorget withdrawn. Sometimes when the urethra has been opened behind the stricture, a fine probe or probe-director can be carried from the posterior incision forwards through the stricture, and the division of the stricture by means of its guidance is much facilitated. Cases of traumatic stricture occur, in which the induration of the perineum by cicatricial tissue extends as far as the neck of the bladder, access to which can be obtained only by slow penetration with repeated cautious cuts in the middle line, until a probe or director can be carried into the bladder, when the division of the stricture may be performed in the way already described. In these cases care is necessary to avoid the rectum in the progress of the knife to the neck of the bladder. Usually, the hæmorrhage is not great, because the naturally vascular structures have been replaced with fibrous tissue. After the operation, the patients recover slowly with a urethra that is very prone to shrink, so that the daily use of the sound or bougie is usually needed to keep it open.

Subcutaneous Urethrotomy is a term applied to division of short ring-like strictures in the penile portion of the urethra. A small grooved staff, straight and about six inches in length, is passed through the stricture. The staff and penis are well steadied by an assistant while the operator, passing a fine sharp-pointed tenotome through the skin and stricture to the staff, carries its point up and down until the stricture is thoroughly divided. The little skin-puncture is then sealed with collodion; a No. 16 (No. 8 English) catheter is passed to the bladder and worn for twenty-four hours to prevent the flow of urine into the cut for that space of time. The external aperture having healed, the catheter is withdrawn and the urethra left at rest for six or seven days. At the end of a week, the dilating sound, No. 24 or 25, should be passed every third day for some weeks until the incision has healed. This method of cutting strictures has been applied to the treatment of long and deeply placed ones; but its success has been doubtful in such cases. When employed for short penile strictures, it has proved a very simple and successful operation. BERKELEY HILL.

URETHRO-VAGINAL FISTULA. *See* VAGINAL FISTULÆ.

URINARY DEPOSITS.—The substances which form urinary deposits in health make up, when exaggerated in quantity (and others added), the sediments of disease. In forming a list, therefore, it will be best not to regard this or that deposit as notably pathological or the reverse, but to arrange them according to their composition, and as to whether they are deposited from neutral, acid, or alkaline urine.

Thus, the following *simple, unorganised, chemical substances* are deposited from—

A. Neutral Urine.
   1. Oxalate of lime.
B. Acid Urine.
   2. Uric acid.
   3. Urates.
   4. Oxalate of lime.
   5. Tyrosin.
   6. Cystin.
C. Alkaline Urine.
   7. Ammonio-magnesic phosphate.
   8. Magnesic phosphate.
   9. Phosphate of lime.
   10. Urate of ammonium.
   11. Carbonate of lime.
   12. Oxalate of lime (if alkalinity is weak).

1, 4, 12, *Oxalate of lime*, appears as a slight white sediment in urine of persons apparently healthy, especially in the tropics (India, &c.). *Tests*—(*a*) Microscopic: Seen as octahedral crystals, rarely spheres, dumb-bells, and prisms; (*b*) Chemical: Insoluble in acetic, soluble in hydrochloric acid. *Importance*—Slight, usually due to vegetable diet; may, however, be a symptom of general metabolic derangement known as the oxalic acid diathesis.

2, *Uric acid*, appears usually as a brick-red sandy deposit, which clings to the bottom of the vessel, and has long been known as the 'lateritious deposit.' *Tests*—(*a*) Micro.: Seen as 'whetstone' crystals usually, the shape being made more characteristic if the acid is allowed to recrystallise from its solution in a drop of hydrochloric acid; frequently the bright-red crystals form great rhombic bundles, in which the whetstone outline is more or less lost; (*b*) Chem.: Heat *gently* in a capsule with a drop of nitric acid until a solid residue remains, which, moistened with a drop of ammonia or other alkaline solution, gives a purple or blue colour (murexide). *Importance*—Considerable if present in quantity, a symptom of so-called uric acid diathesis; is an indication of (1) great tissue-waste, (2) excessive

ingestion of nitrogenous food, (3) imperfect elimination of nitrogen by excretory organs.

3, *Urates*, usually of soda, more rarely potash, for urate of ammonium see below; appear as a white or pink light precipitate, falling as the urine cools. *Tests*—(*a*) Micro.: The heavier urates are frequently amorphous, and so are seen as fine granules which form earthy masses; sometimes, rarely, they crystallise as rhombic needles; (*b*) Chem.: Soluble on warming; dissolve in acid; obtain uric acid test, for which see above. *Importance*—Same as uric acid; *see* above.

4, *See* 1.

5, *Tyrosin*, forms a greenish-yellow precipitate if present in quantity. *Tests*—(*a*) Micro.: Seen as sheaves of needles, rarely in spheroidal masses; (*b*) Chem.: Scarcely soluble in hot water, soluble in alkalies. If the watery solution is boiled with a little Millon's reagent (mercuric iodide dissolved in potassic iodide), the fluid becomes dark red, and a red precipitate falls. *Importance*—Great, as indicating usually acute atrophy of the liver, and, at any rate, great tissue-destruction, since it appears in the tissue in extreme cases of smallpox, typhus, and phosphorus-poisoning. Under these circumstances, it is accompanied usually by leucin, which may share in producing the above-mentioned deposit, and which is recognised, at any rate, by its microscopical characters of colourless spheres of colloidal appearance.

6, *Cystin*, a rare substance, and which, when present in urine, seldom produces a definite deposit, but colours the urine a greenish-yellow. *Tests*—(*a*) Micro.: Seen as colourless hexagonal plates, not to be confounded with *yellow* hexagonal plates of iodoform; (*b*) Chem.: Cystin is precipitated from its solutions as white crystals, which are soluble in ammonia and recognisable under the microscope. *Importance*—Only as possibly leading to the formation of calculi.

7, *Ammonio-magnesic Phosphate.*—This salt, the well-known triple phosphate, is of the greatest clinical interest, forming a white deposit from ammoniacal urine. *Tests*—(*a*) Micro.: The crystals of this salt form regular prisms with trough-like ends (coffin-lid crystals), which form masses in the urine, entangled in mucus, &c.; (*b*) Chem.: The crystals are soluble in acetic acid, &c., but their form is sufficient for diagnosis. *Importance*—The formation of this deposit in the bladder or on the surfaces of wounds made for opening that viscus, when the urine is ammoniacal, leads to the production of thick coatings of friable deposit, held together by mucus. These coatings may assume the proportions of calculi, and produce similar symptoms.

8, *Magnesic Phosphate*, a white salt found with No. 7, forming a floccular sediment. *Tests*—(*a*) Micro.: Seen as rhombic plates under the microscope; (*b*) Chem.: These crystals gradually dissolve in a 20 per cent. solution of commercial carbonate of ammonia, whereas the triple phosphates are unaltered.

9, *Phosphate of Lime.*—(1) The tribasic salt forms a green iridescent scum on the surface of urine (and calculi—Shattock). *Tests*—(*a*) Micro.: Seen as crystalline plates; (*b*) Chem.: Soluble in acetic acid (*see* No. 7) without effervescence. (2) The neutral calcium phosphate forms rosettes of needles or pointed rhombic prisms.

10, *Urate of Ammonium*, is mixed with the phosphatic deposits from ammoniacal urine. *Tests*—(*a*) Micro.: Seen as spheroidal crystals furnished with spikelets; (*b*) Chem.: Soluble in potash with evolution of ammonia. Urate detected as above; *see* No. 3.

11, *Carbonate of Lime*, mixed usually with the earthy phosphates (*see* No. 9). *Tests*—(*a*) Micro.: Usually seen as spheroidal masses, especially in presence of any colloid substance; (*b*) Chem.: Easy to detect by the effervescence on adding acetic acid to the *crystals* under the microscope.

To the above list may be added as a rare curiosity *sulphate of lime*, occurring as a white deposit in acid urine. *Tests*—(*a*) Micro.: Seen as acicular crystals and colourless prisms; (*b*) Chem.: They resist the action of weak acids.

So also *hippuric acid* may occur as a deposit. Care must be taken, of course, to note whether the patient is taking an excess of benzoic acid as food or medicine. Hippuric acid forms a crystalline sediment like the triple phosphate. It is soluble in hot water, and, being dried after treatment with nitric acid, gives a strong smell of nitrobenzol.

The remaining deposits for consideration are those which are formed by portions of the tissues of the urinary tract.

1. *Epithelium.*—Epithelial corpuscles of the urethra, bladder, ureter, and renal pelvis, and of the renal tubules, may be found distinct or massed together, and always possessing more or less characteristic shape, which enables them to be recognised as coming from a definite part of the tract. As a rule, the epithelium is undergoing fatty and granular degeneration, the

nucleus being obscured. It is customary to describe the masses of corpuscles which are derived from the renal tubules as casts, and then to classify them into—(*a*) blood-casts, (*b*) hyaline casts, and (*c*) epithelial casts. This is a practically useful division, and therefore is best retained, it being understood that no special means of production is assumed thereby.

a. Blood-casts are simply small clots expelled from the tubules, and we may find in other kinds of casts numerous red blood-corpuscles.

b. Hyaline casts are clear albuminous moulds of the tubules. How they are formed is a matter of theory, but as they are albuminous they may simply be coagulated exudation, or albuminoid material the result of albuminoid degeneration.

c. Epithelial casts—i.e. shedding of the epithelium of the tubules—may take place in parenchymatous diseases of the kidneys to such an extent as to occur in masses in the field of the microscope. Usually the masses are very degenerate, and often the outlines of the corpuscles are all fused together. The relation of the above-described casts to the various forms of kidney-disease is fairly constant, and, from what has been said, it will be understood that the desquamation of more or less perfect epithelial casts will occur in parenchymatous nephritis, that blood-casts will be seen in acute nephritis, and that fatty and hyaline casts accompany chronic disease.

2. *Mucus* is always present, more or less, as a tenacious cloud settling to the bottom of the glass; it may occur in such quantity as to form a thick ropy mass filling half the vessel. Microscopically it contains numerous 'mucus' corpuscles.

3. *Pus*, recognisable as a yellow, ropy sediment mixed with mucus. Microscopically, the fattily degenerated leucocytes, with breaking-up nuclei, are very characteristic. Chemically, the addition of potash makes the sediment excessively ropy, sticky, and sometimes lumpy.

4. *Semen*.—All the constituents of semen may occur in the urine after emission, &c. Thus, fully formed spermatozoa, spermatoblasts, and colloidal spheres have all been found, and are easily recognisable.

5. *Fragments of New Growths*.—Occasionally, portions of tumours of the urinary tract are found in the deposit. The commonest condition in which this occurs is a villous tumour of the bladder. A portion of the vascular stroma covered with epithelium may be detected by patiently searching the deposit, and especially if any fibrinous shreds are to be seen in it. A shred of villous tumour is so characteristic as not to require detailed description. Next, epithelioma of the bladder may be discovered by finding quantities of greatly degenerated and distorted large epithelial cells, such as obviously come from the bladder. The diagnosis is here much more difficult, but a very accurate surmise can be made by a practised eye. Lastly, epithelial growths, cancers, &c., of the kidney shed typical cells (usually with blood-clots), and sometimes have thus confirmed a diagnosis.

Vegetable Parasites.—All kinds of fungi have been described as occurring in normal urine, but very grave doubt is always to be cast on such statements. There is only one condition known, and that imperfectly worked out, in which organisms (vegetable) have been found in acid urine. Roberts has described a form of bacilluria in which bacilli (resembling B. subtilis; *see* Schizomycetes) have existed in the healthy bladder during life. Passing from this point, it is, of course, a matter of every-day observation that all kinds of organisms—micrococci, bacteria, termo, &c.—grow readily in alkaline urine, and, by keeping up fermentation, cause the deposit of numerous salts.

Animal Parasites. — Among urinary deposits must be mentioned the ova of the Bilharzia worm, which has its habitat in the portal venous system, and which causes hæmaturia. The ova are found entangled in the deposits of blood-clot.

General conditions, such as chyluria, &c., which cause partial deposits, are not properly treated of in this article. *See* Urine.

Victor Horsley.

URINARY FISTULA in the perineum commonly results from abscess, caused by urethral stricture in the ways described under Perineal Abscess. When abscess is the preliminary stage of the fistula, the collection of matter may communicate from the first with the urethra, or may form outside and open into the urethra afterwards. When the suppurating tract has no external opening it is termed a 'blind fistula.' Besides origin in the urethra, fistula may be caused by abscess in the prostate, by sloughing of the integuments over areas invaded by extravasated urine, or by the destruction produced by venereal sores. Again, fistulæ remain sometimes after lithotomy or cystotomy, from the knife having been carried too deeply into the rectum (recto-vesical or recto-urethral fistula). Or,

a piece of calculus or other foreign body lodged in the urethra may set up abscess that terminates in fistula. Fistulæ are produced sometimes in the loin in connection with the kidney. *See* NEPHROTOMY.

Fistulæ usually open in the perineum near the scrotum, in the scrotum or sheath of the penis, but they may also terminate in the groin, above the pubes, at the nates, or in the upper part of the thigh. Usually limited in number to one or two, they may be numerous, even as many as fifty. Their orifices are commonly only the size of pin-holes; but, where there has been sloughing from extensive extravasation of urine, large gaps may be left by necrosis of the soft parts. The urine may escape during micturition as a drop or slight oozing from one or two of the orifices, or most of it may be voided through several openings, and trickle away like water through a colander.

The varieties of fistula may be arranged in four groups.

1. *Simple fistulæ*—that is, one or two canals running from the urethra to the surface, and affording a tolerably direct channel for the outflow of urine, when the urethra is blocked in front of them by a tight stricture.

2. Fistulæ which permeate a perineum indurated by long-continued suppuration of the cellular tissue and skin, underneath which are cavities filled with a mixture of pus and urine, and where the fistulæ wind in devious tracks.

3. Fistulæ which remain as unhealed tracts after the operations of lithotomy or cystotomy, reaching as far back along the urethra as the prostate; or fistulæ which are kept open by the lodgment of fragments of calculi or other foreign bodies escaping from the bladder. These fistulæ often open into the rectum instead of at the surface of the perineum.

4. The last variety comprises fistulæ where wide gaps have been produced by sloughing of the walls of the urethra and overlying integuments.

The course of a urinary fistula is always from bad to worse, so long as the obstruction which caused it remains; the passages become more numerous, the abscesses in their course larger and deeper, the strength of the patient is steadily sapped away, and cystitis from continuous retention of urine in the bladder adds to the patient's sufferings. Further, the kidneys undergo chronic interstitial nephritis, and in time lose much of their secreting tissue. Hence, urinary fistula, in addition to being a cause of constant suffering and pain, is a danger to the life of the patient. In those cases where no impediment to the flow of urine exists with the fistula, as in fistulæ produced by sloughing, the patient's health recovers though the unnatural gap or channel remains unclosed, and he suffers only from deformity, or from the inconvenient exit through which his bladder is emptied.

Treatment.— It will be seen that of the foregoing varieties of fistula the great majority are caused by stricture; consequently, one main requirement for the cure of fistula is to open up the natural passage for the urine. In simple fistulæ, where there has been an abscess of limited extent and the perineum is not indurated beyond the area of the abscess, dilatation of the stricture to its normal width by the interrupted passage of bougies or by internal urethrotomy (*see* STRICTURE OF THE URETHRA), thereby restoring the flow of urine to the natural channel, is often sufficient to cause speedy closure and consolidation of the fistula. But care must be taken to keep open the dilated stricture by the regular passage, at short intervals, of a bougie of large size (No. 24 or 25, French scale). When, in addition to simple obstruction, abscesses or pouches filled with urine and pus have formed along the course of the urethra, or there are more than two passages from the urethra to the surface, simple dilatation or internal division of the stricture is not sufficient; a more direct escape must be provided for the contents of the suppurating cavities. External division is necessary, in order that not only the urine, but also the infiltrating contents of the passages and cavities, may be thoroughly drained away.

In such cases, perineal section is usually performed by one of the following methods. When a Syme's grooved and shouldered staff can be passed along the urethra, the incisions are most conveniently made with its guidance. When a staff cannot be passed through the stricture, the straight staff of Wheelhouse should be carried as far as the stricture, to serve as a guide for the boutonnière incision for exposing the anterior extremity of the stricture. *See* BOUTONNIÈRE. By this means a fine probe and grooved director can be passed through the stricture to the bladder, and the stricture itself thoroughly divided before the fistulæ are laid open and drained. It may happen that, even in the simplest cases, the maintenance of a free passage for the urine along the urethra does not altogether prevent the escape of a few drops into the

fistula at every act of micturition. This small quantity of urine is sufficient to keep up irritation and prevent the closure of the fistula. To overcome this difficulty, the urine must not be allowed to flow at all along the urethra. It must be withdrawn from the bladder through a catheter. If this is done, the walls and the fistula soon granulate and shrink together until thoroughly consolidated. To provide for the removal of urine by catheter, the patient must be trained to pass one himself on every occasion when it is needful to void urine.

By regulating the diet, removing all stimulants therefrom, and limiting the quantity of liquid imbibed, it is seldom necessary to pass a catheter more than thrice, or perhaps twice daily. The urine should always be withdrawn before defæcation, lest straining of the levator muscles drive some drops of urine into the urethra. The catheter should not be tied in the urethra; but withdrawn after each act of micturition. Experience shows that, if a catheter is constantly in the urethra, that canal soon widens or relaxes around it, and the urine not only escapes through the catheter from the bladder, but also by the side of it, and so easily finds its way into the fistula.

Even when great care is taken to maintain a free channel for urine along the urethra, and to prevent its entry into the fistulæ, the latter sometimes refuse to heal. If so, they should be carefully examined for the presence of pouches or blind alleys charged with pus. If any are found, they must be opened and drained. If, on the other hand, no such cause of delay is discovered, and the fistulæ are simply indolent, cicatrisation may be expedited by injecting them regularly with astringent lotions, by irritating them with the galvanic cautery, or with a probe armed by fusing on its tip a globule of nitrate of silver.

For the rectal fistulæ left after lithotomy, the patient should keep the prone position continuously for several weeks, so that the urine may be driven as little as possible against the floor of the bladder and prostate, through which the fistula passes. The gap may be encouraged to shrink and close, by burning its edges from time to time with the galvanic cautery, or, if a very wide gap, the edges may be pared with the knife and brought together with sutures, in a manner similar to that for closing a vesico-vaginal fistula.

The general health is often much broken down in cases of severe stricture and fistula. This must be improved by rest, tonics, and nutritious food.

The last variety—cases where large gaps in the wall of the urethra and integument have been left after sloughing action—are often difficult to treat. Those behind the scrotum usually contract and close in time, if the stricture be kept carefully dilated. Those in the penile portion need plastic operations for their cure; such are fully described under URETHROPLASTY.

BERKELEY HILL.

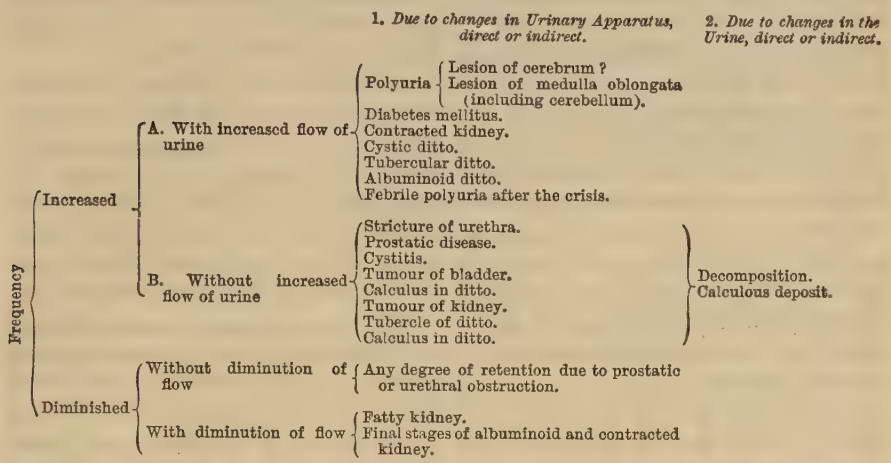
URINE, Morbid Conditions of the, in relation to Practical Surgery.—The importance of the urine in so-called 'surgical' cases, and the points which should be particularly noted by the practical surgeon, will be best described and understood by detailing the conditions met with in clinically examining the urine in such cases, by noting at the same time the pathological products in the same, and by stating what are the causes of their appearance.

The systematic observation of the urine, in the way described below, will not, of course, be necessary in its entirety in every case, but the main points at least must be carefully investigated (e.g. the presence of albumin, sugar, &c.) before any active surgical treatment is ever commenced.

It may be as well here to draw attention to the salient clinical points to be observed in the act of micturition itself, since these depend partly upon the condition of the urine (i.e. quantity, &c.), as well as upon that of the excretory organs; and the relation between the matter excreted and the process of excretion is so intimate that they cannot practically be separated. Following the scheme originally suggested by Sir Henry Thompson, we shall arrange the facts for this purpose under the headings of—(1) frequency; (2) difficulty; (3) pain; and simply tabulate in two columns the causes which produce the abnormal symptoms—viz. those which are directly exciting from changes in the urinary apparatus, and those which arise from the condition of the urine.

Frequency.—As a preliminary, it should be noted whether the frequency is abnormally marked by day or by night or both; since it is obvious that a simple local condition like vesical calculus will, when the patient is up and about in the daytime, give rise to great irritability, which subsides to a large extent when he is at rest at night. And this properly brings us to note that, while, of course, the fact of a patient micturating at night is, under any circumstances, to be regarded as of importance, it must not be forgotten that persons vary in their habits, and that the habit of rising

in the very early morning to micturate is not very uncommon among people in good health; and the same influence of habit, too, determines differences in the number of times a patient micturates during the day.



From the foregoing table the conditions which lead directly to an increase or decrease in the quantity of urine excreted are visible at a glance, and also the relation they bear to the process of excretion, or, in other words, their clinical symptomatology. We will, therefore, rest contented with noting, later on, one or two facts concerning the quantity of urine excreted, and meanwhile briefly refer to the questions of difficulty and pain in the act of micturition, in so far as they depend on morbid states of the urine. For physical changes in the urinary tract, reference must be made, of course, to the special articles on the organs involved. *See* Stricture; Prostatic Hypertrophy.

Difficulty of micturition from the state of the urine may be caused by plugging of the canal by—(1) calculus; (2) blood-clot; (3) portion of new-growth; (4) excessive quantity of ropy mucus (urine alkaline, &c.).

Pain in micturition due to the state of urine may be caused by—(1) excessive acidity (especially noticeable if any part of the passages is congested); (2) passage of calculi, clots, fragments of growths, crystals (urate of ammonia), gravel.

Since the foregoing facts concerning micturition have been detailed as far as they are connected with the morbid conditions of the urine, we can now note systematically the changes which arise in the condition of the urine in disease, and especially with reference to surgical practice. The order followed is that one which is found most useful clinically — namely, quantity; smell; reaction; colour, including blood; specific gravity; urea (*see* special article Urea); albumin; sugar; chyle; fat; urinary deposits and crystals. *See* Urinary Deposits.

Quantity.—The quantity of urine excreted by a healthy person in full exercise is, clearly, very different from the amount secreted by the same person at rest in bed, and this difference is not always adequately discounted in clinical observation. In the first place, it may safely be laid down that the quantity excreted varies nearly directly with the quantity ingested, and, consequently, a person confined to bed not infrequently excretes only 25 to 30 ounces in the twenty-four hours. Further, this quantity will vary with the amount of excretion of fluid by the bowels and skin, one compensating for the other.

In the foregoing table, showing the conditions which produce increased or decreased frequency of micturition, those which influence the quantity excreted are also classified, so that reference is here directed to the list there given. It only remains to observe that, between a slightly diminished flow and complete Suppression of Urine, a condition of inadequate excretion or oliguria may result, which usually terminates fatally from uræmic poisoning.

Smell.—The smell of urine is a valuable mode of investigating its condition, since all fermentative changes reveal themselves

at once, especially the ordinary ammoniacal destruction of the urea, &c. The normal urinous odour appears to vary in degree with the amount of nitrogenous solids in the urine; but this correlation can only be accepted as the very roughest estimate, and the more especially since it is not at present determinable what substance produces the odour. It need hardly be said that observations made on the smell of urine are of value only when the urine has just been passed or drawn off with a catheter. Artificial odours of all kinds may be produced by drugs.

Very rarely, sulphuretted hydrogen, H_2S, gives its characteristic odour to the urine. In the majority of cases it has simply been absorbed into the circulation from a foul abscess, usually connected with the bowel. It may arise, too, from the decomposition of pus in the urine.

Reaction.—The normal acid reaction of the urine, while of value in resisting the invasion of that fluid in the bladder and kidneys by putrefactive organisms (which of course require, in the large majority of cases, an alkaline pabulum), nevertheless varies greatly in degree, the person being still in apparently perfect health—thus urine may be weakly acid, neutral, or really alkaline. Diet is the main causative agency determining these differences; a nitrogenous flesh diet causing greater acidity, and vegetable food, on the other hand, producing alkalinity; but a distinctly alkaline non-decomposed urine must always be regarded suspiciously, until proved to be otherwise normal. Thus, for instance, the urine has frequently this reaction in diabetes.

In cases where the acidity of the urine aggravates symptoms—e.g., those of gonorrhœa, granular urethritis, &c.—it is easily made alkaline, and therefore non-irritating to the inflamed mucous membranes. Conversely, it is made acid by the administration of mineral acids. It may not be out of place to refer here to the former attempts to effect the prevention, if not the solution, of renal and vesical calculi by altering the reaction of the urine. Although the treatment of the various calculous deposits is now entirely directed into operative channels, it is still desirable to point out that distilled water is of great value in aiding the natural solution of acid salts in the tubules of the kidney, and that by this simple method a valuable flushing out of that organ is obtained.

Colour.—The normal colour of the urine is interesting from the very important point of view of its origin. That it is derived from the hæmoglobin of the blood is probable, but the process of formation of the pigment (urobilin) is absolutely unknown, and reference must be made to text-books for discussion of this point. Pathologically, the colour of the urine may be altered as follows:—

1. *Diminution of Colour.*—Every degree of paleness may be found in urine in proportion to the increase in the watery constituents, the solids remaining the same. Diminution, however, of the normal pigment may occur without increase in the watery excretion. This diminution of pigment is found in connection with general failure of pigment-formation in the body—as in cases of anæmia, albuminoid disease, &c.

2. *Increase of Colour.*—The urine may be 'high-coloured,' as it is termed, from an increase of tissue-metabolism and excretion of solids; and, in cases where this condition has been produced by pyrexia, a red colour is seen to be added to the urine, being produced by a pigment which has been termed 'urerythrin,' but which is perhaps only an altered condition of normal urobilin.

3. *Additional Coloration.*—(*a*) The urine may be coloured from a dusky red to a dark brown from the presence of blood. *See* URINARY DEPOSITS; HÆMATURIA.

Further, similar colour is produced by hæmoglobin—that is to say, methæmoglobin—when that form of the blood-colouring matter is found dissolved in the urine without a trace of red blood-corpuscles. In some cases the amorphous red deposit, found in the urine, has been taken for hæmatin. And this condition, under which the colouring-matter is excreted apart from the corpuscles, has been termed hæmatinuria; but spectroscopic examination shows that, in the large majority of cases, the substance is methæmoglobin, and the condition, therefore, should be known as hæmoglobinuria. It is scarcely necessary here to do more than point out the great importance clinically of recognising this state of things in cases of hæmaturia, and, further, that a leading characteristic is its proclivity to be paroxysmal, and that each paroxysm is evoked by cold and nerve-fatigue.

Detection of methæmoglobin is rendered easy by—(1) the fact of the colour being present in the absence of corpuscles; (2) the characteristic spectrum; thus, the urine being *perfectly fresh*, there will be seen a band in the red between C and D, together with the ordinary bands of oxy-

hæmoglobin on the green side of D, while no broad absorption from E to F is seen, such as is produced by hæmatin.

The accompanying table may be of value in estimating the clinical import of the occurrence of blood in the urine :—

Condition of the mixture of blood and urine		
1. Completely mixed. (Note that the blood-discs are mostly broken up, and that blood-casts are common.)		Acute congestion (idiopathic and reflex action of drugs). Pyelitis (acute septic). Embolism. Tubercular disease (usually pyelitis). Traumatism (*vide infra*). Renal calculus. „ tumour (especially carcinoma). Acute specific conditions (scurvy, blackwater fever, &c.).
2. Incompletely mixed (i.e. usually numerous clots). (Note that the blood-discs are mostly unaltered, and that casts are rare.—Salkowski u. Leube.)		Renal traumatism (laceration, gunshot wounds, &c.). Renal tumour (portion of growth may be entangled in clot). Rupture of bladder. Cystitis. Vesical calculus. Vesical tumour (blood usually expelled at end of act of micturition). Portion of growth may be entangled in clot.

It is, of course, to be remarked that the above table only represents the commoner conditions under which blood occurs as such in the urine, and that the distinction drawn between the degrees of mixture and the presence or absence of clots is to be regarded as liable to frequent exception. Within reasonable limits, however, the above facts will be found to hold good.

Of course, no mention is made here of bleeding from the urinary passages after micturition. *See* URETHRA, Diseases of the.

(*b*) Bile-pigments are commonly present in the urine in cases of jaundice (obstructive) as a dark brown coloration, which is due to all forms and derivations of bilirubin, and easily detected by Gmelin's test of the play of colours produced by the addition of nitric acid.

(*c*) Melanin. This substance, the pigment of melanotic tumours, is occasionally found in the urine of patients suffering from that form of new-growth. It is usually brought out by the action of oxygen, either by exposing to the air or by oxydising reagents, such as nitric acid.

(*d*) Indigo occasionally appears in the urine in excess, and is of especial interest to the practical surgeon from two points of view. In the first place, its precursor, indican, is excreted by the kidneys whenever the substance indol, which itself is the precursor of indican, one of the putrefactive results of pancreatic digestion, is absorbed (and formed) in quantity by the small intestine. The circumstance of practical interest under which this occurs is that of acute obstruction of the small intestine. Occasionally, the indigo may reveal itself by its colour when the urine is allowed to putrefy with exposure to the air, but, as a rule, it is necessary to mix the urine with an equal quantity of hydrochloric acid, and then to add a very little chloride of lime, when the well-known colour of indigo-blue appears, and may be dissolved in chloroform. More frequently we have seen the colour to be a red purple from the formation of indigo-red, &c. There is no doubt whatever that this reaction is useful as an aid in determining whether the obstruction, in a given case, is affecting the large or small intestine.

The second point of interest is that, as discovered by Dr. Ord, it is possible for an indigo calculus to be formed, although, of course, this is very rare.

(*e*) The above rarer pigments have been described before reference is made to the black colour produced in urine by the action of carbolic acid, because they are mostly exaggerated amounts of derivatives normally produced by tissue-metabolism, whereas, of course, the colour produced by carbolic acid is almost always an artificial effect. Although phenol compounds have similarly been found to occur in the urine as the result of absorption by the small intestine of some of the katalytic products of its action, still the coloration of the urine by carbolic acid usually means its employment in excessive quantity as a therapeutic agent. The well-known black brown coloration of the urine is produced by oxydation of hydrochinon, which is the form in which the phenol compounds appear in the urine. The hydrochinon is at first present as a colourless sulphate, which splits up, and the hydrochinon becomes oxydised to a brown product. A parallel substance termed brenzcatechin by Baumann, which also darkens on exposure to the air, is a phenol derivative belonging to the aromatic series.

Having discussed the preliminary points to be observed—viz. the quantity passed, the smell, reaction, and colour—we will now briefly consider the solids found as pathological constituents in the urine, it being remembered, of course, that many of these occur under normal conditions of

health, and that it is their exaggeration or diminution which brings them into the following category. The points to be observed are arranged in the order of their practical importance.

Specific Gravity.— The estimation of the specific gravity is of some value, when the quantity of urine excreted is known, as indicating the amount of solids present; but variations, not exactly commensurate with increase in weight of the solid constituents, occur when the specific gravity is raised by the presence of sugar, albumin, &c., an average normal being 1020.

Urea. *See* UREA.

Albumin.—In the very large majority of cases the albumin, which appears in the urine as the necessary result of destructive degenerative conditions attacking the glomeruli, &c., of the kidney, is serum albumin, pure or mixed with serum globulin, and as such is detected by the now classical methods of heat, acidification, picric acid, Oliver's test papers, &c., for details of which the manuals of urine-testing may be consulted. The quantitative estimation, however, deserves especial attention, as being a factor of great moment in deciding the practicability of surgical operative procedures in a patient suffering from this, the ordinary form of albuminuria. A rough estimate of the amount passed may be made by taking a sample of the whole twenty-four hours' urine, precipitating the albumin, and allowing the precipitate to settle for twenty-four hours. The latest form of this method (Esbach's) consists in perfect precipitation with picric acid, and collection of the urine and precipitate in graduated tubes. The more elaborate results, obtained by weighing the dried mass obtained from the total twenty-four hours' urine, are to be relied on only where very accurate work is required, but a sufficiently good clinical result will be obtained by the above simple methods of allowing the precipitate to settle. The influence of the albuminous urine on polarised light is also made use of in estimating the amount of albumin more or less accurately. Before alluding to the practical importance, in clinical surgery, of correctly estimating the occurrence and degree of albuminuria, it will be better to tabulate the kinds of albumin known with certainty to be excreted pathologically, and at the same time to note the conditions of such excretion. The fact, however, that albumin in the form of egg albumin, or albumen, when taken in excess by way of diet will appear as such in the urine (having escaped digestion by reason of its quantity), is first to be thought of in seeking for a cause in any given case of albuminuria; and further, it is to be remembered that, in a certain proportion of people who are apparently in fair health, albuminuria may appear in an intermittent or paroxysmal form, the exciting causes of which are very obscure.

The following list gives the various kinds of albumin producing the condition of albuminuria:—

Albumin.		*Causation of Abnormal Excretion.*
1. Serum albumin (and serum globulin).	*a.* Renal vascular changes	Arterial blocking (vasomotor ?). Venous obstruction (pressure of tumours, &c.).
	b. Renal parenchymatous changes	Acute inflammation (simple or septic). Hyperæmia, &c., in fevers of severe and continued type. (This includes all specific diseases, zymotic and septic.) Chronic nephritis. Chronic interstitial ditto (granular contracted kidney). Albuminoid degeneration. Pregnancy.
	c. Injuries, &c., of the nervous system	These probably are indirectly through the vasomotor system for the most part, but possibly also of course by direct action on the kidney.
	d. Drugs	All violently acting substances, which increase renal secretion.
2. Hemialbumose (halfway substance between albumin and peptone). Determinable by clotting in the cold after urine has been boiled with HNO_3 and filtered hot.		Osteomalacia (Bence Jones). Urticaria (Salkowski). Hæmoglobinuric condition (Neale).
3. Peptone. Determinable by precipitation by tannin, phosphomolybdic acid, and by giving a red violet colour when mixed with alkaline copper sulphate solution. If albumin is already present, it is got rid of by treating the urine with acetate of soda and ferric chloride, boiling and filtering.		Occurs when general metabolism is much disturbed, as in phosphorus-poisoning and in profuse suppuration. *See* ALBUMINOID DEGENERATION.

The clinical importance of albuminuria, in its relation to practical surgery, will be seen from the foregoing table to narrow itself to two distinct issues. In the first place, the condition indicates general depression of metabolism both primary and

secondary, and therefore, if general operative measures are in any way contemplated, their performance should depend entirely on the amount of albumin daily excreted on the one hand, and the urgency of the operation on the other. Further, a prognosis as to the chance of the wound healing, the recovery from shock, &c., must also be determined simply by the degree to which the albuminuria extends, compared with the general physical condition of the patient. In expressing these very general conclusions, it is to be understood that the kidneys are supposed diseased in any of the above-mentioned ways, except that by albuminoid degeneration. In this last condition several cases have from time to time been recorded with indubitable accuracy, where there was albuminuria coupled with the other signs of the disease, and yet where recovery has followed even such an operation for complete removal of the diseased part as amputation through the hip-joint. The second point is much more important—namely, the question how far it is advisable to operate upon the urinary tract, where there is coexistent albuminuria. Under the heading URETHRAL FEVER will be found described that condition of the nervous system which is excited by operations on the urethra; the reflex congestion of the kidneys which follows such interference, in a large proportion of such cases, must of course demand special attention when the kidneys are already so degenerated as to admit of the excretion of albumin. As a rule, the precautions described in the article referred to will prevent an untoward result if the albuminuria is slight, such as not infrequently accompanies severe strictures. As most operative measures on the urinary tract, however, are surgical necessities, the fact of coexistent albuminuria will not usually weigh much with the surgeon in deciding what to do, but it should count very heavily in the formation of a prognosis. Indeed, for such a prognosis, the degree of albuminuria must, other things being equal, be regarded as the factor of first importance. *See* ALBUMINURIA.

Sugar.—Of the utmost importance to the practical surgeon is the occurrence of glycosuria, for not only has he then to do with a disturbance of the proper storage and metabolism of the carbohydrates in the body, but, also, has to take into account the great derangement of the general metabolic processes which follows as a secondary result of the circulation of sugar as such, and which is revealed by the clinical observations of emaciation and the often greatly increased excretion of urea. The causes of glycosuria, where the sugar is dextrose, may be tabulated as follows:—

Action of—	
1. General causes	Pregnancy. Suckling. Over-feeding.
2. Lesions of the nervous system	Injuries of the medulla oblongata and base of the brain and cervical spinal cord. Hæmorrhage into parts of the cerebrum. Concussion, with laceration of the brain. Meningitis. Tumours of the base of the brain.
3. Specific diseases	Malaria, cholera, diseases of the liver, diseases of the heart and lungs which produce congestion of the liver—e.g. chronic lung-diseases and tricuspid incompetency.
4. Drugs	Chloral, chloroform, ether, alcohol, amyl nitrite, morphia, curare, &c.

The detection and estimation of the sugar, by means of Fehling's solution, is too well-known to need repetition here. We, therefore, shall pass on to glance at the general effect on the system which is produced by glycosuria, and which necessitates great alteration in the surgical treatment of disease. In the first place, as just remarked with reference to albuminuria, and hinted at in explaining the increase of urea excreted in this disease, the general degeneration of the tissues will render it of course highly advisable not to perform any operation, unless absolutely or urgently necessary, upon a diabetic patient. It is this degeneration of the connective tissues, of the skin, &c., which easily leads to suppuration, boils, &c., commonly attacking these patients. The transitory glycosuria which occasionally attacks members of a glycosuric family, and senile glycosuria also, must be distinguished from the ordinary fatal disease, diabetes, in forming any such conclusions as that above indicated. Very rarely, sugar of muscle, inosite, has been found in the urine.

Chyle.—In chyluria the urine contains a white albuminous fluid, which forms a sort of sediment, partly composed of small cells, &c. In chyluria the coexistence of albumin and fat is of importance, as sug-

gesting at once the true nature of this condition; but it is impossible to confound it with that seen (rarely) after fractures of bones (so-called Lipuria, *vide infra*), the milky emulsion showing that the fluid in the urine is chyle, and not the mechanical mixture of oil and urine about to be described. How the lymphatics come to discharge their contents into the urinary passages is unknown; but both in India and in England (in persons who have been abroad), the *filaria sanguinis hominis* worm has been detected in the blood, apparently possessing a causal relation to the condition. In many cases, however, this factor is apparently wanting, and its pathology remains obscure. Chyluric patients are, by reason of the direct interference with the absorption-power of the lymphatic system, specially bad subjects for surgical treatment. *See* Chyluria.

Fat, or excretion of fat, will readily occur under mechanical conditions which liberate it from its normal position, such liberation being effected by traumatic means. This is not the place to describe in detail the pathology of fat-embolism; but in very severe crushing fractures, where a quantity of bony cancellous tissue, medulla, &c., is injured, as e.g., at the lower end of the femur, fat is occasionally absorbed (of course as oil), and has produced embolism in the lungs, &c. That it should be excreted by the kidneys is not surprising, and more than one author has detected the fat on the surface of the urine. This, however, is not the experience of English observers, and it is yet doubtful how far the kidneys can excrete the fat in such cases. *See* Fat Embolism.

The causes of fat (as such) being present in the urine are—

1. Traumatism of bones.
2. Phosphorus-poisoning.

Very rarely cholesterin has been found in the urine (Salkowski).

Victor Horsley.

URINE, Retention of. *See* Retention of Urine.

URTICARIA (*Synon.* Cnidosis; Nettle-rash).—An acute or chronic disease of the skin, characterised by the appearance of wheals on any part of the cutaneous surface, including the scalp, and occasionally on the mucous membrane of the mouth and throat. Wheals, which are pathognomonic of urticaria, are due to acute circumscribed œdema of the skin, and vary much in size and appearance. They may be no bigger than a split pea, or as large as an egg or more, and sometimes, when closely placed or confluent, may occupy a large tract of the skin (urticaria conferta). Their colour varies with the amount of hyperæmia by which they are accompanied; they are vivid pink, or of a paler red tint, which is not uncommonly limited to the margin of the wheal, the central part being of a bright whitish-grey (U. porcellanea); sometimes the whole wheal is white, and is seated on faintly erythematous, but otherwise normal, skin. They are circumscribed, and project above the surface to a varying extent, being nearly always flattened; but in some cases they are accompanied by œdema of the subcutaneous areolar tissue, and are then not only of large size, but very prominent (U. tuberosa; giant urticaria). When they are situated on parts in which the skin is loose (eyelids, prepuce, scrotum), they give rise to much diffused swelling. In shape they are rounded or oval as a rule, giving rise by confluence to the most various gyrate and map-like figures, but often form prominent streaks, straight or irregular in course. Sometimes, the amount of serum poured out in a wheal is so great as to raise the epidermis in a bleb (U. bullosa), or congestion is so extreme that rupture of capillaries may occur, blood being poured out into the skin (U. hæmorrhagica; purpura urticans). The one character which is common to them all is their evanescence; they appear suddenly, and after lasting a short time (a few hours at most), disappear completely with equal suddenness, leaving absolutely no trace of their existence, the skin on which they were seated returning to a perfectly normal condition, except when vesication or hæmorrhage has occurred.

Wheals are due to a great variety of causes, but in order that these should be efficient there must be a specially irritable skin, or idiosyncrasy, in the affected persons; for, of many subjected to the same conditions, by no means all get urticaria. When this irritability is extreme, simple friction by rough clothing, as flannel, is enough to produce wheals, and they can always be evoked by rubbing with a blunt instrument or scratching (U. factitia). Contact with aniline dyes, exposure to cold, and electrical stimulation, will also produce wheals on specially sensitive skins. All diseases of the skin in which there is much itching are very liable to give rise to urticaria, as scabies, phthiriasis, eczema, prurigo; further, the more direct irritation of the bites and stings of insects, fleas, bugs, gnats, &c., and contact with nettles, may

give rise to more or less extensive outbreaks of wheals. Indirect causes of urticaria are very numerous; the more important are—(*a*) irritation of some part of the mucous membrane of the digestive, urogenital, and perhaps respiratory tracts; thus, outbreaks have been observed to follow dentition, the passage of gall-stones, puncture of hydatid cysts of the liver, intestinal worms, the application of leeches to the os uteri, menstrual irregularities, miscarriage and asthma. (*b*) Certain diseased conditions have been noticed to be frequently accompanied by urticaria; for instance, jaundice, diabetes, Bright's disease, ague, rheumatism and typhoid fever. (*c*) Various articles of food are among the most frequent causes: chiefly shell-fish—as crabs, lobsters, and mussels; eggs, mushrooms and cucumbers; raw fruit—especially strawberries and currants—and various other substances, in specially susceptible persons. (*d*) Many drugs have occasionally given rise to urticaria: as copaiba, cubebs, turpentine and essential oils, capsicum, santonin, chloral, morphia, and salicylic acid. The three last-mentioned groups probably give rise to urticaria owing to the circulation of abnormal materials in the blood. (*e*) Lastly, urticaria may have a purely neurotic origin; it has been noticed to alternate with or replace neuralgia; and mental excitement, the passions of anger, fright, and grief are sometimes the starting-point of severe outbreaks.

Urticaria is doubtless to be looked upon as an angio-neurosis, an irritation of the terminations of sensory nerves in the skin and mucous membranes being followed by reflex spasm of the arterioles in the affected part, and this, again, by paresis, leading to congestion and serous effusion. Accordingly, the microscopic appearances of a wheal are mainly œdematous swelling of the rete Malpighii and of the corium, with a slight accumulation of leucocytes in the latter around the blood-vessels, which are dilated and full of blood at the margins of the wheal, the central parts being anæmic owing to pressure of the effusion; the lymphatic vessels of the part are also dilated and full of corpuscles.

Urticaria consists essentially in the appearance of wheals, which have been already fully described; but the following varieties may be noticed, as their symptoms differ to some extent.

1. Acute Urticaria.—This form is often accompanied by a rise of temperature, preceded by languor, chilliness, &c.; sometimes the fever is very high (U. febrilis), and there may be delirium. The patient is much distressed by sensations of burning, tingling, or itching, which are soon followed by a copious outbreak of wheals, generally affecting a large part of the cutaneous surface, and accompanied by much erythema; when the face is affected much disfigurement results from general œdema. In this severest form of urticaria, which is fortunately rare, the mucous membrane of the mouth, fauces, and pharynx is often implicated; the tongue, uvula, and soft palate become much swollen, and swallowing is rendered difficult. Dyspnœa often is present, especially when the larynx is involved; notwithstanding the severity of the general symptoms, the fever is sometimes very slight. The onset is very sudden, and, happily, subsidence also, a few hours to a few days bringing the attack to an end. The commonest cause of this variety appears to be a severe mental shock; but errors in diet, of the kinds already enumerated, not infrequently give rise to a severe general urticaria (U. ab ingestis), which runs a very rapid course, and may be at an end in a few hours (U. evanida).

2. Chronic Urticaria.—An acute attack, however, not uncommonly passes into a milder condition, without fever, in which wheals continue to appear from time to time on various parts of the body, and this state, with remissions, may continue for weeks, months, or years. The remissions, though usually distinct, are sometimes so slightly marked that there is a practically continuous production of wheals; which, however, retain their distinguishing characters of abrupt appearance and subsidence and short duration (U. perstans; urticatio). This condition is the cause of much suffering to the patient, and may give rise to anæmia and weakness, sleep especially being much interfered with. It has, on rare occasions, been followed by blotchy pigmentation of the skin.

3. Urticaria Papulosa (Lichen urticatus).—This variety is confined to children, and usually occurs in those who are out of health and weakly, but is now and then met with in the robust. It is characterised by the appearance, chiefly at night, of pale red wheals, varying in size from a finger-nail to an almond, scattered over the trunk and extremities, most plentifully on the former. The wheals subside, but leave behind them small pale hemp-seed-sized papules, which are more permanent, lasting several days; these are due to effusion of lymph, and are undoubtedly produced by scratching, as they are found excoriated or

with minute adherent blood-crusts, are intermixed with scratch-marks, and differ in no particular from the precisely similar papules which are met with in scabies, phthiriasis, and prurigo. The disease is very obstinate, and resists treatment, especially when it cannot be associated with digestive derangement, dirt, and bad hygienic conditions.

4. Urticaria Pigmentosa.—This name is given to an extremely rare affection, of which about twenty cases have been described. They all occurred in children, the age of onset varying from a few days to six months; the general health was usually good; the duration of the disease always very long, lasting for years. The lesions met with are of two kinds: (*a*) flat, pigmented, more or less erythematous patches of varying size, not raised, scattered over the whole surface except the palms and soles, most numerous and largest on the trunk; the erythematous patches are constantly the seat of fugitive wheals. (*b*) Raised, pigmented nodules, which are permanent; the distribution is the same. The pigmentation in both varies from buff to light brown, and the wheals, although met with in both, are most characteristic of the first form. The permanent pigmented nodules, although they may occupy the site of wheals, are no longer to be included in this category; they last for many years, and are richly infiltrated with cells.

Diagnosis.—The diagnosis of urticaria need give rise to no difficulty, if it be remembered that wheals are the essential mark of the disease, and that these, however various in aspect, size, and distribution, are invariably characterised by abrupt appearance and subsidence, and by evanescence; further, that itching, stinging, and tingling are prominent symptoms in urticaria, and are absent, or only slight, in other affections to which it bears a superficial resemblance. When the face is attacked, and especially if there be high fever, the œdema of the eyelids and general swelling may be so considerable as to produce a close likeness to erysipelas; the rapid evanescence, the large cutaneous area simultaneously affected, the absence of spreading at the margin, and subsidence without branny desquamation, will be sufficient to distinguish it. The red rash which accompanies acute urticaria may be mistaken for scarlatina; but its occurrence on the face, its more sudden onset, the intense itching, and the absence of the characteristic throat and tongue of scarlatina, are sufficient distinctions, even without the characteristic wheals. Some gyrate and annular wheals are like the lesions of certain varieties of erythema multiforme; but in the latter we have a characteristic localisation, a darker red colour, a greater permanence, and much less itching. The large swellings of erythema nodosum are not unlike the wheals of urticaria tuberosa; but here also localisation, permanence, absence of itching, and especially the characteristic bruise-tints during subsidence, will easily clear up the case. The bullous form of urticaria is not likely to be confounded with pemphigus, if it be borne in mind that in the latter the bullæ appear in successive crops, and are mostly seated on skin which is in all respects normal. Only a careless observer can take the chronic, unchanging, pigmented maculæ and nodules of urticaria pigmentosa, unassociated as they are with any other lesion—except wheals, for infantile syphilis.

Treatment.—The treatment of urticaria resolves itself into discovery of the cause, and its removal when possible; when this cannot be done, the results of medication are often very unsatisfactory, although great improvement may be nearly always obtained and the distress relieved by palliative measures. When the wheals are due to scabies and pediculi, these parasites must be destroyed by the usual methods; the irritation caused by the bites of fleas, bugs, and gnats should be met by removal of the cause when possible, and by the application of a lotion containing bicarbonate of soda, or of sal volatile. If eczema be present, that must be cured first, and, when it is at an end, the urticaria will probably not require much further treatment. The other sources of external irritation, rough flannel in contact with the skin, stuffs coloured with aniline dyes, or even badly-fitting undergarments, which are likely to cause friction especially at the root of the neck, across the shoulders, and around the waist, should be carefully looked for, and rectified when found. The dress of urticarial patients should be neither too light nor too heavy, since both heat and cold are likely to be injurious; for this reason they should avoid crowded hot places, as theatres, and sleep in a cool room, with light bedclothes.

If no external cause can be discovered, we must inquire into the condition of the internal organs, more especially the alimentary canal, and it is here that the irritation which is reflected upon the skin will be very frequently met with; if it be found that any of the articles of food already specified have been recently taken, or that any drug has been administered likely to

cause an outbreak of wheals, these should, of course, at once be stopped. The attack itself is best treated, if seen early, by a quick emetic, such as sulphate of zinc or mustard, and a brisk purge, more especially if the mucous membrane of the mouth and throat be affected; if there is much fever, an antimonial saline will be beneficial, or the administration of alkalies and diuretics, together with fluid food, may be sufficient. When there has been much antecedent dyspepsia, this should be treated carefully, and the diet must be regulated; of course all the articles likely to cause urticaria must be forbidden, and, in addition, coffee, pungent condiments, and stimulants should be excluded; but it is necessary to study the idiosyncrasy of each patient with regard to food, as perfectly harmless substances, such as milk or eggs, will often cause urticaria in the specially predisposed. When tænia or other intestinal worms are present, they must be treated by appropriate means. Locally, lotions may be employed to allay the itching, the best being one of carbolic acid (1 to 40 or 60) or chloral (gr. x. ad f℥j.); alkaline and starch baths are also useful. If the urticaria occurs in association with menstrual irregularities in anæmic and hysterical women, iron is especially indicated, and arsenic is occasionally of value in small doses; but these cases are often obstinate and difficult to treat. When the affection appears in the course of acute disease, as rheumatism and typhoid fever, it requires no special treatment beyond a little soothing lotion, and will subside of itself when the illness which it complicates is at an end.

The same rule applies to cases occurring in association with chronic disorders, as Bright's disease and diabetes; but here, as the irritation is due to the circulation in the blood of abnormal materials which are a necessary concomitant of an incurable condition, it is obvious that amelioration only can be looked for, the urticaria improving *pari passu* with the general health. An acute urticaria due to mental shock will subside of itself, and requires no special treatment beyond a day or two's rest in bed; possibly, a saline purge may be required. Where a purely neurotic urticaria is of intermittent type, quinine, especially combined with hydrobromic acid, and arsenic are indicated; in other chronic neurotic cases much difficulty will be encountered, and the drugs recommended are so numerous that it is plain that all are often unsatisfactory. The following may be tried: Salicylate of soda, tincture of cannabis indica, tincture of belladonna, and bromide of potassium; atropin by the mouth, in doses of 1 to 2 milligrammes (about grain $\frac{1}{100}$ to $\frac{1}{50}$) per diem, has lately been much praised; it is also necessary in these cases that all dietetic and hygienic precautions should be taken, and good results have been stated to follow change of air and scene.

In the treatment of urticaria papulosa, hygienic measures are of the first importance; without cleanliness, pure air, good food, and suitable clothing, but little progress can be made. When these conditions are favourable, treatment should be directed to improving the digestion, which is nearly always faulty, the urine being often loaded with urates, and the stools deficient in bile or otherwise abnormal; a mixture containing bicarbonate of soda in some aromatic water, with or without bismuth, to which bromide of potassium may be added, and occasional doses of grey powder or rhubarb and soda will be found beneficial; while anæmia and debility are best treated by cod-liver oil and iron. If intestinal worms are present, treatment should be directed to their removal. Locally, weak alkaline baths, followed by inunction with oil or vaseline, may be recommended, and, in very chronic cases, an ounce of potassa sulphurata may be added to the bath; if the itching is extreme, a lotion of carbolic acid or some other antipruritic may be used. It should be remembered that the affection is very obstinate, and liable to relapse under any treatment. JOHN CAVAFY.

UTERINE APPENDAGES, Removal of the.—The position of the patient, of the tables, and of the instruments, spray-producer, &c., are exactly the same as for OVARIOTOMY, and need not be again described. The opening in the macintosh sheet which covers the abdomen should be long and narrow: long, because if it be found advisable to remove the tumour a long incision will be necessary; and narrow, to expose as little of the abdominal parietes as possible, so as to avoid chill during the operation. In addition to the instruments required for ovariotomy, a couple of Kœberle's serre-nœuds which have been for some days in carbolic oil (1 to 20), several wires of different lengths and sizes, a pair of special forceps for tightening and cutting the wire, and a strong nickel-plated corkscrew should be at hand. The Nélaton forceps and the vulsellum will not be wanted, and need not be placed in the trays.

An incision three inches long should first be made, so that the hand can be introduced

and the position of the ovaries and tubes and their relation to the tumour ascertained. If the size and nature of the tumour be such as to afford a good prospect of cure from the removal of the appendages, and the relations of the latter to the tumour such that they can be cleanly and safely removed, they should be dealt with just as in OVARIOTOMY and OÖPHORECTOMY; but special care must be taken not to puncture any vessels in transfixing, because it is much more difficult always, and often quite impossible, to apply a fresh ligature on the proximal side of the puncture to stop hæmorrhage from it. Both sides should be securely ligatured, and any sponging of the peritoneum completed before the appendages are cut away, and it is advisable to leave the stumps a little longer than in oöphorectomy.

Supra-vaginal Hysterectomy.—If hysterectomy be decided upon, the incision should be prolonged to the left of the navel, so as to allow the uterus, with tumour and appendages, to be brought out without undue bruising of the edges of the incision. The raising of the mass is often very difficult, especially if it be wedged or adherent in the pelvis; the extraction will be made much more readily if a strong broad-bladed corkscrew be screwed into the fibro-myoma, to serve as a handle to lift it out of the abdominal cavity. Abdominal adhesions should be separated and secured as far as possible before the extraction, and it is much more often advisable to divide them between two forceps or two ligatures than in ovariotomy, the solid tumour allowing hæmorrhage more readily than the collapsed cyst-wall.

As soon as the tumour is extracted, its base must be carefully examined to see whether the appendages can be included in the wire; in some cases it will be better to transfix the broad ligaments and tie them off separately, applying the wire round the uterus where the broad ligaments are cut on each side, or even transfixing the ligaments on each side with the wire. The relation of the bladder to the uterus in front must also be carefully defined before the wire is tightened, and it will often be necessary to make a transverse incision just above its vesical fundus and peel it back, so as to allow the wire to be properly applied. When the wire has been made to encircle the base of the mass in the desired place, generally just above the internal os, it is drawn up as tightly as possible by means of a special pair of forceps, and twisted twice round the knob of the screw of the serre-nœud, and then twice round the stem; the wire is then slowly and carefully screwed up. Haste or undue force may break the wire or cut the uterus, and cause serious hæmorrhage. The wire loop must, of course, be firm, but it is better not to screw it up too forcibly at first, as it can be tightened little by little afterwards as the tissues shrink and when the uterus and tumour have been cut away. When the wire has been screwed up, a long strong pin, with a little looped handle at one end to hold it by, should be pushed through the whole mass just on the distal side of the wire, and its point protected by a little cap which screws on over it. Sponges are then packed round the base of the tumour, and it is rapidly cut away; it is well to leave a large stump at first, as it can be trimmed down after the wire is finally screwed up and the other steps of the operation completed. If the ovaries and tubes are included in the wire (not tied off separately), care should be taken in putting the pin through to make it thoroughly transfix the broad ligament on both sides as well as the uterine stump, and it is advisable also to run a needle, threaded with a strong silk, round the cut peritoneal edge of the broad ligament on each side and into the fibrous tissue of the stump, and thus tie the cut broad ligaments, bag-mouth fashion, tightly to the edges of the stump. Adhesions having been all secured, the peritoneum should now be sponged out, especial care being taken to cleanse the pouch in front, which is practically shut off from the general cavity, when the operation is completed.

The stump is then held up in the lower angle of the abdominal incision and a strong silk suture is passed through the peritoneum and parietes just above it, and at once tied so as to hold it in position. This suture should not be too tight, or it may cause suppuration by tension, but it should be tight enough to keep the peritoneum and other tissues closely applied all round the stump. It is better not to place any suture below the stump. The remaining sutures are now introduced and the wound closed. Drainage by the glass tube is to be especially avoided in this operation, because the mouth of the tube comes out close to the uterine stump, in the centre of which is the opened uterine cavity—a certain source of sepsis; and if the tube is once put in, and requires to be kept in beyond the first two or three days, putrefaction will be almost certain to invade it from the stump. When the abdominal cavity is closed, the stump should be pared down as closely as it safely can be; it is

better to cut out its central solid part, and leave its peritoneal edges rather longer. When it has been sufficiently pared, it is carefully packed round with small pieces of dry carbolic gauze, which should also be placed under the pin and serre-nœud to prevent them from cutting into the skin, as there is frequently considerable pressure upon them in the course of the first week after operation. The raw surface of the stump should be carefully treated with solid perchloride of iron: this dries it, and prevents it from decomposing. Of course, care must be taken not to put on so much iron that it can, before the peritoneum has sealed, trickle beside the stump into that cavity; but the surgeon who allows this must be a very clumsy manipulator.

In ordinary cases, especially when adhesions are absent and the appendages can be included in the wire of the serre-nœud, the operation of supra-vaginal hysterectomy is an extremely simple one, and far easier than a difficult ovariotomy, or than any operation for the removal of the uterine appendages; but in cases with many adhesions, or in which there is a broad base requiring enucleation from the broad ligament before the wire can be applied, it may be an exceedingly difficult one. The hæmorrhage from adhesions and during enucleation is often very profuse, and may try the nerve of the bravest surgeon. In dressing the wound after operation, the upper part of the incision should be dressed with a separate dressing, and then the lower straps and the dressing over and round the stump can be changed as often as is necessary, while the main part of the incision can be left undisturbed, as in ovariotomy, till it is time to remove the sutures. If the stump be carefully treated with perchloride of iron at the time of operation, the first dressing may be left on two days, then changed under the spray, the screw tightened, the stump clipped and redressed with iron, and this may be repeated every second day, until very little of the stump remains to separate or cut off when the serre-nœud and pin are removed. Sometimes, the wire cuts through in a couple of weeks, and the serre-nœud, pin, and stump are found loose under the dressing, but more often it is necessary to cut through the wire and remove it about that time, and clip away the dead stump. Care is required, in doing this, to avoid cutting into living tissue, or very severe hæmorrhage or serious septic absorption may result. Even when cutting in the slough, the mucous membrane lining the remains of the uterine cavity will often be still living, and bleed so as to require the application of a little fresh iron.

After the removal of the serre-nœud, &c., or its natural separation, the stump sinks deeply and forms a cone-shaped depression which heals slowly by granulation. If the drag on the stump has been great, it may tear the tissues which have adhered round it as it sinks, and some hæmorrhage may occur, or still more dangerous septic absorption; and whenever this seems probable, it is well to touch the granulation-tissue all round with the perchloride of iron: this at once checks any oozing and seals the small vessels. Various other methods of treating the stump have been tried, but none is so sound, both in theory and practice, as the use of the perchloride when it is properly applied.

Wire clamps and serre-nœuds of various kinds have also been invented, and the old ovariotomy clamp has still its advocates; but the Kœberle serre-nœud is infinitely easier of application, simpler, cleaner, and more efficient than any of them.

The method above described is called the extra-peritoneal, in contradistinction to the various methods of ligature of the stump with suture of flaps, and dropping it into the peritoneum. The fatal objection to all the intra-peritoneal methods is, that in the opened uterine cavity of the stump there is a putrefactive centre, and, however it is treated, it is impossible to be quite sure that it is rendered aseptic or thoroughly shut off from contaminating the newly-cut surfaces. The most dangerous of these methods is undoubtedly the imitation of the practice in ovariotomy—i.e. transfixion, ligature, and simple dropping of the stump. In this method the putrefactive centre is left in the middle of half-strangled uterine tissue, actually open in the peritoneum; and the terrible mortality of the procedure makes it quite unjustifiable.

Schrœder has proposed and practised, with considerable success, the following method: the appendages are ligatured off, and a strong elastic ligature is temporarily placed round the uterus instead of the wire; the tumour is cut away, and a V-shaped piece is cut out of the centre of the stump; the cavity is cleaned or cauterised with strong carbolic acid solution (1 to 10); the mucous edges of the cut cavity are sutured together at the bottom of the V, and the sutures cut short; successive rows of sutures are then applied, cut short, and covered in by the succeeding rows until the peritoneal edges are reached and sutured. The elastic ligature is then

removed and the stump dropped in. The objection to this method is, of course, less than to the simple ligature mentioned above, but the cleansing of the uterine cavity must be imperfect and uncertain, and the sutures in the cut edges of the uterine cavity are very liable to absorb putrid material, and become so many centres of septic infection. The enclosing of successive rows of short sutures in dense tissues, without provision for escape of effused products, is also objectionable. In cases in which it is impossible to bring the stump outside with the wire and pin, this is doubtless the next best method.

In some cases, it may be necessary or advisable to employ both methods, bringing the central stump out with the serre-nœud, and closing large cavities in the broad ligament, left by enucleation of the base of the tumour, with sutures. It is, however, still an open question whether it is not better to secure all bleeding points and allow the edges of the cavities simply to fall together, so as to avoid collections of fluid in closed spaces, the serum running into and being rapidly absorbed by the peritoneum if it is allowed free access to that cavity.

Another extra-peritoneal method, which has succeeded well in Germany, is the replacing of the serre-nœud by the elastic ligature, the stump still being pinned outside and treated with chloride of zinc.

If it be absolutely necessary to use the glass drainage-tube in any of these operations, its mouth should be shut off as much as possible from the stump and wound by being made to project through a pure rubber sheet, which grasps its collar tightly and is filled with carbolised sponges, to take up the discharge as it overflows from the tube.

Whether a cure be brought about by removal of the uterine appendages, or by some method of hysterectomy, it is clear, from recent results, that a new and successful era has dawned in the surgical treatment of uterine tumours.

J. Knowsley Thornton.

UTERINE TUMOURS.—Fibro-myomata, fibro-cystomata, polypi, sarcomata, and the various forms of carcinoma, are all of great importance, as their presence necessitates some of the most formidable operations which the surgeon is called upon to perform. They vary so greatly in their causes, symptoms, diagnosis, and treatment, that general remarks upon them are of little value, and each is therefore discussed separately.

Fibro-Myomata, as their name indicates, are composed of fibrous tissue and unstriped muscle-cells, the relative proportions of these tissues varying much in different growths.

Cause.—There is but little, if any, definite knowledge of the causes which excite the growth of these tumours; probably, they owe their origin to prolonged congestion and inflammation of the uterine walls, and anything which produces these pathological states may start their formation. Irregularities of menstruation, displacements of the uterus, and mechanical injuries, are exciting causes. Single and married women are both liable to them, but married women are their more frequent hosts. Married women, who are childless, more often have large tumours than those who have borne children; but this may be in part, at any rate, due to the fact that the involution of the uterus, which follows childbirth, frequently causes the absorption and disappearance of these growths. Small fibro-myomata, which would have grown large in single or sterile women thus disappear, probably in many cases without their presence ever having been detected. Their presence may also cause sterility.

Pathology.—The appearance on section, and the density of a fibro-myoma, vary according to the relative proportion of fibrous and muscular tissue which it contains: when the former predominates it is glistening, white, and hard, cutting like cartilage; when there is a preponderance of the muscular element it is soft and red-looking (fleshy). The substance of the growth is but sparingly supplied with blood-vessels, but large vessels ramify over its capsule, from which it appears to derive much of its nutrition. There is usually one point at which its tissues are directly continuous with those of the uterine wall, and here such blood-vessels as it possesses enter; hence, the broader this base the greater the vascularity of the growth, and, as a rule, also, the more pronounced its muscular element. Generally, there is a distinct capsule of areolar tissue, but sometimes the growth seems merely to occupy a hollow space among the proper tissues of the uterus. Lymphatic spaces are sometimes found between the bundles of fibrous and muscular tissue, and nerves have been traced into the substance of the tumours.

There are three chief varieties named according to their relation to the proper uterine tissues—subperitoneal, interstitial or mural, and submucous. The first and last may be either pediculate or sessile. The subperitoneal are the slowest in growth and usually the least dangerous, as they do not,

as a rule, enlarge the uterine cavity, and do not give rise to hæmorrhage; they are apt, however, to cause ascites from mechanical irritation of the peritoneum, and, from the same cause, form adhesions to surrounding organs. The interstitial and submucous both enlarge and deform the uterine cavity; the former are often a cause of much pain, and the latter of serious hæmorrhage. All varieties are liable to degenerative changes —cystic, calcareous, and suppurative—and the submucous are apt to cause necrosis of the mucous membrane, and then slough themselves. The interstitial variety often cause very considerable hypertrophy of the whole uterus, and thus produce hæmorrhage of a different kind from that due to the submucous. All much more commonly affect the body of the uterus than the cervix, and the almost pure myoma is commonly situated in the fundus.

Symptoms and Diagnosis.—The chief symptoms which indicate their presence are disordered menstruation, especially menorrhagia and metrorrhagia, pelvic pain, and a sense of fulness and bearing down, vesical and rectal troubles, nerve pains in the lower extremities, and œdema of feet, legs, or vulva. Some one or all of these symptoms may be present while the growths are comparatively small, and may disappear with the later symptom of abdominal enlargement, just as like symptoms disappear when the pregnant uterus rises out of the pelvis. In a large number of cases they produce no symptoms at all, and sometimes they attain an enormous growth without the patient knowing that there is anything wrong.

The diagnosis of their presence must be made chiefly by their physical examination by the vagina, by the rectum, and externally, and by a combination of these methods; the symptoms to which they give rise being also useful as corroborative of the more definite physical signs. The latter are their consistence, their continuity with the uterus, and their relations to neighbouring organs which are found to be healthy. The differential diagnosis has already been given, to some extent, under Ovarian Tumours, as they have to be differentiated from the same morbid conditions there described. In the majority of cases, anyone with fair experience and careful examination will find no great difficulty; but, when they are small and confined to the pelvic cavity, it is sometimes quite impossible to be absolutely certain. The uterine sound, denoting the length of the cavity, is useful for the interstitial and submucous varieties, but is of little use for the subperitoneal, as the cavity is with them often normal, and moving them in the abdomen does not affect the sound *in utero* more than the same moving of an ovarian tumour with a short pedicle. The sound should always be used with extreme care or it may give rise to very dangerous hæmorrhage, or, by perforating a thinned mucous membrane, cause sloughing of the growth and septicæmia.

Treatment.—If it be thought advisable to remove a subperitoneal fibro-myoma which has a pedicle, the operation is exactly the same as Ovariotomy. The extraction of the large solid growth will probably require a longer incision, and may be facilitated by screwing a strong corkscrew into the growth, and using this as a handle to lift it out of the peritoneum. The pedicle should be firmly tied by a No. 4 silk ligature, and the ends of the ligature should then be threaded into a strong straight needle, and passed through the pedicle on the distal side of the first tie, and then again firmly tied round each half of the pedicle. By this method any oozing from the transfixion puncture is avoided.

If the pedicle be very thick, it may be prepared for the silk ligature by having an elastic ligature first applied, or the wire of a serre-nœud firmly screwed up, and then the silk is tied in the groove thus formed, the elastic ligature or wire having been first removed.

If the pedicle be too thick to admit of this treatment, a temporary elastic ligature should be applied round the body of the uterus, the tumour cut away, and two flaps formed out of its pedicle or its base in the uterine wall. These flaps should then be brought together by a succession of rows of fine silk sutures, the first row being applied at the bottom of the angle between them; the flaps are cut short and covered in by a second row applied in the middle of the flaps, and these again are covered in by a third row applied to the peritoneal edges (Schrœder's method). In cutting the flaps, care should be taken not to cut so deeply as to open the uterine cavity.

Submucous fibro-myomata which bulge much into the uterine cavity, especially if the mucous membrane over them has necrosed, may be removed by enucleation. The cervix is dilated by Hegar's dilators, the capsule of the tumour is incised, and the growth is enucleated by the operator's fingers, which may be aided in some cases by Thomas's spoon-saw. If the base be very broad, it may be necessary to divide it

with the écraseur. Bleeding points may be touched with perchloride of iron, or compressed with long pressure-forceps, and the cavity stuffed with plugs of iron cotton. A very efficient method of checking oozing, and at the same time securing asepticity, is to plug the cavity with a sponge squeezed out of tincture of iodine. If this be used, it must be long enough to project through the cervix, or it may be drawn within the cavity, when the cervical canal will close and its extraction will be a matter of much difficulty. If it be left projecting well into the vagina, the uterus will expel it in the course of twenty-four hours, or it can be easily drawn out. In all cases, full doses of ergot should be given for the first few days after enucleation, and the vagina must be frequently syringed out with some antiseptic solution.

If the submucous tumour has a very broad base, and is deeply bedded in the uterine wall, it is better to treat it in the same way as the intramural variety—i.e. by the removal of the uterine appendages.

If an intramural fibro-myoma, a submucous fibro-myoma, or a general thickening of the uterine wall be thought to necessitate operation, the removal of the uterine appendages is the operation to be recommended. *See* Uterine Appendages, Removal of the.

In advising this operation, however, it is necessary to explain to the patient that, though it will probably cure, the process is a gradual one, and, also, that after the abdomen is opened the relation of the ovaries and tubes to the tumour, or the adhesions they have formed, may be such as to render the operation impossible, or to make it more difficult and dangerous than the complete supra-vaginal ablation of the organ (supra-vaginal hysterectomy). In ordinary cases, the operation of removal of the appendages is a much less dangerous one than a complete supra-vaginal hysterectomy, but it should always be left to the discretion of the surgeon which operation he will employ, when he has opened the abdominal cavity and thoroughly examined the tumour.

Fibro-Cystomata.—These are rare, and usually arise from softening of a fibro-myoma, the fluid being contained in spaces between the bundles of fibrous or muscular tissue, and large cavities being formed by the absorption of the intervening trabeculæ. In another form the fluid gathers in lymph spaces, and the cavities are lined with endothelium.

The symptoms are identical with those which arise from the presence of the solid growths, except that the fibro-cysts expand very rapidly. If an old fibro-myoma begin to enlarge quickly, it may generally be inferred that it is becoming cystic.

The diagnosis, except in this last form, is very difficult, as fibro-cystoma closely simulates ovarian tumour. The uterine sound may in some cases aid in the formation of a correct opinion. It is not a matter of much moment, as their rapid growth renders it necessary to remove them whenever possible. The operation for their removal corresponds with that for the removal of fibro-myomata, except that they may be reduced by tapping before extraction. Sometimes they are pediculate, and sometimes they may be enucleated, but more often it is necessary to perform complete supravaginal hysterectomy.

Polypi. — Submucous fibro-myomata, which are in process of spontaneous enucleation, may become polypoid (fibrous polypus). They are often very large, distending the uterine cavity or the vagina, or even protruding from the vulva. They are rounded or pyriform in shape, and usually have a smooth covering derived from the mucous membrane of the uterus. The base may be broad and thick, or so long and narrow that the growth is entirely extruded, only its stalk remaining in the cavity of the uterus. As they are not very vascular, the base or stalk rarely contains any large vessels.

Mucous polypi are rarely of large size, and are more often developed from the endometrium than from the cervical mucous membrane. Their structure corresponds with that of the mucous membrane from which they spring, and they are extremely vascular. Pediculate Nabothian follicles and placental polypi are also occasionally met with, and their names sufficiently indicate their origin.

The submucous polypi may degenerate into sarcoma or be sarcomatous from the first, and are then apt to recur after removal. The mucous polypi are also liable to both sarcomatous and carcinomatous degeneration.

Symptoms.—Sometimes polypi give rise to no symptoms, or simply to some sense of irritation and discomfort, or they cause leucorrhœa or dysmenorrhœa, but their most serious and common symptom is uterine hæmorrhage; this may merely show itself as menorrhagia, or metrorrhagia, or there may be a constant bloody discharge.

Sterility may be caused by their presence, or, if pregnancy occur, they may greatly impede delivery.

Diagnosis.—When they are still contained in the cavity of the uterus, it may be impossible to differentiate them from other conditions causing like symptoms, and the cervix must be dilated for their discovery. When they protrude through the external os, they are readily recognised either by touch or sight. An inverted uterus may be mistaken for a fibrous polypus, but a careful examination of the relations of the mass at its neck, and the passage of the sound into the uterine cavity, should render the differential diagnosis easy.

Treatment.—When dilatation is necessary, the polypus should be removed at the same sitting, and it may be either twisted off, cut off with scissors, or with the écraseur, according to the size and vascularity of its neck. The mucous polypi may usually be twisted off, but if large should be tied, as they are very vascular. After removal of the growth, the uterine cavity and cervical canal should be cleansed with tincture of iodine, and it may be necessary to adopt some kind of plugging, as described after the enucleation of a submucous fibro-myoma. If the polypus be so large as to block the vagina and distend the vulva, it may be necessary to cut it up with the chain écraseur, and remove it bit by bit in order to obtain access to its pedicle.

There are various methods of dilating the cervical canal. It may be dilated slowly by sponge, or tangle, or tupelo tents, or it may be dilated at one sitting by graduated bougies or dilators, the patient being in the lithotomy position and anæsthetised. The latter is far the safest and most satisfactory method, and is much pleasanter for the patient. Hegar's dilators are the best, and full dilatation may generally be obtained in about an hour. The uterine cavity should always be sponged out after their use, first with dry cotton on a Playfair's probe, and then with cotton that has been dipped into tincture of iodine. The vagina should be frequently syringed with some antiseptic solution till all discharge ceases.

Some operators prefer the Sims position, but the lithotomy position is much more convenient for the operator, and it dispenses with the need for the use of a speculum.

Sarcoma.—Sarcoma of the uterus is met with in two forms—the diffuse and the circumscribed, and differs from carcinoma in that it more often affects the body than the cervix.

The diffuse form arises from the subepithelial connective tissue, and grows in rounded nodules which project into the cavity, causing softening and disintegration of the mucous membrane, which is liable to carcinomatous degeneration; and this causes a complication which is very likely to mask the original disease. The circumscribed form occurs more often in the uterine wall, and differs from fibro-myoma, as it has no capsule.

By some these uterine sarcomata are believed only to occur as degenerations of pre-existing fibro-myomata, but this is very unlikely, as there is no reason why sarcoma should not grow from the cellular tissue of the uterus as well as from that in other situations. The round-cell sarcoma is the most common form, but other varieties are occasionally met with. The only cure for sarcoma is, as for carcinoma, the complete extirpation of the uterus.

Myxoma is also found, and may be a degeneration of the connective-tissue elements of a fibro-myoma, or be mixed with the ordinary sarcoma, as in other situations. The myxoma is of special interest to the surgeon, because this form of tumour is not amenable to treatment by the removal of the appendages, but may be dealt with by supravaginal hysterectomy if it is entirely confined to the body of the uterus, and the same treatment may cure the circumscribed sarcoma if the operation be performed early enough.

Carcinoma.—There are three varieties of this disease which are generally recognised as affecting the uterus—encephaloid, scirrhus, and epithelioma. The two first are really the same disease, but the encephaloid is softer and more rapid in its progress from the predominance of the cellular elements; while the scirrhus form is harder and slower in its progress, the fibrous element being more marked than the cellular. Epithelioma also occurs in two forms, one flat and the other papillary; the former occurs chiefly in the cervical canal and in the interior of the uterus, and the latter more often at the os, projecting into the vagina as the well-known cauliflower excrescence. All varieties of the disease attack the cervix much more often than the body of the uterus.

Causes. — Heredity is a predisposing cause in from seven to ten per cent. of all cases. Age is also a predisposing cause, the vast majority of cases occurring between thirty-five and seventy-five, the mean between these extremes being the most common period for its occurrence. Anything which greatly depresses the vital powers also appears to predispose to the disease.

Married women who have borne many children or who have had many miscar-

riages are especially liable to uterine cancer, particularly if the births or miscarriages have followed one another very quickly. It is commoner among the poor than among the rich. Erosions and lacerations of the cervix and chronic uterine catarrh also favour the production of this disease.

Pathology.—There is wide difference of opinion as to the pathology of uterine cancer. Virchow and his followers, among whom Ruge and Veit must be specially mentioned, believe that it has its origin in the connective tissue; while Thiersch, Waldeyer, and others believe that it grows from the epithelium, and they are again divided in opinion as to the exact layer of epithelium from which it springs.

Symptoms.—These, of course, vary according to the stage, situation, and variety of the disease. In the early stages, hæmorrhage, and pain in the back, pelvis, and down the thighs are the prominent symptoms. Later, when ulceration has commenced, watery discharge, wasting and general debility, disturbance of the digestive organs, yellowness of the skin, and special pains according to the organs which are implicated, notably of the bladder and rectum.

In the still more advanced cases, dribbling of urine, escape of fæces from the vagina, hydronephrosis from obstruction to the ureters, or jaundice from secondary deposits in the liver, herald the fatal termination. Peritonitis, sudden and severe hæmorrhage, or thrombosis are among the rarer accompaniments of advanced disease.

Exhaustion, uræmia, septicæmia, peritonitis, hæmorrhage, and thrombosis are the common causes of death, the two first accounting for the larger share of the mortality.

Diagnosis.—In the early stages the diagnosis is often extremely difficult, especially in the rare cases of cancer of the body.

The early stages of cervical cancer will have to be diagnosed from mere inflammatory induration with erosion, from syphilitic ulceration, from simple hypertrophy of the cervix, from lupus, from sloughing polypi or fibro-myomata, from retained portions of placenta or membranes, and from sarcoma. If the disease be in the body, it may be necessary to dilate the cervix and scrape out a small portion for microscopical examination, and, if in a more accessible situation, microscopic investigation will alone give a certain diagnosis.

Careful examination of the pelvic tissues surrounding the uterus, made both by the vagina and rectum, is also important.

Treatment.—This is either palliative or radical; the former belongs rather to the physician, but may be briefly referred to.

The local application of iron or of other styptics and astringents will be useful for checking hæmorrhage, also cold applied to the vulva and cold water injections, ergot and gallic acid internally; plugging the vagina may be necessary, or the use of strong caustics or of the actual cautery. Offensive discharge must be treated by frequent antiseptic injections. Pain must be relieved by the hypodermic injection of morphia, by atropine and morphia combined, by chloral, and by sedative pessaries. Iodoform is reputed to be useful both for relieving pain and as an antiseptic. Chloride of zinc is valuable both as a caustic and as a disinfectant.

J. Knowsley Thornton.

UTERUS, Extirpation of the.—*Abdominal Operation* (Freund's).—The usual incision having been made through the parietes and the peritoneum opened, the intestines are drawn out of the pelvis, the broad ligaments are transfixed on each side by three ligatures which are made to interlock when tied; the first loop passes through the ovarian ligament and edge of the peritoneal covering of the Fallopian tube and secures the ovarian vessels, the second loop passes through the round ligament and secures the *pampiniform plexus*. When the first two loops have been tied on each side, the ovaries and tubes are cut away, and the uterus is firmly drawn up out of the pelvis by a ligature passed through the fundus, or by a special forceps, and a transverse incision is made through the peritoneum between the uterus and bladder; the latter is then peeled back, and the incision carried through into the vagina. The uterus is then held forwards, and the peritoneum divided transversely behind to the same extent as in front, and the vagina opened into through the pouch of Douglas. The uterus is now merely held by small portions of tissue on each side, which contain the uterine arteries, and the third loop of the broad ligament ligatures is passed through on each side into the vagina, or from the vagina by a special grooved needle, and tied round the tissues containing the uterine arteries; these small bridges of tissue on each side are then cut through and the uterus removed. If the vagina is large enough to allow the separated uterus to be drawn through it, it is better to remove it by that outlet than through the abdominal incision, as there is less chance of fouling the wounded tissues

and peritoneum with the cancerous discharge.

The various steps of the operation will be facilitated by inserting an india-rubber bag, with a tube to it, into the rectum, blowing it up and tying the tube; this raises the uterus and appendages out of the pelvis, and may enable the operator to dispense with the use of the transfixing ligature or forceps to draw up the uterus. Both these are to be avoided if possible, as the punctures they make may allow putrid fluid to ooze through on to the peritoneal surfaces, whilst manipulating the organ during the various steps of the operation.

When the uterus has been removed, any bleeding points, not already secured by the transfixing ligatures, are tied with fine carbolised silk ligatures with their ends cut short; a large T-shaped rubber drainage-tube is then placed in the deep parts of the wound with its central limb protruding through the vagina, and the edges of the peritoneal wounds are brought together by points of interrupted suture, so as to shut out the tube and deeper raw surfaces from the peritoneum; the abdominal incision is then closed in the usual way. In his later operations Freund has abandoned the peritoneal suture, and leaves the ligatures which transfix the broad ligaments uncut, and hanging out in the vagina. It is, of course, advisable to thoroughly cleanse the vagina, before the operation, with a strong antiseptic irrigation, and the cervical canal may be packed with cotton or sponge soaked in a strong antiseptic such as tincture of iodine. These are necessary precautions, but they cannot be depended upon for preventing the access of septic material to the wounded surfaces, sponges, or peritoneum during the progress of the operation, and the use of the spray and full Listerian precautions are therefore not of the same importance as in other abdominal sections, in which fresh and pure surfaces only are dealt with.

Various modifications have been suggested in the method of applying the ligatures, but they are unimportant, and space will not allow their discussion. In some cases the vessels may be ligatured as they are divided, and if there is a flaccid abdomen and roomy pelvis, this modification may be found possible, and has the great advantage of avoiding the ligature of masses of tissue along with the vessels.

Vaginal Operation (Schrœder's).—The vagina and uterus having been thoroughly cleansed with strong antiseptic solution, and the patient placed in the lithotomy position in a good light, the operator seats himself in front of the perineum with his back to the window. Seizing the cervix with a strong vulsellum, which he hands to an assistant to hold, he cuts through the vaginal mucous membrane all round the cervix, giving the disease as wide a berth as possible. The pouch of Douglas is then opened, and two fingers, passed in and over the fundus uteri to the front, enable the opening into the vagina to be safely made between the uterus and bladder; the fundus is then retroflected and forced into the vagina through the opening in the pouch of Douglas. The broad ligaments are now transfixed and ligatured on each side, and the uterus is drawn down, separated from them, and removed. Any bleeding points are separately tied and a T-shaped drainage-tube introduced; the broad ligament pedicles are secured in the angles of the wound by a point or two of suture on each side, or the wound may be left altogether open, the drainage-tube being merely packed round with antiseptic cotton or gauze. One great objection to this operation is that the ovaries and tubes are usually left behind, because if they are removed there is not room to securely ligature the broad ligaments, and secondary hæmorrhage may ensue. The leaving of the ovaries is not a matter of much consequence, but the tubes are structures in direct continuity with the uterus and its lining membrane, and leaving them is a fundamental breach of the law which governs all operations for the removal of malignant disease. Structures in continuity with the diseased parts, or, in other words, the entire organ diseased, should always be removed, or operative procedures are not justifiable. The great danger, in both the abdominal and vaginal operations, is the risk of including the ureters in the ligatures which secure the uterine arteries. That this is a real danger the autopsies of fatal cases abundantly prove. Septicæmia is another great danger, and in dealing with necrosed cancerous tissues it is often impossible to avoid infection of the wounded surfaces; hence, free drainage is an essential in these operations, and antiseptic irrigations should also be employed.

The vaginal operation is decidedly the simplest and least fatal, but a serious objection to it has been pointed out above, and, at present, the ultimate cures are so few that the results of the operation cannot be pronounced encouraging. Time alone can decide whether complete extirpation of the uterus for cancer is destined to establish for itself a permanent place in surgery, or

is to sink into oblivion again, as it has already done in the past, after a very decided attempt to establish it, though not on such a careful and scientific basis as in the present revival of the operation.

Partial Operations.—The above operations are, of course, the only procedures possible when cancer invades the body of the uterus, but in the commoner forms of epithelioma which attack the os and cervix, partial operations will often give much relief and decidedly prolong life, while at the same time making it, while it lasts, tolerable both to the patient and to her friends.

The cautery, caustics, the écraseur, the scissors, and the knife each have their advocates.

The method introduced by the late Marion Sims is on the whole the best. The diseased parts are freely cut away with the scissors, then the raw surface is curetted till healthy tissue is reached, and the cavity left is packed with iron cotton (subsulphate of iron one part to two of water) and the vagina plugged with antiseptic wool. Iodoform gauze is also an excellent material. In forty-eight hours the plugs and iron are removed, and the cavity carefully packed with cotton wrung, almost dry, out of a solution of equal parts of chloride of zinc and water. The vagina and surrounding tissues are protected by being smeared with equal parts of vaseline and bicarbonate of soda, and the vagina packed with plugs of wool wet with a solution of the latter drug. After the removal of these plugs, which may be safely left in position for four or five days, as the chloride of zinc is a powerful antiseptic, the vagina is frequently syringed with an antiseptic solution. In due time a thick white slough of the wall of the cavity separates, either gradually or in a large cast; the raw surface is then carefully examined, and, if any suspicious points are seen, they are again packed with the chloride of zinc cotton. Then, from time to time during cicatrisation, the surfaces are carefully examined, and if necessary a further application is made. In ordinary cases but little risk attends this procedure, and very satisfactory results are often obtained. Care must be taken, however, not to leave the iron cotton too long, or septicæmia may result, as mixtures of blood and iron seem to have a special tendency to rapid putrefaction when wet. A good substitute for the iron solution is the ordinary 1-20 carbolic lotion, saturated with pulverised alum. Hæmorrhage is rarely troublesome, but it may be necessary to use forceps or the actual cautery to some of the bleeding points, before packing in the iron cotton. If the disease be very extensive, and the cutting and scraping carried far into the cavity of the uterus, care must be taken in packing with the chloride of zinc, or the thin shell of uterine tissue may be perforated and fatal peritonitis result. In cases in which much of the uterus has to be cut or scraped away and the operation is prolonged, very alarming collapse sometimes comes on.

Schrœder has introduced two other partial operations, which are worthy of notice, and are applicable according to the extent to which the disease has penetrated the cervical tissues.

Amputation of the vaginal portion is performed by dividing the cervix deeply with scissors on each side, so as to form an anterior and posterior lip, then removing a wedge-shaped portion from each of these artificial lips, and uniting the flaps with sutures. The lateral incisions are also sutured. Supra-vaginal amputation of the cervix is performed by drawing the cervix down with a vulsellum, dividing the vaginal mucous membrane round the base of the anterior lip into the cellular tissue, and peeling back the bladder, which carries with it the ureters; then carrying the cervix forward, and incising the mucous membrane of the posterior fornix till the ends of the incision meet those made in the anterior fornix; then clearing the sides of the cervix. This is more difficult, as the cellular tissue is dense, and larger vessels are apt to be divided and should be ligatured. The cervix is cut out by the knife in a wedge shape, and the anterior cervical wall is sutured to the anterior vaginal wall, and the posterior cervical wall to the posterior vaginal wall. The lateral wounds are closed with sutures deeply placed, so as to control hæmorrhage.

In some cases, the pouch of Douglas is opened and a portion of it may have to be excised with the cervix. Schrœder had thirty-three immediate recoveries out of thirty-seven operations, so that the operation is not so dangerous as it would appear likely to be. J. Knowsley Thornton.

UVULA, Diseases of the.—The uvula in its normal state consists of a thin mucous membrane superficially, a subjacent layer of racemose glands, and the fasciculi of the 'azygos uvulæ' muscles in the centre. Its physiological variations with regard to form and size are considerable, and it may be congenitally deficient, or may present a median fissure in consequence of a failure

in the union of its component halves during the process of development.

As a dependency of the velum palati it is liable to all the affections of that structure (*see* PALATE), and morbid conditions, extending from adjacent parts, may induce a special train of symptoms referable to the uvular lesion, or may become almost entirely confined to the appendage. It may also become involved in more general or remote diseases, sharing in the manifestations of anæmia, hyperæmia, and anasarca; deflected to one or other side in facial palsy, or hanging powerless in bulbar and some other paralytic complaints.

The diseases of the uvula which require a separate consideration are atonic relaxation, chronic inflammation ('hypertrophy'), and certain neoplasms.

Atonic relaxation of the uvula depends upon partial or complete loss of power in the azygos uvulæ, a condition favoured by muscular debility, and usually excited by excessive use of the voice, as in singers, public speakers, &c.

The affection, when unassociated with inflammation, often escapes recognition, since the organ may present no alteration of appearance beyond an increase in length. It will, however, be found that, during contraction of the muscles of the velum in phonation, it hangs almost or quite motionless; while the patient observes that his voice has lost both strength and quality. In some cases, nausea and paroxysms of coughing may be induced by contact of the flaccid appendage with the pharynx or glottis.

In the treatment of this disorder, repose of the affected parts, the local use of astringents, and the internal administration of tonics may be sufficient to effect a cure; but, should these measures fail, the superfluous length of the organ must be cut off. This operation may be effected (after the parts have been rendered anæsthetic by cocaine, if necessary), with a pair of ordinary blunt-pointed scissors, while the extremity of the uvula is held with forceps; or use may be made of specially constructed 'uvula scissors,' which seize the part to be removed at the moment of cutting. It entails no bad after-results, and, although some trouble has arisen from hæmorrhage in exceptional instances, the loss of blood is usually limited to a few drops. Should it be necessary, the bleeding may be checked by the application of a piece of lint steeped in a strong solution of perchloride of iron.

Chronic inflammation or '*hypertrophy*' of the uvula is an occasional result of repeated catarrhal affections of the parts. The uvula undergoes a persistent enlargement, assuming in some cases the size of a thumb, and reaching down to the orifice of the glottis. The mucous surface is usually red and dry, and the muscular movements are impaired or lost. Histological examination has shown that the morbid changes are principally located in the submucous tissue, which becomes enormously thickened by inflammatory proliferation, and the papillary layer of the mucous membrane is slightly increased in depth. The muscular and glandular elements are little altered.

The effects are very variable. In some cases, the enlargement may attain considerable proportions without entailing any inconvenience, but in others a distressing train of symptoms may follow: a sense of discomfort in the throat, as from the presence of a foreign body; severe attacks of coughing, especially on rising in the morning and lying down at night, and on exposure to cold or after exertion of the vocal organs; and the voice may become harsh or hoarse and more or less enfeebled. The cough is usually of a peculiar character—remarkably metallic and barking, paroxysmal, difficult to check when the fit is established, and liable to terminate in sickness, but there is little or no expectoration unless the condition be complicated with laryngeal or bronchial catarrh. Occasionally, the contact of the swollen appendage with the back of the pharynx may induce frequent hawking and retching, or even vomiting; and, where the extremity of the uvula extends as far as the glottis, violent suffocative paroxysms may be superadded.

In this state the patient may continue for months or even years, alarming himself and his friends by an incessant cough, the noisy character of which is popularly supposed to be of dire portent; incapable of exercising his vocal functions without distress; and consuming numberless bottles of useless expectorants; until the real nature of the complaint is detected and proper measures employed, when the symptoms are ended by an apparently magical cure.

The treatment is that of simple relaxation—rest to the voice, local astringents, tonics, and, should they fail, amputation of the appendage. The morbid dilatation of the vessels may give rise to some little bleeding when the redundancy is cut off, but this will yield readily under the application of styptics.

Neoplasms. — The only tumours that have been found localised to the uvula are small papillomata and polypi, both of which may be removed by the scissors.

WILLIAM ANDERSON.

V

VACCINATION is the inoculation of the virus of cowpox. Cowpox is a vesicular disease of the cow, the vesicles appearing on the udder and teats of milch cows, and more frequently on young animals than on those which are older. Observers describe the incubation-period of the so-called natural disease to be usually of three or four days' duration, while that which is known to be transmitted by inoculation by milkers is believed to be two or three days longer. Apart from this difference, the subsequent local manifestations are identical: a papule forms which develops, and, at the end of three or four days more, becomes vesicular and umbilicated. During each subsequent day the vesicle increases in size, and, on the tenth or eleventh day or earlier, an areola forms which gradually extends, while the contents of the vesicle become cloudy and purulent and the vesicle loses its umbilication. From this time a crust forms over the surface, the vesicle becoming dried up and disappearing, the crust remaining for five or six days before it is finally shed.

The apparent difference in the incubation-period, between the natural and inoculated cowpox, is probably due to the fact that the moment at which inoculation takes place could not be ascertained, and if this explanation be accepted, the probability becomes greater that the disease is communicated by inoculation alone; later, under the heading *Animal Vaccination*, it will be seen that the incubation-period of inoculated cowpox is much shorter than the period stated. There is said also to be frequently variation in the length of time occupied by the various changes, and that, on the same animal, the eruption is often found to consist of papules and vesicles in different stages of development; this is probably the result of inoculation from some of the earlier vesicles, or of fresh inoculation from the original source of infection. Space does not permit a description of other vesicular diseases of the cow, but it will suffice to say that these affections are often mistaken for cowpox, and have thus led to some confusion.

There is much difference of opinion as to the origin of cowpox. Jenner, in the first instance, believed that it resulted from the inoculation of a vesicular disease of the horse known as 'grease.' Subsequently, it was found that this affection was altogether distinct from cowpox, but that the horse was also liable to suffer from horsepox just as the cow was liable to suffer from cowpox. In the horse, however, the vesicles occur most frequently on the hocks, and are not limited to animals of the female sex. It has also been observed that cowpox has appeared among herds of cows who had not been exposed, either directly or through their milkers, to infection from horses. Finally, experiment has shown that the cow can be inoculated with horsepox and the horse with cowpox, rendering both these animals insusceptible to any effect from further inoculation by horsepox, cowpox, or smallpox. Horsepox and cowpox may, therefore, be regarded as identical, and the only point remaining for discussion is the relation of this affection to human variola.

Attempts to inoculate the cow with variolous matter have produced very different results in the hands of different experimenters. Briefly, it may be stated that in the hands of many experimenters the inoculation has altogether failed; in the hands of others a papule has been developed, the contents of which, when introduced into the skin of the human subject, have given rise to smallpox, sometimes, indeed, after the virus has been transmitted through several animals before it has been used for the inoculation of man; while a few others have succeeded in producing well-defined vesicles in the cow, the virus of which produces, when inoculated into the human subject, the usual manifestations of vaccinia. It must be borne in mind that the failure of the greater number of investigators does not invalidate the results obtained by others. Both Badcock and Ceely in England, and Thiele in Kasan, succeeded in growing definite vesicles in heifers by the inoculation of smallpox virus, and the lymph taken from these vesicles has been transmitted from child to child, producing no other results than those which follow the use of lymph taken from the vesicles of cowpox. More recently, Voigt, in Hamburg, has published successful results obtained by him in the inoculation of heifers with smallpox virus. His method has been to inoculate the animal

in the first instance with variolous matter and, immediately afterwards in another part of the body, to inoculate the same animal with cowpox. The growth of the vaccine vesicle has been accompanied by the appearance of other vesicles at the site of inoculation with smallpox virus, and the lymph taken therefrom has since been transmitted through other animals and largely used for the vaccination of human beings.

The question of the relation between cowpox and smallpox may be found in the future to have an important bearing upon the protection which is afforded by vaccination against smallpox, and it will be well, therefore, to consider very briefly the reasons which exist for regarding the two diseases as identical.

In the first instance, it may be noted that spontaneous cowpox occurs only in the female animal, and is limited to the udder and teats, man, as a rule, coming only into intimate contact with the cow and with these parts of the body during milking. Again, it is deserving of note that the horsepox appears in the horse on the part of the body which comes in most intimate contact with the hands of man, and is not limited to the female, as in the cow. Moreover, it is somewhat remarkable that spontaneous cowpox has become much less frequent in England since smallpox in rural districts has become a rare event. The simultaneous disappearance of these two affections, from country districts, points strongly to the probability that man, in some way or other, was concerned in the production of disease in the cow. Whether he merely acted as a means of conveyance of the disease from one animal to another, or whether, by becoming himself the subject of inoculation, he communicated the affection, or whether while suffering from smallpox he originated the disease in the cow, is not obvious, but that he played some part in its production there can be but little doubt. The disappearance of spontaneous cowpox from England may be explained by the fact that his condition is now altered by his vaccination in infancy, which renders him less susceptible both to subsequent cowpox and smallpox, and therefore less able to act in this capacity.

The chief argument against the identity of the virus of cowpox with that of smallpox, is the extreme difficulty with which the cow can be inoculated with the latter. In reference to this point, some importance may perhaps attach to the fact that efforts to inoculate smallpox virus have hitherto been almost limited to the use of virus taken from the general eruption of smallpox. In an unvaccinated community, the occasional inoculation of the hands of attendants on cases of smallpox must more frequently have taken place than at the present time, when vaccination is general. It may be that greater success would attend the inoculation of heifers with virus taken from the inoculated or mother vesicle of inoculated variola, the limited number of experiments at Lyons in 1865 (*Mémoires et Comptes-Rendus de la Société des Sciences Médicales de Lyon*, tome v.) not sufficiently negativing this possibility.

This question is not of mere theoretical value. If there is any foundation for the opinion, which is held by some, that the humanised lymph now generally used is less protective against smallpox than in the time of Jenner, the remedy is not necessarily to be found in the use of calf-lymph which has been transmitted through numbers of animals, but more probably in the use of lymph which has been obtained by the recent inoculation of the calf with smallpox virus. There is, indeed, no substantial foundation for the belief that the vaccine virus more naturally has its home in the bovine than in the human animal. So far a lesson is taught by the ease with which the virus can be cultivated in the one, and in the other an opposite conclusion is indicated, and, if this conclusion be well founded, the resort to calf-lymph, unless the latter be recently developed from small-pox virus, is the adoption of the shadow without the substance.

Pathology.—The experiments of Chauveau and Burdon Sanderson have proved that the virus of cowpox is particulate, and that the clear liquid which can be separated from this matter by filtration is inoperative. Microscopical examination shows that the lymph contains micrococci which may be single, in dumb-bells, or in chains. As yet these micrococci have not, after successive cultivation in nutrient fluids, been successfully inoculated into man, and this final proof is therefore wanting.

When vaccine lymph is applied to an abraded and absorbent surface in a human subject who has never suffered from variola, and who has not before been vaccinated, a growth of cells, both in number and size, accompanied by the production of intercellular fluid, takes place in the middle layer of the rete Malpighii, eventually forming cavities which are bounded by cells driven together by the fluid. At the same time the swollen cells burst, adding to the fluid in the cavities. The earlier part of this pro-

cess produces the papule, the later part producing the vesicle which is subsequently developed. The next change is the formation of a slight areola around the vesicle. The superficial areola is accompanied by an inflammation of the true skin, and the stratum lucidum becomes separated from the rete Malpighii, which in turn has developed in it a new stratum lucidum, any cellular matter above it being included in the space between the new and the old. The substance thus formed constitutes the scab, which also includes the cells lining the hair-follicles and sweat-ducts, and extending to a greater depth. The separation of the scab next takes place, the shedding of that part which is derived from the hair-follicles and sweat-glands giving rise to the foveation which is found in a normally constituted cicatrix.

Excessive inflammation will frequently lead to the destruction of the true skin, and, under these cirumstances, the foveation is necessarily absent, or the new stratum lucidum may be imperfectly formed, when exudation will continue to occur from the part which is deficient. Thus the appearance of the cicatrix may be accepted as indicating the behaviour of the vesicle, in so far as it shows not only the size of the vesicle, but the fact whether it has run a normal course.

The constitutional changes that take place are very remarkable, inasmuch as they render the individual, at any rate for some time to come, insusceptible to further inoculation. These changes are not brought about directly by the introduction of the virus into the blood, but are dependent upon the growth of the vesicle in the skin. Dr. Robert Cory has shown this by a well-devised series of experiments. Dr. Cory found that it was possible to successfully vaccinate the same child every day until the ninth day was reached, after which further inoculation became impossible. Vesicles, produced by inoculation on the later days, overtook in their development those produced by inoculation on the earlier days, so that all arrived at maturity at the same time. Thus, it was found that the subsequent course of any one vesicle was entirely dependent upon the stage of development of the first vesicle, at the time of the subsequent inoculation. A further experiment consisted of the vaccination of children having supernumerary fingers upon those fingers, and of their subsequent amputation before the vesicle had arrived at maturity. When these children were again vaccinated, a month after the amputation, it was found that the vesicles resulting ran a course which was identical with the course they would have had, if the second inoculation had taken place on the day on which the supernumerary finger was amputated, and if the amputation had not taken place; proving that the amount of protection was directly influenced by the stage of development of the first vesicle, and was arrested by its removal.

Symptoms.—The local appearances have already been indicated under the heading of *pathology*. In more detail, they consist of the formation of a papular elevation on the second or third day after inoculation, often attended by local irritation; the papule gradually increases in size, and on the fifth or sixth day becomes vesicular. The vesicle develops until the eighth day, when it has a bright pearly appearance, a depressed centre, and in the latter part of that day or the beginning of the next commences to be surrounded by an areola.

The areola increases until the tenth day, when it is usually about two inches in width, measuring from the vesicle; the vesicle then becomes cloudy, dark in the centre, and begins to scab, the areola at the same time fading. The scab usually falls about the twenty-first to the twenty-fifth day from the time of inoculation, leaving a depressed sore having a definite outline, and its surface covered with a number of minute depressions, forming the foveation which is characteristic of the vaccination scar. The general symptoms are, as a rule, but very trifling: there is often a slight increase of temperature of the body in the latter half of the first week and lasting until the seventh or eighth day, when the temperature falls, a further rise taking place about the ninth day and lasting but a few hours; in some cases there is a distinct feeling of indisposition, especially about the ninth or tenth day.

From this course there may be several departures, due to conditions peculiar to the lymph and to conditions peculiar to the child.

The vesicle may be retarded in its development, not arriving at maturity until twenty-four or forty-eight hours after the eighth day, but, apart from this, going through the usual course. Cases are also said to have occurred in which no result followed the inoculation for some weeks, but after this period vesicles eventually were formed; such cases must, however, be exceedingly rare. Other cases occasionally occur where the inoculation has apparently produced no results, but, after further

vaccination on the eighth day, vesicles appear at the site of the first inoculation. The formation of the areola is occasionally postponed or prevented by the child being under the influence of mercurial treatment. The formation of an early areola, and the more rapid development of the various stages, will result when the child has an irritable or eczematous skin, or if it has been unsuccessfully vaccinated a short time before, or when care is not taken to select lymph from vesicles running a normal course, the use of such lymph being often attended also by failure to produce any result. Such lymph will sometimes cause distinctly irritant effects; eczematous children are especially susceptible to such influences, and even when lymph is used which in healthy children produces absolutely normal results. That the lymph itself sometimes contains the elements for producing irritative results, is obvious from the fact that, of a number of children vaccinated from the same vaccinifer, several may be thus affected at the same time.

The behaviour of the vesicle in such cases is as follows:—On the eighth day there is often no abnormal appearance beyond, perhaps, the existence of a somewhat larger areola than usual; but, on the tenth day, the areola becomes extensive, spreading over the arm. At the same time, supernumerary vesicles appear in the neighbourhood of the primary vesicles, and the whole number coalesce, forming a large bleb, which scabs and constitutes a thick crust, from beneath which there is an offensive discharge, leaving eventually a deep unhealthy-looking ulcer. These symptoms are almost invariably attended by the appearance, on the tenth day, of a general eruption of *vaccinia lichen*, to be hereafter described. In the latter part of the second week, fugitive patches of erythema occasionally appear on the extremities and other parts of the body, and may be mistaken for erysipelas, which they somewhat resemble. Lymph may, however, show its irritative qualities at an earlier date than this; thus, there may be on the eighth day a large areola, the vesicles at the same time being broken and discharging freely a serous fluid. Such cases can, however, only result when every regulation for the selection of proper lymph for vaccination is disregarded.

The vaccine vesicle, and especially in children with irritable skins, occasionally differs in other respects from normal vesicles: thus, the vesicle may never fully develop, but, while spreading from the edges, is flat and depressed, and has a grey-brown appearance; it does not properly scab over, but the scab becomes detached piecemeal, leaving an unhealthy indolent sore, which is often of considerable duration before cicatrisation finally takes place, the surface later becoming sometimes covered with large granulations, which rise up above the level of the skin and exude moisture. A further irregularity may occur, at the time of separation of the normal crust, by the formation of another from the discharge of the surface beneath; under these circumstances, the second crust will remain an indefinite time and often has eventually to be removed by poulticing.

Treatment.—The normal vesicle requires no interference. The day after the inoculation has taken place, the surface may be sponged gently to remove any coagulated blood which may have collected at the site of operation. After this, it should be protected by a soft piece of clean linen, and every care taken to prevent injury from rubbing and scratching. Shields should never be worn; they constantly become displaced, and by pressure often interfere with the circulation. It is not uncommon to find them used for one case after another, and thus they become soiled with animal matter and are a very possible source of danger. Poulticing and moistening the vesicle should be avoided; this practice interferes with the natural process of scabbing, and poulticing frequently leads to the whole vesicle sloughing out, leaving a deep ulcer. In cases where the crusts have run together and a thick mass is formed, sufficient time should be given to allow this to separate; if, however, the separation is unduly delayed, and at the same time an offensive discharge escapes from beneath, the whole should be poulticed until the crust separates, and the remaining ulcer dressed with lint and zinc ointment. When the scab has either not formed properly or has separated prematurely, leaving an unhealthy-looking ulcer, zinc ointment dressing will be found to answer exceedingly well.

Eruptions.—The vaccination of infants is occasionally followed by cutaneous eruptions. Those most common are *roseola* and *vaccinia lichen*, occurring usually from the seventh to the tenth day after vaccination. The former appears in slightly raised erythematous patches over the chest, back, and extremities, but in the course of a day or two the eruption fades. Vaccinia lichen also appears about the same time, usually, and is often associated with the roseolous rash. It appears in the form of numerous

minute papules on the face, chest, back, and the front of the limbs; often the papules become vesicular, resembling the vesicular rash which occasionally occurs in scarlatina. In most cases the eruption lasts but two or three days, and then gradually fades; in certain exceptional cases the vesicles on the foot and face become much increased in size, and are somewhat persistent. Later erythematous blushes have been already alluded to. Eczematous rashes are also occasionally produced, usually from the seventh to the tenth day after vaccination, in eczematous children, the fissures behind the ears, which are often found in such children, at the same time increasing and discharging serous fluid.

Syphilitic children in their turn may suffer from syphilitic eruptions. Vaccination-Syphilis is treated of later on, but it may be stated here that the inoculation of syphilitic virus at the time of vaccination does not immediately show itself, but usually, after the scab has formed, some ulceration takes place at the site of the cicatrix, and later the specific eruption makes its appearance. Apart from this, however, specific eruptions occasionally appear about the tenth day after the vaccination of a previously syphilitic child. In these cases there is no special appearance about the vesicle, which runs a normal course. The vaccination has simply been the occasion of the appearance of the symptoms. The writer holds that the lymph may be eliminated from suspicion, as the same event will equally occur after the use of calf-lymph. Erysipelatous eruptions may result from the inoculation of erysipelatous matter at the moment of vaccination, or later when the vesicle is opened for the collection of lymph; or it may occur at any time if the vesicle be broken and the child exposed to the infection of erysipelas, even at the time of the separation of the crust, should the subjacent tissues be not entirely healed.

These eruptions may be treated on general principles, altogether apart from any consideration of the fact that the child has been recently vaccinated.

Selection of Lymph.—Lymph, which is intended for vaccination, should be taken from vesicles not later than the eighth day after inoculation—i.e. on the day week of operation—and only from perfectly healthy infants having a good family history. The child should be carefully examined as to physiognomy, skin-eruptions, snuffles, and all other signs of syphilis, the buttocks and arms should be inspected, and any appearance which gives rise to the least doubt or suspicion should be a reason for the lymph being condemned. Lymph should only be taken from the primary vaccination vesicles of infants, and never from older persons or from any child undergoing re-vaccination. The vesicle should have run a normal course and be normal in appearance, clear, pearly white, and no lymph should be taken if any one of the other vesicles is broken or is abnormal in appearance. There should be but little areola. It is commonly recommended that lymph should only be taken from vesicles absolutely without areola; but this rule has been departed from by experienced vaccinators, who do not discard a vesicle on account of a commencing areola. Indeed, the best results are often obtained when there is an areola which is of limited area, of a bright colour, and when it is accompanied by the appearance of slight papular elevations, which may occasionally be interspersed with minute vesicles on the surface surrounding the vesicle.

While the general rule must be laid down that the lymph should be perfectly clear and translucent, it must be admitted that cloudiness may exist, which does not interfere with the production of perfectly normal vesicles; lymph which flows rapidly should be distrusted, it is often of poor quality and likely to lead to failure. Too much lymph should not be collected from any one vesicle; as the lymph exudes from the vesicle after puncture, it is sometimes replaced by serum, which necessarily dilutes the virus, and it is therefore well to abide by the official recommendation: 'From such a vesicle as vaccination by puncture commonly produces, do not, under ordinary circumstances, take more lymph than will suffice for the immediate vaccination of five subjects, or for the charging of seven ivory points, or for the filling of three capillary tubes; and from larger or smaller vesicles take only in like proportion to their size. Never squeeze or drain any vesicle.'

Precautions as to Vaccinee.—The best age for the vaccination of infants is before the beginning of dentition; the law, therefore, wisely requires the vaccination of children before the end of the third month, but there is no reason why it should not be performed earlier. There does not appear to be any special risk attaching to the vaccination of infants only a few days old, nor is this early period a reason for vaccinating less efficiently than at a riper age. Except in cases where there is im-

mediate risk of exposure to infection of smallpox, only healthy subjects should be vaccinated. The child should, therefore, be in good health and free from any sign of eczema, such, for instance, as fissures behind the ears. No child should be vaccinated who is exposed to contact with any of the acute infectious diseases but smallpox, and the infection of erysipelas should be especially avoided.

Method of Operation.—A great variety of instruments have been invented for the inoculation of vaccine lymph. It is unnecessary to describe them in detail: many are constructed with a groove which is intended to hold the lymph, and to give opportunity for its better introduction at the moment of incision. It must be remembered that any such irregularity of the surface serves also to retain other matter, and to interfere with the proper cleanliness of the instrument; such apparatus should, therefore, not be used. There is no better instrument than an ordinary bleeding lancet, which is not too sharp. The sharper the blade, the greater will be the hæmorrhage resulting from its use; and excess of bleeding is not only on sentimental grounds to be avoided, but it has also a tendency to wash out the lymph. The only appliances which are necessary are the lancet, a clean napkin, and a small basin or glass of water. In the performance of the operation, the vesicle of the vaccinifer should be carefully punctured in a number of places, the greatest care being taken to avoid the drawing of blood. Should there be the least appearance of blood in the lymph which exudes, the vesicle should be abandoned, and the lancet carefully cleaned.

Assuming no such accident to happen, a globule of lymph should be taken upon the point of the lancet, the arm of the vaccinee should be firmly grasped by the left hand of the operator, the skin of the child at the site of inoculation being stretched between his fingers and thumb. The lymph may be inserted by puncture, by a series of scratches, or by both methods. At the moment of puncture the lancet should be half-turned, so that the edges of the blade open the small wound which has been made, and, during scratching, the blade should not be held at right angles to the skin, but obliquely, in order that a larger amount of absorbent surface may be produced by each scratch. The amount of surface to be covered by the scratching must necessarily depend upon the size of the vesicle it is intended to produce. Lymph from more than one vaccinifer should never be used for the vaccination of the same child. A caution is needed as to the mode of transference of the lymph from the vaccinifer to the vaccinee. The lancet should be charged with sufficient lymph to enable the operation to be completed without the necessity of returning to the vaccinifer for more. Should, however, this necessity arise, the lancet should be dipped in the water and carefully wiped, to prevent communication to the vaccinifer of any blood or other matter from the vaccinee, where it might not only cause injury to the vaccinifer, but to other children vaccinated from him. In direct arm-to-arm vaccination, ivory or bone points should never be used for this purpose instead of the lancet. They can never be properly cleaned, but are liable to retain animal matter about them, and have indeed been a potent source of mischief.

If lymph is about to be used which is stored in capillary tubes or on ivory points, the procedure is necessarily a little different. If stored in tubes, both ends should be broken off, and the lymph blown on to the point of the lancet and immediately inserted. If stored in points charged with humanised lymph, it is sufficient to rub the point over the excoriated surface, the blood which is drawn providing enough moisture to remove the lymph from the point. In the case of points charged with calf-lymph, it is desirable to dip the charged end, which adheres more firmly to the ivory, momentarily into water, to shake off immediately the superfluous moisture, and to allow the point to remain for a few minutes before it is rubbed over the surface.

The important question of the size and number of the vesicles which must be produced has to be considered. There is too much tendency at the present time to forget the sole object of vaccination—the protection against smallpox—and to consider only the requirements of the law, which does not specify the details of size and quality of the vesicle. The duty of the practitioner is obviously to vaccinate in such a manner that the infant shall be protected, if possible, for life, and certainly until it has arrived at an age when it can decide for itself whether the protection shall be renewed. To yield to the oft-made suggestion of the mother to vaccinate the child in few places, is to be guilty of a breach of duty to the patient. The production of one small vesicle will undoubtedly render the child absolutely insusceptible to smallpox, but for a time only; the return to susceptibility occurs

more rapidly than when the vaccination is more efficient. The statistics of every small-pox hospital, which have been tabulated, tell the same story, that the severity of attack and mortality from smallpox occurring in vaccinated persons is inversely proportionate to the number and quality of the vaccination cicatrices. The official memorandum, *Instructions to Vaccinators under Contract*, recommends: 'In all ordinary cases of primary vaccination, if you vaccinate by separate punctures, make such punctures as will produce at least four separate good-sized vesicles, not less than half an inch from one another; or, if you vaccinate otherwise than by separate punctures, take care to produce local effects equal to those just mentioned.' Again, the award to public vaccinators, for vaccination of the first grade, is only given when the scars produced are well-marked in their foveation, and have collectively at least half a square inch of total area.

It is, however, necessary to ascertain whether the same amount of protection is afforded by a vesicle producing one large cicatrix as by several which together cause a smaller cicatricial area. The data upon which an opinion can be expressed is not yet sufficient for such opinion to be very definite; but a lesson may perhaps be learnt from the behaviour of the vesicle, in revaccination of persons whose primary vaccination in infancy was of such a character as to leave one large cicatrix having a large superficial area, and comparing these results with the behaviour of the vesicle in revaccination of other persons whose primary vaccination produced three small vesicles, leaving cicatrices whose aggregate did not exceed the area of the one large cicatrix.

Results of Revaccination of Persons aged from Ten to Thirty Years.

	Cases in which the areola of the revaccination declined on the eighth day or earlier, and were therefore further removed from condition of complete susceptibility	Cases in which the areola of revaccination declined after the eighth day, and therefore more nearly approached complete susceptibility
Possessing one primary vaccination cicatrix having a diameter of five-eighths of an inch or more	11, *or 48 per cent.*	12, *or 52 per cent.*
Possessing three primary vaccination cicatrices each having a diameter of three-eighths of an inch or less . .	119, *or 67* „	58, *or 33* „
Possessing one primary vaccination cicatrix having a diameter of half an inch or more.	17, *or 53* „	15, *or 47* „
Possessing three primary vaccination cicatrices each having a diameter of a quarter-inch or less	49, *or 75* „	16, *or 25* „

It will be seen by the above, that the protection afforded by primary vaccination has lasted longer where the cicatrices are numerous and small, than where there is but one large cicatrix. The numbers on which the percentages are calculated are undoubtedly small, but there is, nevertheless, sufficient uniformity in the result to warrant the belief that one large vesicle will protect less than three smaller vesicles, although the aggregate cicatrices of these may be smaller than the cicatrix of the one large vesicle.

The writer does not propose to theorise upon this point; it is sufficient to state, for practical purposes, that not less than four vesicles should be produced, the combined resulting cicatrices of which would not be less than one half of a square inch in area.

To ensure that the operation shall successfully produce these results, the vaccination should always be done, when possible, directly from arm to arm, and without resort to the use of stored lymph. Arm-to-arm vaccination in the hands of a good operator will be attended by the production of not less than 97 or 98 vesicles in every 100 insertions, while the use of stored lymph will reduce this success by 25 or 30 per cent. In thickly populated communities, no difficulty will be encountered in vaccinating, week by week, from the arms of children inoculated during the previous week; but in more sparsely inhabited districts, where

but three or four children would be vaccinated every week, it is better not to attempt to carry on weekly vaccination throughout the whole year, but to do so only during some portion of the year, so as to ensure a larger number of vaccinations on each day. It is often necessary, under these circumstances, to resort to stored lymph for the purpose of beginning the series, but its use should be limited to this object.

Revaccination.—When a person is vaccinated, complete protection is afforded against smallpox. Of this the best evidence is, that it is impossible to produce any result by the subsequent inoculation of the smallpox virus, but, as time goes on, there is a gradual return to susceptibility. This is particularly well shown in the effect which the vaccination of persons at the time of infancy has had upon the ages of death from smallpox. In pre-vaccination times, the majority of children born were attacked with smallpox before reaching the age of four years, and, after a terrible loss of life, the majority of the remainder were left protected by this attack from subsequent attack. Vaccination does not appear to produce such permanently protective results as smallpox, and, hence, the diminution of death from smallpox in early life, which has resulted from vaccination in infancy, has been attended by an increasing death-rate from smallpox amongst people of the later period. This is best shown by the following table, which is extracted from the *Forty-third Annual Report of the Registrar-General of Births, Deaths, and Marriages in England*, and which illustrates the period of life at which vaccinated and unvaccinated people respectively die from smallpox.

Proportion of deaths under and over fifteen years of age per 1,000 *deaths from smallpox, in vaccinated and unvaccinated persons respectively* :—

Age	Unvaccinated	Vaccinated
Under fifteen . .	672 . .	334
Over fifteen . . .	328 . .	666
	1,000	1,000

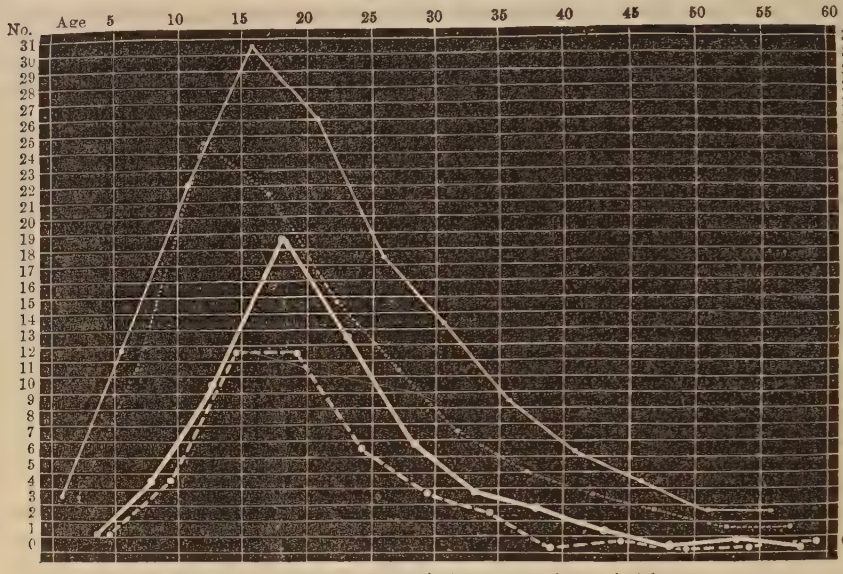
The question necessarily arises during how long a period does vaccination afford protection, for it is obvious that protection can be renewed by revaccination.

There is no doubt that this must, to some extent, depend upon conditions peculiar to the individual, but is also dependent in a very important degree upon the character of the first vaccination. This is shown by the evidence derived from smallpox hospitals, which proves that the severity of illness of a person, suffering from smallpox, and the probabilities of death are dependent upon the number, size, and quality of the vaccination cicatrices, and the interval which has elapsed between the time of vaccination and the attack of smallpox. In this connection may be cited the statistics of Collie, Gayton, McCombie, and Marson, the three first published in the reports of the Metropolitan Asylums Board.

A lesson may also be learnt from the number of persons admitted into the smallpox hospitals with good and indifferent vaccination-marks, and for this purpose it will be sufficient to study the statistics of Dr. Gayton, which relate to the cases which came under his personal observation. The writer of the present article has constructed from these statistics the following diagram, which represents the number of males and females, with good and indifferent primary vaccination cicatrices respectively, at each quinquenniad of life in each 1,000 of total admissions which were received into the hospital.

The numbers have been corrected with a view to showing what is the effect upon equal populations at each age period, and it has been assumed that the numbers of persons with good and indifferent marks in the population have been equal. As a matter of fact, the number of persons with good marks is in excess of those with indifferent marks; but inasmuch as the proportion between the two is not accurately known, it has been thought better to regard them as equal. But it may be borne in mind that in reality the diagram shows, in consequence, an exaggerated number of admissions with good marks in proportion to those with indifferent marks, but the diagram as regards males and females of each class is probably strictly comparable (p. 764).

It may be assumed for all practical purposes that the community is vaccinated, better or worse, shortly after birth, and that the increasing number of admissions, as time goes on, is due to the gradual return of these persons to a condition of susceptibility to attack from smallpox. It will be observed that, after ten years has passed, females return to this condition somewhat more rapidly than males, and that some circumstance comes into effec between ten and twenty years which checks and diminishes this increasing susceptibility. This is undoubtedly chiefly due to revaccination, but also in part to attack from smallpox; and the fact that the in-



Top line shows number of males with indifferent primary cicatrices.
Second line shows number of females with indifferent primary cicatrices.
Third line shows number of males with good primary cicatrices.
Fourth line shows number of females with good primary cicatrices.

creasing susceptibility of women is checked at an earlier age than that of men must be mainly caused by these influences.

It is within the power of revaccination entirely to check this growing susceptibility, and the diagram shows that in no instance should revaccination be delayed after fifteen years of age, especially in those cases where the vaccination cicatrices are indifferent in character. Revaccination before ten years of age would largely reduce liability to attack from smallpox, and still better results would doubtless follow if revaccination, performed at this earlier period of eight or ten years of age, were repeated shortly after puberty. Whether this would permanently protect against all attack from smallpox for the rest of life must remain doubtful; and it is obvious that it is better to adopt the recommendation of the German Vaccination Commission and resort to revaccination during each subsequent ten years of life, and, if there be definite exposure to smallpox, that the operation should not be delayed till the end of this period.

The local manifestations of revaccination usually differ from those of primary vaccination. The individual is already, as a rule, partially protected against cowpox and smallpox, and the results of inoculation have only to make up the differences between the amount of insusceptibility already obtained and total insusceptibility. In some persons, the susceptibility which remains after primary vaccination is so slight as to need only the development of papules, which last but a day or two, and then fade, or the development of vesicles may be required to give the additional protection which is needful to produce complete insusceptibility. The local manifestations of revaccination may, therefore, be little more than mere irritation—the production of a vesicle which rapidly runs through its course, becomes pustular, and is surrounded by a crust during any period of the latter part of the first week, or early in the second week; or again, of a vesicle which runs the same course as that of primary vaccination.

There is frequently seen more œdema of the arm and a larger extent of areola in revaccination than in primary vaccination; but this is probably due to the fact that in revaccination the areola generally develops earlier, and is therefore more extensive on the usual day of inspection.

Preservation of Vaccine Lymph.—The most common methods of preservation of lymph are in capillary tubes and on ivory points. For the purpose of collection in the former, the end of the tube is inserted

into the bead of lymph which exudes after puncture of the vesicle, and the tube being held obliquely or horizontally, the lymph rapidly rises. When one-third of the length of the tube is filled, the lower end, which is in contact with the vesicle, is raised and the lymph allowed to gravitate to the centre. The moistened end of the tube is then heated in the flame of a spirit lamp, the part containing the lymph being protected by being covered by the finger and thumb holding the tube, so as to prevent the lymph from becoming coagulated or damaged by the heat; the tube thus becomes coated with charcoal, which must be burnt off in the upper part of the flame before the tube will close. The end of the tube is then melted and the tube closes; the other end is next taken between the finger and thumb, the lymph being protected in the same way. The tube is rapidly passed through the flame from the end up to the point where it is held, and, the air having been expanded and partially expelled by this means, the end of the tube is melted and closed. The fact that the tube is hermetically sealed is assured by the collapse of the melted end of the tube.

The preservation of lymph on ivory points is effected by collecting a bead of lymph on the end of the point and exposing it to the air until it has become dry. The lymph should cover the flat surface of the point as well as the extremity, and the point should preferably receive two coatings. In drying it, care should be taken that the moist surface does not come in contact with any substance which can impart dust to it. The points should be afterwards stored in close bottles. A third but less frequently adopted method of preserving lymph is by means of small square pieces of glass. The centres of two pieces of glass are brought in contact with the punctured vesicle, and the lymph is thus transferred to it. The glasses are then brought face to face with the moistened surfaces in contact with each other, and the edges are sealed by dipping them in melted paraffin. A fourth method is the preservation of undried lymph in bottles. This, however, cannot be recommended, as the lymph is very liable to decompose, and its use is attended with some risk unless but very few hours intervene between its collection and subsequent inoculation. The admixture of lymph with glycerine and with a solution of thymol or other preservative is also practised, but the data for comparing the advantages of one method over another are not sufficiently great to warrant any other recommendation than that lymph should be preserved either in tubes or on points, as already described.

For immediate use—i.e. within a week after collection—the method of storage on ivory points is most to be depended upon. The preservation of lymph in tubes is less frequently attended by good results, most probably because of the tendency of the particulate matter to adhere to the sides of the tubes than of any alteration in its composition. For longer intervals of some weeks, tubes produce somewhat better results than points.

Animal Vaccination.—The cultivation of lymph in the calf differs from the cultivation in the human subject chiefly in the circumstance that in the calf only one hundred and twenty hours, or five times twenty-four hours, are required for the full development of the vesicle, while in the human subject one hundred and sixty-eight hours, or seven times twenty-four hours, are required for this purpose, a fact probably due to the higher temperature of the calf, which is usually from 100° to 102° Fahrenheit. The method adopted for the inoculation of the calf is as follows: A calf, which should be from three to six months of age, is placed on a table constructed so that the animal's hind legs can be separated, exposing the abdomen. This part of the body, the perineum, and flanks are shaved, and the surface cleansed by washing with a solution of carbolic acid. The lymph (which is preferably collected at the same moment from another calf) is taken on to the upper side of a rather blunt tenotomy knife, and a number of incisions, usually seventy or eighty, are made with this knife in the skin, but not through the skin; the incisions should be about an inch in length and arranged in lines, an interval of an inch being left between the successive rows, and the knife being charged with more lymph from time to time. Another method is to inoculate the calf by puncture with a small barbed instrument, grooved so as to better hold the lymph. The animal is then returned to the stable, and is provided with a collar in order to prevent it from licking the vesicles. After forty-eight hours, a papular elevation appears at the site of each inoculation, and at the end of another thirty-six hours these become vesicular, the vesicles being sufficiently developed on the fifth or sixth day for use for the vaccination of other calves or children. On the latter of these days an areola forms; lymph may, however, be taken for the same purposes after another twenty-four hours, but later it is purulent and unfit for use.

The pustules scab over, and fall between the fifteenth and twentieth days.

Lymph cannot be collected in the same manner as from the human subject. It is necessary to squeeze the vesicle, and for this purpose curved forceps with a sliding catch are used. The pressure on the vesicle ruptures it and the clear lymph exudes, and may be collected on the knife for immediate use, and on points or in tubes, as in ordinary vaccination. Animal lymph ordinarily produces in the child the same symptoms as humanised lymph. In calf-vaccination there is, however, not the same opportunity for selecting the vaccinifer from a number as occurs when humanized lymph is used, and hence calf-lymph is perhaps a little more variable in its results. It has been found, too, in the hands of some vaccinators, that if calf-lymph be introduced into a station, and used for renewing the stock, the first few children of the series have less regular results. How far this may be due to the use of lymph obtained from Continental stations, where it is collected after a less definite period than in England, is not known, for other operators have found no such results from the use of lymph cultivated in this country, where the rule is to collect lymph one hundred and twenty hours after inoculation.

By the use of calf-lymph the possibility of inoculation of syphilis is eliminated, and the risks of erysipelas reduced by the fact that it becomes unnecessary to open the vaccine vesicle of the infant for the purpose of procuring lymph for carrying on operations. Apart from this, however, erysipelas may occur, as after every wound of the surface.

The fear of inoculation of tuberculous matter by the use of animal lymph need not be entertained. The experiments of Acker tend to show that tubercle does not exist in the vaccination vesicle of tuberculous subjects, while the experiments of Josserand at Lyons confirm this opinion. There is, moreover, the important fact that at Brussels it is the rule to examine the bodies of all calves which have been previously used for vaccination purposes, and in no single instance has tubercle been found in these calves, although some thousands have been examined. Again, in Würzburg, in the slaughterhouse, of 150,000 calves not one was found to be tuberculous. It is thus quite possible to eliminate any risk of tubercle by the selection for vaccination purposes of healthy calves in good condition. The chief disadvantage of calf-lymph is the expense involved in its production, leading to the limitation to large centres of population of direct vaccination from calf to arm. Sparsely inhabited districts would necessarily have to depend upon the use of stored lymph, and, as a result, vaccination would be performed with less efficiency than is now possible when arm-to-arm vaccination is practised. Direct calf-to-arm vaccination of infants produced in the London Animal Vaccine Station during 1884, in the hands of two operators, 985 and 991 vesicles for every 1,000 of insertions which they respectively made. The use of stored lymph materially reduced this success. There is not, however, any positive ground for the statement that the keeping powers of calf and humanized lymph differ from each other. The experience of the above-named institution fails to show that such difference exists.

Vaccination Law.—In the year 1841 an Act was passed enabling every person to be vaccinated at the public cost, and in 1853 it was rendered compulsory, under a penalty of twenty shillings, that every child born after the passing of the Act, should be vaccinated, and should be brought back for inspection, under a further penalty of twenty shillings. In 1858 officers were empowered to be appointed to conduct proceedings before justices under the Acts relating to vaccination, and in 1867 a further Act was passed which repealed nearly the whole of the previous legislation, but re-enacted the chief provisions.

By the Act of 1867, unions and parishes were to be divided into vaccination districts, subject to the approval of the Poor Law Board, and the guardians were to contract with a duly qualified medical practitioner for the performance of vaccination of all persons resident within each district; the vaccinator appointed was required to possess such qualifications as were prescribed by the Lords of the Privy Council.

Other provisions were an authority for the payment of a sum not exceeding one shilling for every child successfully vaccinated, in addition to the sum paid by the guardians; the scale of fees to be paid by the guardians was not less than one shilling and sixpence, for every vaccination done at an appointed station situated at or within one mile from the residence of the vaccinator or in the workhouse of the Union; for every vaccination done at any station over one mile and under two miles distant from his residence, not less than two shillings; and for every such vaccination done at any station over two miles distant from his residence, not less than

three shillings, such distance being measured according to the nearest public carriage road; but in respect of successful vaccinations performed elsewhere than at a station or in the workhouse as aforesaid, the payment to be according to the terms specified in the contract as approved by the Poor Law Board. The fee for the revaccination of persons who may apply to be revaccinated, the Poor Law Board having issued regulations in respect thereof, to be two-thirds of the fee payable for each case of primary vaccination. No contract to be valid unless approved by the Local Government Board. The public vaccinator cannot charge for the vaccination or revaccination of any person not resident in his district.

In sparsely-populated districts, the guardians may arrange for public vaccination every three months, and no parent is to be liable for neglect to procure the vaccination during this interval, if the omission is due to the fact that the vaccination cannot be performed on account thereof.

The provisions for ensuring the vaccination of a child are the delivery of a notice by the registrar to the parent or other person having the custody of the child at the time of registration of birth, requiring the child to be taken to the public vaccinator within three months of birth for the purpose of being vaccinated, and to again take the child on the day week to him for inspection, and for him, if he sees fit, to take lymph for the performance of other vaccinations. In the event of a child being unfit to be vaccinated, a medical certificate to be necessary to postpone the vaccination for a period of not more than two months without renewal of the certificate. Children who have had smallpox, or who have been unsuccessfully vaccinated three times, to be exempt, on medical certification of either fact. The public vaccinator to sign the certificate, and, if required, to give a duplicate to the parent, and to forward the former to the registrar in whose district the vaccination shall have been performed; if the operation have been performed by a medical practitioner not being a public vaccinator, the certificate is to be forwarded to the registrar by the parent. The parent is to be liable to a penalty not exceeding twenty shillings for neglect to procure the vaccination of a child, and the public vaccinator and parent to be liable to the same penalty for neglect to perform their respective duties as to forwarding the certificate. Justices may make an order for the vaccination of a child under fourteen years of age not previously vaccinated, and any neglect of the parent to comply with the order shall render him liable to a penalty of twenty shillings. Previous notice must be given to the parent. Any person signing a false certificate to be guilty of a misdemeanour. Inoculation of smallpox is forbidden, under a penalty of not more than a month's imprisonment.

By the Act of 1871, vaccination officers are empowered to be appointed to undertake such duties previously devolving upon registrars and others; they are to receive from the registrar lists of births and deaths in his district. When a revaccinated person fails to reappear for inspection, he shall pay a fee to the guardians of two shillings and sixpence. The penalty for not producing a child, when required by a summons under the Act, is payment of a sum not exceeding twenty shillings. Complaints to be made and information to be laid for offences under the Vaccination Act within twelve months from the time when the matter of such complaint or information arose, and not subsequently. When a child has been successfully vaccinated by some one else, the public vaccinator, on the request of the parent, and after personal examination, may certify to this fact. When the Poor Law medical officer is in attendance as such upon a person suffering from smallpox, he may charge for the vaccination and revaccination of other persons in the house, as if he were a public vaccinator.

SHIRLEY F. MURPHY.

VACCINATION-SYPHILIS.—There is unfortunately no longer the least room for doubt that the pellucid lymph of a vaccine vesicle may contain the contagium of syphilis. It is not a necessary condition that blood should be drawn, or that the vesicle should be allowed to 'drain,' for if the vaccinifer be syphilitic, no precautions in these directions will give security. In saying this, it is by no means implied that such precautions are valueless; probably they are far otherwise, but they do not remove risk. Long after all doubt was past as to the possibility of conveying syphilis by vaccination, there seemed reason to hope that it could occur only when the lymph was mixed with blood or with fluid which, by draining after the vesicle was emptied of its original contents, had recently transuded from the tissues or blood-vessels. We are now, however, obliged to face the fact that these accidents are not essential, and that the virus may exist, in full potency, in lymph which is per-

fectly clear, and which has been taken with the utmost care. We owe this melancholy advance in our knowledge to the self-sacrificing enthusiasm of a public vaccinator, who repeatedly tried the experiment on himself. He selected vaccinifers who were suffering obviously and severely from inherited syphilis, and in three instances he failed, but in the fourth he succeeded. In this last experiment he produced, on his own forearm, three indurated chancres, which were followed in due course by complete syphilis. Since the greatest care was taken to use only clear lymph, and the whole details of the experiment were under the observation of skilled observers, no more evidence on this point can possibly be desired. Men engaged in the practice of vaccination have in future to realise that, under no conditions, are syphilitic vaccinifers safe, and must devote their efforts at prevention almost solely to the exclusion of such subjects from use.

In some respects it is well that the facts should have been thus simplified. If, at first sight, it may seem that the area of danger is enlarged, we may, on the other hand, feel confident that safety comes with knowledge. The open and complete removal of supposed grounds for security, which were wholly untrustworthy, can only result in reduction of risk. All that is necessary is that the facts should be made widely known.

When the syphilitic virus is conveyed in vaccine lymph, the behaviour of the sore may present certain variations. As a rule, however, with but few exceptions, if the vaccination takes, the vesicle passes through its stages and heals in the usual manner. Nothing is suspected until, at the expiration of probably about five weeks, the scar becomes irritable, and in the course of a few days enlarges into a little papule. In another week it will be hard, and subsequently will, in most cases, present all the usual features of an indurated sore. In some cases the scar may inflame in less than five weeks, but very rarely in less than a month. It does not make any difference whether the vaccination has taken or not. In each instance, the first signs of irritation in the site of the puncture occur at the same time. If it have not taken, then it is possible that all trace of a puncture may have disappeared before the syphilitic inflammation commences. When once an indurated chancre has developed, its subsequent progress will depend upon the treatment and the proclivities of the individual. If mercury be given early, the sores will soon disappear, and but few evidences of the secondary stage will probably be witnessed. If mercury be not given, the sores may enlarge indefinitely, and perhaps coalesce, and may be attended by a good deal of inflammation. In rare cases, phagedæna may occur. Almost always there are enlarged and hard glands in the armpit, and these scarcely ever suppurate. There is no reason to believe that the virus of syphilis is ever absorbed after vaccination without the intervention of a local chancre; and, usually, the conditions of the latter are very definite, and leave no room for error. If vaccination-vesicles have passed through their stages, dried up, disappeared, and nothing more has occurred, it may be assumed as certain that there has been no introduction of syphilis. It is not without exception that an interval occurs between the healing of the vaccination vesicle and the development of syphilitic changes in its site. In some cases the sore remains unhealed throughout, and it may be acutely inflamed. In such we must suppose that pus-elements, in addition to the specific virus, have been introduced.

The constitutional phenomena after vaccination-syphilis do not differ in any respect from those of the disease when obtained in other ways. Nor is there any difference in the rules as to treatment. If mercury be given early, the primary phenomena soon disappear, and it is exceptional for any of the secondary stage to be witnessed. Some of the series of cases of syphilis after vaccination have offered unusually good opportunities for observing the laws of development of this malady, since it was known to be conveyed from the same source to many individuals at the same time. Observations on series of this kind lead to the belief that its stages, more especially that of incubation, are more uniform in duration than had been generally believed. It appears that the interval between contagion and the first signs of morbid action is very rarely less than a month, and definite induration is seldom produced till near the end of the fifth week.

It is probable that the virus of syphilis is not always present in the vaccine lymph of syphilitic vaccinifers. When it is present, it may show its vigour by producing chancres in almost all those vaccinated, and in almost all the several punctures made in each person. Multiple chancres are the rule under such conditions, and usually more punctures are infected than

escape. Yet, with such facts before us, we find that it is possible to vaccinate intentionally from syphilitic infants repeatedly with effect. No doubt this has been done unwittingly in many cases, and we may believe with confidence that it is only in exceptional instances that syphilis is communicated by vaccination, even when tainted children are used. Nor does the risk seem to be in relation with the apparent severity of the disease in the child. In two of those employed in the experiment just mentioned the disease had induced much cachexia, whereas in one of those from which a whole series of infections resulted, the vaccinifer appeared to be in excellent health.

In the all-important matter of the selection of a vaccinifer, the surgeon should carefully examine both the child and its mother, unless, indeed, he be already well acquainted with the family history. The child's nates and anus should be inspected, since sometimes eruptions or even condylomata are present on those parts in children apparently free from disease. By care in this matter, the risk may be reduced to a minimum; but it must still be admitted to be possible for both mother and child to be free from any suspicious symptoms, whilst syphilis is yet present. It is well, therefore, to adopt the rule of never employing a first-born child. If there be one or more healthy elder children, and the child itself and its mother are free, then it may be regarded as practically certain that no taint exists.

Although vaccination-syphilis is a reality, and unquestionably demands our utmost circumspection for its prevention, yet it is fortunately very rare. Since the several series of cases which the writer recorded about ten years ago, not a single instance of it has come within his knowledge, nor have any been mentioned to him by his professional friends.

JONATHAN HUTCHINSON.

VAGINA, Affections of the. — The vagina, extending from the vulva to the uterus, is lined by mucous membrane continuous with the investment of the external organs of generation. Anteriorly, the canal is intimately united below with the urethra, and above with the base of the bladder (*vesico-vaginal septum*); while, posteriorly, it is connected more or less closely below with the anterior surface of the rectum (*recto-vaginal septum*), but lies for the upper third of its extent in immediate relation to the peritoneum lining Douglas's space. The *vulvar orifice*, which is the narrowest part of the vagina, is partially closed in the normal virgin state by a membranous structure termed the *hymen*, of which the remains after rupture constitute the tubercles known as *caruncul*æ *myrtiformes*, found seated around the entrance of the canal.

I. MALFORMATIONS, whether congenital or acquired, owe their chief clinical importance to the obstruction which may be offered to the free escape of the menstrual fluid. But, short of this, they may interfere with coitus, or even impede the passage of the child in the event of pregnancy and labour.

1. *Congenital malformations* resulting from defective development, or from subsequent closure during fœtal life of a part of the canal by inflammatory processes:— *Complete absence of the vagina* is an extremely rare condition, usually although not invariably associated with imperfect development of the uterus and ovaries, and hence less likely than some other minor malformations to call for active surgical interference. *Septate* or *double vagina* is another deformity of very rare occurrence, characterised by the existence of two distinct canals separated by a more or less complete vertical septum, and often communicating with a bifid uterus, of which one horn is commonly more developed than the other. *Partial occlusion* (*atresia*) of the vagina may be due to an obstruction seated in the upper or middle third of the canal, or more frequently immediately within the orifice. But the most common form of occlusion is that known as *atresia hymenalis*, from the presence of an imperforate hymen.

2. *Acquired malformations*, resulting from cicatricial bands or septa, may present almost any degree of constriction, from partial narrowing up to complete obliteration of the canal. Among the causes producing them may be mentioned extensive sloughing after parturition, or consequent upon diphtheritic or other severe inflammations, surgical injuries, &c.

IMPERFORATE HYMEN is the malformation which most frequently requires active surgical interference, on account of obstruction to the escape of menstrual discharges. In the normal virgin state, the hymen, a thin fold of mucous membrane, is either crescentic forwards or else diaphragmatic with a central aperture; but, in the condition under consideration, the vaginal orifice is closed by an imperforate membrane of a dense and often extremely tough structure.

Symptoms.—As a rule, the malformation does not excite attention until the age

of puberty, when the non-appearance of the menses, coupled with the recurrence of successive monthly attacks of pelvic pain and severe constitutional disturbance, usually leads sooner or later to investigation.

Diagnosis.—Inspection reveals a tense bulging membrane filling the orifice of the vagina; and, on rectal examination, the pelvis is found occupied by a firm elastic tumour, which abdominal palpation will usually detect rising to a variable height above the level of the pubes, often bearing upon its summit a small firm body recognisable as the uterus.

Prognosis.—The condition, if unrelieved, almost invariably proves fatal by hæmorrhage or by septic peritonitis, resulting from rupture of a distended uterus or of a blood-sac in a Fallopian tube. Occasionally, however, the obstructing membrane may give way, and allow the escape of the fluid imprisoned in the sac formed by the distended vagina.

Treatment for Retained Menses.—In all cases, two main sources of danger connected with the operation required have to be kept in view. The *first* of these, arising from too rapid collapse of the distended sac, is due to the risk thereby entailed of rupture of the Fallopian tubes or of vascular adhesions connecting them with the pelvic walls. This accident, liable to prove fatal by septic peritonitis or by hæmorrhage, should always be guarded against by avoiding any abdominal pressure upon the sac while its contents are escaping. The *second* source of danger referred to is that of septicæmia following the operation, as the result of decomposition of the discharges, a complication which may be averted by the maintenance of efficient drainage and the use of antiseptics.

Operation for Imperforate Hymen.—The best time to select for its performance is midway between two menstrual periods, as indicated by the recurring catamenial molimina. The patient, after anæsthetisation, should be placed in the usual lithotomy position, and the parts then be thoroughly cleansed with 1–20 carbolic lotion. The protruding membrane is next punctured with a full-sized trocar, previously immersed in carbolised oil, and the fluid, usually of a dark colour and thick tarry consistence, must be allowed to escape slowly. On its ceasing to flow, the canula is withdrawn, and the opening freely enlarged by a cruciform incision made with a blunt-pointed bistoury. The cavity should now be gently washed out with a warm antiseptic solution (carbolic acid or corrosive sublimate); and, if thought desirable, a short, full-sized, glass or vulcanite drainage-tube may be inserted. Finally, a thick pad of some absorbent antiseptic material is applied to the vulva. The patient must be confined to bed for some few days after the operation, during which time the dressing should be changed, and the vagina syringed out, twice or oftener in each twenty-four hours.

Operation for Partial Occlusion of the Vagina.—Having first passed a sound into the previously emptied bladder, the surgeon introduces his left index finger into the rectum in order to ascertain the extent and depth of the occluding tissue, as well as the exact position of the distended sac.

After satisfying himself on these points, he entrusts the sound to an assistant, and, with his finger still in the rectum to act as a guide, makes a horizontal incision between the labia, carefully dissecting through the tissues until the sac is reached. This is then punctured and evacuated, with the same precautions as in the above described operation. The cavity having been carefully washed out, is loosely packed with strips of lint soaked in carbolised oil, or with iodoform gauze, and an antiseptic pad is applied externally. The plugs, which require renewal every six or eight hours during the first few days, may then be replaced by a perforated glass or vulcanite tube, which should be worn more or less continuously for a week or two, in order to avoid contraction and closure of the newly-made orifice.

The malformation known as *septate vagina* may require surgical interference for relief of menstrual accumulation, in connection with one or other horn of a bifid uterus. The treatment of such a condition (termed *hæmato-kolpos*) would resemble that above described.

The operation for *complete absence* of the vagina, independently of any menstrual retention, is justifiable only in cases where it is possible by combined exploration of the rectum, the bladder, and through the abdominal wall, to ascertain clearly the existence of a well-developed uterus and ovaries. The procedure required is a much more difficult one than any of the above, owing to the fact that the surgeon will possess no other guide to his incision than the position of the cervix; in all other respects the operative details are the same as in the cases of partial occlusion of the canal.

Partial septa, either congenital or acquired, occasionally necessitate interference. They are best divided by means of the thermo-cautery, care being taken to avoid injury to the vaginal wall.

II. Surgical Injuries.—1. *Wounds* of the vagina always result from direct violence, accidental or intentional. Their immediate gravity in any case depends upon whether or not the peritoneum has escaped injury.

Their *causes* may be various, including falls upon upright pointed objects; violence inflicted by thrusting foreign bodies into the canal; the passage of instruments for purposes of abortion; or the unskilful use of the same during labour.

Superficial wounds of the vaginal wall, not involving the peritoneum, usually give rise to very free hæmorrhage, which may require for its arrest the introduction of a firm plug of some antiseptic material. If extensive laceration have occurred, points of suture may with advantage be inserted as required. Rest in bed and the frequent use of antiseptic injections will readily promote healing. Any subsequent tendency to faulty cicatricial contraction must be combated by the occasional introduction of a full-sized cylindrical speculum.

Wounds *involving the peritoneum* are necessarily of a far more serious nature. Their infliction always gives rise to more or less serious collapse, often succeeded by symptoms of septic peritonitis, which may rapidly prove fatal.

Treatment.—Small *punctured wounds* are best left alone, nothing being attempted in the way of local management beyond the free application of iodoform powder to the surface of the vagina, followed by the introduction of a plug of iodoform gauze, which should be renewed daily. In cases of *extensive injury* to the peritoneum, it is best, as a rule, not to attempt the introduction of any sutures, but to trust to the readiness with which the serous membrane will unite on mere apposition of its torn surfaces. Should the intestine have prolapsed, it must be carefully cleansed with warm carbolised lotion before being returned to the abdominal cavity. In any case of wound of the peritoneum, the patient should as quickly as possible be brought well under the influence of opium, and be so kept until all risk of peritonitis is over.

2. *Foreign bodies* sometimes require to be removed from the vagina. These may have been wilfully introduced by the patient herself; or may consist of pessaries originally placed there under medical supervision, and subsequently neglected. In either case, their presence in course of time gives rise to pain, irritation, and puriform discharge, and may ultimately lead to ulceration, followed by the formation of a fistula. Removal of a foreign body must be effected with care, in order to avoid laceration of the vaginal wall. If large, it may require to be broken up with strong nippers and then taken away piecemeal.

III. Inflammation of the Mucous Membrane of the vagina (*vaginitis, colpitis*) occurs in the *acute* form either as a simple or as a specific affection.

Causation.—*Simple* vaginitis arises primarily from severe irritation of almost any kind, whether of a chemical or mechanical nature. It may also result secondarily from acrid uterine discharges, from secretions due to carcinomatous affections, from the irritation produced by urine or fæces in cases of vaginal fistulæ, or from that caused by the continued presence in the passage of any foreign bodies, such as tampons, sponges, ill-fitting pessaries, &c.

Specific vaginitis is usually caused by direct gonorrhœal infection; but it may also be found as a concomitant of chancroid affections of the external genitals.

A variety known as *diphtheritic* vaginitis is occasionally met with in badly-nourished unhealthy women during the puerperal state, or again in the course of typhus, smallpox, or scarlet fever.

All forms of acute vaginitis, with the exception of that last mentioned, are exceedingly liable to become *chronic* if long unrelieved. The gonorrhœal variety especially is often of the most intractable type, and is moreover dangerous from its tendency to spread to the uterine cavity.

Symptoms and Diagnosis.—In both the simple and the specific form of vaginitis the prominent subjective symptoms are a sense of heat and aching pain about the part, with great discomfort and tenderness on locomotion. On examination, the vaginal mucous membrane is found reddened, inflamed, and swollen, often granular in appearance, and covered with a profuse cream-coloured or greenish puriform discharge. When due to direct gonorrhœal infection, the disease is usually accompanied in the early stage by more or less acute inflammation of the vulva, and not uncommonly by some amount of urethritis, giving rise to frequent and painful micturition. The differentiation, however, between the simple and gonorrhœal varieties cannot with any certainty be made from the physical signs alone, apart from the history.

Treatment, during the *acute* stage of the disease, consists in the administration of a free mercurial purge, followed by a course of diuretic salines with tincture of hyoscyamus, the patient meanwhile being confined to bed and kept on light diet. The vagina should be well douched every four or five hours with a warm solution of acetate of lead in decoction of poppies, or with a lotion containing half an ounce of borax to the pint of warm water. This may be replaced in time, as the acute symptoms pass off, by the use of a colder solution containing tannin or alum in the proportions of one or two drachms to the pint. A remedy often employed with advantage in the *subacute* stage consists of a solution of nitrate of silver (℈j.–iij. ad ℥j.), which should be freely applied to the entire vaginal surface once in every three days.

Should the affection be seen in the *chronic* stage, the daily use of an astringent injection, followed by the introduction of a vaginal suppository, containing twenty grains of iodoform powder, will constitute the best mode of treatment.

IV. Tumours and Prolapse.—*Fibroid growths* in the substance of, or dependent from, the anterior vaginal wall are extremely rare. Removal by enucleation after incision of the capsule, or, if the growth be polypoid, by division of the pedicle with scissors or the thermo-cautery, may be readily effected.

Cysts, varying in size from that of a small cherry to a bantam's egg, may occasionally be found seated on the anterior vaginal wall, within a short distance of the orifice. As a rule they occur singly, but two or more may be met with. They are thin-walled, and usually contain a clear, glairy fluid; but, in some instances, the contents are of a semi-gelatinous consistence, and dark chocolate in colour. Their mode of origin is doubtful.

Unless of any size, they give rise to no special symptoms. On examination, their recognition is easy from the smooth, elastic, and globular nature of the swelling. If small, the cyst may be removed entire by means of a little careful dissection. Another plan of treatment consists in freely laying open its cavity, and cauterising the lining membrane, which subsequently granulates.

Sacculated dilatation of a portion of the urethral canal gives rise to an oval-shaped swelling, of which the position and reducibility on pressure will reveal the true nature.

Treatment consists in removing an elliptical portion of mucous membrane, with its long axis in the direction of the urethra, and approximating the edges of the incision with sutures.

Prolapse of the vagina may be *partial*, involving chiefly the anterior wall (*cystocele*), or more rarely the posterior wall alone (*rectocele*); or it may be *complete*, when both walls are everted with descent of the uterus—a condition often preceded by, although not essentially dependent upon, perineal rupture. The exciting factor in all cases of prolapse is intra-abdominal pressure, commonly resulting—in patients predisposed thereto—from habitual neglect in obeying the calls to evacuate the bladder or rectum. *Partial* protrusions require the employment of suitable vaginal supports, combined with the use of astringent injections or pessaries, and careful regulation of the patient's habits. *Chronic cases* of more or less irreducible prolapse may demand operative treatment with the object of contracting the vaginal orifice, which can best be effected by the usual operation for ruptured perineum, combined with excision of a portion of the redundant mucous membrane of the posterior vaginal wall.

Other procedures which aim at producing cicatricial contraction, or even closure of the canal, rarely prove of any lasting benefit to the patient.

V. New Growths.—*Malignant disease* occurring primarily in the vagina is extremely rare. When met with, it consists either of a localised, broad-based, papillomatous growth usually seated on the posterior wall, or else of a diffused carcinomatous infiltration, sometimes leading to constriction of the canal. Early infection of the inguinal glands commonly takes place.

Diagnosis and Symptoms.—The *papillomatous* form is most frequently seen in aged women, and is usually painless in the early stage, but later on gives rise to a certain amount of fetid discharge, with occasional hæmorrhages. The *diffused* variety, met with in younger women, is very often found to be secondary to uterine cancer.

Treatment.—The frequent use of a dusting powder composed of equal parts of tannin and iodoform will serve to control hæmorrhage and discharge, in addition to promoting the patient's comfort by diminishing fetor. If operative interference be deemed advisable, the diseased tissues must be excised as freely as possible with the help of the thermo-cautery.

Sarcoma of the vagina has been described as occurring either in a diffuse form or as circumscribed nodules. The affection is one of great rarity. Extirpation of the growths may be attempted.

W. A. Meredith.

VAGINAL FISTULÆ in connection with the urinary apparatus are named, according to their situation, *urethro-vaginal*, *vesico-vaginal*, *vesico-uterine* (where the fistulous tract traverses the anterior lip of the cervix to open into the cervical canal), and *uretero-vaginal* (where direct communication exists between a ureter and the vaginal canal). Of these four varieties, the last two mentioned are very rare, the last extremely so.

In the form known as the *vesico-vaginal*, which is by far the most commonly met with, the fistulous opening may be found at any point of the vesico-vaginal septum, varying in size from a minute slit to a large oval or somewhat quadrangular aperture. The margin, at first irregular, swollen, and ulcerated, subsequently, in the course of cicatrisation, becomes thin and firm. In long-standing cases, where the urine escapes readily, the bladder may in time become permanently contracted, the urethra also partaking of the same change from long disuse.

Causation.—Apart from malignant disease, which is the most common cause of vesical fistula in this situation, the majority of cases result from injuries inflicted during parturition, either by direct laceration, or else indirectly from sloughing due to prolonged pressure in tedious labours. Occasionally, ulceration set up by the presence of a foreign body may act, in a somewhat similar way, as a cause.

Symptoms.—The leading feature in all cases of vesico-vaginal fistula is the incontinence of urine. In puerperal patients this symptom, unless when due to direct laceration, may not ensue for some days or even for a week or two after delivery, its occurrence depending upon the separation of the slough caused by the injury. When once established, the flow will vary in constancy according to the position of the fistula; thus, if the opening be seated high up, the lower portion of the bladder will retain a certain amount of urine, and no overflow may occur so long as the patient is erect, although escape at once takes place if she lies down; on the other hand, if the opening be near the neck of the bladder, incontinence will probably be a more or less constant symptom.

Diagnosis.—The chief difficulty of this may lie in ascertaining the exact seat of the fistulous opening. When of any size, its existence on the anterior wall of the vagina can be readily recognised by digital touch, confirmed, if necessary, by the passage of a sound into the bladder and thence into the vagina. But small fistulæ often require the use of considerable care for their detection, either in consequence of the minute size of the aperture, or from the fact of its being concealed beneath a fold of mucous membrane. Should careful inspection, after thorough exposure with the help of a duck-bill speculum, fail to discover it, resort may be had to the plan of gradually distending the bladder by the injection of milk or of some coloured solution, of which any escape through even the smallest opening in the anterior vaginal wall would be readily detected. If no evidence of leakage be seen, a careful examination of the cervix uteri should be made to discover the existence of a fistulous tract.

Treatment.—Small fistulæ, when recent, will often close naturally, provided that rigid cleanliness be observed, and the bladder be kept relieved by the use of the catheter. Even when of some size and standing, their closure may occasionally be effected by cauterisation, but, as a rule, operative measures are required. These are most likely to succeed when undertaken within two to three months after the occurrence of the injury, by which time the tissues will have acquired sufficient soundness without being too firmly cicatrised. In all cases, before anything be attempted, the patient's general health must be attended to, while the parts involved should be brought into as healthy a state as possible.

Three main points require to be observed in the performance of the operation.

1. *The fistulous opening should be completely exposed, in order that its position and extent may be kept well in view throughout the procedure.* For this purpose it is well to have the patient anæsthetised, although as a rule the operation is not a painful one. The first essential is a good light, in front of which the patient should lie in the usual lithotomy position, but with the hips raised to a somewhat higher level than the shoulders, while the thighs are forcibly flexed upon the abdomen. If preferred, she may be placed in the lateral or semi-prone position. The vagina having been well cleansed, a full-sized duck-bill speculum is introduced and maintained firmly in position, so as to retract the perineum and posterior vaginal wall, and allow

free exposure of the vesico-vaginal septum. A sound in the bladder will serve to depress the anterior vaginal wall, thus bringing the fistula within more easy reach; or the same object may be attained by drawing down the cervix uteri by means of a vulsellum or a thread.

2. *The margins of the fistula should be thoroughly pared, so as to obtain a continuous raw surface.* In doing this, the operator, with the help of a tenaculum or fine-toothed forceps, first seizes and puts on the stretch some portion of the marginal mucous membrane. This is next transfixed with the knife in such a way as to split the vaginal layer through the edge of the fistula, and the knife is then carried laterally right and left, so as, if possible, to remove a complete circle of mucous membrane of the desired extent, leaving a continuous border of denuded surface around the opening on its vaginal aspect. If much cicatricial tissue be present, the margin must be more freely pared, even to the extent of removing a rim of vesical mucous membrane; but as a rule this latter should be avoided, in order to prevent risk of after-hæmorrhage into the bladder. The edges having been thoroughly denuded in the way described, or, if preferred, by means of scissors in place of the knife, all oozing must be arrested by the use of ice or of the hot douche.

3. *The sutures are to be introduced, and the freshly pared surfaces brought into accurate apposition so as to completely close the opening.* The best and most manageable material for the sutures is stout silkworm gut, but silver wire is also much used. They may be introduced by small curved needles fixed in a needle-holder; or, if preferred, by means of a handled needle, which is to be threaded after its passage and before being withdrawn. In any case, the needle should be entered about one-third of an inch from the edge of the abraded surface, and be made to transfix both margins of the opening in close proximity to, but without actually piercing, the vesical mucous membrane. When the tissues are dense, its passage may be facilitated by using a blunt hook to afford counter-pressure at the point of exit. The sutures are to be placed at intervals not exceeding a quarter of an inch, care being taken to introduce them evenly, so as to prevent subsequent puckering of the edges. After a sufficient number have been passed and all bleeding has ceased, the raw surfaces are carefully dried with a sponge, and brought into apposition by traction on the sutures, which are then firmly tied, their ends being left long and looped together to facilitate subsequent removal. If silver sutures have been employed, they may be either tied or twisted; or, if preferred, the ends may be passed through a Bozemann's plate and clamped with split shot.

After-treatment.—The bladder should be kept empty by means of a self-retaining vulcanite catheter with tubing attached, or else the urine may be drawn off at frequent intervals by the nurse. Some operators, however, allow the patient to empty the bladder naturally from the first. During convalescence, the vagina must be well douched twice daily with some antiseptic solution. The bowels, as a rule, are to be kept quiet by means of opium for a week or ten days, after which they may be relieved by the use of oil and gruel enemata. The sutures usually require removal on the sixth or seventh day, but, if not causing irritation, they may with advantage be left for a few days longer.

The *less common forms* of vesical fistulæ will require operative treatment varying according to their seat and extent. Thus, for the closure of an opening *in close proximity* to the cervix uteri, it may be necessary to make use of the anterior lip; or if this have been extensively destroyed, the posterior one may have to be brought into requisition by an operation involving obliteration of the os uteri, and thus leaving the uterine cavity to open into the bladder.

In the case of a sinus traversing the cervix (*vesico-uterine*), the anterior lip should be split through in order to fully expose the fistulous tract, which must be freely denuded before re-approximating the opposed surfaces by means of deep sutures.

When *direct* closure of a fistula is impossible owing to very extensive loss of tissue, an operation termed 'kolpokleisis,' consisting in transverse obliteration of the vagina *below* the seat of the opening into the bladder, may be deemed justifiable as the only means of relieving the patient. This object is effected by the removal of a complete ring of mucous membrane from the vaginal wall, and the subsequent coaptation of the denuded surfaces by the help of sutures, until firm union has taken place.

Recto-vaginal Fistula commonly arises from carcinomatous or syphilitic disease of the rectum, in neither of which cases would it be amenable to operative treatment. It may occasionally, however, result from sloughing, consequent upon injuries of the same nature as those which lead to vesical fistulæ. The symptoms com-

plained of are due to the passage of flatus and fæces *per vaginam*.

Treatment consists in paring the edges and closing the opening with sutures, which must not include the rectal mucous membrane. The bowels should afterwards be cleared rather earlier than in the case of a vesical operation, in order to obviate danger arising from scybala. W. A. Meredith.

VAGINAL HERNIA. — In this variety the rupture projects into the vagina. It usually protrudes through the lateral wall of the vagina behind the broad ligament. It may be found in front of the broad ligament, or deep down in the recto-vaginal pouch. The rupture is most often seen in multiparæ. The contents are usually small intestine. In at least one instance a loop of the sigmoid flexure is said to have been involved. So far as reported cases go, it does not appear to have been the subject of strangulation. The tumour may form a serious obstacle in labour.

Frederick Treves.

VAGINAL LITHOTOMY. *See* Lithotomy; Stone in the Female Bladder.

VAGINISMUS is a term applied to a condition occasionally met with in married women of a nervous, irritable temperament, arising from the presence of some persistent local source of irritation about the vulva or the orifice of the vagina. Among such may be mentioned:—Vascular growth of the meatus; fissures of the fourchette or nymphæ; irritable caruncule myrtiformes; an inflamed or only partially ruptured hymen, &c.

The chief *symptom* of the disease is intense pain and spasm of the parts, induced by any attempt at coition.

Diagnosis must be made by inspection, a careful search being instituted for the discovery of any one of the above-named sources of irritation. Should no local cause be found, the possibility of the symptoms depending upon some internal condition, such as a tender prolapsed ovary, or upon the existence of perimetritic trouble, must be considered.

Treatment will consist in the removal of any local source of irritation.

Vascular growth of the meatus should be destroyed with the help of the thermo-cautery.

Fissures of the fourchette, or around the vaginal orifice, are best treated by division with a sharp knife, or by the application of the cautery, followed in either case by the use of an ointment containing iodoform.

The condition known as *irritable caruncule myrtiformes* is recognised by the presence of extremely sensitive, nodular projections on the surface of the mucous membrane immediately within the orifice of the vagina; these consist of the remains of the ruptured hymen. In order to obtain a cure in such cases, it is necessary to remove a complete ring of tissue, including the growths in question. This should be effected, with the help of sharp curved scissors, while the patient is under an anæsthetic. The vaginal orifice must next be freely dilated, and then firmly plugged with a roll of iodoform gauze, over which a pad of the same material is to be applied and kept in place by a T-bandage. The use of a self-retaining catheter, with rubber tubing attached, will prevent soiling of the dressings. The plug which, in addition to acting as an efficient dilator, is also a perfect antiseptic, may be left undisturbed for five or six days, when, on its removal, the raw surface will be found healed. The subsequent daily employment, for a few hours, of a glass or vulcanite dilator will prove useful in completing the cure.

A somewhat similar treatment may be followed in cases of an *abnormally tough* or only *partially ruptured hymen*, in newly-married women. W. A. Meredith.

VARICOCELE.—This term was formerly used to denote a varicose condition of the superficial veins of the scrotum, and Circocele was the name given to varix of the veins of the spermatic cord. Circocele has become obsolete, and varicocele is always used at the present time to denote a dilated varicose condition of the spermatic plexus of veins.

Causes.—The disease is most frequently seen between the periods of puberty and full manhood. Cases are occasionally observed in young boys and just before puberty, and the writer has operated upon a man fifty-four years of age, who attributed the development of the varix, and apparently with reason, to a blow received seven months previously. The disease is therefore, probably, in some way associated with the great developmental changes occurring in the testicle at puberty, and the functional excitement of the parts during the years of early manhood. Frequent masturbation, or a lascivious habit of mind, by keeping up a more or less constant congestion of the part, may favour the

development of varicocele; on the other hand, the regular sexual relations of marriage are of use in curing the disease when slight. The more definite local causes of varicocele are the great length and vertical direction of the slender spermatic veins, their plexiform arrangement in the scrotum, with their termination in one, or at the most two, small veins in the abdomen; the imperfect support afforded to the veins by the loose tissues of the scrotum; the great vascular changes attending sexual excitement; injury; and acute inflammation of the epididymis and cord. Occupations involving continuous standing or slow walking, or attended with frequent concussions of the parts, and hot climates are believed to predispose to the venous dilatation, while there is evidence to show that general debility, with a feeble state of the circulation, and a relaxed flabby condition of the tissues, leading to a pendulous condition of the scrotum, is of etiological importance. In a large proportion of cases, the subjects of varicocele are healthy, well-nourished, and well-developed men, in whom it is impossible to detect any cause of increased intravenous pressure, or of deficient external support. In such cases, the writer has suggested that the disease is to be regarded as a true venous hypertrophy, arising during the active changes occurring in the associated organs at and after puberty.

The much greater frequency of varicocele on the left side than the right has been accounted for by the greater length of the left vein, by the fact that the left spermatic vein enters the renal vein at right angles, while the right opens into the vena cava parallel to its current, and by the passage of the left vein under the sigmoid flexure, which, when loaded with fæces, may compress and obstruct it. It must be confessed, however, that, with the exception of the greater length of the left vein, no valid reason for the undoubted fact has been as yet adduced, and even this does not appear to be sufficient to account for the remarkable preponderance of left-sided varicocele. The occurrence of varicocele has also been attributed to the absence of valves in the left spermatic veins; in addition, however, to several valves in different parts of these veins, a single valve, or a pair, are found at, or within a very short distance of, the outlet of the vein on each side; it is easy to demonstrate the competency of these valves, and the impossibility of injecting fluid from the renal vein or vena cava into the spermatic vein.

Pathology.— The affected veins are dilated, pouched, elongated, and tortuous; their walls are thickened with an overgrowth of fibrous and muscular tissue, to such an extent that when cut across they stand open like arteries. Probably all the veins of the spermatic cord are never affected, and the degree to which the dilatation progresses in different veins, and in different cases, varies much. The venous dilatation has been shown to extend to the vessels of the mediastinum testis, and to those lying beneath the tunica albuginea. Localised thrombosis, with the subsequent formation of a phlebolith, may occur. The most important pathological question arises in connection with the testicle. That organ is most often found of its natural size and plumpness, and apparently unaffected by the presence of the varix. In some cases the testicle is a little smaller and softer than its fellow, and in a certain number of cases the testicle is found markedly smaller than its fellow, but of the normal shape and consistence. The explanation of these facts is probably as follows:—If the disease be limited to the cord, as is usually the case, and come on after the testicle has reached its full development, it exerts no injurious influence upon the structure of that organ. But when the vessels within the testicle are varicose, it may lead to a slight shrinking of the tubular structure. If, however, the varices develop before or at puberty, the usual enlargement of the testicle may not take place, and it may continue in its puerile state. The important fact is, that where the testicle is found much smaller than its fellow, it is an undeveloped organ, and not atrophied. There is no evidence that simple varicocele can produce marked wasting of a healthy testicle. Similarly, it appears probable that a varicocele does not interfere with the due elaboration of semen, or render its subject either impotent or sterile. Mr. Curling cites three cases in which the spermatic fluid was found destitute of spermatozoa; but, as in each of these cases the testicle was distinctly small, it is probable that they were instances of the association of varicocele with failure of development of the testicle.

The superficial scrotal veins may be found varicose, and occasionally there may be varices of the superficial veins of the legs. In the worst cases of varicocele, the scrotum is usually very pendulous.

Symptoms.— There may be no subjective symptoms whatever attendant upon even a very large varicocele; the patient,

in such cases, is at the most only conscious of a greater fulness of the left than of the right side of the scrotum, and it is not uncommon for the surgeon to discover a varicocele of which the patient has been quite unconscious. In the majority of cases the patients complain of a sense of weight in the scrotum, and of a dragging pain, extending up into the groin and round to the loin of the same side; this is exaggerated by standing, by effort or by fatigue, and is relieved by rest in the horizontal position, or by support to the scrotum. The frequent or constant occurrence of this pain exerts a markedly depressing influence upon some minds; it also tends to centre the thoughts of the individual upon his sexual organs, excites groundless fears of impotence or sterility, and if the man be deficient in moral control, he may become a sexual hypochondriac. In some rare cases the pain has been so intense that the patient has been quite disabled, apart altogether from emotional disturbance. The pain may be only felt, or felt most, when the bowels are constipated, and it is greatly exaggerated after sexual intercourse, although at the time relief may be experienced. It is a common belief that varicocele may cause frequent seminal emissions; but careful inquiry has shown this to be groundless.

Diagnosis.—Varicocele is generally present on the left side only, and, if present on the right, the left swelling is the larger of the two. The diagnosis is usually made with the greatest ease. The swelling involves the cord, and in many cases projects behind and even below the testicle, but is limited to the scrotum, not extending up into the groin. It is soft, elastic, opaque, compressible, dull on percussion, with a distinct expansile impulse on coughing, and the irregular tortuous veins give to it the feel of a bag of worms. If the patient lie down, the swelling is reduced by simply raising the scrotum, and without a gurgle, or the sensation of a sudden slip, as in the reduction of a hernia. If now the surgeon place his forefinger lightly over the external abdominal ring, and allow the patient to rise, he will observe the gradual reappearance of the swelling first at the lower part of the scrotum, and without his feeling anything slip past his finger. This sign, and the fact that the swelling is limited to the scrotum, will readily distinguish varicocele from hernia, for which it has been most often mistaken; the impulse on coughing, the knotty feel of the swelling, and its ready reducibility distinguish it at once from the œdema of the cord produced by wearing a truss, or the thickness due to the presence of the sac of a hernia.

Treatment.—The first thing to be done in most of the cases coming under the surgeon's notice, is to assure the patient of the innocuousness of the disease—that it will not induce impotence, sterility, or exhausting seminal emissions. If the surgeon is successful in quieting the patient's mental distress, it is not uncommon for all physical distress to pass off too. Where, however, pain is complained of, palliative measures should be adopted. The patient should constantly wear a well-fitting suspender, of which the best is probably one that laces up the front; another good one is that which raises the scrotum into the left groin by a strap fastened to a band round the waist. Night and morning the scrotum should be well douched with cold water, to improve the 'tone' of the dartos. The bowels should be carefully regulated, and if the patient be pale, anæmic, and flabby, the perchloride or other preparation of iron should be given, and moderate outdoor exercise should be insisted on. Severe exertion, or sudden strains, are to be forbidden; but it is most essential to avoid leading these patients to consider themselves to be invalids, or unfitted for the active duties of life; the more they can be absorbed in their occupations, and the better their general health is maintained—by whatever means—the less distress will a varicocele occasion. All vicious practices must be absolutely abandoned, too frequent seminal emissions should be controlled by bromide of potassium, in doses of ʒss., given at bed-time. In some cases a well-fitting truss, maintaining gentle compression on the spermatic veins in the inguinal canal, affords more relief than a suspender, and leads to the gradual shrinking of the varix; it is, however, difficult to adjust a truss with just the right amount of force. When the presence of a varicocele debars a youth from one of the Government services, or from any particular occupation; when the subject of it wishes to live in a hot climate; when palliative measures fail to give relief, and the varix is increasing, or has attained a large size; when the testicle on the same side is notably smaller than its fellow; a radical cure of the varicocele should be attempted. It is probably well to operate upon all varicoceles present before puberty; but in no case is the operation to be recommended until palliative means have failed to give relief, and unless the varicocele is a cause of distinct

inconvenience to the patient. The operation should not be undertaken simply for the relief of the mental distress so often associated with this disease.

Many operations for the radical cure have been devised and practised, but only three require notice here:—(1) The simplest procedure is to pass a straight needle, armed with carbolised silk or chromicised catgut, through the scrotum, between the vas deferens and the veins, and then back again between the veins and the skin, so that the dilated vessels are enclosed in a subcutaneous loop. The thread should then be tied tightly, and the ends cut off short and allowed to slip inside the scrotal puncture. Some surgeons prefer to place two such ligatures round the veins, about an inch apart. (2) Excision of the veins. The part is shaved and rendered aseptic by thorough cleansing with turpentine, corrosive sublimate 1–500, or carbolic lotion (5 p.c.); a small fold of skin, over the front of the varix, is raised and transfixed; the large veins at once appear, and are to be cleaned, carefully separated from the vas deferens, and any small, undilated veins, ligatured at the upper and lower end of the exposed part with chromic catgut, and the intermediate portion excised. The skin-wound is to be carefully sewn up with a continuous suture, and a small drain placed in the lower end of the wound. The whole operation, and the subsequent dressing, should be conducted aseptically. This operation certainly cures the disease, and if the above-named precautions be taken, is a safe measure; but the writer has known it to be attended with suppuration, and with extensive hæmorrhage from slipping of a ligature; he, having performed it a few times, has come to regard it as inferior to the following procedure. (3) Subcutaneous division of the veins with a galvanic écraseur. The vas deferens is to be carefully separated from the veins at the upper part of the scrotum, and the skin pinched in between the two is to be transfixed with a tenotome or some slender knife, and divided parallel with the vas for $\frac{1}{3}$ inch. Through this incision, a needle, armed with a platinum wire, is to be passed, and returned through the same skin-apertures, but between the skin and the veins. The veins are thus secured in a loop of the wire. The ends of the loop are to be affixed to an écraseur, and the current of one cell of a Grove's battery, or of a small bichromate battery, passed through it; the heated wire quickly severs the veins and securely sears the cut ends. A moderate traction should be kept up on the wire, so as to draw the veins out of the scrotum as much as possible, and in that way the action of the hot wire is limited to the veins; the wire must be heated to a dull red colour only. The patient must subsequently rest quiet and still in bed, with the scrotum supported and a small pledget of iodoform wool over each skin-wound. The veins will be felt to become filled with clotted blood, which gradually becomes absorbed. As a rule, the patients are kept in bed for a week, and are able to resume active duties in ten to fourteen days; they should wear a suspender for another month. Having performed this operation about twenty-five times, the writer can strongly recommend it, on account of its ease, safety, painlessness, and the certainty with which a cure is obtained. The radical cure of a varicocele, by any one of these methods, is not attended with danger to the testicle.

A. Pearce Gould.

VARICOSE ANEURISM. *See* Arterio-Venous Aneurism.

VARICOSE VEINS.—A vein is said to be varicose when it is the seat of permanent pathological dilatation. This condition is frequently met with in the spermatic and hæmorrhoidal veins. *See* Varicocele; Hæmorrhoids. Of other sites the lower limbs are by far the most frequent, although varix is occasionally found in the veins of the arm, of the neck and face, and also in the deep as well as the superficial veins of the trunk.

1. *Causes.* — The commonly accepted view of the etiology of varicose veins is that they are dependent upon increased intravenous pressure, or a deficient resisting power in the vein-walls, or upon these two conditions acting together. The increased intravenous pressure is usually attributed to one or other of three conditions: increased supply of blood to a part, obstruction to the outflow from a vein, and the influence of gravity. The active hyperæmia associated with chronic ulceration and other inflammatory processes, or with prolonged muscular contraction, throws a greater amount of blood into the veins of a part, and increases the pressure of the blood upon the venous walls. The influence of obstruction to the outflow from a vein is shown by the effects of the pressure of the pregnant uterus or other pelvic tumour upon the iliac veins; in women, the first occurrence of varicosity of the superficial veins of the leg is very often attributed to

pregnancy. A tight garter applied below the knee, and the pressure of a badly adjusted truss, are other examples of slight venous obstructions acting continuously, to which have been attributed the production of varicose veins in the lower extremities.

The column of blood in the arteries of the lower limb supports that in the veins, but the pressure of the blood upon the venous walls is increased by gravity, and is greatest, therefore, at the lower end of the column. When the valves are intact, the effect of gravity is annulled, but when, from injury, atrophy, or the dilatation of a vein, the valves are inefficient, the influence of gravity is fully felt. Deficiency in the tone or power of resistance of the vein-walls may be an inherited or a primary defect in their structure and function; or it may result from injury to the vein, inflammation of the outer coat of the vein, or from absorption of the tissues which usually support the veins externally. Probably, in some cases, varices are dependent upon obscure vital rather than upon simple physical causes, and the enlarged veins are to be regarded as hypertrophies or overgrowths of the veins, rather than as the results of the intravenous pressure and the tonic resistance of the venous walls.

Conditions to be specially noticed are heredity, age, sex, and occupation. In many cases there is found distinct evidence of the influence of heredity, varicose veins being seen in two or three generations of a family; where heredity is most marked, the varices generally appear early, and affect the larger superficial veins. Varicose veins most frequently begin to show themselves between the age of twenty and thirty-five, just when the frame is attaining to its full development and displaying its greatest activity. Varices are not infrequently met with earlier or later than this age; on the other hand, some cases improve after middle life. The disease is said to be more common in men than women; with the exception of pregnancy and the pressure of pelvic tumours, men are more exposed to the above-mentioned causes of varix, and to this the somewhat greater prevalence of the disease in them than in women is probably due. Any occupation which entails prolonged standing, such as that of a policeman, omnibus conductor, or of a washerwoman, both by the influence of gravity, and also by the powerful muscular contractions necessary to support the body in the erect position, is liable to cause varix. Any occupation entailing constant contractions of the muscles of the lower limbs may have the same effect. A narrowing of the saphenous opening or of other apertures by which the superficial veins communicate with the deep veins has been alleged as a cause of varix, and a plan of treatment has been based upon this assumption. This view has, however, been entirely abandoned, especially since it has been shown that the venous dilatation affects the intermuscular and intramuscular veins as well as the subcutaneous vessels, and probably spreads from the former to the latter, while the superficial veins are specially prone to be dilated at the points where the deeper intermuscular veins communicate with them. A sudden severe strain, causing great distension of a vein, with or without rupture of a valve, may be the starting-point of a varix.

The effect of pregnancy upon the circulation in the lower limbs of women varies much. In many cases there is no interference whatever; in some cases there is some œdema of the feet and ankles in the later stages, without any apparent distension of the veins of the limbs; but in other cases the veins of one or other lower limb, or of both, or of the vulva, are considerably distended. This distension may come on quite early in the course of the pregnancy, before the uterine enlargement can be sufficient to account for it, and in these cases the varicose condition may not become worse in the later months of pregnancy. In other cases, the veins swell out only when the uterus has attained some considerable size, and may be supposed to exert considerable pressure upon the iliac veins. Not infrequently a woman will pass through her first pregnancy without any apparent distension of the veins of the legs, and yet suffer from it in subsequent pregnancies. The venous distension from pregnancy, when once it has occurred, is always repeated with any successive pregnancy; it may or may not persist in the intervals. Varicose veins may be met with in the healthy and robust, but are more common in persons with pale skin, flabby muscles and fibrous tissues, and of lymphatic temperament. The greater frequency of varix in the left than the right leg has been attributed to the pressure of a loaded sigmoid flexure upon the left iliac vein.

2. *Pathology.*—The disease is by no means limited to the superficial veins. It is very rare in the main deep veins of the limbs, except the posterior tibial, but it is common in the intermuscular and intramuscular veins of the lower limbs, and may

attack them before the subcutaneous vessels are dilated. The distribution of the affection in the subcutaneous veins also varies very much. In some cases, the whole length of the internal or external saphenous vein is enlarged, no other vessels being obviously affected; at other times, these large veins are dilated at a few isolated spots only; again, these trunks may be quite unaffected, and certain of their tributaries dilated to a size far in excess of the vessels into which they pour their blood. The small venules of the skin may be distended, or be quite normal; in many cases all these varieties of the disease are met with together. The superficial veins appear to be specially prone to varix just where the deep veins communicate with them, as if the vessel-walls yielded before the force of the double current of blood flowing into them. Varicose veins may be simply dilated transversely; more often they are elongated as well, and thrown into sinuous curves and coils, while, in the worst cases, the vein loses its cylindrical shape, and its walls are pouched out into aneurism-like dilatations.

Changes are usually met with in all the coats of a varicose vein: the inner coat is thickened, and, on slitting up the vessel, is seen to be thrown into longitudinal wrinkles; sometimes it is irregularly thickened (atheroma); or again it may be found to have undergone fatty degeneration and to have lost its transparency. The middle coat is commonly hypertrophied, the muscular tissue as well as the fibrous being in excess, but it may be thinned or absent altogether, especially over the saccular dilatations of a vein. The outer coat is less markedly thickened. Altogether, the venous walls are so notably thickened that, on section, the vein remains open like an artery. The valves are in places absent altogether, or they are found as delicate cords, sometimes adherent to the vein by one extremity only. The coils of a tortuous vein are united by firm fibrous bands, and similar bands unite the vessel to the overlying skin. The skin and subcutaneous fascia over a varix may be thickened, but more often they are gradually thinned; where a large varix lies over a bone, it may be hollowed out into a groove for the vessel. Thrombosis is liable to occur, and lead to the obliteration of the vein or the formation of a phlebolith. A more serious complication is a gradual thinning of the vein and of the skin over it, until it bursts.

3. *Symptoms and Diagnosis.*—An extreme degree of varix may be met with without giving rise to any symptoms whatever. The worst case ever seen by the writer was in the leg of a man eighty years of age, in whom the whole length and circumference of the limb had been covered with very large tortuous veins for about sixty years; during the whole of this period there had been no pain or œdema, nor any symptom to trouble the patient. More often, varices are the seat of a dull aching pain or a sense of weight and fulness in the part, when from prolonged standing or walking, or any other condition, they become fully distended. Occasionally, when a vein presses upon a nerve, the pain is more acute, and is referred to the extremity of the nerve. The pain is quickly relieved by raising the part and lessening the fulness of the veins. Varix of a deep vein has been thought to explain the occurrence of cramp-like pains in a part. Varicose veins are often associated with simple œdema, chronic induration of the skin and subcutaneous tissue, eczema and chronic ulcers; but how far these conditions are directly dependent upon the dilated veins is open to question.

The *diagnosis* of superficial varix is quite easy: the enlarged vein is recognised by its tortuous cylindrical outline, its compressibility, the readiness with which it fills out again into a soft swelling when pressure is removed, and by its continuity with normal veins. When the varix is large and near the trunk, there may be a distinct expansile impulse on coughing. When the coverings are thin, the blue colour of the vein may be distinctly seen. This is especially the case when a venous pouch is about to burst. The varices vary greatly in size, extent, and distribution; they may be found at intervals along either saphena vein, or forming a close network of veins below either malleolus. A varix is often found crossing the front of the leg above the middle, or running over the front of the patella, or in the lower third of the front of the thigh. Varices of the small cutaneous veins appear as fine blue lines in the skin, generally grouped in a stellate manner. Rupture of a varicose vein may occur spontaneously or during some straining effort; the bleeding is rapid, blood flowing from each end of the vein. This accident generally happens to branches of the main veins, and particularly in the lower third of the leg; it may occur in the vulva. Deep varix may be diagnosed when the patient has dull or cramp-like pains in the leg on standing, which are at once relieved by lying down or raising the limb.

4. *Treatment* may be spoken of as palliative or curative, of which the former is the more generally applicable. Where varix has developed acutely after some sudden strain or prolonged exertion, the patient should rest in bed or on a couch for a month or six weeks, with the part evenly bandaged, and during this time the diet should be unstimulating and the action of the bowels carefully regulated. Subsequently, he should carry out the usual palliative treatment, which consists in affording external support to the veins and in preventing their undue distension. The external support may be afforded by well-fitting elastic stockings or by a carefully applied bandage. The stocking should not be too tight or too strong, and should fit the leg evenly; the bandage may be of cotton, thin flannel, or thin perforated pure rubber, and, when well applied, is often more comfortable than an elastic stocking. When any one vein is specially enlarged, it is a good plan to place a pad of corresponding size over it under the stocking or bandage. Where the venous enlargement is only slight, it is often sufficient for the patient to wear well-fitting silk or angola stockings, putting on a fresh pair each morning. Garters should not be worn at all, or only fastened round the thigh.

Venous engorgement should be prevented by avoiding prolonged standing, sudden straining efforts, or fatiguing exercises, these rules being enforced with a stringency in direct proportion to the acuteness of the disease, its tendency to increase and affect additional veins, and the distress it occasions to the patient. In the great majority of cases, walking and the various athletic exercises may be practised with advantage to a point short of fatigue or pain, especially if afterwards the leg be raised to a level with the hips. Applying to the part, after the cuticle has been removed by a blister, the solution of perchloride of iron, or the external use of the tincture of witch-hazel has been recommended, but the writer is unable to advocate either measure from his personal experience. Constipation is to be carefully avoided. Where the patient is anæmic, the astringent preparations of iron should be administered internally.

When varicose veins arise during pregnancy, the patient should wear a bandage on the legs, and rest as much as possible in the horizontal position, and, after her confinement, she should still continue to wear the bandage for some weeks.

When a vein is threatening to burst, the part should be carefully bandaged and kept horizontal. When a varix has ruptured externally, the bleeding may be easily controlled by raising the limb; a pad of lint should then be firmly bandaged over the wound, and the leg kept at rest for a week until the scar is sound.

Many modes of obtaining the radical cure of varicose veins have been suggested and practised, only some of which need be mentioned.

1. *Acupressure.*—A flat needle, preferably with a curved point, should be passed beneath the vein, and a piece of quill or gum bougie be laid over the vein, and held firmly in place by silk twisted over the ends of the needle in a figure of eight. Two pins may be placed near together, and the vein divided subcutaneously between them. If, on introducing the needle, venous blood escape, its point should be withdrawn and passed in deeper at a closely adjacent spot. The pins should be withdrawn in about a week, but this time may be shortened or lengthened if the reaction in the part is excessive or too slight. The pins must not be passed where the skin is inflamed. This method often fails to obliterate the veins.

2. *Ligature.*—An incision just long enough to expose the vein is made through the skin and cellular tissue, and through it, by means of an aneurism needle, carbolised silk or chromic acid catgut is passed around the vein and tied. The ligature is generally applied in several places; it may be used as a double ligature, and the vein be divided between. It obliterates the vein safely and certainly; the extent of the vessel obliterated at each ligature is usually only small.

3. *Excision.*—An incision is made over some length of a varix, and carried down so as to expose the vein. A double ligature is then tied around one end of the vessel, and the latter is divided between and raised from its bed; each branch entering the varix and its lower end are similarly divided between double ligatures, and the edges of the skin-wound are united by sutures. This operation is more formidable than the others, but completely removes the disease.

The external application of caustics or the intravenous injection of coagulants is not to be recommended.

In view of the implication of the deep veins in varicose disease, the radical cure of superficial varices is not generally advisable, and when practised is often disappointing. The cases most suitable for it are those in which there are only one or two veins affected, or in which some one or two varices are the cause of special in-

convenience or suffering. Where a patient is disabled by the disease, and this is limited to one or a few parts only, the radical cure should be attempted, and the younger and more healthy in other respects the patient, the greater the desirability of the operation. As a rule, to which there are few exceptions, chronic œdema or induration or ulceration of the skin and subcutaneous tissues is a bar to operation; but where a varix can be traced down to an ulcer, obliteration of the vein is sometimes the best means of curing the ulcer. Where the varix to be treated consists of an isolated 'bunch of veins,' excision is the best operation. Where it is desired to obtain the obliteration of a number of varices or of several parts of one long dilated vein, the application of the ligature or of acupressure is the best means to adopt, and of these the ligature is preferable. Ligature and excision should be performed with careful antiseptic precautions. The dangers of spreading phlebitis and of embolism must be kept in view in the after-treatment. A. Pearce Gould.

VARIX OF LYMPHATICS. *See* Lymphangiectasis.

VEGETATIONS, Adenoid. *See* Naso-Pharyngeal Growths.

VEGETATIONS, Syphilitic. *See* Syphilis.

VEINS, Air in. *See* Air in Veins.

VEINS, Diseases of. *See* Phlebitis; Thrombosis.

VENESECTION, the operation of opening a vein for the purpose of general blood-letting. One of the vessels at the bend of the elbow is commonly chosen, but if these should be too small or from any reason unsuitable, the external jugular vein at the root of the neck or the internal saphena above the ankle may be utilised.

Apparatus required.—Lancet or small double-edged scalpel, bandage, tape, pad of lint, bleeding basin, sponge and water.

Operation.—I. *At bend of Elbow.*—The patient being in the recumbent or sitting position, with the limb extended and supinated, a piece of tape should be tied around the upper arm at about its middle, sufficiently tightly to obstruct the venous circulation without interfering with the pulse. The veins having become swollen, the median cephalic or median basilic, whichever happens to be the larger, is selected; if they are of equal size the median cephalic is preferable, in consequence of the extreme proximity of the median basilic to the brachial artery.

The elbow having been grasped in the operator's left hand, the vein is fixed by placing the thumb on it just below the site of the proposed opening. The lancet-blade, held between the finger and thumb of the right hand, is then passed into the vessel until the blood flows by its side, the blade is carried onwards, horizontally, for about one-third of an inch and made to cut its way out so that the wound in the skin shall be larger than that in the vein. The pressure of the thumb is then removed, and the blood allowed to flow into the bleeding-bowl until the required amount has been taken. If the stream be sluggish, the patient should hold a stick or rolled bandage in the hand, and grasp it firmly at frequent intervals.

To arrest the bleeding, the constriction around the arm must be removed, a pad placed on the wound and retained in position by a figure-of-eight bandage or tape. For two or three days the arm should be carried in a sling; at the end of the fourth day, by which time the wound has, as a rule, healed, the pad and bandage may be dispensed with.

In opening the vein, it is of the utmost importance to avoid cutting too deeply, otherwise the posterior wall of the vessel may be laid open, a mishap which sometimes proves serious in the case of the median basilic vein, when the brachial artery is likely to be wounded and a varicose aneurism or aneurismal varix to follow. Care must also be taken to prevent the skin from gliding over the opening in the vein and so forming a valve-like wound, which is apt to impede the flow of blood and lead to subcutaneous extravasation.

II. *At root of Neck, Venesection of External Jugular.*—The patient being, if possible, in the reclining position with a pillow under the shoulders, and the head turned to the side opposite that selected for the operation, a small cork or hard pad of lint should be placed on the vein, as it dips under the clavicle at the outer border of the sterno-mastoid muscle, and held firmly in position by the thumb, or, more conveniently, by a bandage passing beneath the opposite axilla. The vein should then be opened in the manner already described, as it lies on the surface of the sterno-mastoid, the incision being made in the direction of the fibres of that muscle—i.e. transversely to the fibres of the platysma. The blood may be caught in a shallow receiver, or conducted into a bleeding-basin by means

of a small funnel or a channel made of paper or cardboard.

To arrest the bleeding, a compress should be placed on the wound and held in position by the thumb until the pad above the clavicle has been removed, when it may be firmly strapped in its place. Much care is necessary in the adjustment of the clavicular pad, as its great object, in addition to obstructing the circulation, is to obviate the possibility of air passing down the vein, which is the main risk in this operation; for the same reason it should on no account be disturbed until the opening in the vein has been closed.

III. *Above Ankle.—Venesection of Internal Saphena.*—A method rarely practised in this country. A tape having been tied around the leg just below the calf to obstruct the circulation in the vein, the operation is performed in the same way, step by step, as that described at the bend of the elbow. To increase the flow, should it be sluggish, the foot may be continually rubbed in an upward direction or held in warm water. WILLIAM H. BENNETT.

VENOMOUS SERPENTS, Bites of.—The poison is secreted by a gland situated behind the eye and beneath the masseter muscle; thence the fluid is conveyed through a curved duct to the base of the fang, and by a channel traversing this tooth, or by a groove in its posterior surface, the secretion is discharged. The upper fangs alone admitting the venom, it is important always to estimate in any case the size, position, and number of the punctures.

Poisonous serpents abound in India, America, Africa, and Australia, and in England there is one—the adder. The best known are the Indian cobra, the American rattlesnake, and the Australian tiger, black, brown, and copperhead snakes. The general effect of the poisons of all these is very similar, and it is probable that the essential lethal element is the same, while certain peculiarities give different local effects.

The Venom.–The secretion of the poison-glands seems to be in all venomous reptiles essentially the same in appearance. Thus, Prince Bonaparte described that of the viper as 'having a gummy appearance, somewhat resembling uncoloured varnish, perfectly clear and transparent;' while Halford says of the venom of the black snake of Australia that it is a 'faintly yellowish pellucid fluid, ranging in consistence from thin syrup to thick gum-water, and upon exposure rapidly thickens, and becomes like hard gum.' Fayrer describes the cobra-venom as a 'clear, slightly viscid fluid, soluble in water, and slightly acid.' It will keep months or years between slips of glass and still retain its virulence, and even after the heads have been long in spirit the poison retains its power.

The effects of the venom are the same in all the most deadly snakes. There seems no limit to the amount that may be taken harmlessly into the stomach, nor does it matter whether the animal be fasting or not. This explains the freedom from poisoning after sucking a wound; but here it must be pointed out that, as the poison may be absorbed through an abrasion, great care is necessary. While the mucous membrane denies a passage to the poison, the synovial membranes allow it to pass rapidly into the system. It is stated by Fayrer that the flesh of animals killed by the venom is not poisonous, and is eaten by the natives. The coagulating power of the blood seems to be destroyed in nearly all cases, and this is shown, not only by its fluid condition after death, but by the free bleeding from the wound, the ecchymosis, the hæmoptysis, and the escape of blood in the stools.

Mitchell observed that when rattlesnake poison was applied directly to the mesentery, rupture of the small vessels occurred, an effect going far to explain the hæmorrhages. Extravasations are found in the serous membranes. Rigor mortis is said always to be present.

Symptoms.—In England, the bite of the adder sometimes gives rise to serious symptoms. Several cases are recorded in the journals from which, and from a case seen by the writer, this account is drawn. Locally, pain is immediately felt—acute and burning—and is rapidly succeeded by swelling. The punctures are very fine and appear as two discoloured points. In one class of cases the part swells rapidly, the skin retaining its natural hue. The swelling extends up the forearm and arm, over the shoulder, down the side of the chest, over the back, and may reach the abdomen and groin, and with all this there may be no discoloration, no pain, no glandular enlargement, and few, if any, constitutional symptoms after the first few hours. Gradually the swelling subsides, leaving the arm unaffected. This form of swelling is peculiar, and does not correspond with any of the common affections, and seems special to this poison. In other cases, however, lividity and ecchymoses accompany the swelling, or even a diffuse cellular inflam-

mation may occur, as in a case recorded by Mr. O. Pemberton.

The general symptoms appear quickly, faintness, sickness, and diarrhœa being the earliest and most constant. The pulse is quick, feeble, and may become imperceptible. Dyspnœa also is common. Some complain of intense epigastric pain, and in one case mucus and blood appeared in the stools. The removal of a ligature in one case produced sudden fainting, and it was a week before the patient recovered. Again, in others there may be few or no general symptoms.

Weir Mitchell says that the bite of the rattlesnake is sometimes followed by pain of a pricking or burning character, which gradually becomes intense. Blood flows freely from the punctures, and the parts around swell and become discoloured from extravasation of blood. The wounded extremity becomes larger and the pain greater, the skin assuming a mottled, marbled aspect. A phlegmonous inflammation follows in some cases as a secondary effect, associated with glandular enlargement, suppuration and even gangrene, great depression of the nervous system and general prostration with profuse sweats, vomiting, dyspnœa and diarrhœa. Five and a half hours he gives as the shortest period in which death occurred.

After the cobra-bite death may occur very quickly, with prostration and other symptoms like rattlesnake-poisoning. Fayrer gives one case in which death occurred in half an hour; others lasted two, ten, and twenty-four hours, and one as long as eight days.

Halford says of the bites of the snakes of Victoria that the commonest effects are vomiting, dilated pupils, feeble and intermittent pulse, followed by lethargy and coma. In other cases consciousness is very slightly or not at all impaired, and there are muscular spasms, chiefly of the neck, and tenesmus. These latter are the more serious.

Treatment.—The leading authorities—Weir Mitchell, Halford, and Fayrer—on snake-poisons agree that the mortality of fang-wounds has been greatly exaggerated, for many are inflicted by non-poisonous serpents, and, as much depends upon the condition of the reptile at the time, a poisonous snake does not always give a fatal bite. It is from neglecting such points as these that so many innocent substances, as olive oil, snake root, ammonia, salt, &c., have obtained an undeserved reputation. No doubt the great drawback to successful treatment is the delay caused, in many instances, by the distance of the victim from efficient help, and, amongst natives, to their preference for the charms and incantations of their medicine-men. There is again the great confusion attending the occurrence, its suddenness, the rapid gliding away of the serpent, the doubt as to whether it was poisonous or not, and the intense mental dread of impending death and the shock consequent thereon. The native methods also of beating the victim with sticks, walking him about, and keeping him awake by loud noises, tend to increase the exhaustion, while, on the other hand, amongst more civilised communities, the custom of administering large quantities of brandy or other spirit, produces a variety of symptoms, in which it is difficult to say how much is due to the remedy and how much to the poison. Therefore it is that all writers with a practical acquaintance advise a more deliberate use of remedies, and a careful estimation beforehand of the amount of venom probably introduced. Whatever the kind of snake, whether Indian, American, or Australian, one treatment is applicable in all cases. The following summary is drawn from the writers named. It must be here remarked that in the case of the English adder, immediate ligature with incision, sucking or cupping, followed by the 'relaying' of the constricting band, is sufficient local treatment.

In all cases, where possible apply a ligature tightly above the wound, and one or two others higher up the limb, at intervals of a few inches. Tighten that nearest the wound by twisting with a stick, as it requires a great deal of pressure to prevent absorption.

Now consider the case; determine if possible whether or not the snake was poisonous, whether a large dose of poison is likely to have been introduced or not; examine the number of fang-wounds. We may by such inquiries be enabled to reassure the patient, and allay the mental dread, or obtain sufficient data for extreme measures.

In all cases freely excise the part, taking away the subcutaneous connective tissue, and apply to the raw surface strong carbolic acid, the cautery, or a mineral acid; or, before this is done, let the wound be sucked by the patient if possible, or by someone not unwilling to incur a slight amount of risk. Instead of this a cupping-glass may be applied.

If the snake be a deadly one, or if the dose of poison be large, amputate at once above the wounded part.

Now await the onset of symptoms, keeping the patient quiet; if they appear, give stimulants gradually to restore the force of the heart. Should the patient recover the first absorption of the poison, loosen the highest ligature and wait for the renewal of the symptoms, and when these appear, reapply the ligature, and administer the stimulants. Repeat this method of 'relaying' the ligature, finally removing it altogether, for the parts beyond are sure to suffer if deprived too long of their blood. The sudden removal of a ligature, in the case of an adder-bite, produced fainting in a lad showing no symptoms up to that time. By admitting the poison which must necessarily enter the circulation in this intermittent way, the patient may be able to survive the effect of small doses. 'There is reason to believe,' says Halford, 'that, if applied without delay, a ligature may stay the course of the poison and life be saved.' Unfortunately, it is neither applied quickly nor tightly enough, owing to the ignorance of those most commonly bitten.

If a ligature cannot be applied, the part must be at once freely excised, and the blood removed by sucking or by a cupping-glass, and then the wound freely cauterised. A live coal is often used for this purpose.

The general symptoms must be met as before by stimulants, hot bottles, sinapisms and galvanism.

The intravenous injection of ammonia was introduced by Professor Halford in poisoning by Australian snakes, and the cases he records leave no doubt as to the efficiency of the remedy under some circumstances; and when it is remembered that Halford himself states that the venom of the cobra and crotalus (rattlesnake) is identical in action with that of the Australian snakes, it is disappointing to find that a like success has not attended the use of the remedy in the hands of Indian and American physicians. The number of cases in which ammonia has been employed is sufficient to prove that no harm has resulted from its use, and therefore this fear need not deter others. The *liquor ammoniæ fortior* is used, mixed with distilled water. The following proportions are taken from Halford's cases: ten minims to twenty of water restored consciousness; twelve to a drachm of water restored a man whose pulse was feeble and intermittent, and whose pupils were fixed and dilated; fifteen with five of water, and again in the same case twenty minims with five of water were injected twice, while in another case one and a half drachms in all were used.

Permanganate of potash has recently been recommended, but has, with liquor potassæ, been found of no value by the majority of observers, so that at present we have no specific against snake-bite.

CHARTERS JAMES SYMONDS.

VERRUCA. *See* WARTS.

VERTEBRAL ARTERY, Ligature of the.—This artery was first tied by Dr. Smith, of New Orleans, on May 9, 1864, as an adjunct in the surgical treatment of an innominate aneurism. In 1879 and following years the writer performed the operation on thirty-six cases of epilepsy. After the first case he mostly tied both arteries simultaneously. He also performed the same operation on two cases of infantile paralysis, two cases of locomotor ataxy, and one case of chorea.

The operation is best performed in the following manner:—An incision, three to four inches long, is made in an upward and outward direction along the hollow which exists between the scalenus anticus and the sterno-mastoid muscle. The incision should begin just outside and on a level with the point where the external jugular vein dips over the edge of the sterno-mastoid muscle, or if the vein is invisible, about half an inch above the clavicle. The external jugular vein is to be drawn inwards with the sterno-mastoid muscle. The connective tissue now appearing in the wound is opened up by a blunt director until the scalenus anticus muscle, the phrenic nerve, and the transverse cervical artery are seen. It cannot be too well remembered that the pleura is at the inner side of the wound, whilst below lies the subclavian artery. It is now only necessary to separate the edges of the scalenus anticus and the longus colli muscles to see the vertebral artery lying in the space between them. The artery is generally covered completely by its vein, and the latter has to be drawn aside previous to ligature. Some surgeons look for the prominent transverse process of the seventh cervical vertebra, and this is a good landmark.

Should the artery enter the vertebral foramina higher than usual, the vessel must be looked for to the inner side of its usual course. The overlying vein may be drawn outwards or inwards. Generally the first is more convenient, and may be easily managed by means of an aneurism-needle. Another needle is now passed from without inwards behind the artery, its eye threaded with catgut, and the needle

withdrawn, carrying the ligature. The vein is then to be released, and the ligature tied and cut off short in the usual way. The wound is now to be sponged out with boracic or other lotions, a drainage-tube inserted, and dressings—either strictly or modified antiseptic ones—applied. If the operation is performed with suitable retractors and a good light, the proceeding is a very easy one, and without both it is well-nigh impossible. It is also safe, as no important structure need be at all interfered with.

It has been recommended to tie the artery by coming down upon it directly from the surface, but it is better not to describe that method here. It is only a dissecting-room operation, in which interference with the pleura and the subclavian branches and large veins does not signify much, and cannot compare practically with the easy, safe, and natural operation already described.

Value of the operation in Epilepsy.—It was performed by the writer in the hope that a lessened supply of blood to the hinder brain and spinal cord would result in a diminution or cessation of the epileptic convulsions. On most theories of epilepsy the expectation was a very reasonable one; because it was hoped that the diminution would be more permanent to the parts supplied after ligature of the vertebrals than after ligature of other vessels, on account of the absence of anastomosing branches, and the restraints to dilatation of the unligatured vessels by the bony canals through which the cerebral vessels pass, as the experiments of Sir Astley Cooper on dogs tended to prove. For a time these expectations were realised, but soon relapses occurred, and in May 1884 an analysis of thirty-six cases of operation for epilepsy showed only eight cases which have had so few fits since operation that they may be practically considered cures. Eleven were for several months so much improved that they seemed to be cured; and, although the fits have recurred in all, yet the improvement is still distinctly manifest in many. In sixteen cases there did not seem to be any decided improvement, either of a temporary or permanent kind. Three died out of the thirty-six, one from hæmorrhage, one from embolism, and one from pleurisy. All the cases operated on were chronic, hopeless epileptics, many of whom had gradually become mentally affected. None of the latter were permanently benefited to any practical extent. Of the others the best case was an idiot boy, now in the Albert Asylum, Lancaster, and the next best a perfectly sensible, healthy lad. In two cases of traumatic epilepsy, one was cured and the other much benefited. It is impossible, therefore, to say, before operating, what cases would probably derive benefit from the operation and what would not.

On account of this uncertainty, the writer has ceased to recommend or perform the operation for the last two years. Of the cases of infantile paralysis, one patient was completely and rapidly cured, the other was unaffected. Great temporary advantage occurred in one case of locomotor ataxy. The pains and ataxy rapidly diminished for a time; the other case remained unaffected. The case of chorea ceased to twitch, until hæmorrhage from a small vein set in, that, allowed to pass unnoticed, ended in death. The twitching reappeared after the hæmorrhage. As far as the writer can at present see, this chapter of surgery may be closed.

Wm. Alexander.

VESICO-INTESTINAL FISTULA.

A communication between the interior of some part of the intestine and that of the bladder. The congenital form of this condition and those which result from injury or disease of the rectum have been described under Atresia Ani; Injuries and Diseases of the Rectum.

Vesico-intestinal fistula may also result from wounds or malignant disease of the bladder, or from suppurative inflammation of the intestine, bladder, or adjacent structures. Adhesion of the intestine to the bladder, directly or indirectly, is essential for the formation of the fistula. The channel may be short or long, direct or tortuous, narrow or wide. In some cases, it passes obliquely through the walls of the intestine or bladder so as to render the aperture valvular, and thus resembles the connection of the ureters with the bladder. The intestinal aperture may be in the rectum, the sigmoid flexure, the vermiform appendix, the cæcum, or the small intestine. The vesical aperture may be on any surface of the bladder. Of these varieties the recto-vesical form occurs most frequently. In vesico-intestinal fistulæ, of traumatic or malignant origin, the intestinal aperture is almost invariably in the rectum or sigmoid flexure. Of eighteen cases, not of traumatic or malignant origin, collected by Blanquinque, nine opened into the rectum, four into the sigmoid flexure, two into the vermiform appendix, one into the cæcum, and two into the small intestine.

Traumatic vesico-intestinal fistulæ may be caused by gunshot or other penetrating wounds from without, or by perforation of

the bladder or rectum by foreign bodies introduced through the urethra or anus. Non-traumatic fistulæ most frequently result from necrosis of malignant growths involving both rectum and bladder. Fistulæ of suppurative origin may result from typhoid ulceration of the small intestine, typhlitis, perityphlitis, perforation of the vermiform appendix by impacted foreign bodies, or from ulceration caused by simple or syphilitic stricture of the rectum or sigmoid flexure. When the fistula originates in the bladder, chronic cystitis, especially when associated with a sacculated condition of the bladder, appears in some cases to have been the exciting cause. Suppuration or tuberculosis of the prostate gland may result in a recto-vesical fistula. Pelvic abscesses may also open into both intestine and bladder, and so produce a fistulous channel interrupted by the abscess-cavity.

The *symptoms* of vesico-intestinal fistula vary in different cases. Usually, the attention of the patient is first attracted by the passage of gas from the bladder towards the end of micturition with a sound—compared, by those who have had an opportunity of hearing it, to that produced by the passage of the last portion of fluid from a soda-water siphon. If the fistula be narrow, this may be the only symptom, and may only occur occasionally. The intermissions are, probably, due to blocking of one or other aperture of the fistula by inflammatory swelling of the mucous membrane of the bladder or intestine. If the channel be wider, urine may pass into the intestine, or some of the solid contents of the intestine into the bladder. In recto-vesical fistula, the passage of urine by the anus cannot fail to attract the attention of the patient. In other forms the diarrhœa, which would probably result from the irritation of the mucous membrane of the bowel by contact with urine, would mask this symptom. Any solid matter passed from the bladder should be examined microscopically for the undigested residue of animal or vegetable food, and chemical tests for the bile-acids might also be applied. The bladder is in some cases very tolerant of these foreign substances; in other cases they excite severe cystitis, and always endanger the formation of calculi and retention from the possible occlusion of the vesical orifice.

The *diagnosis* of vesico-intestinal fistula is usually not difficult. The passage of gas from the bladder at the end of micturition is almost pathognomonic. In recto-urethral fistula, gas may also pass from the urethra; but this may occur at any time, and not necessarily during micturition. In vesico-intestinal fistula it is always towards the end of micturition. Gas is said to be sometimes generated in the bladder from decomposition, in rare cases of acute cystitis; but in such cases a speedily fatal result would terminate all doubt. The passage of urine by the anus, or of solid intestinal contents by the urethra, could leave no doubt of the nature of the case. Sometimes, the diagnosis is aided by the urine, passed normally from the bladder, being coloured by the drugs employed to check the diarrhœa. There is very great difficulty in localising the intestinal aperture, if this be beyond the reach of digital or ocular examination. The injection of coloured fluids into the bladder or the rectum has been suggested as a possible aid, but in some cases the requisite force might produce dangerous consequences, and in others a valvular aperture to the fistula, or the intervention of an abscess-cavity in its course, might render the experiment fallacious. Careful bi-manual examination of the pelvis and minute inquiry into the previous history might give some indications; but there must always be uncertainty as to the position of the intestinal aperture in non-malignant fistulæ, when the aperture is higher up than the rectum.

The *treatment* must vary with the nature of the case. When the fistula has supervened on malignant disease, lumbar colotomy will, if the condition of the patient allow of the operation, afford great relief by diverting the course of the fæces. In two cases of non-malignant fistula, this operation was performed by Pennell and Holmes with very satisfactory results. This procedure can only be adopted, when there is reasonable probability that the artificial anus will be above the intestinal aperture of the fistula. In one case of non-malignant fistula, where the channel was probably narrow, permanent occlusion was effected by the constant retention of a catheter for six weeks, the bladder being thus kept in a contracted condition. In similar cases, if the catheter should cause irritation, a temporary perineal fistula would probably be of service. If the case be complicated by a vesical calculus, this should be removed by lithotomy or lithotrity; but if the fistula has resulted from chronic cystitis, the condition of the kidneys might contra-indicate any operation. When more active treatment is impossible, careful irrigation of the bladder and attention to cleanliness and diet will give some relief.

JEREMIAH MCCARTHY.

VESICO-VAGINAL FISTULA. *See* VAGINAL FISTULÆ.

VESICULÆ SEMINALES.—The diseases of the seminal vesicles have received but slight attention, and little is known concerning them. These organs may be the seat of acute, subacute, or chronic inflammation, and the acute form of the disease may run on to suppuration, the abscess bursting into the bladder or the peritoneal cavity. Chronic inflammation may cause obliteration of the common ejaculatory ducts. The vesicles may be dilated into cystic swellings opening into the urethra, or closed cysts attaining a large size may develop in connection with them. Small spermatic concretions, or larger calculi, may form, and lodge in the vesicles. Lastly, they may be the seat of strumous or of cancerous disease. The vesicles can be easily explored from the rectum, and the diagnosis of their affections mainly rests upon the results of a rectal examination.

1. *Inflammation.*—The most common cause of inflammation is gonorrhœa; other causes are venereal excesses, masturbation, caustic urethral injections, and prostatitis. When *acute*, there is general febrile disturbance, severe pain felt in the groin, hip, and round to the loin of the same side, frequent painful micturition, and the finger in the rectum detects a tender firm swelling just beyond the prostate. Should *suppuration* occur, there may be a rigor, the swelling is increased, and fluctuation may be detected in it when suprapubic pressure is made. *Subacute* and *chronic* inflammation are characterised by local pain and tenderness, frequent micturition, frequent painful erections, the presence of spermatozoa in the urine, a gleety discharge, and excessive nocturnal pollutions, the semen being discoloured red or brown; in some cases similar emissions occur during defæcation.

Treatment.—In the acute form, rest in bed, hot hip-baths, a brisk saline purge, slop diet, and opium and belladonna suppositories. As soon as fluctuation can be detected, the abscess should be opened through the rectum. The treatment of chronic inflammation is unsatisfactory; sexual excitement and constipation must be avoided; tonics, such as quinine and iron, may be useful; but a cure can only be hoped for after a period of many weeks or months.

2. *Cysts.*—These rare tumours may cause difficulty in defæcation and frequency of micturition. They displace the bladder upwards and forwards, fill the pelvis, and then rise into the belly. The diagnosis is made by noticing the position of the tumour between the rectum and bladder, by finding, when a catheter is introduced into the bladder, that that viscus is empty and stretched over the front of the swelling, and by detecting fluctuation in the mass. The only appropriate treatment is to tap the tumour, with a trocar and canula, through the rectum. Should this, when repeated, fail to cure the case, it would be right to inject iodine into the cyst, as in the case of a vaginal hydrocele.

3. *Tubercular Disease* of the seminal vesicles is only known as occurring secondarily to tubercular inflammation of the testicles, prostate, or bladder. The pathological changes are similar to those in the testicle. There are no special symptoms distinguishing this affection, and it can only be recognised by detecting the nodular and slightly tender mass of the enlarged vesicle lying between the rectum and bladder behind the prostate. Owing to the frequency of this complication, and the ease with which it can be recognised by rectal examination, it should be sought for in all cases of tubercular disease of the testicle. The only suitable treatment is the constitutional treatment mentioned under *Tubercular Disease of the Testis.* *See* TESTIS, Diseases of the. Should any part of the infiltrated vesicle fluctuate, it might be opened through the rectum. A. PEARCE GOULD.

VIBRIO is a small organism, one of the SCHIZOMYCETES, the form of which is that of a curved bacillus. The curves may be one to two in number.

Vibrios are found in stagnant water, in the fluids of the mouth, and recently in considerable quantities in the small intestine in cholera.

Vibrio choleræ, also called the 'comma bacillus' (Koch), is an organism which behaves in its mode of growth, in both solid and liquid cultures, just as a putrefactive organism; it liquefies gelatine, forming a deep well in the substance, and when grown in liquids it forms a scum which afterwards sinks.

In form it exhibits various shapes between the simple curved rod and a spiral (?) figure, produced by segmentation without separation of the individual organisms. Experimental inoculation on the lower animals has, so far, been productive of results of only doubtful value, so that it cannot be said to have been proved to possess specific properties; and moreover, Klein has shown that in fulminating cases often only

a few 'commas' are to be found, and those only in the mucous flakes of the bowel. The two views held at the present time are those of Koch and Klein respectively; the former believing that the comma organism is the cause of cholera, the latter regarding it simply as a consequence of the disease. In the absence of more accurate experimental evidence than we at present possess, no positive decision can be expressed on this point. VICTOR HORSLEY.

VILLOUS TUMOURS are so called from the resemblance which they present to the villi of the chorion. They grow in the bladder, breast, cerebral ventricles, intestine, larynx, rectum, and stomach. Formerly, all such tumours were looked upon as malignant, but pathologists of the present time class them under the two and groups of non-malignant papillomata malignant sarcomata and carcinomata.

The *Non-malignant* or *Papillomatous* forms are found in the bladder, rectum, and larynx. They consist of branched outgrowths from the mucous membrane of these parts. Each outgrowth is composed of connective tissue covered with a layer of tessellated or cylindrical epithelium, which readily separates when the tumour is macerated. In the centre of the outgrowth are an arteriole and venule, which communicate by a peripheral loop of capillaries. The capillaries are often dilated into small botryoidal appendages. The main papilla gives off secondary and these again tertiary papillæ, which are identical in structure with the parent stem. In this way we find long fimbriated processes arising from a small circumscribed base, such as have been described under BLADDER, Tumours of the. The villous tumours of the stomach are less complex than those just described, inasmuch as they consist of simple papillæ without secondary offshoots.

The villous papillomata undergo various forms of degeneration: thus, they may ulcerate or the delicate capillaries may rupture, and the blood escaping into the villi may be converted into pigment. On the other hand, the vessels may become calcified, or the villous tumour may become encrusted with a phosphatic deposit; the latter degeneration is especially liable to occur in the bladder, where the fringes float in the urine. The investing cells in some cases undergo colloid degeneration.

The *Malignant Villous Tumours* are either sarcomata or carcinomata. It is now recognised that a non-malignant or papillomatous growth may, in course of time, become converted into a malignant growth of similar microscopic appearance. The chief obvious difference between these two classes of tumours is that, in the non-malignant papillomatous growth, the epithelium is situated only upon the surface of the papillæ, and is therefore homologous, whilst, in the malignant varieties, the cells are found as well within as without the connective-tissue basis of the papillæ, and they are therefore heterologous.

The malignant villous tumours are either sarcomata or carcinomata of an epithelial or adenoid type.

The *Villous Sarcomata* are said by Billroth to grow from serous membranes, the cellular elements consisting of enlarged cells derived from endothelium, the stroma being formed of connective tissue. They are found growing from the membranes of the brain and from their nerve-sheath prolongations.

The *Villous Carcinomata* are either epithelial or adenoid in type. They grow most frequently from the stomach and urinary bladder, though they are occasionally found in other parts.

Epithelioma of the bladder occurs as a warty or villous excrescence of the mucous membrane, having the usual character of an epithelioma. The growth commences in the mucous membrane, and is covered with tessellated epithelium. It is recognised by its invasion of the submucous and muscular coats.

Villous cancer or duct cancer is a rare form of carcinoma occurring in the breast. It is described by Cornil and Ranvier as a tubular epithelioma, and by Rindfleisch as a cysto-sarcoma (fibrous or mucous). It is a malignant growth springing from the galactophorous ducts. The new growth obstructs these ducts, thereby converting them into cysts. Processes of fibrous tissue covered with columnar epithelium and containing blood-vessels, which may rupture, grow into these cysts. The growth has the appearance of an encephaloid cancer. A similar villous cancer may develop from the sweat or other simple tubular glands, such as those of the neck of the uterus and the soft palate.

Columnar epitheliomata grow from the glands of the large intestine, and cylindrical epitheliomata from the brain and orbit.

Villous growths of an innocent nature occur on the synovial fringes of bone in osteo-arthritis as the result of simple hypertrophy, and as granulations from the choroid plexus and Pacchionian bodies.

D'ARCY POWER.

VISION, Disorders of, from injuries of the head and spine.—The vision of one eye or of both may be impaired or destroyed, temporarily or permanently, by injuries to the head, even when the eye itself is absolutely unharmed. The commonest perhaps amongst these are fractures of the base of the skull, where the line of fracture runs through some part of the anterior fossa, in the neighbourhood of the optic foramen or of the lesser wing of the sphenoid. Cases of this kind are very often fatal, and it has been clearly established by Hölder and others, who have directed their attention to the state of the optic nerve in such injuries, that the sheaths of the optic nerve, subdural and sub-arachnoidal, one or both, are frequently distended with blood. This observation throws light on the cases where a patient discovers, on regaining consciousness after severe head-injury, that he has completely lost the sight of one eye—on the side, that is, where the line of fracture runs.

The blindness is, probably, due to pressure on the optic nerve by blood within its sheath, a view supported by the fact that no changes or signs of injury can be found in the eye itself, and that vision sometimes undergoes improvement, or even, it may be, restoration, as the blood is gradually absorbed. The result, in all probability, depends upon the amount of blood which has been extravasated, and on the state of the neighbouring circulation, matters on which, clearly, no opinion can be expressed in individual cases. If the amount of blood extravasated be large, it is not only unlikely that it will be altogether absorbed, but there is also a risk that, from its continuous pressure, some interference may take place with the nutrition of the optic nerve itself, and the ophthalmoscope may in course of time reveal signs of atrophic or other changes in the optic papilla. Whether treatment of any kind can be of any avail, in such cases, is extremely doubtful. The prognosis can only be unfavourable when absolute blindness dates from the moment of the accident, and consolation must be sought in the fact that one eye only has been affected, a circumstance dependent on the usual obliquity of the line of fracture, which thus involves only one optic foramen. *See* Optic Nerve, Diseases and Injuries of the.

Cases, moreover, may be met with in which, as the immediate result of severe injury to the head, there is impairment of vision of both eyes. Here it seems probable that the line of fracture, or seat of injury to nervous structures, lies posterior to the optic foramina, and involves the region of the optic chiasma or tracts. A careful examination of the fields of vision is essential, in such cases, to determine the seat of injury, whether it be in the optic nerve, which contains all the fibres going to the retina of its own side, or in the optic tract which contains the fibres running to the temporal half of the retina on its own side and the nasal half on the opposite. The phenomenon of homonymous hemianopia may therefore be an important diagnostic and prognostic symptom; for there seems to be a better chance of restoration of sight when the extravasated blood lies at the base of the brain, than when it is confined within the optic sheaths, from the fact that absorption can in all probability be more easily and speedily accomplished in that situation. *See* Perimetry.

The *prognosis* in all such cases, however, is bad, whether the loss of vision affects one or both eyes, and when the history of the injury warrants a belief that there is fracture of the base of the skull or some severe injury to the brain. To aid this diagnosis the surgeon must look for other signs and symptoms, bleeding from and deafness of one ear, subconjunctival extravasation of blood for example, and paralysis of special nerves. Yet, every such sign or symptom may be wanting, even in cases of severest injury; and the absence likewise of any evidence of damage to the eyeball itself, after careful ophthalmoscopic examination, may be the only clue, and that merely negative, that the loss of sight is probably due to the causes above-named.

As far, therefore, as pathological knowledge at present enables us to affirm, immediate one-sided blindness, after severe head-injury, is probably due to hæmorrhage within the sheath of the optic nerve, associated, in a large percentage of cases, with, or caused by, fracture passing near or through the optic foramen; whereas double blindness, complete or partial, is in the same circumstances probably due to basal hæmorrhage, with or without fracture in the middle fossa of the skull, which presses upon the optic chiasma or tracts. And yet hæmorrhage within the sheaths of one optic nerve is by no means invariably associated with fracture of the base, for cases are on record in which hæmorrhage in this situation has been found after injuries to the head, where there has been no fracture through or near the optic foramen, but where the extravasation has

been simply the direct extension of hæmorrhage at the base of the brain. This may occasionally happen, even when there has been a history neither of severe blow on the head itself nor of concussion of the brain, and the patient has perhaps only fallen heavily on his feet. The prognosis in such cases is probably more hopeful than when there has been fracture of the base, although an increase of the hæmorrhage is to be feared from vessels which were so easily ruptured, and are, therefore, probably, diseased.

In all severe injuries to the head, there may be more immediate damage to nervous structures themselves—rupture, for example of the optic nerve, laceration or rupture o the commissure, of one or both of the tracts Lesions such as these are hardly likely to occur alone. There is yet another class of cases where, after severe concussion-injuries of the brain, the vision of one or both eyes begins to be impaired some time after the accident, and where the immediate effects upon the sight were nil. In these cases, ophthalmoscopic examination frequently reveals the presence of changes in the optic disc, such as are seen in the various stages of optic neuritis from non-traumatic causes. Seeing that optic neuritis may advance considerably without any impairment of the normal acuity of vision, it seems highly probable that, in many cases where optic atrophy is discovered at a considerable length of time after head-injury, examination of the fundus might have revealed the early stages of neuritis, had attention only been called thereto by impairment of sight. Ophthalmoscopic examinations after injuries to the head have been, as yet, far too few to warrant any decisive opinion on this point, but in the not uncommon cases of optic atrophy, discovered at some distance of time from the accident, the changes in the fundus are probably the result of a neuritis which has run through its various stages without causing noticeable loss of vision, and which has gradually gone on to atrophy and blindness.

A routine use of the ophthalmoscope by surgeons is therefore most desirable, as thereby alone can a settlement be made of these various interesting points in connection with blindness arising after head-injuries, for it is useless to wait for the symptom of blindness before examination is begun. The changes must be observed at their very beginning, the time of their origin noted, and their progress recorded from day to day, for otherwise the opportunity of treatment will be lost, at the time when alone it can be of any service. In such cases, it is probable that the optic neuritis originally starts in connection with some basal meningitis, the result of injury, contusion it may be, of the substance of the brain. This seems to have been the sequence of events in a case brought before the Ophthalmological Society by Dr. Coupland, where total blindness supervened in about three weeks after a severe fall upon the head. The necropsy showed that there had been extensive contusion, both superficial and deep, of the brain without fracture of the skull; and a basal meningitis which 'in extent and disposition singularly imitated the favoured region of tubercular inflammation.' Cases like this throw light on the development of optic neuritis after severe head-injuries, even when there is no fracture; and in all probability the condition is much more common than is ordinarily supposed, from the simple fact that vision may be at first unaffected and therefore no ophthalmoscopic examination is made. At any rate, meningitis at the base has been found both with and without fracture, extending by direct continuity along the sheaths of the optic nerves, even within twenty-four hours of accident. Death is due in all probability far more to the severity of the injury to the brain than to fracture of the skull, but, if the patient survive, it must depend largely upon the amount and extent of the meningeal inflammation whether vision is restored or whether atrophy will result.

Opinions differ amongst surgeons as to the influence which the administration of mercury may have in helping the absorption of inflammatory products upon the membranes of the brain; but, looking to the ill-results which are pretty sure to follow from the organisation and pressure of lymph on the optic nerves, chiasma, or tracts, it is hardly right, by withholding mercury, to deprive the patient of what may be his only chance of complete recovery from the baneful effects of inflammatory exudation, the result of injury at the base of the brain. In all these cases it is desirable, if possible, to gain some definite information as to the exact site of the original blow upon the skull, for not only does this to a large extent determine the position of the basic fracture, but we may also learn therefrom at what point there is likely to be hæmorrhage or contusion of brain-substance from *contrecoup*. Impairment of the sense of smell from damage to the olfactory bulbs is frequently caused by severe blows or falls on the back

of the head, and the like phenomenon of injury to, or in the neighbourhood of, some part of the optic nerve apparatus, may be caused by injuries apparently inflicted at remote parts of the skull. It is not inconceivable, moreover, that hæmorrhage may occur from injury in the substance of the brain at such a site as to cause amblyopia by involving the visual centres. A careful examination of the field of vision in both eyes can alone lead to a diagnosis, together with accurate knowledge of the results of experimental and pathological observation as to the central origin of the nerve fibres which go to different parts of the retinæ.

Again, vision may be impaired by the more direct pressure of blood upon the eyeball itself by large extravasations within the orbit, which may even cause exophthalmos. Here is a definite physical sign of blood-extravasation after injury, which of course varies with the amount of blood poured out, and usually occurs immediately after or within a few hours of the accident. Pain in the orbit and impaired movement of the eye are likewise present in such cases; but it is by no means clear how vision may be disturbed, whether by immediate pressure on the eye or by pressure on the optic nerve. Ophthalmoscopic examination has revealed both diminution in the size of the arteries and distension of the veins, as if from pressure; and the ultimate result no doubt depends upon the length of time such pressure lasts. In all probability there is some more serious injury than simple blood-extravasation, which will lead to a fatal issue at an early date; but, if this be escaped, the surgeon will do well by careful pressure to restore the eye to its natural position, and so help, moreover, in the absorption of the blood.

Recovery is usually complete, for, unless it be a gunshot accident, the eye itself is rarely injured, so securely is it protected from concussion by its various cushion-like surroundings. A risk there is, however, in such cases that the hæmorrhage may be from some vessel of more than capillary size, and that aneurism may ultimately result. Upon the position of the aneurism the character of the impairment of sight will depend, whether the pressure thereof be upon the optic nerve, upon the globe itself, or on the nerves which supply its various muscles. *See* Orbital Aneurism.

Severe injuries of the head may also cause impairment of sight, or rather interference with perfect binocular vision, by simultaneous damage to one or more of the nerves which supply the muscles of the eye. Here, again, the symptom diplopia may be developed either early or late—early, when in all probability the nerve has been completely torn through at the moment of the accident, or is pressed upon by rapidly extravasated blood; late, when the pressure of meningeal thickening or inflammation interferes with the proper function of the nerve or nerves so affected. The diagnosis of the various forms of diplopia are not dealt with in this article. The muscular paralysis may ultimately pass away, but let it be remembered that even in traumatic paralyses of individual ocular muscles, the course of recovery may perchance be retarded by a syphilitic element, the treatment of which will best remove the special symptoms apparently due to injury alone. *See* Ocular Muscles, Affections of the; Strabismus.

The effect which severe blows in the neighbourhood of the orbit have upon vision, has long been a matter of observation amongst surgeons, and, in pre-ophthalmoscopic days, it was generally believed that vision was impaired through the influence of the fifth nerve, which, being damaged in one of its branches, wrought some change by reflex or other agency upon the nutrition of the eyeball itself. It is very questionable, however, whether such is the real sequence of events, and whether there is any true relationship of cause and effect between injury in this region and ultimate deterioration of sight; although it seems not altogether unreasonable to conclude that a severe lesion, causing neuritis, for example, of the supra- or infra-orbital branches of the fifth nerve, might indirectly produce some effect upon an organ lying so near, and supplied by other branches of the same cranial nerve. The ophthalmoscope, however, has shown that, if we exclude the cases where a severe blow near the orbit has caused damage to the eye itself, rupture of iris or lens-capsule, detachment of retina, rupture of choroid, or hæmorrhage into the vitreous, there remains hardly any case to support this doctrine; and lesions which may cause severe injury to one branch of the fifth, the infra-orbital, in fractures of the upper jaw, are not commonly followed by any impairment of sight. This result has apparently arisen only in cases where the injury has had the indefinite description of a severe blow in the neighbourhood of the orbit, and no ophthalmoscopic examination has been made. It is true that many cases are to be found, in medical literature, which seem to establish

the fact that injury to a branch of the fifth may lead ultimately to amaurosis; but this also is not less remarkable, that cases of the kind are becoming rarer day by day, as the ophthalmoscope throws light on hitherto unseen parts of the eye itself, and as pathological investigation shows by what central lesions sight may be affected or destroyed.

Passing to other and more special forms of accident, we find that impairment of sight is a not uncommon complaint of patients after railway collisions.

The symptom varies much in importance in different cases, but it is usually a passing condition, wholly independent of structural change. It cannot indeed be said that railway accidents give rise to any special or characteristic form of loss of vision, for the impairment, whether temporary or lasting, differs not in the least from that which may be induced by injuries in other accidents, of every form and variety. The circumstances of a railway accident are merely such as to provide the requisite causes of certain disorders of vision. The commonest is simple asthenopia, which may or may not be associated with some error of refraction. The patient complains that reading or fine work is difficult or impossible, because the lines run together and rapidly become blurred, and added thereto, if the effort be continued, is pain about the orbits and brows. Fatigue is, in fact, very early induced by the muscular effort of accommodation; fatigue of the same kind as renders any sustained effort, whether of mind or body, impossible during the state of general weakness and prostration which are the very common result of the physical and mental shock sustained in a railway collision. And, as might be expected, early fatigue of accommodation is more likely to arise in those who have some error of refraction, and in whom, therefore, an extra muscular effort is needful to bring objects to a focus on the retina.

It is not after railway accidents only that such defects may be discovered. The same thing happens not infrequently in the course of an exhausting illness, in the period of weakness following it, or in that which is induced by prolonged suckling. In a previous state of health, the muscular strength may have been adequate for the purposes of accommodation, and the defect has been unknown. Illness prostrates and the defect is revealed, for all muscular power is weakened, whether of the limbs, of the heart itself, or of the eye. That the discovery should cause considerable alarm, after an accident, is not to be wondered at, nor is it surprising that persons, so suffering, should with difficulty be led to believe that some more serious injury has not been inflicted, and that the failure of sight is not the beginning of an impairment which will end in blindness because of some grave damage to nervous centres. Careful testing with lenses will usually establish the diagnosis and indicate the treatment; but as long as the condition of nerve-prostration lasts, it is idle to hope for complete relief for the asthenopia by the use of glasses. Returning strength alone can restore the ciliary muscle to its natural vigour, but it is only in cases of emmetropia, or in the slighter grades of ametropia, that the patient will probably be able in the future to dispense with glasses.

When the refractive error is considerable, glasses will in all probability be found a permanent necessity; but, if the asthenopia is simply due to general weakness alone, the trouble will completely pass away. The same remarks apply to those in whom presbyopia is just commencing; and when this condition is well advanced, any severe shock or illness will in all probability entail a further presbyopic change, which will call for stronger lenses. Given, then, after railway collision a case where there is no question as to the genuineness of the symptoms, asthenopia becomes a symptom of some value in forming an estimate of the general muscular and nervous prostration. It is in these cases that muscæ volitantes are so often troublesome; but they are of no pathological significance, being due to the presence of small floating bodies in the vitreous. In the severer forms of neurasthenia after railway collision, we sometimes meet with a considerable degree of photophobia; but it is impossible to say on what the condition depends. It is associated with extreme general prostration, and does not seem to have any definite pathological basis. The state of nervous exhaustion from shock is often accompanied, perhaps is caused, by extreme feebleness of circulation, and it is possible that asthenopia may in some cases be due to a general retinal anæsthesia so to say, whereby there is concentric limitation of the field of vision. To cases apparently of this nature the term 'reflex amblyopia' has been recently given by Mr. Priestley Smith (*Ophthalmic Review*, May, 1884). The condition seems to be independent of any discoverable pathological change, and the tendency is

towards complete recovery, when the general health has been restored.

Symptoms such as these are naturally extreme in persons of an hysterical or emotional temperament, and when it is remembered that an emotional state is frequently induced in both sexes by the shock and fright of a railway collision, and that hysteria—using the term in the very broadest sense—is so commonly developed thereby, it is not strange that they should be common results of such accidents, and it is needful to exercise the greatest caution in forming a diagnosis. Complaints of bad sight are, moreover, very open to exaggeration, and the difficulty of diagnosis may often be great when we have to rely upon the statements of the patient alone. Let care be taken that normal physiological varieties, such as may be seen in the colour of the fundus oculi, in the distribution of the vessels, or in the appearance of the disc and its margin, be not mistaken for pathological changes. Certain it is that pathological changes as the result of railway accidents, spinal or otherwise, are extremely rare; and this is the common experience of ophthalmic surgeons and in ophthalmic hospitals, although the vast number of persons who have been hurt in railway accidents might have afforded many examples of eye-disease. It is in cases of railway injury, moreover, when the prospect of compensation opens out so great a temptation to exaggeration, imposture, or untruth, that the surgeon may be called upon to decide the important question, whether and how far some existent pathological condition is due to any injury received, or whether it has preceded the accident, and is really altogether independent of it. A patient may assever, with every semblance of truth, that his sight has been impaired or destroyed by the accident, and ophthalmoscopic examination may reveal pathological changes amply sufficient to account for the defect, or it may fail to find any lesion at all. In the latter case it will be essentially necessary to make repeated examinations, at short intervals, to discover whether any changes in the fundus oculi of an atrophic character do gradually become developed, before speaking with certainty as to the truthfulness of the patient; while, if other circumstances of the case throw doubt upon his *bona fides*, and special examination with prisms and coloured glasses, &c., referred to in another article, detects unquestionable flaws in his statements, the absence of pathological changes will of course tend to support the conclusion that the loss of vision is either imaginary or assumed. *See* Vision, Feigned Disorders of.

More difficult, however, of decision and certain etiological diagnosis, are the cases where pathological changes undoubtedly exist and the patient at the same time assures you that his failure of sight, or even his blindness, dates from the time when he was subjected to injury. Are the discovered changes due thereto either wholly or in part, or have they been pre-existent and been aggravated by the alleged injury sustained? In the decision of these points, on which important medico-legal questions may depend, certain possibilities must be borne in mind. The patient may, for example, have been totally ignorant of his blindness or failure of sight in one eye, even though of long standing. This is a matter of common observation, and it is well recognised that a cataract of one lens may have advanced to almost complete opacity before the patient accidentally becomes conscious of the fact; and the same ignorance may at times be displayed in the case of other and more deep-seated lesions. That such discoveries should coincide with, or shortly follow, the receipt of railway or other injury, is not to be wondered at, when it is remembered that asthenopia due to failure in accommodative power is so common after such accidents, and that a patient then for the first time has his attention specially directed to his eyesight.

The surgeon may also meet with cases where a patient has been perfectly aware of his defect, and yet persistently declares that his old complaint is really new, and therefore presumably due to the injury sustained. Granted that he has had an adequate experience of eye-diseases, the judgment of the surgeon is far more valuable than the asseverations of the patient, in the presence of familiar pathological changes, for it may be to the great pecuniary advantage of the patient intentionally to deceive. But, given an instance of perfect truthfulness on the part of the patient, no more difficult questions can well present themselves to the surgeon than the real causation of the various pathological conditions which may be met with after railway accidents. Happily, such questions but seldom arise, and they are likely to be less common as familiarity with the ophthalmoscope increases in the hands of the practitioner, and as he becomes better acquainted with the real nature of the injuries to which railway accidents commonly give rise.

The writer can call to mind a case of well-marked choroido-retinitis, and opacities in the vitreous of one eye of a patient who had received a cut over the left eyebrow, and slight momentary concussion, and who first noticed, or complained of, failure of sight in the left eye some three weeks after he had been in a railway collision. He had some years before lost the sight of the other eye from injury, and presumably therefore he would be able to say, with tolerable certainty, how much his vision had changed after the accident. The fact that he had observed no failure of sight for about three weeks seemed fair evidence that no direct blow of any severity had been received upon the eye itself. The parts about the macula and disc were perfectly healthy, but towards the equator were patches of widely-scattered choroidal atrophy due to disseminated choroido-retinitis, which none of the surgeons who examined him would have ever connected with injury in the absence of the patient's own statements, the changes being in no wise different from those met with from other constitutional causes. In the absence of a history of such causes, could a blow upon the head, or in the neighbourhood of the orbit, have transmitted such a physical shock to the globe as to rupture minute vessels in the choroid and retina, and cause scattered specks of hæmorrhage which became foci of irritation, and so set up choroido-retinitis? It seemed hardly likely that such changes, thus induced, would affect all parts of the equator, for violence would most probably produce damage at one particular spot. The appearances and the history alike negatived the supposition that recent injury was the cause of the pathological changes, and the general conclusion arrived at was that the choroido-retinitis preceded the accident, and was perhaps aggravated—who could really say?—by the blow sustained. The asseverations of the patient and the opinions of the surgeons were thus diametrically opposite, and in the end large compensation had to be paid. Years after this claim was settled and pecuniary compensation had been enjoyed for the alleged injury, it was learned that the failure of sight had really existed before the accident, and had always been attributed to the injury to the other eye. These facts, however, were carefully concealed after the railway collision, and the problem to be decided by the surgeons was as difficult as could well be conceived.

Like difficulties, of which other examples might be named, have arisen, and will again arise in other cases, and this example has been detailed at length to point the lesson that the surgeon should, in such instances, place less reliance on the patient's statements than on the results of his own examination. Let him learn an accurate account of the accident, and of the precise mode whereby injury was sustained, and let him apply his knowledge of ordinary disease to an elucidation of the disease which he finds before him. Neither here nor in any more elaborate treatise can any special rules be laid down for guidance or diagnosis in these cases of railway injury; the tact, judgment, and experience of the surgeon must avail him for the task of decision. Again, it must not be forgotten that the severe shock and fright of a railway accident very often give rise, in both sexes, to profound functional disturbance of the nervous system, and that, in the state of general neurasthenia so induced, there are likely to arise numerous varieties of functional or so-called hysterical disorders in which vision may be affected.

Complete blindness of one or both eyes, diminution of the normal acuteness of vision, limitation of the field of vision, with loss or diminution of the colour-sense, may perchance be met with, and their true significance can only be determined by the fact that they exist in conjunction with other obvious nervous disorders. Hemianæsthesia, for example, has been observed in both sexes after the shock of a railway collision; and anæsthesia may likewise involve smaller and circumscribed areas of the cutaneous surface. It is very essential to look for, and if possible discover, such evidences as these of functional nervous derangement, for their presence may form a most valuable aid to diagnosis when other features of the case may have been wholly obscure, and a diagnosis thereof difficult or impossible. Amongst them are various defects of sight of a purely functional nature, in which the ophthalmoscope reveals no evidence of structural disease. Such cases are by no means rare, in males as well as females, after railway collision or other severe accidents, and the surgeon will do well to bear the possibility of their occurrence in his mind when making his investigation.

Of greater importance, however, than these cases of simple functional disturbance, are those where some obvious pathological change is present in the fundus oculi, as a consequence or accompaniment of damage

to nervous structures remote from the eye itself. The association of morbid changes in the optic nerve with cerebral disease is a matter of daily observation; but of not less interest is the possibility of similar changes being induced by injury or lesion of the spinal cord. Many years have gone by since Dr. Clifford Allbutt first asked the question whether disturbances of the optic nerve and retina commonly follow spinal mischief, and it cannot be said that precise information on the subject is as yet anything but fragmentary. Isolated cases have from time to time been published, which show that morbid changes in the fundus oculi are sometimes met with in association with injury of the spinal cord, but there is little real evidence to establish the relationship between them of cause and effect. Optic atrophy, it is well known, is often found in cases of tabes dorsalis—locomotor ataxy—and other disseminated scleroses of the nervous system, and may, in fact, be one of the first signs of disease; but it can hardly be said that the atrophy is the result of the sclerosis in the spinal cord, and there are numbers of cases where advanced degeneration in the spinal cord has had no concomitant changes in the optic nerve. Nor is there any clearer connection between the two in cases of spinal injury. One thing only seems tolerably certain—that the higher the seat of injury to the cord the greater likelihood is there that changes may supervene in the eye, and the sooner are such changes prone to arise.

As to the nature of these changes observers seem pretty well agreed that optic atrophy, such as is met with in the system-diseases of the cord, is not seen after spinal injury, but that there may be a condition of hyperæmia of the disc and adjoining parts. In Dr. Allbutt's words, 'the retinal arteries do not dilate, but become indistinguishable, while the veins begin to swell and become somewhat dark and tortuous. The disc then becomes uniformly reddened and its borders are lost, the redness or pinkness commencing with increased fine vascularity at the inner border, which then so invades the white centre and the rest that the disc is obscured or its situation known only by the convergence of the vessels.' Such changes are of slow development, and their tendency is to end in resolution rather than in atrophy. They seem rather to point to circulatory disturbances than to primary change in nerve-tissues; but it must be confessed that the number of observations, or at any rate of recorded observations, is as yet far too few for any settled opinion on the subject, and not only is a greater number of observations necessary, but post-mortem examinations also are needed to throw light on the association, if there be any, between cord-lesions and optic changes. The same kinds of appearances have been recently observed by Mr. Bruce Clarke in cases of spinal injury, and have been recorded in *St. Bartholomew's Hospital Reports* (vol. xvi.), the distinguishing characteristics of them being that the hyperæmia was seen early and was essentially transient. Thus, in a case of fracture of the fourth, fifth, and sixth cervical vertebræ with complete division of the cord at the level of the fifth and sixth, there was noted on the third day 'well-marked hyperæmia with considerable œdema of both discs; a good deal of effusion obscuring the vessels in many places.'

The facts, then, seem to be established so far that occasionally after spinal injury, and most commonly when the injury is high up, changes in the fundus oculi are to be found, consisting chiefly of a hyperæmia, either transient or longer continued, which leads to obscuration of the disc itself; and, further, that this hyperæmia may or may not be associated with, or give rise to, impairment of vision. The actual relationship between the two conditions is not, however, by any means clear, and no observations have yet been recorded to shake the suggestion of Dr. Clifford Allbutt that the changes are probably dependent on a greater or less extension of the meningeal and vascular irritation from the spinal cord up to the base of the brain. For it is well recognised that encephalic meningitis is a not uncommon accompaniment or extension of spinal meningitis, and it seems highly probable that optic changes arise only when this extension has taken place. The same conclusion, as to the absence of any more immediate relationship, seems to be borne out by those cases of disease in which acute optic neuritis has been found associated with acute myelitis of the spinal cord.

A goodly number of such cases have now been published, but it is noteworthy that in several of them the optic neuritis has actually preceded any evidence of mischief in the spinal cord. Markedly was this the fact in a recent case brought before the Ophthalmological Society by Dr. Sharkey, where failure of sight and acute optic neuritis began at least a month before the myelitis of which the patient ultimately died. No connecting link whatever could

be found *post mortem* between the neuritis and the myelitis, and the inference seems inevitable that both were merely the widely separate manifestations of one disease arising from some common cause. At any rate, the association of the two phenomena is so rare, that it is impossible to lay it down as an established pathological fact that optic neuritis is caused by myelitis; nor do present facts allow of our saying more than this, that the less serious phenomenon of optic hyperæmia, whether transient or of long duration, is sometimes found accompanying injuries at the upper part of the spinal column. Be the connection, however, what it may, it is obvious that such morbid changes in the fundus oculi may be of considerable diagnostic importance after obscure injuries to the upper part of the spine.

Although the significance of these pathological changes in the deeper parts of the eye is a matter of uncertainty, the more visible phenomena of alterations in the pupil, with which we have next to deal, seem to have a closer relationship of cause and effect with injury to the upper part of the spinal cord, and of the nerves which come off from it, of those which go to form the brachial plexus, and of the sympathetic nerve itself. Injury of any one of these various nervous structures may give rise to changes in the size and activity of the pupil, which in the main confirm the results of experimental observation, both as to the origin of the nerve-trunks and their association with the sympathetic, and of the connection which this in its turn has through them with the upper part of the spinal cord. Let it be noted, however, in the first place that, other causes having been carefully excluded, the size of the pupil gives a very fair indication of the patient's general nervous tone; that if the tone be low the pupils are often large, and that dilatation of pupils may be due to defective tone of the retina and nerve-centres, and to the fact that a larger supply of light is necessary in such conditions. This has been pointed out by Mr. Hutchinson, and his observation certainly holds good in the state of general nervous prostration which is so common after the severe shock of a railway accident.

Here it is impossible to enter into those physiological questions which are of great interest and importance in connection with the sympathetic nerve and its association with the eye. Suffice it that well-marked oculo-pupillary symptoms are induced both by division and irritation of the sympathetic in the neck, and that the same phenomena may be caused by division or injury of the lower roots of the brachial plexus and of certain regions of the spinal cord. Leaving aside the well-known vaso-motor phenomena which follow division of the sympathetic, phenomena which seem rather to affect the vessels of the side of the head and neck than of the eye and orbit, together with alteration in temperature of the affected area, the symptoms caused by division of the sympathetic in the neck are contraction of the pupil—paralytic myosis—retraction of the globe of the eye, diminution in size of the palpebral fissure, some flattening of the cornea, and occasionally slight rolling inwards of the eyeball. Irritation of the sympathetic gives rise to exactly opposite phenomena, and a region in the spinal cord extending from about the sixth cervical vertebra to the third or fourth dorsal has been named the 'regio cilio-spinalis,' and by Bernard the 'centrum oculo-pupillare,' because irritation thereof causes the same phenomena as irritation of the sympathetic trunk itself. While, however, these symptoms may readily be induced experimentally on animals, as to injuries of the spinal cord in man little more can be said than this, that sometimes one or both pupils are contracted, or non-dilatable, as in some cases recorded by Brodie, sometimes one or both may be dilated, and that these opposite conditions are in all probability due to differences in the nature and precise position of the lesion. One cannot say for certain what lesion of the cervical or upper dorsal cord it is which will certainly give rise to this or that form of oculo-pupillary symptoms, but recorded observations seem to show that paralytic myosis is much more common than mydriasis. Division of the trunk of the sympathetic, however, gives rise with comparative certainty to the appearances already named.

With reference to this paralytic myosis it must be remembered that the condition is not one of spasm of the circular fibres of the iris, but that the pupil has simply lost the power of dilatation because of palsy of its dilator fibres, and that, in a fairly bright light, there may therefore be no noticeable inequality in the two pupils. This is only revealed when the patient is placed in a dull light; but even then we must beware lest the condition be mistaken for paralysis of the third nerve with consequent mydriasis, and it is necessary, therefore, in order to arrive at a correct diagnosis, to observe the state of the pupils both in light and shade.

'Inequality in the size of the pupils,' Mr. Hutchinson wrote many years ago, '*the smaller one being the fixed one*, is then the cardinal symptom of paralysis of the sympathetic, just as inequality of the pupils with the larger one fixed is the cardinal symptom of paralysis of the third nerve, as far as supply to the iris is concerned.' Paralytic myosis is the most pronounced and most usual symptom, retraction of the eyeball being by no means well-marked in all cases. This latter phenomenon is due, in all probability, to paralysis of the musculus orbitalis, whereby the recti are enabled to draw the eye deeper into its socket, and is often more marked in animals after experiment than in man. The muscle is probably less well-developed in man than in animals, and may perhaps even be absent, so that this symptom of its paralysis is very variable. The same variability is also to be noted in the narrowing of the palpebral fissure, which may be due in some degree to the lids having lost the natural support of the eyeball, or to paralysis of the muscular fibres in the lids, or 'musculus orbitalis' of Müller, which are supplied by the sympathetic. In one of Weir Mitchell's cases of injury of the sympathetic in the neck from a bullet, the pupil was not only contracted, but was also slightly deformed, being oval rather than round. There was also slight ptosis, and the outer angle of the eye seemed to have dropped a little lower than the inner. Some or all of these phenomena, it must be borne in mind, may be induced by the pressure of new-growths on the sympathetic, and it is well recognised that oculo-pupillary changes may give valuable diagnostic help in suspected aneurism of the root of the neck.

All that has been written above with reference to the symptoms of paralysis of the sympathetic might be repeated in a description of the symptoms caused by rupture of the roots of the brachial plexus, many cases having been published in which the same oculo-pupillary phenomena had been caused by this injury. Symptoms, of apparently greater physiological than surgical interest, may thus be of considerable diagnostic importance in deciding between cerebral and peripheral lesion as a cause of extensive palsy of one arm, the result of injury. There seems to be a general consensus of opinion that no lasting changes are to be seen in the retina in the subjects of these injuries, although, in experimental observation on rabbits, after division of the sympathetic some hyperæmia has been noted. Alterations in temperature do not usually last long, but minute observations on this point in the human subject are as yet wanting. The inconvenience to the patient appears to be small. Slight difficulty in accommodation is all that has been observed, even though the paralytic myosis may have lasted for years. There is no evidence to show that the nutrition of the eyeball is interfered with in the least; but it has been pointed out by Mr. Hutchinson that occasional giddiness is complained of, owing to 'inability on the part of a tract of the vaso-motor nerve to regulate the calibre of the cerebral arteries, and thus control the supply of blood to a certain portion of the brain.' It is possible also that this may likewise be the cause of the dimness of vision which is sometimes felt in these cases; but, if with Eulenburg and Guttmann we regard the functions of the sympathetic as divisible into three groups—the oculo-pupillary, the vaso-motor, and the trophic—it must be admitted that it is in the domain of the first of them that changes usually fall under the notice of the surgeon.

HERBERT W. PAGE.

VISION, Feigned Disorders of.—What may be designated the real disorders of vision are dealt with under the various heads of ACCOMMODATION; AMAUROSIS; AMBLYOPIA; REFRACTION, Errors of, &c. In this article only the feigned or simulated disorders will be considered. Even these will be discussed rather from the diagnostic than from the pathological point of view.

SIMULATED AMAUROSIS.—Amaurosis is occasionally, though not very frequently, simulated, certainly less frequently than amblyopia or mere impairment of vision, and for the obvious reason that it is much more difficult to keep up the deception in the latter than in the former case. A single slip or act of forgetfulness will discover the one, whilst it may easily pass unobserved in the other. The simulation of amaurosis in one or in both eyes is practised by those who wish to escape conscription, in countries where military service is compulsory, and is also sometimes observed as one of the vagaries of hysteria and pregnancy. It may be pretended, and with considerable chance of success, by those who have some real defect of vision, such as may result from cloudiness of the cornea, lens, or of the fluid media of the eye, or from some lesion of the optic nerve.

Simulation of Bilateral Amaurosis.—When amaurosis of both eyes is simulated, the surgeon who is called upon to determine whether a fraud is being prac-

tised or not must take all the circumstances of the case into consideration, and reflect whether any probable or sufficient motive exists for its perpetration. As a general rule, the dilatation of the pupil in amaurosis is moderate, and no contraction of the iris can be observed on sudden exposure to bright light. Extreme dilatation excites suspicion that atropine has been employed. The discovery of an impostor pretending to be blind may be, and has been, effected by persistent, though unobtrusive, watching; by observing whether the patient avoids obstacles, picks up coin placed in his path, or performs any act requiring vision. As a rule, some physical changes are observable in the eye with the aid of the ophthalmoscope, such as white atrophy of the optic disc, hæmorrhages or inflammatory changes in the choroid or retina, especially at or near the yellow spot.

Simulation of Unilateral Amaurosis.—The movements of the iris assist the surgeon in the diagnosis of simulated unilateral amaurosis. When healthy eyes are suddenly exposed to light, or are made to converge upon a near object, both pupils can be seen to contract. Moreover, if one eye be shaded whilst the other eye is alternately exposed to light and darkness, it will be found that the pupil of the shaded eye contracts and expands simultaneously with the other. This is termed the consentaneous action of the two pupils. In addition, it may be remarked that when a near object is intently regarded, contraction of the pupils occurs, which is a movement functionally associated with the act of accommodation. The reaction of the pupil to light shows that the retina is sensitive to light, and that the impression is conducted to the brain through the optic nerve, and occasions a reflex impulse to be propagated through the third nerve. This may be unattended with conscious perception of light, but it is suggestive of simulation. Consentaneous action, with the play of the opposite pupil when one eye is perfectly blind, may occur, though it is usually feeble in real amaurosis. The absence of any movement of the pupil in one eye, when exposed alternately to light and shade, whilst contraction and expansion occur simultaneously with the movements of the healthy eye, would supply strong evidence of the genuineness of the complaint. Dr. S. Baudry remarks: 'When no information can be gained from direct inspection, we must adopt physiological proceedings, which are for the most part of the nature of a surprise, and, as several of them depend on the accuracy of the statements of the patient, it is necessary for the surgeon to see that he does not close one eye, and to state frankly that, if he persists in doing so, the experiment will be regarded as having demonstrated the excellence of his vision in the eye declared to be at fault.'

In simulated unilateral amaurosis, a method in common use for its discovery is to cover the sound eye, and then for the surgeon to make, with a pencil or penknife, a sudden stabbing movement. Reflex closure of the lids on the first attack, if the patient sees, is almost unavoidable, or can only be overcome by considerable practice. A second method is that of Dujardin, to place before the sound eye an ordinary convex glass, 16 D, and place the patient at twenty feet from the usual test-types; if he is able to decipher any letters, the eye complained of is not blind. A third method is that of Javal—viz. to interpose a ruler held vertically between the sound eye and a line of print: words will be read which the surgeon, by a previous experiment on himself, knows could not be seen except with the eye in which blindness is simulated. Stilling recommends, for the discovery of the fraud, a test with coloured glasses. A word is placed before the patient, one half of the letters of which are red and the other half green, painted with transparent colours on an opaque ground. In 'friend,' for example, 'f, i, n,' are green, and 'r, e, d,' are red. Then, whilst leading the patient to believe we are testing the healthy eye, we place before it a red glass, the colour of which exactly corresponds with that of the red letters. This will permit the healthy eye to see the red letters, but will altogether prevent the green from being seen, so that if the patient be really amaurotic in the eye he declares to be blind, he will say he sees the letters 'r, e, d.' In the event of his recognising all the letters, and reading the entire word 'friend,' it is clear that he is perceiving the green ones, 'f, i, n,' with the eye he states to be blind; and by having a set of coloured types similar to those of Snellen, we may go a step farther, and measure the visual acuteness of the impostor's blind eye.

Another method is by means of prisms. In normal vision the eyes converge upon the object, and the divergence or wandering of an eye, when an object in near and middle distance is fixed, is strong presumptive, though not absolutely certain, evidence of some imperfection in its vision. By means of a prism, it is not difficult to make one eye wander without the control of the

patient in certain directions, and the movements which may be observed when vision exists in both eyes constitute the method of Wetz. In this method, a prism of about 14° is placed before the eye stated to be blind, with the base outwards. In order to obtain single vision, if the patient sees with this eye, he rolls it inwards, and again rolls it outwards when the prism is withdrawn. This movement and the subsequent rectification do not take place in cases where one eye is really blind. Berthold has suggested a slight difference in the application of this method—namely, the rotation before the supposed blind eye of the prism, when it will be found very difficult to read small print or decipher small signs, in consequence of the superposition and interference of the images.

The method suggested by Von Graefe, as modified by Baudry, consists in puzzling the patient with double images by placing a prism before one eye. The proceedings should be divided into two stages or periods. The first should be directed to making the patient comprehend, what, as Giraud-Teulon observes, he often knows and believes beforehand, that he may have double vision with one eye. For this purpose the blind eye or eye supposed to be blind is covered, a prism with the base upwards is brought upwards till it divides the pupil horizontally into two halves, and he is directed to look at a distant candle; he at once sees two images, one above through the natural pupil, and the other through the prism, the latter being projected below the other. This is tried several times, and in various ways, until the patient is satisfied of the fact; then, apparently unconsciously and without display, and as though by forgetfulness, the supposed blind eye is set free, whilst at the same moment the prism is raised so as to cover the whole pupil. If the patient still sees two images, the simulation is exposed.

A modification of this method has been devised by Galezowski, which consists in using a double refracting prism of Iceland spar, a method that has been again improved upon by M. Monoyer, who employs two prisms united by their bases, by which means simple or binocular diplopia may be produced at will, according to whether one of the prisms or the line of junction is in front of the pupil.

The method in which the stereoscope is utilised is also employed for the discovery of simulated monocular blindness. In this the photograph is replaced by a sheet of white paper, divided into two equal parts by a vertical line. Near the top of the sheet, at a distance from the vertical line of two centimètres, are symmetrically fixed two wafers of different colours, say, red on the right and green on the left; near the bottom of the page, and at a distance of five centimètres from the vertical line, two other wafers are placed, also symmetrically, say, blue on the right and black on the left. If binocular vision exists, the wafers distant two centimètres from the vertical line give crossed images, whilst those distant five centimètres give direct images. If an eye is really blind, supposing it to be the right, the patient would see the red and the blue.

Simulation of Amblyopia.—The simulation of amblyopia is more common than that of amaurosis. He who pretends to be completely blind, requires to be constantly on his guard, lest by some unwary movement or observation he betrays that he possesses vision; whilst the man whose vision is only, according to his own account, dim, may act in a way that may indeed excite suspicion or distrust, but is hardly sufficient to convict him of imposture. Yet there have been men, who, pretending blindness, have been so collected as to avoid all the traps laid to expose their deceit, and even, at considerable risk, to walk without hesitation into water or into a pit. Before the invention of the ophthalmoscope, the objective examination of the patient ceased with mere inspection of the eye; and dilatation and immobility of the pupil, with a particular and easily imitated gait, were regarded as most important reliable signs of blindness. But even these were known to be absent in some cases of genuine amaurosis; and so many causes of this affection existed, of which no account could be given, that when such simple proceedings as the placing of a coin or other object in the path of the supposed patient failed to surprise him, no other course was left than that of watching him, which soon became wearisome, and was only continued for a period so short that he was, without much strain on his attention, able to maintain the deceit. The use of the ophthalmoscope has rendered the simulation of blindness far more difficult. Yet it must be admitted that, even with all the aid this instrument affords, cases still occur in which, on the one hand, the most careful examination fails, for a time at least, to discover the slightest disease in the interior of the eye; whilst, on the other hand, it sometimes reveals conditions which, if the patient declared he was blind, would be regarded by any ophthalmic surgeon as sufficient to

justify his statement, and which may yet be compatible with very good and useful vision. To meet these difficulties, various methods have been adopted, some of which depend for their success on the statements of the patient, and require considerable intelligence on the part of the surgeon to render them reliable, whilst others rest on circumstances beyond the control of the simulator.

It not infrequently happens that an artisan receives an injury to one eye which temporarily incapacitates him from work, and, his club ceasing to furnish supplies, he seeks to prove that the lesion is permanent, and founds a claim against his employers. He may declare that one eye is completely blind, or only that the acuteness of vision in it is so far dulled that it seriously interferes with his work. The former case is more easily discovered than the latter, but, in both, circumspection is required on the part of the surgeon. He should first make a careful ophthalmoscopic examination and satisfy himself whether serious organic mischief is present or not, whether the media are clear, whether there is any hæmorrhage or effusion, whether the disc presents signs of atrophy, and whether the vessels are normal in their position, colour, size, and course. He should then proceed to test the refractive power of the media by retinoscopy or by means of the ophthalmoscope, for hitherto unsuspected and unknown defects of refraction are sometimes rendered conspicuous by the loss of accommodation which follows a sharp blow on the eye.

It is, of course, useless to place the patient before a set of test-types and ask him what he can see. He either says that one or both eyes are blind, or admits only a certain amount of vision. Where both eyes are stated to be blind, the proceedings already mentioned under the head of *Simulation of Bilateral Amaurosis* must be adopted; but, when only impairment of vision in one or both eyes is complained of, something may be learnt from careful observation of the patient's behaviour in regard to test-types. If, for example, he can make out letters of a given size at a certain distance, he should be able to read letters of a quarter this size at half the distance, and of four times this size at double the distance, or at least any great discrepancy should awaken suspicion. Again, a lens of slight magnifying power may be placed before the eye or eyes, and if he admits that he sees a little better, it may be somewhat ostentatiously and positively stated that a lens of double the power will further improve the vision though it will by no means make it perfect. The patient's suspicions being allayed, instead of adding a second convex lens, a concave one of the same power may be added, which, of course, neutralises the first, and has no more effect than a piece of plane glass. Yet the patient will sometimes name letters far smaller than those which he at first stated were the extreme limit of his vision.

If no defect can be discovered, and blindness of one eye be declared to be present, it must be borne in mind that such blindness may result from shock to the retina (*commotio retinæ*), as from blows with champagne-corks, in which case, however, if the blow has not been very severe, recovery usually soon follows; or, in cases of falls on the head, from injury to the optic nerve in the optic foramen, in which case, white atrophy usually soon follows. If, however, doubt exist as to the statement of the patient, attention must now be paid to the state and reactions of the iris. In amaurosis, the pupil is usually, but not always, dilated and motionless, and it can be, as is well and generally known, rendered so by atropine, which is therefore used for the purpose by impostors.

As a means of diagnosing amblyopia M. Dariez recommends the employment of feeble currents of electricity. The healthy eye as a rule responds by a luminous sensation to an interrupted current, the strength of which does not exceed one-tenth of a mille-ampère. In atrophy of the optic nerve resulting from primary sclerosis or concomitant with medullary sclerosis, in cases of atrophy from neuritis, embolism, hæmorrhage, or glaucoma, in fact in all those cases in which the forecast is bad, the electric phosphene can only be produced by currents amounting to 5, 10, 50, or 100 tenths of a mille-ampère. On the contrary, in toxic forms of amblyopia, such as those resulting from tobacco and alcohol, the reaction is normal, as it is also in cases of congenital and hysterical amblyopia.

HENRY POWER.

VISUAL ACUITY.—It is of the utmost importance, in order to estimate the degree of functional perfection of the eye, as well as to ascertain from time to time the result of our treatment or surgical interference in any case, to have some means of testing and recording the acuity of vision, which shall furnish us with results both accurate and capable of comparison *inter se*. For-

tunately we do possess such means, and so simple and easily applied are they that the habit of neglecting them and contenting oneself with the more or less vague statements of patients as to improvement or deterioration in their sight is little short of unpardonable. In testing the sight it is not sufficient to note the size of print which the individual is able to read, as a little experience will soon convince one that even the smallest print can be read by persons possessing very different degrees of acuity of vision. The proper test is made at a distance, and rests on a scientific basis which will be shortly explained.

The individual to be tested is placed at the distance of six mètres, or twenty feet, from a board on which are printed seven rows of letters, the so-called Snellen's test types, each row except the top containing different letters of the same size, but the size of the letters becoming smaller and smaller in each successive row. The top letter is of a size capable of being distinguished at the distance of sixty mètres, or 200 feet, whilst the distances at which the letters of the 2nd, 3rd, 4th, 5th, 6th, and 7th rows might be made out are 36, 24, 18, 12, 9, and 6 mètres, or 100, 70, 50, 40, 30, and 20 feet respectively, according as the boards have been constructed for metrical or ordinary notation. It is clear that anyone placed at six mètres from the board, and only being able to distinguish the top letter, might have the acuity of his vision expressed by the fraction $\frac{6}{60}$ or $\frac{20}{200}$, inasmuch as an object, the shape of which can be made out at 60 mètres with the normal eye, can only be seen by him at 6 mètres. There is an advantage in retaining the fraction in this form, and this is almost always done, instead of reducing it to the simpler form $\frac{1}{10}$, as the numerator gives the distance at which the individual tested is placed from the board, and the denominator indicates, by the distance at which it should be visible, the line he sees. If he does not even see the top line at six mètres, he may be approached to the board until he sees it, then if he sees it first at four mètres, his vision is $\frac{4}{60}$. On the other hand, though he is unable to see the second line at six mètres, he might still see the first at seven or eight mètres, corresponding to a degree of visual acuity equal to $\frac{7}{60}$ or $\frac{8}{60}$. It is not, as a rule, convenient or even possible, however, to make examinations at so great a distance, so that it is customary rather, under such circumstances, to test the distance at which the second line is seen instead, in the case in point, say, at four or five mètres, giving a fraction for the acuity expressed nearly by $\frac{4}{36}$ or $\frac{5}{36}$. The acuity of vision corresponding to seeing 2nd, 3rd, 4th, 5th, 6th, or 7th line and no more is, adopting the same notation, $\frac{6}{36}$, $\frac{6}{24}$, $\frac{6}{18}$, $\frac{6}{12}$, $\frac{6}{9}$ and $\frac{6}{6}$. The last, or $\frac{6}{6}$, i.e. when all the letters in the last line can be made out at six mètres, indicates the possession of normal or full visual acuity.

In the same way, as already explained, we may obtain intermediate fractions, though it is seldom that a greater degree of accuracy is desirable, and indeed it should not be aimed at except in cases where we are certain that the circumstances are always exactly similar during the period of examination. Thus we should have to know that the illumination was the same, and that the individual tested was not influenced in his answers by practice and having previously known the letters, as might be the case after repeated examination, or when one eye was considerably better than the other.

In cases where the vision is extremely bad, the test types become inapplicable, and it is usual then to find the distance at which the patient can count the oustretched fingers against a dark ground, noting the result in the following way: V = fingers at 1 foot, 2 feet or more, as the case may be. The vision may be so bad as to render the patient incapable of counting fingers even close up to his eye; still he may have sufficient vision to see the movements of the hand, up and down and from side to side—a degree of vision which may be expressed by noting V = Hand movements close, at 1 ft., 2 ft., &c., according to the distance. When there is not even perception of light we have V = 0.

Let us now consider what we mean by visual acuity, and what are the natural limits to it. It is a very popular belief that if we see objects at a great distance we must necessarily have good sight, but this is by no means the case, as an object may be seen at practically almost an infinite distance provided it be sufficiently luminous, yet we may be very far from being able to make out any detail in it. The visual acuity is scientifically determined by the smallest visual angle under which two or more objects, if presenting sufficient contrast to the intervening space, can be made out as separate, discrete objects. If a straight line be drawn from any point in an object to the first nodal point of the eye (towards the back of the lens), the position of the image of that point on the retina is given by drawing a line parallel to the first from the second nodal point to where it meets

the retina. The two lines determining the positions of the images of two points will accordingly necessarily form an angle between them, the apex of which angle lies at the second nodal point. It is this angle which is called the *visual angle*, and it evidently equals the angle formed by the two lines drawn from the separate points to the first nodal point, or, what comes to the same thing practically, when considerable distances are involved, the angle formed by the lines passing from the two points to the centre of the cornea.

Knowing, then, the distance from the eye of two points, and their distance apart (or more correctly the component of that distance at right angles to the former line), it is an easy matter to determine the visual angle under which they are seen. Thus, if for instance we take a series of black and white squares of equal size, we shall be able, under suitable conditions, to determine the acuity of vision (expressed as a definite visual angle) by noting the greatest distance at which they may still be seen as separate squares, and are not blurred into a more or less homogeneous shaded surface, the details of which cannot be distinguished. Experiments have shown that with normal visual acuity the smallest visual angle may be taken at not much less than 1 minute. The calculated size of the retinal image corresponding to this angle (which again varies according to the position of the second nodal point relatively to the retina) agrees sufficiently closely with the distance between the centres of two contiguous percipient elements of the retina. It is thus probable that a limit is given to the possible acuity of vision by the anatomical structure of the retina, and that the theory is correct which infers that, in order that two objects may be seen separately, the size of the image of the intervening space must at least be so great as to equal the distance between the centres of two contiguous cones, so that it may be possible for one cone at least to receive a different impression from those around it.

The test types above described, and which are those in general use, are based on the assumption that the normal eye is capable of distinguishing objects having an angular separation of 1 minute; thus the black and white portions of the letters in the last line are separated by intervals which subtend angles of 1 minute to the eye at a distance of six mètres (the height of the letters subtending angles of 5′–50), so that when they are seen at six mètres the visual acuity (V) = $\frac{6}{6}$ or 1. The same angles are subtended by the other lines at the distances 9, 12, 18, 24, 36 and 60 mètres respectively. It has been found that the assumption of 1 minute as the size of the visual angle corresponding to full visual acuity makes it rather too small than too big; this is more than counterbalanced in practice when alphabetical letters constructed on this basis are employed, owing to the large angle subtended by the letters as a whole, as well as to the elaboration of an imperfect image arrived at by education and practice. Thus we find that the corresponding more regular figures which constitute the illiterate test type of Snellen cannot be deciphered at the same distance as the letters, and that children or individuals who have only just learnt to read, exhibit more difficulty in making out the letters than others who have learnt to make the most of their retinal images. The visual acuity depends on the optical perfection of the eye, the total as well as relative illumination of the objects to be seen, and the degree of functional perfection of the retina and nerve-centres connected with vision.

G. A. Berry.

VITILIGO. *See* Leucoderma.

VITREOUS, Diseases of the.—The vitreous may be altered by inflammation, by invasion of its substance from without, or by degenerative changes.

Acute hyalitis is not infrequently of a suppurative character. The changes may be very rapid and severe, implicating also the optic disc, retina, and uveal tract. This suppurative panophthalmitis may be secondary to a general pyæmic condition—e.g. after severe wounds of distant parts—or it may arise from purulent uveitis, the result of similar local causes. Its symptoms are congestion of the globe, loss of vision, yellowish-white turbid opacity in the vitreous chamber, dulness of aqueous humour and iris, and chemosis. The globe becomes proptosed and loses its mobility, and a thin purulent discharge escapes from beneath the swollen upper lid. Corneal perforation or, more commonly, shrinking of the globe without perforation is the ultimate result. The active symptoms are associated with marked general febrile disturbance.

But a suppurative hyalitis may run its course with little visible implication of any other structure than the vitreous itself. In such cases the condition may be indicated simply by ciliary congestion, loss of sight, opacity behind the lens, and, ultimately,

retraction of the peripheral part of the iris, with slight softening and gradual shrinking of the globe.

Such inflammations may be the result of wounds implicating the vitreous itself rather than the uveal tract, or consecutive to or concomitant with some forms of meningitis in children. Of this last nature are the greater part of the cases now absurdly designated as *pseudo-glioma*. Their diagnosis from true retinal glioma depends upon the history, the absence of hæmorrhagic spots or blood-vessels from the opaque surface behind the clear lens, the gradual retraction of the iris-periphery, and the development of diminished tension. But suppuration may be localised so as to constitute a true abscess of the vitreous.

Non-suppurative hyalitis may be the result of wounds; of various inflammations of the iris, ciliary body, and choroid, especially those exciting sympathetic disease; or aroused sympathetically. It is also associated with retinitis as a frequent late lesion of secondary syphilis. It is found also in glaucoma and myopia, and is the usual result of the presence of cysticerci, blood-extravasations, and other foreign bodies. The condition is indicated by the presence of local films or haze, or of universally-distributed fine, dust-like opacities. Unless the opaque particles are so far forward and so large as to be visible by oblique illumination, we shall find the ophthalmoscopic mirror, held at perhaps a foot's distance, to be the best means for their individual recognition. A plane mirror has often a distinct advantage over the usual concave one. In many cases, however, the optic disc simply looks reddish, like the sun seen through a mist, and the fundus reflex generally somewhat obscured. The disease may result in the restitution of the normal condition, in the formation of opaque shreds or films, or in the shrinking and condensation of the vitreous. In severe cases, the retina, choroid, and sclerotic will follow the shrinking vitreous till the eye is reduced to a small, deeply-grooved stump. If, however, the ciliary body has been little involved, the globe may preserve its proper size and shape notwithstanding the detachment caused by the general or partial inflammatory adhesion of the retina to the shrinking vitreous. More rarely, the retina is left *in situ* (detachment of the vitreous), separated by serous fluid from the vitreous, which forms either a translucent, filmy, well-defined hemisphere on the posterior surface of the lens and ciliary processes, or a convolvulus-shaped detachment from the retention of its connection with the optic disc. A localised, traumatic, non-suppurative hyalitis may simply encapsule a foreign body, or form a band marking the track of a penetrating wound. Detachments of the vitreous are common after operations attended by loss of vitreous, and are consistent with a fair degree of sight.

It is only in the acute cases of glaucoma that hyalitis can be diagnosed by rapidly-occurring vitreous haze. Pathological examinations of advanced cases always show the vitreous firm and containing an excess of cells, especially those of the spindle and stellate variety. The central canal—the canal of Cloquet—is widely dilated, and the vitreous, as a comparatively thin layer, lines the internal retinal surface. Consequently, retinal detachment is of rare occurrence in this disease.

Vitreous opacities are extremely common in high degrees of myopia, and take the form of freely floating films or veils. They are probably the result of a low inflammatory condition, with subsequent shrinking and condensation of the vitreous. This may be partial or entire, in which case the shrunken vitreous is only represented by a much-folded convolvulus-shaped membrane, which, retaining its attachments at the disc, and at and in front of the ora serrata, floats freely on any sudden movement of the eye between the much-increased fluid of the subhyaloid space and that of the canal of Cloquet. From the want of proper support, detachment of the retina and trembling of the iris are easily brought about. Finer vitreous opacities—for the most part invisible by the ophthalmoscope—the result of very slight inflammation, are also much complained of by myopic patients. The opacities of syphilitic hyalitis present at first a fine dust-like appearance. They may entirely disappear, or floating opacities like those described in extreme myopia may be formed. The retina is also involved in this condition, so that the disease is really a retino-hyalitis.

Cysticercus in the vitreous is very rare in this country as compared with Germany. The cyst is of rounded form, with bluish-grey surface and white shining margin. The hyalitis aroused by it may be slight; but irido-choroiditis and shrinking of the globe are the more common result.

Penetrating foreign bodies, such as fragments of metal and gun-cap, if they do not cause speedy suppurative panophthalmitis, usually result in the same manner.

Hæmorrhages into the vitreous may depend upon some constitutional condition,

such as gout, hæmophilia, or anæmia; but they sometimes occur, especially in young adults, without obvious cause. One eye alone is frequently affected, and relapses are not uncommon. Minute hæmorrhages are sometimes found in severe glaucoma, and depend on disease of the vascular walls. The opacity resulting from blood-infiltrations is greater than can be caused by the amount of blood present, and is due to a secondary hyalitis. The result is, usually, the formation of opaque films or of freely floating shreds, as has been described in myopia. Similar appearances are common after retinal detachments from blows, and are probably there also of hæmorrhagic origin.

Tubercle or *glioma* cells may infiltrate the vitreous, extending loosely from the adjacent affected retina or uveal tract. It is even supposed that tubercle may develop primarily within the vitreous.

Persistent hyaloid artery is rare. It is seen as a greyish cord extending along the canal of Cloquet, from the disc to the back of the lens-capsule.

Muscæ volitantes are only subjectively observed by the patient, and trouble him more or less according to the sensitiveness of his retina. They continue their movement after the eye has been brought suddenly to rest, and thus can be diagnosed from the fixed opacities, which may be of serious moment. Against a white surface, they present to him the appearance of fine filaments which are variously twisted and beaded. They are supposed to be due to minute opacities, which normally exist within the substance of the vitreous.

Fluid degeneration of the vitreous (synchysis) occasionally occurs as a senile change. It is indicated ophthalmoscopically by the free mobility of fine suspended particles, and also by tremulousness of the iris (iridodonesis). The floating particles may appear very bright and glistening (sparkling synchysis). They are made of cholesterine crystals, in occasional association with tyrosine and phosphates.

The *pathology* of hyalitis has been much discussed. The increased corpuscular elements, which at its onset give increased firmness to the vitreous, must be derived either from immigration from the neighbouring blood-vessels, or from a multiplication of the rarely-occurring corpuscular elements of the vitreous itself. These are either small (diam. = ·009) and rounded, with comparatively large nuclei, or similar in body to these but tailed, or much larger (diam. = ·024), well-defined and vesicular, with lateral nucleus. The first-described is probably the form from which the others are derived, and is most abundant in the peripheral parts of the vitreous. Immigration must be the main factor in metastatic suppuration and in the rapidly-developing cases of suppurative panophthalmitis from local injuries. But slight local abscess of the vitreous, or non-suppurative hyalitis developing round a foreign body, is far more likely to be due to a direct cell-proliferation, since the surrounding vitreous has occasionally been observed to remain clear during the development of such local processes. Moreover, in the earlier stages of suppuration of the entire vitreous, we find the opacity not universally distributed but collected mainly into two areas, one covering the ciliary body and in less degree the optic disc and retina, and the other occupying the vitreous centre. The last is mainly constituted by large granular cells of faint outline and faint feebly-staining nucleus, each very like in many respects to the larger cells of the normal vitreous; whereas the former contains, together with a few of these, many smaller multinucleated corpuscles. The larger cells of the centre are probably, like those of local abscesses, derived from a proliferation of the smaller vitreous corpuscles, whereas the cells of the periphery are derived mainly from the neighbouring blood-vessels, to whose colourless corpuscles, as seen within their lumen, they present a very close resemblance. But the multinucleated corpuscles, whencesoever derived, are certainly in a state of very rapid proliferation. In non-suppurative hyalitis many-tailed cells are ultimately developed, by the contraction of which the condensed filmy vitreous occupies less space. Such cells are most abundant near the ciliary body, where they may often be seen to extend from between the elements of the pars ciliaris retinæ. Or, if similarly connected with the retina, they will by their contraction detach this membrane. Otherwise, the vitreous may leave the retina *in situ*, and form a well-defined translucent hemisphere on the posterior surface of the lens and ciliary body, or a convolvulus-like detachment.

Treatment.— When suppuration appears to be threatened, we shall find local warmth, together with the internal use of quinine and stimulants, to be the best means at our disposal. If foreign bodies are the cause, their removal, either by the magnet or otherwise, should be attempted. Failing the accomplishment of this, we should proceed at once to the enucleation of the globe. The symptoms of fully de-

veloped suppurative panophthalmitis are only relieved by time or by the enucleation of the globe. Cysticercus may, in rare cases, be successfully removed by operation. The hyalitis of myopia demands rest, the use of tinted lenses of proper strength, and local blood-letting. That of syphilis is most effectually treated by mercury. If circumstances will not allow of the sufficiently free and long-continued administration of this drug by the mouth, we shall do well to give daily vapour-baths of calomel (gr. x.). Or perchloride of mercury in aqueous solution (1–60) should be daily injected into the muscles, in doses of from 2 to 6 minims. Vitreous hæmorrhages, supposed to be dependent on gout, will be best treated by the regimen and drugs appropriate to this disease. Those due to anæmia will be favourably influenced by the administration of iron and of arsenic. In any case the bowels should be carefully regulated. Hot foot-baths may be also of use in recent cases. Nitrate of pilocarpine has been vaunted as a means of removing vitreous opacities. It should be given subcutaneously in daily diaphoretic doses (gr. $\frac{1}{6}$). But the writer's experience has not confirmed the statements as to its value. The constant electrical current may daily be used for ten minutes, in strength just sufficient for the patient to appreciate a flash when the current is made or broken. One pole should be placed on the nape of the neck and the other over the closed lids. Some, however, prefer the interrupted current. Muscæ volitantes and persistent hyaloid artery admit of no treatment.

W. A. Brailey.

VOMITING as a Symptom in Injuries and Surgical Diseases.—In the following injuries vomiting as a symptom is of importance:—

(1) Head-Injuries. — Concussion is commonly followed by vomiting, even in slight cases. The symptom comes on at the commencement or during the period of reaction, and is favourable. Care should be taken to turn the patient's head well on one side. In slight cases of concussion, the patient does not usually vomit more than once or twice. More persistent vomiting, without corresponding reaction, points rather to contusion or laceration of the brain. In some cases of head-injury, with but slight cerebral symptoms, the vomiting is oft-repeated; in such cases it is probable that the vomiting centre in the medulla has suffered injury or disturbance. *See* Head-Injuries.

(2) Spinal Injuries.—Injuries to the cervical, more rarely to the upper dorsal spine, are occasionally followed by persistent vomiting. Mr. Erichsen records a case in which, after a blow on the cervical spine, vomiting persisted daily for many months. Usually, the symptom occurs soon after the injury. In head and spinal injuries the vomiting is attended with little or no retching or distress, and it does not become stercoraceous; the tongue remains clean, and the breath pure. One-grain doses of calomel, frequently repeated, will often relieve the symptom. *See* Back and Spine, Injuries of the.

(3) Abdominal Injuries.—These are all likely to be followed by vomiting, which is indeed a most constant, though not an invariable, symptom. When the rupture is high up the vomit is usually bloody. It is persistent, attended with severe pain, great collapse, and commonly occurs early, while the retching is constant. In a case, however, of ruptured duodenum under the writer's care, in which the patient walked into the hospital and thought he was scarcely injured, the vomiting did not commence for some hours and was very slight. As a rule, however, the nearer the injury is to the stomach the earlier does the vomiting begin. *See* Abdomen, Injuries of the.

(4) Surgical Diseases.—In all cases of intestinal obstruction, vomiting is a most important symptom. In acute obstruction, arising from volvulus, intussusception, &c., it commences early, persists, is associated with great pain, and rapidly becomes stercoraceous. At first the vomit is green and watery, then contains much mucus; soon it becomes darker in colour, and then acquires the characteristic odour. The time that elapses before the vomit becomes stercoraceous affords no reliable test as to the situation of the obstruction. The vomit, though spoken of as fæculent, is not actually so. The theory of 'inverted peristaltic action of the intestines' is now, the writer believes, abandoned, and the vomiting ascribed to nervous influence. *See* Intestinal Obstruction.

Acute strangulation or internal hernia not involving the intestine will give rise to vomiting of the same description, for vomiting will occur when any of the abdominal contents are strangulated—e.g. a portion of omentum or of the bladder, &c. Often, in the former case, the omentum seems to constitute the sole contents of a hernia, but includes and is wrapped over a loop of gut, forming an 'omental sac.' So,

too, when an empty hernial sac is inflamed, in acute orchitis of a retained testis, &c.; in fact, when the lesion affects any part supplied by the abdominal sympathetic nerves.

The symptom, if persistent, is the most important indication for operation; if allowed to go on too long, it will not cease after relief of the obstruction by operation. In external strangulated hernia the symptoms, as regards vomiting, are the same as in the preceding cases. In rare cases of strangulated hernia vomiting is a late symptom, but in such there will be a feeling of nausea and a tendency to retch. The more acute the strangulation the earlier will the vomiting commence; but it often happens, particularly in old herniæ, that the patient vomits once almost immediately after the descent of the hernia, especially when, as too often happens, some purgative medicine has been taken. The hernia may still, though irreducible, not be strangulated. Bearing this in mind, it may be laid down as a rule in cases of strangulated hernia, that the occurrence of decided vomiting, if repeated on more than three occasions, demands gentle taxis under anæsthesia, and if this fails, operation. More lives would be saved if the greater gravity of the operation did not too often deter the surgeon from adopting the same rules of treatment in acute internal obstruction. Persistent vomiting after operation for obstruction is the most grave symptom that can occur. *See* Hernia, Strangulated.

In the rare form of hernia known as Littre's, or partial enterocele, the vomiting is less persistent, and not stercoraceous; but in these cases no complete obstruction exists, as is constantly shown by the passage of fæces.

In chronic intestinal diseases vomiting marks the completion of obstruction. It is rare consequently in malignant disease of the intestines.

It not infrequently happens that, after operation for strangulated umbilical hernia, the division of the stricture is almost immediately followed by profuse vomiting attended with scarcely any contraction of the abdominal muscles. It will occur when the stomach or upper part of small intestine is involved. This passive kind of vomiting occurs when the stomach is full of unabsorbed fluid, and is the gravest possible symptom. Vomiting occurs early in all forms of acute peritonitis. The pain is often intense in these cases, but the vomit does not tend to become fæculent. In profound shock, after grave operations, vomiting occurs often in a severe and constant form. Here nutrient and stimulant enemata are demanded. C. T. Dent.

VULVA, Affections of the. — The *vulva*, or external genital apparatus in the female, comprises the following parts:— In front is situated the eminence known as the *mons pubis*, whence on either side extend backwards the *labia majora*, which limit the genital fissure behind by their union in a thin fold of mucous membrane, the *fourchette*, at the anterior border of the perineum. From the *clitoris*, seated immediately beneath the mons, two diverging folds of mucous membrane enclosing erectile tissue, and known as the *labia minora*, or *nymphæ*, pass backwards to blend with the inner surface of the labia majora. The intervening space, termed the *vestibule*, shows the opening of the urethral canal (*meatus urinarius*) seated in the middle line immediately in front of the vaginal orifice.

I. Malformations, involving more or less complete obliteration of the genital fissure, are always congenital, and constitute one or other of the various forms of the condition usually known as hermaphroditism.

Adhesion of the Nymphæ is a minor malformation occasionally found in young children, either as a congenital condition or as the result of some local inflammatory mischief in early infancy. On separating the labia majora in such cases, the vulvar opening is seen to be partly occluded by a membranous structure connecting the margins of the nymphæ, and continuous posteriorly with the skin of the perineum. The membrane, however, is always deficient anteriorly, where an aperture exists corresponding with the opening of the meatus urinarius; and the introduction of a probe at this point will at once reveal the true nature of the deformity.

Treatment.—The adhesion, as a rule, can be easily torn through by means of a probe, or by forcible separation of the parts; but, if necessary, it can be divided on a director with the knife; the only after-treatment required being the introduction of a strip of oiled lint for a few days, in order to prevent re-union of the torn surfaces.

Hypertrophy of the Clitoris is sometimes seen in infants. Removal by means of the thermo-cautery may be deemed advisable.

Acquired malformations in the adult, as the result of cicatricial contractions after sloughing due to injury, are extremely rare.

II. Surgical Injuries.—*Contused* or *incised wounds* of the labia occur either from intentional violence, as kicks, blows, or stabs; or more commonly as accidental injuries, from falling or sitting upon some pointed or sharp-edged object. The extreme vascularity of the tissues, while always causing free hæmorrhage at the time of the accident, has the advantage of promoting rapid healing.

Treatment.—After careful cleansing, the skin-edges should be accurately adjusted by sutures, and a dry pad of some antiseptic material be applied to the vulva and retained in place by a T-bandage, the patient meantime being confined to bed. Should leucorrheal discharge exist, daily syringing of the vagina with a carbolised lotion will be required in order to avoid any decomposition.

Contusions—due to violence—may lead to considerable swelling and inflammation of the labia, best treated by the early and continuous application of cold compresses.

Hæmatoma, or *thrombus*, are terms applied to a rapidly formed swelling of the labium, caused by a subcutaneous effusion of blood—an accident which is favoured by a varicose condition of the vessels of the part consequent upon intrapelvic pressure. In addition to external violence as an exciting cause of this injury, may be mentioned the pressure of the child's head during parturition, or even the sudden strain of a violent muscular effort—inducing rupture of an over-distended vein. The rapid formation of the swelling, in a patient subject to varix, will at once suggest the true nature of the injury.

Treatment.— Absolute rest, with the continuous application of an ice-bag, will prevent further effusion and favour absorption. For some few days after the accident, the bladder and rectum should be evacuated without the patient's being allowed to strain in any way. If suppuration occur, poulticing, followed by early incision, will be required. This operation should, as far as possible, be performed with all antiseptic precautions, in order to avoid risk of septic absorption, especially when the accident has occurred during parturition.

Lacerated contusions, with free external hæmorrhage from a ruptured varicose vein, may prove rapidly fatal from loss of blood. The patient should at once assume the recumbent position, when firm pressure by means of a pad and a T-bandage will usually control the bleeding.

Fissures about the nymphæ or fourchette, resulting from injuries inflicted during coitus or a first labour, sometimes give rise to much discomfort and pain on exertion, and may even render intercourse unbearable. Complete rest for a few days, combined with the use of boracic acid ointment or of some other mild application, will in most cases readily suffice for their cure, when recent. Failing this, division with a sharp knife, followed by the employment of iodoform powder or ointment, may be required.

III. Inflammation of the Vulva (*Vulvitis*).— 1. *In Children.*—Simple catarrhal inflammation of the mucous surfaces occurs in weakly infants from neglect of cleanliness, or from sympathetic irritation due to the presence of thread-worms. The parts are found swollen and tender, and bathed in muco-pus.

Treatment. — Frequent ablution with warm lead lotion, followed by the application of boracic acid ointment, will usually effect a cure, if any co-existing source of irritation be at the same time removed.

Noma is a rare disease met with in unhealthy, ill-fed children during the course of, or as a sequela to, measles, scarlet fever, or typhoid. The affection, which commences by the formation of a small vesicle seated upon an indurated base, leads rapidly to localised gangrene of the part, accompanied by much inflammatory œdema. Constitutional symptoms are always severe, and may readily induce fatal exhaustion.

Treatment.—The constant use of warm charcoal poultices, or of strips of lint soaked in hot boracic lotion and covered with oiled silk, answers best as local treatment. Meanwhile, good nourishment and wine must be freely administered, and the patient's strength maintained by means of a mixture containing ammonia and bark, or chlorate of potash and quinine.

2. *In Adults.—Simple* vulvitis, due to deficient cleanliness, irritating vaginal discharges, skin-affections, or other sources of irritation, is not of very uncommon occurrence, and if neglected may readily become chronic. In the *acute* form, the parts are swollen and tender, the mucous surfaces red and irritable, and coated with muco-purulent discharge. The *chronic* form is always accompanied by much irritation (pruritus); the labia are thickened and indurated, and often the seat of painful fissures.

Treatment during the *acute* stage requires rest in bed, combined with avoidance of all friction between the opposed surfaces, which should be frequently bathed with warm lead lotion and kept covered with

strips of wet lint protected by means of oiled silk. Should abscess of the labium occur, it must be opened by an early incision. When the affection has become *chronic*, any discoverable cause of irritation must be removed, and the parts then kept scrupulously clean and frequently dusted over with oxide of zinc and starch powder.

Specific vulvitis, due to gonorrhœa, does not differ materially from the ordinary acute affection, excepting that it is usually accompanied by some urethritis, and often leads to formation of abscess. The vaginal mucous membrane also is very often acutely inflamed at the same time. For treatment, *see* VAGINA, Acute Inflammation of the.

IV. SKIN-AFFECTIONS. — 1. *Eruptions* affecting the vulva — whatever be their nature or origin — invariably give rise to intense irritation (pruritus), relief from which is usually sought in rubbing or scratching. This, in time, leads to abrasions and inflammatory changes, which readily mask the original characters of the eruption, and, in long-standing cases, may induce marked alterations in the appearance of the parts due to thickening and induration of the tissues.

2. *Parasites.*—The presence of the *pediculus pubis* causes a lichenoid eruption chiefly affecting the mons and adjacent parts of the labia majora. The large size and colour of the parasite render its detection an easy matter. Thorough inunction of a mercurial ointment, or frequent ablution with 1-20 carbolic lotion, followed by the application of a vaseline ointment containing one part in ten of carbolic acid, will usually destroy the source of irritation and cure the disease.

The only other parasitic affection here met with is *scabies*, which may cause an impetiginous eruption involving the mons and the neighbouring parts of the abdomen and thighs. The characteristic itching and the existence of the rash elsewhere—about the patient's wrists and fingers — will suggest the nature of the disease, which yields readily to the use of sulphur ointment.

VENEREAL WARTS (*Verrucæ*), are met with on the vulva quite independently of any constitutional taint, but simply as the result of persistent irritation of the mucocutaneous surfaces from neglect of cleanliness. They are thus not uncommonly found coexistent with gonorrhœal discharges. Their most usual seat is on the inner aspect of the labia, where they appear as irregular cauliflower-like growths, often more or less pendulous, and occasionally of considerable size.

Treatment. — When small, they are readily removable with scissors, after which their base should be touched with nitrate of silver. Scrupulous attention to cleanliness, and the use of a dusting powder of oxide of zinc, or calomel and starch, will usually prevent recurrence. If large, the growths should be removed with the help of the thermo-cautery, in order to avoid hæmorrhage.

CHANCRES occurring upon the female genitals may be either simple (non-infecting) or specific (syphilitic). Their most usual situation is just within the fourchette, or upon the nymphæ; but they may occasionally be seen upon the cervix uteri; and very rarely upon the vaginal mucous membrane. When seated externally, they are sometimes difficult of detection, owing to the inflammatory œdema caused by the irritation due to their presence.

The *simple non-infecting* chancre is the form most commonly met with, occurring usually as multiple sores of a circular shape with sharply-cut but shallow edges, and often accompanied by much swelling and tenderness of the parts.

Treatment.—A crystalline powder of iodoform, dusted upon the sores twice daily, will rapidly modify their character and promote their healing. All friction between the opposed surfaces of the labia must, meantime, be avoided by the interposition of strips of lint spread with boracic acid or some other antiseptic ointment, and whenever possible the patient should be confined to bed. If thought desirable to at once destroy the special virus of the sores, this may be effected by the application of fuming nitric acid, while the patient is anæsthetised; on the separation of the resulting slough, a healthy surface is left, which will heal readily if perfect cleanliness be ensured with avoidance of friction.

The *specific* or *syphilitic* chancre occurring on the mucous surfaces of the female genitals rarely presents the characteristic induration of the true Hunterian sore, owing to the constant moisture of the part. When seated upon the mons or the outer aspect of the labia, it will, however, possess the ordinary features of a hard chancre. In any given case, the presence of a single sore, apart from its special character, which may be masked by its situation and by the degree of irritation to which it has been exposed, will point to the probability of a specific origin.

Treatment.—Beyond strict attention to cleanliness, and the subdual of inflammation by appropriate means, the local treatment consists in the use of black wash, or of calomel and starch powder as a dry application. For the constitutional management of the patient, *see* Syphilis.

Mucous Tubercles are met with as a local secondary manifestation of constitutional syphilis, which fact in relation to their origin constitutes an important distinction between them and the ordinary venereal warts. They consist of flat, broad-based, slightly elevated patches of soft papillary growth, usually seated upon the inner surface of the labia, where they readily spread by contact. The discharge due to their presence is extremely contagious.

Treatment.— Frequent ablutions, followed by the use of a calomel and starch dusting powder will answer best in the way of local treatment, which must be supplemented by constitutional remedies.

V. Tumours.—*Hypertrophy.*—A simple variety of this deformity is occasionally seen affecting the labia minora, which may become so thickened and pendulous as to cause serious inconvenience, and thus require removal. Another form of enlargement, often traceable to syphilis, and resembling in a minor degree the condition known as elephantiasis in tropical countries, is sometimes met with involving the labia majora, and thence extending forwards over the mons and backwards over the skin of the perineum. The clitoris is also occasionally the seat of this disease. The growth, which consists in a thickening of the layers of the true skin, combined with increased formation of connective tissue and dilatation of the lymphatic spaces and ducts, presents on the surface a hard, irregular, tuberculated appearance. When of long standing, it may constitute a mass of considerable size, causing much discomfort by its weight and bulk. Excision with the cautery knife is the proper treatment for all such growths.

Fibromata, identical in structure with the same formations as met with in the uterine walls, sometimes develop in the labia majora. Their tendency is to become pedunculate, when their removal is a matter of no difficulty.

Lipomata, originating in the adipose tissue of the mons or of the labia, are of rare occurrence. When large they may require to be excised.

Cysts, due to distension of the vulvo-vaginal glands, as the result of inflammatory occlusion of the mouth of the duct, are not infrequently seen. They give rise to an oval-shaped or somewhat lobulated swelling at the lower part of the labium, tense and elastic to the touch, and not tender unless inflamed. The retained secretion consists of a clear glairy fluid, occasionally of a brownish hue.

The only *symptom* usually complained of is discomfort felt in walking; but, should the cyst inflame and suppurate, it will give rise to all the signs of an acute abscess.

Treatment consists in complete evacuation of the cyst, and subsequent destruction of its secreting surface. This may be effected, after free incision practised on the inner aspect of the labium, by seizing the base of the cyst with a tenaculum and everting as much as possible of its wall, which is then excised with scissors. Another plan consists in freely destroying the lining membrane by means of the thermo-cautery. In either case, the cavity should be afterwards plugged with carbolised lint or iodoform gauze, and allowed to close by granulation.

Pudendal hernia, corresponding with scrotal hernia in the male, may result from a congenital patency of the process of peritoneum, which to a greater or less extent invests the round ligament in its passage from the external abdominal ring to be inserted into the dartoid tissue of the labium. The possibility of such a condition, although a very rare one, should always be borne in mind when examining any tumour of the labium. The presence of the prolapsed gut, apart from the occurrence of any strangulation, which is extremely uncommon in this situation, usually gives rise to a sense of discomfort sufficient to draw attention to the part. Impulse on coughing, with resonance on percussion, combined with the possibility of reduction by taxis and position, will serve to reveal the true nature of the swelling. The hernia should be supported by means of a well-fitting truss; or, if desirable, a radical cure may be attempted.

Hydrocele of the canal of Nuck is an extremely rare condition, due to a sacculated collection of fluid in the unobliterated portion of the process of peritoneum above alluded to. The irreducibility of the swelling and the absence of resonance and impulse would serve to distinguish it from intestinal prolapse; while puncture with the needle of a hypodermic syringe would settle the diagnosis. Aspiration of the fluid followed by injection of tincture of iodine as in the case of an ordinary hydrocele, constitutes the most effectual treatment.

VI. New Growths.—*Malignant disease* of the vulva, usually of an epitheliomatous type, is not very uncommon, although much less frequently seen than cancer of the cervix uteri. The affection, which may originate in any part of the cutaneous or mucous surfaces, usually commences in the immediate neighbourhood of the clitoris as a small nodular growth, which in time ulcerates and gives rise to a sore with raised and indurated margins, showing no tendency to heal. Progress at first is slow and painless, but, as the ulceration extends, severe attacks of hæmorrhage occur, and rapidly reduce the patient's strength. As a rule the inguinal glands soon become involved.

Treatment. — Complete extirpation of the diseased tissues at an early stage of the affection, before the occurrence of secondary deposits, offers the only chance of relief. This may be effected by means of the knife or scissors, followed by the application of the thermo-cautery for the arrest of hæmorrhage.

Vascular growth of the meatus urinarius—*urethral caruncle*—is a somewhat common affection in middle-aged women, often productive of great discomfort. It may be described as a species of angeioma developed from the mucous membrane at the entrance of the urethral canal, where it appears as a vascular excrescence of a bright red colour, bleeding readily when touched, and usually extremely sensitive, often to such a degree as to give rise to exquisite agony on micturition or during coitus. The only effectual treatment consists in destroying the growth with the thermo-cautery, while the patient is under the influence of an anæsthetic.

W. A. Meredith.

W

WARDROP'S OPERATION FOR ANEURISM. *See* Aneurism.

WARTS (*Synon.* Verrucæ).—Warts are small growths mainly consisting of hypertrophied papillæ of the skin.

Several distinct growths besides the true wart (Verruca vulgaris) are included under the general term 'warts.' Tyloma is sometimes regarded as a warty growth, but it differs altogether from warts in structure, being simply a hypertrophic growth of epidermic structures without hypertrophy of the papillary layer of the skin.

Warts are of two kinds—*Acquired warts* and *Congenital warts.*

Acquired warts are met with in two varieties—(1) Verruca vulgaris; (2) Verruca senilis.

Verruca Vulgaris. — Common warts first appear under the cuticle as smooth, slightly raised, little tumours; as, however, they increase in size and prominence, the smooth epidermic covering is lost, and then the top of the wart presents a rough granular or filiform surface, which is due to the exposure of the enlarged papillæ. Warts may appear on any part of the body, but they are most common on the hands in children, and on the scalp in adults. Sometimes they appear in great numbers, so as to constitute a veritable eruption. The writer has met with several instances in which the face of a patient has been completely covered with small, discrete, warty growths.

Verruca senilis differs from the common wart in being softer and more flat. Warts of this kind usually occur in great numbers, especially on the backs of old people. They are of a greasy character, and generally of a darker colour than the surrounding skin. They are essentially a senile change.

Verruca acrochordon, *see* Acrochordon.

Congenital warts are not very common. They do not generally take the rounded shape of common warts, but form groups which are irregular both in size and distribution. They are really a kind of malformation of a limited portion of the skin, in which there is a permanent hypertrophy of the papillæ. Congenital warty growths generally assume a dark appearance, and, when they form considerable and elongated patches, they constitute the Ichthyosis hystrix of writers; it is, however, an error to regard these warty patches as any form of ichthyosis, which is essentially a *symmetrical* disease, involving changes in the skin of a different kind altogether. Congenital warty growths are always unsymmetrical in distribution, are wart-like in structure, and are surrounded by perfectly healthy skin; in these respects they contrast remarkably with ichthyosis. The term Ichthyosis hystrix has been mis-

applied, and should now be dropped out of our nomenclature. *See* Ichthyosis.

Treatment.—Soft warts are easily cured by painting them daily with a saturated solution of salicylic acid in flexible collodion. The best caustic for hard warts is a saturated solution of potassa fusa in water.

R. Liveing.

WASHING OUT THE BLADDER. *See* Prostatic Hypertrophy.

WATSON'S PLASTER OF PARIS SWING SPLINT for excision of the knee consists of two parts:—(1) A wooden back splint cut away freely opposite the knee, so that the leg and thigh pieces are only connected by a narrow bridge behind the ham; (2) a suspension rod, made of telegraph wire or hoop iron, reaching from the toes to the groin, and across the knee in the form of a bracket. The limb is enveloped in cotton-wool and placed on the back splint, to which it is fixed by plaster of Paris bandages. The suspension rod is next placed in position along the front of the limb, and fixed by the final layers of the bandage. The splint is suspended to a cross-bar placed over the bed.

WEBBED FINGERS. — The digits may be united by coalescence of the bones (*see* Fingers, Congenital Deformities of the), but a more common deformity is that known as web-fingers, in which the digits are united throughout the whole or part of their length by a prolongation of skin, similar in nature to that which normally intervenes between their bases. Sometimes the union is more intimate and formed by a closer union of the deeper tissues, when no separation is possible; but, with the more usual web, a certain amount of lateral movement and therefore of usefulness is attainable. The deformity is less often symmetrical than not.

Treatment.—Where a true web exists, it is desirable to effect an artificial separation, especially of the thumb from the index, and of the little finger from its neighbour, and of the other fingers in order of their relative importance. Many devices have been adopted for this purpose. The main principle should be to avoid cicatrisation as far as possible; and this is best effected by making a dorsal and a palmar flap, the one to be applied to the outer edge of one finger, and the latter to the inner edge of its fellow. When the union involves the deeper structures, more harm than good will come of interference, though success has in a measure been obtained by engrafting skin from the haunch and other parts.

As opposed to the condition above described, the clefts between the fingers are sometimes found to extend for an unnatural distance into the palm, and even up to the carpus. As a general rule such conditions interfere but slightly with the usefulness of the member, and surgical interference is more likely to do harm than good.

John H. Morgan.

WHITEHEAD'S OPERATION. *See* Tongue, Operations for Removal of the.

WHITLOW, or PARONYCHIA, is a generic name for an acute inflammatory affection of a finger, which is often extremely painful, and may lead to very serious consequences. The varieties of the disease are easily classified according to the tissue in which the inflammation commences, and the symptoms and consequences of these varieties are different in degree and in importance.

1. Acute inflammation of the skin (paronychia ungualis). This is by far the least serious form, and is seen most frequently in children as the result of some unhealthy condition of the blood.

Symptoms.— The pulp of the ungual phalanx becomes swollen, and is slightly painful; it is at first red, and afterwards hot and throbbing. On the third or fourth day a bulla appears containing serum, which becomes mixed with pus, and often with blood. There is not much constitutional disturbance, but as the condition of one finger improves, others, on the same or on the opposite hand, become similarly affected. The bulla breaks, and, its contents becoming discharged, the surface beneath is raw and tender, but soon is covered with healthy epidermis.

Treatment.—The state of the tongue and of the bowels should be corrected by a slight mercurial purgative, and some tonic in the form of bark, quinine, or iron given internally. The fingers must be frequently bathed with warm water, and some boracic ointment on lint is to be applied, covered with cotton-wool to promote warmth and to prevent injury.

2. A more painful variety of whitlow is that in which the inflammation attacks the areolar tissue of the last phalanx. This usually results from the introduction of septic matter through some slight scratch or crack in the skin, although this cannot always be detected. The end of the finger becomes tense both on the palmar and

dorsal surfaces, and is extremely painful, with throbbing in the part. The inflammation may spread up the finger and into the hand, or there may be lymphangitis with swelling of the lymphatic glands. As a rule, however, the inflammation is confined to the structures of the last phalanx, all of which may become implicated. From the fact that the long flexor tendon has in this situation no prolongation of its sheath, the tendon at its insertion frequently becomes involved, especially if proper treatment is delayed, and the tendon eventually will come away as a slough, and necrosis of the phalanx will often follow. The amount of pus is small in proportion to the pain or to the constitutional disturbance.

Treatment should consist of making at an early period a deep clean incision along the centre of the palmar surface of the phalanx. This should never be carried to the end of the finger, where the large supply of nerve-ends makes the part exquisitely tender. It is well not to wait for suppuration to occur, and indeed it may often be prevented by early incision. Warm antiseptic lotions should be applied, and the finger should be frequently held in very hot water, and the hand must be raised or carried over the opposite shoulder. If destruction of the tendon or of the bone has taken place, they must be allowed to separate of their own accord.

3. The third form of whitlow has a different seat of origin—viz. the sheath of the flexor tendon. Paronychia tendinosa or thecal abscess commences in the sheath, either spontaneously, or as a result of some slight puncture through which septic matter is introduced.

Symptoms.—At first there is a throbbing, painful swelling on the palmar surface of the middle or proximal phalanx, which gradually extends so that the whole finger is involved, and the tension and swelling gradually spread upwards into the palm, which becomes red, doughy, and distended with pus, and this condition may even extend beneath the annular ligament of the wrist into the forearm. The pain, from the distension of the canal, and the constitutional symptoms soon become severe. If not treated by early incision, the pus is discharged from one or more sinuses at the side of the finger, which are marked by fungous granulations, and through which also the sloughing portions of tendon are discharged; later, the bones and joints become implicated, and in the former sequestra are formed, which remain to be exfoliated. As the matter finds vent the swelling diminishes, but when the tendon has been destroyed the finger becomes contracted, withered, and useless.

4. In the remaining form of whitlow, paronychia osseosa, the inflammation commences in the bone or periosteum, generally of the terminal phalanx; but these parts are more usually involved as a consequence of one of the other varieties of this disease, and in any case the symptoms resemble those of the second variety, except when disease of the bone follows upon crushes or other such injuries, and death of the whole or part of the bone ensues.

Treatment.—In all the three latter forms early incision through the affected part, in the middle line and down to the bone, is the only means of allaying pain and of preventing extension of the disease. After this, the hand should be held in very hot water every two hours, and in the interval should be raised and enveloped in lint steeped in warm boracic lotion. Due time must be allowed for the separation of necrosed parts of tendon or of bone, and, as soon as the inflammation has subsided, frequent passive movements of the joints must be employed. If the destruction has been extensive, amputation of the finger may become necessary. In the constitutional treatment, a free purge should be given early, and bark and ammonia, with stimulants and opium to relieve pain. If matter has collected in the palm, it must be afforded a free and early exit.

JOHN H. MORGAN.

WOOL-SORTERS' DISEASE. *See* MALIGNANT PUSTULE.

WOUNDS, Treatment of.—Recent solutions of continuity in the external soft structures of the body constitute the great majority of wounds; but the term has a much wider application, etiologically, physiologically, and therapeutically. A subcutaneous rupture of the tendo Achillis and a transverse fracture of the tibia, an opening into the knee-joint, and a simple fracture through the femoral condyles, are lesions of unequal seriousness; but they are nevertheless wounds, essentially alike biologically and surgically, repaired by the same process, and amenable to analogous principles of treatment. The parallel is substantially true, however various be the causes producing the solution of continuity; although some wounds—e.g. from gunshot or from the bite of rabid animals—present special therapeutic indications. *See* GUNSHOT WOUNDS; HYDROPHOBIA.

It is to the treatment of wounds strictly so called, and as met with in ordinary surgical practice, that this article is specially devoted.

The typical and most common wound is an incised one, and it may be taken as the basis of the description of wound-treatment generally. The peculiarities of punctured wounds do not materially affect the principles and plan of dressing; but contused and lacerated ones deserve some special notice.

In the case of a slight, clean-cut wound, all that is usually required is to stanch the bleeding by pressure with a dry absorbent material, and keep the edges in close contact. Pressure for a few minutes may suffice to cause adhesion, which at first is a purely mechanical sticking together, rapidly converted into a living bond of union by the process of organisation. A little goldbeater's skin, or brushing the part with collodion, common glue or gum, protects from the air and maintains coaptation. If the wound be a little more extensive, an absorbent pad and bandage, or non-irritating adhesive plaster, may be usefully employed to secure immobility. Additional protection may be given by a splint, which is best prepared of pliant material, so as to admit of being moulded to the part and left to solidify. Such splintage may be made with folds of gummed paper, wire or thin wood, light rough millboard soaked in dextrine or paraffin, absorbent tissue impregnated with paraffin, or plaster of Paris.

In larger lesions, the precept to be observed in the first treatment of all wounds becomes specially important—to search for and remove foreign bodies. As a general rule, too much inquisitiveness is to be discouraged; but if a wound be of considerable depth, it is only by probing it that the presence of foreign bodies can be ascertained. When admissible, the finger is the best searcher; but a porcelain-tipped probe and a magnet have their special uses in detecting metallic bodies. Whatever be the means of exploration, it is scarcely possible to exercise too much gentleness.

Arrest of Hæmorrhage.—One of the first indications in the treatment of wounds is to stop bleeding from divided vessels. In the articles Hæmorrhage, Ligatures, and Torsion, the methods for arresting bleeding in surgical practice generally are fully dealt with; and it will only be necessary here to recapitulate briefly, with special reference to wound-treatment. Too much anxiety about bleeding from small vessels before the edges of a wound are brought together is, as a rule, inadvisable; very frequently it is mischievous. More than a century ago, Mr. Robert Mynors of Birmingham gave this wise counsel:—'We need not be too solicitous about the security of small arteries by ligature; for, if the recently divided soft parts are gently brought together, and nicely retained in contact, if a passive state of the muscles surrounding them is duly attended to, and their own natural contraction properly assisted by the judicious and artful application of a bandage, a perfect security from future hæmorrhage will be insured, as well as the most likely means employed to obtain a speedy and easy cure of the wound by the first intention.' If the oozing be rather more free than can be controlled by mere apposition of divided surfaces, light pressure with a pad or sponge squeezed out in iced water or in very hot water will be found a good hæmostatic. As aids to immobility and pressure in the arrest of hæmorrhage, styptics are valuable, and foremost amongst them may be named the compound tincture of benzoin, collodion, and styptic colloid. If these simple means be not sufficient to check bleeding, acupressure or forcipressure, ligature or torsion must be resorted to, with a tourniquet or Esmarch bandage, according to the circumstances of particular cases; but the beneficial influence of position should never be neglected as a powerful agency in reducing the rate and amount of blood-flow. By raising the hand and bending the elbow at an acute angle, the radial pulse is at once reduced to bare perceptibility. So with the thigh and leg, and the popliteal and tibial arteries; the physical effect being almost as obvious, and for the same reasons, as when an india-rubber pipe connected with a water-tap is raised and bent. Whatever be the chief agency relied upon for arresting bleeding from wounds—be it a ligature, forcipressure, or a styptic—immobility, position, and pressure are powerful contributories; and they are also the most potent factors in maintaining wound-apposition, preventing irritation, and promoting repair.

Wound-Cleansing.—Dirt is foreign material, which it is necessary to remove with care before attempting the apposition of wound-edges. If that can be done without liquid, all the better; but if any fluid be required for cleansing purposes, it is advisable to use equal parts of spirit and water, or a saturated solution of borax with the addition of about one-eighth of its bulk of glycerine. Another good cleansing liquid may be prepared with equal parts of water,

glycerine, and methylated spirit. Mr. Bryant recommends for the same purpose water, to which sufficient tincture of iodine has been added to make it a light sherry colour; and Dr. B. W. Richardson has suggested, with the same object, proof spirit containing tannin and glycerine. In using any of these liquids it is advisable to avoid ordinary sponges—a very common source of contagious poisoning. Camel-hair pencils, pledgets of lint, soft hempen tow, or absorbent gauze and cotton tissue are very good cleansing agents. A still better one is prepared on the writer's suggestion by Messrs. Bourroughs & Wellcome. It is an artificial sponge made up with a combination of elastic and absorbent fibres in an absorbent gauze covering, and enclosing any antiseptic prescribed in a central capsule. This can be preserved any length of time, and the antiseptic set free, by squeezing the capsule to breakage, just before the sponge is required for use. On the same principle, very efficient absorbent and antiseptic pads may be constructed for wound-dressing.

Anæsthetics.—If the patient bear the exploration and cleansing of the wound without much pain (and it is understood that all manipulation is to be most gentle), then the next step in the dressing may be proceeded with. If much pain be unavoidable, an anæsthetic should be administered, for upon the accuracy of every step in the first dressing the healing of a wound largely depends. Nothing is more important than to save pain, which is a cause as well as a sign of physiological disturbance, and a very potent factor in the initiation and development of pathological changes.

Wound - Apposition. — The wound cleansed and the bleeding stanched, its edges have to be adjusted and means provided for keeping them in accurate apposition. This is the time to make provision for drainage. It is important in closing the wound to include within it as little fluid as possible, and for this purpose it is well to exercise equable pressure and to give exit at the dependent angle to fluid as it is exuded. Only experience can teach whether the wound may be completely closed with safety; but, as a rule, direct union may be attempted throughout their whole extent, in wounds of the head and face and upper limbs, for in those parts compression can be effectually exercised, and immobility secured. But when the serous cavities are penetrated, or the large vessels tied, and when the bone is implicated, as in amputation, compound fracture, and excision, the safest course is not to close the fresh wound completely, but to make adequate provision for drainage.

Drainage, as a general rule, should be provided for at the dependent aperture, either by an india-rubber tube, or by a finer drain, such as horsehair, silk, or catgut. These agents may be left of sufficient length externally to perforate the dressings, so that these need not be changed while the liquid is drained outward into a convenient receptacle—a physical process which may be powerfully assisted by position and pressure. One of the chief advantages of absorbent dressings is that, provided the edges of the wound be not hermetically closed through its whole extent, exuded fluid may be taken up without the intervention of a draining conduit.

Sutures.— Metal is the preferable material for sutures; and iron, while very much cheaper, is as good as silver; but catgut, hemp, or silk may also be used. The number of sutures and the depth to which they are inserted must depend upon circumstances. It is of no use bringing together edges and leaving deeper wounded parts asunder; and the combination of deep and superficial sutures is very desirable. Accurate apposition being of the first necessity, as many sutures must be inserted as are necessary to secure it. When adhesive plaster is used, the writer prefers Southall's elemi; but in fresh wounds preference is to be given—as an aid to, or substitute for, sutures—to strips of absorbent gauze or tissue soaked in styptic colloid, tincture of benzoin, or collodion. When the latter agent is employed, allowance must be made for its contraction, which is least in the flexile preparation. While accurate apposition is important, tension must be avoided, because always opposed to wound-healing. *See* Sutures.

Pressure and Immobility.—Pressure is a most beneficial agency in maintaining temporary, and promoting permanent, union of wound-edges. It not only keeps the parts mechanically together and so prevents nerve-tension, but it opposes stasis and effusion, and promotes absorption. Pressure is best exerted by soft absorbent bandages, equably applied without reverses over absorbent tissue or pads, which should be used abundantly, and with all necessary means, such as moulded splints and suspension, for maintaining the nearest possible approach to absolute immobility.

When the dressing is complete, much remains to be done for the patient's comfort to ensure perfect rest. That position of the body is the best which is the easiest,

and limbs require to be fixed or suspended, and the bed to be made or raised, so as to facilitate venous return and favour muscular relaxation. The quieter the part and the patient are kept, the better, in conformity with the truth embodied in John Hunter's generalisation:—'*The first and great requisite for the restoration of injured parts is rest.*'

Infrequent Dressing.—When the first dressing is to be disturbed can only be determined by closely watching constitutional symptoms; taking heed of the patient's feelings, pulse, respiration, and temperature. Infrequency of dressing is most conducive to successful wound-healing. When the first dressing is removed, it is preferable to cut the bandages than to unrol them. If styptic dressings have been employed, they must be softened with ether or common spirit, and the utmost care taken to effect the least possible mechanical disturbance and to cause the minimum of nervous apprehension. Every step of the dressing should be conducted with the utmost lightness and without hurry. What sutures are to be removed, whether drainage-tubes are to be withdrawn or shortened, must be determined by the condition of parts. Applying the same kind of materials as used in the first dressing with equable elastic pressure, attending to physiological position, and securing the nearest possible approach to perfect immobility and painlessness, the treatment of the wound may safely be conducted to complete cicatrisation.

Antiseptics have, so far, only been mentioned incidentally; but the materials recommended for the wound-dressings, such as borax and glycerine, tincture of benzoin, styptic colloid, and collodion, are in an eminent degree antiseptic. So, too, is the action of drainage and of all absorbent dressings, in direct proportion to their power in taking up secretions and leaving the neighbourhood of a wound clean and dry, in a condition as little as possible favourable to putrescence. In so far as rest, position, and pressure prevent irritation, they are opposed to vascular excitement and attendant effusion, which is the material for decomposition. Thus they are in effect antiseptic. The question in wound-treatment is not one of antiseptics or no antiseptics, but of the form and proportion in which they should be employed in particular conditions. The great antiseptic is life. The living tissues have a natural preservative power, which, if guarded and conserved by the surgeon on physiological principles, offers the surest guarantee for healthy repair, which is only an adaptation and extension of normal nutrition. In exceptional cases—e.g. in the wound formed in the opening of a psoas abscess—when perfect drainage and pressure are impracticable, the need for antiseptic applications is exceptionally great. It is under such circumstances that the merit of the Listerian method (*see* Antiseptic Surgery) is best illustrated; but even in many of those *cliniques* in which the carbolic spray found most favour, it has been abandoned; while such recognised principles of wound-dressing as cleanliness, drainage, and immobility, infrequent dressing, position, and pressure, are steadily making way.

Cleanliness, and infrequent dressing which is the corollary of the great principle of absolute rest or immobility, are powerfully aided by the use of *absorbent and dry dressings.*

The healing of wounds, once apposition has been effected, is favoured by dryness, not in the mere literal sense of the term, but as opposed to accumulation of fluid. In general, it may be said that repair and healing, liquefaction and decay of animal structures, proceed together. Healing is rapid in direct ratio to dryness and compactness of tissue; in inverse ratio to effusion and laxity. This is the key to the physico-chemical influence of drainage in favouring wound-healing. The same explanation applies to absorbent dressings, which, by carrying off effused fluids as rapidly as they are poured out, keep the wound clean and dry, and are in direct measure antiseptic. By checking arterial supply, favouring venous return, and preventing extravasation, position and pressure contribute to wound-dryness, and so to wound-healing. By its great affinity for water, glycerine enhances the drying power of absorbent dressings, and its peculiar antiseptic property acts in the same direction. Absorbent, astringent, and antiseptic powders, such as bismuth and iodoform, charcoal, earth, sawdust, and sugar, have a multiple therapeutic action, in which their drying power is one of the principal factors. It is a fact of common knowledge to butchers and housekeepers, that to preserve meat it is essential it should be kept cool and dry,—the freer the current of air around it the better. Any moisture which exudes on the surface from time to time must be wiped off, and the practice of sprinkling with flour or other absorbent material is based on the well-known necessity of keeping the meat dry.

Moistening and putrefaction, drying and preservation, go together. Experience proves that it is along damp courses and alluvial plains that contagia spread, not on sandy hills. So with wounds: the dry ones heal, the wet ones rot in direct proportion as the moisture accumulates. Scabbing typically illustrates what has just been said of drying and healing, as does the influence of poultices in promoting effusion and suppuration, and *pari passu* preventing cicatrisation. It has long been a matter of common knowledge that heat and moisture promote putrefaction; and, since bacteriology has been closely studied, it has been proved that, as a general proposition, moisture is essential to the development of bacteria, thus explaining the antiseptic action of dry and absorbent dressings. While, as a rule, dry wound-dressings are to be preferred, it may sometimes be desirable to moisten them, or to protect the edges with boracic, elemi, zinc, or other ointment, to prevent too great adhesiveness. In the widely varying conditions of wounds, local and constitutional, healthy and diseased, principles must in practice be subordinated to special indications, and therapeutic resources be judiciously combined; but, as a rule, the drier wounds are kept the more quickly do they heal, and proportionately less is the amount of suppuration.

A great variety of materials has been employed in the preparation of absorbent wound-dressings, which may be treated with any antiseptic, but the absorbent gauze and cotton tissue manufactured by Robinson & Son, Chesterfield, is, probably, one of the very best materials for surgical dressings—very cheap, absolutely pure, and powerfully absorbent; it is also very elastic, has a perfectly level surface, is of uniform thickness, and may be folded and cut to any shape. It requires to be used freely to make efficient padding for equable compression. Soaked with collodion, paraffin, or plaster of Paris, the tissue makes an efficient splintage, and by enclosing within a fold or roll of the tissue picked oakum or tenax, pads may be prepared of great use in cases attended with profuse discharge.

The cotton-wool treatment long since advocated by Mayor and Burggraeve, and more recently by Guérin, is carried out with greater facility and thoroughness when absorbent cotton or tissue is employed. The very process by which the cotton is rendered absorbent is one of depuration antagonistic to wound-putrescence, and the deprivation of fatty matter renders cotton more elastic and a better medium for the application of equable pressure. This is specially exemplified in the treatment of

Contused and Lacerated Wounds.—Bruising or contusion may complicate an incised wound, and sometimes, especially over bone, a blow may produce a wound with such well-defined edges that it may be extremely difficult to say whether it have been produced by a cutting instrument or by a blow. In such a case the wound may be treated as an incised wound, special care being taken to provide for the drainage of any existing or succeeding subcutaneous extravasation. There is also greater need for uniform elastic pressure, because the swelling which immediately attends a contused wound is essentially hæmorrhagic, and is best constrained by equable compression with absorbent elastic materials. More commonly contused wounds are also lacerated, and care has to be taken in effecting apposition not to introduce sutures and draw upon soft parts, the vitality of which is so much compromised that very slight violence may suffice to extinguish it. Some parts of a contused wound may well bear sutures; in others the apposition may be well secured by strips of plaster, and, better still, by absorbent gauze or lint, soaked in collodion, styptic colloid, or compound tincture of benzoin. Provision being made for drainage, and a compressing absorbent pad adjusted with accurately applied bandage, attention being paid to physiological position and immobility, the wound may be left with impunity for some days; and it is remarkable to note how extensively torn and bruised wounds so treated often heal by the first intention. Local pain, rise of temperature, and other signs of constitutional disturbance, are obvious indications for inspecting the injured part; but if the first dressing be perfectly accurate, and physiological position and absolute rest enjoined, the healing of contused and lacerated wounds is often rapid and uncomplicated. It may be a question whether much bruised parts should be cut away before apposition is effected. It may be prudent to do so when the crushing has obviously proceeded to the extinction of local life; but if there be any doubt, chance of recovery should be allowed. The styptic applications recommended have a decided antiseptic action, and the absorbent pads take up the products of disintegration. Under the circumstances just referred to, borax, bismuth, or iodoform powders have a

beneficial drying and anti-putrescent action.

In amplification of the preceding general sketch of wound-treatment, reference may be made, in addition to the articles already quoted, to the following: Adhesion; Cold; Collodion; Drainage; Immobility; Irrigation; Position; Pressure; Rest; Suspension. It now remains to offer some observations on prognosis, constitutional influences, and comparative physiology and therapeutics, in connection with wound-treatment.

Prognosis of Wounds.—A wound being visible presents no diagnostic difficulty so far as the mere question of its existence is concerned; but in determining the parts involved, the presence of foreign bodies, and other complications, ample scope for diagnostic accuracy presents itself as an important preliminary to prognosis and treatment.

In prognosticating the effects of wounds, it is essential to bear in mind that all solutions in the continuity of living tissues are important until completely healed; since some of the most trivial wounds every now and then prove fatal, and complications, such as blood-poisoning and tetanus, sometimes appear when cicatrisation is far advanced. Wounds are not necessarily dangerous in proportion to their extent; thus, a scalp half-torn from the cranium may heal by the first intention after re-adjustment, while a very small wound on the vault may imminently endanger life, in consequence of penetration through the bone, constituting that most formidable lesion, a punctured fracture of the skull. For obvious anatomical reasons, exceptional danger attaches to, and special treatment is required in, wounds into the large visceral cavities, into the joints, and in the course of the great blood-vessels and nerves. Those are matters fully dealt with under separate headings throughout this work.

Constitutional Influences and Treatment.—Irrespective of position and extent, the constitutional state has a direct bearing on the issue of all wounds. Patients suffering from albuminuria and diabetes do badly after comparatively trivial injuries; and it is always prudent to take the constitutional state into careful consideration, in prognosticating the course of wounds after operation or accident. The thermometer, and the pulse and respiration ratio, yield the most reliable diagnostic and prognostic data. So long as those are satisfactory, the constitutional powers unimpaired, and the main sources of blood and nerve supply uninjured, very formidable-looking wounds heal, as a rule, under good management. No precise rules can be laid down for saying what wounds may heal; and the question of amputation is often debated on the assumption that a particular lesion is so extensive as to preclude the possibility of local repair. But experience justifies very great faith in recuperative powers. Conceding that some lives have been lost for want of timely amputation, there is good reason for believing that not a few limbs are sacrificed which might be saved by carefully putting into practice the physiological principles of wound-treatment. A clear perception of correct principles is obviously important; but accurate and painstaking, gentle and thorough manipulation in dressing is not less essential.

The surgeon has to take constitutional influences into consideration in determining the propriety of wound-making in a variety of operations. The well-known disposition to hæmorrhage in some constitutions—bleeders popularly so called—weighs against the performance of all but vitally important operations, and imposes the necessity of extreme care whenever a solution of continuity occurs by accident or design. Phthisis, scrofula, and syphilis powerfully affect the progress of wounds, and demand appropriate treatment in the several conditions. There can be no doubt that temperate persons, other things being equal, exhibit superior powers of healing, to say nothing of the delirium tremens so apt to follow injuries after habitual intemperance. Nervousness is a disturbing cause in wound-convalescence, and renders exceptionally important the precautions which should always be observed to avoid giving pain and alarming patients. The value of anæsthetics in fulfilling those objects is too well known to need more than reference; but what is scarcely sufficiently appreciated is the possibility of avoiding almost all pain in wound-dressing, by extreme lightness and nicety of manipulation.

In watching the constitutional state of a wounded patient much may be learned from the expression, manner, and position. The pulse and respiration ratio is an indicator of first importance; and so is the temperature of the skin to the touch, still more so to the thermometer. A rise of the latter by two or three degrees is always important, but not necessarily alarming. Such rise not infrequently occurs after irregular action of the bowels, a detail apt to be overlooked. A mild aperient or

an enema frequently brings down the temperature to normal in a very few hours. Amongst the agencies powerfully influencing the constitution, diet, tranquility, and ventilation must not be overlooked. As a rule, patients after injuries require liberal diet, but excess may be as great an evil as deficiency. If sufficient food be taken, the need for stimulants is proportionately less; but the symptoms and needs of particular patients must be watched and met, independently of any theoretical preoccupation. Tranquility, mental and bodily rest, cannot be too complete, while ventilation without cold draughts is obviously important. Close, small rooms have caused the death of many persons suffering from wounds, whose local and constitutional condition might speedily have been changed by removal into a larger apartment or to the outer air under the cover of a tent.

In illustration of the science and practice of wound-treatment in the human subject, valuable information may be derived from the

Comparative Physiology of Wound-healing and Therapeutics.—That the process of repair after wounds and injuries generally is only an adaptation and extension of the physiological process of nutrition, is a truth borne out alike by original research and clinical observation in the study of man and animals. The direct bearing of comparative anatomy and physiology on the study of those sciences in immediate relation to man is admitted by common consent; but comparative pathology is less frequently appealed to, though at least as fruitful in lessons bearing directly on the practice of human surgery. That is especially so in the matter of wounds. Suppuration after injuries is comparatively rare in brutes, healing of their wounds usually rapid and uncomplicated. Whereas even small wounds in man are attended with serious and sometimes fatal results, recovery is almost the invariable rule, even after large wounds, in animals. The difference has a great bearing on the etiology of suppuration and on the question of wound-treatment, and is due to a variety of causes, constitutional and physical. Beasts are always temperate, and in comparison with many men virtuous. Their procreation is largely governed by interested intelligence, and they are consequently comparatively free from the blighting and rotting operation of hereditary disease. The horizontal position of animals is favourable to drainage; when at rest they are not smothered under clothing which prevents bodily ventilation and confines heat, which is a potent factor in putrefaction; and the open air which animals usually inhabit is favourable to wound-drying and scabbing. This very exposure to the air is an exceptional cause of one form of traumatic death of animals after injuries—that is, tetanus. It is important to bear in mind the traditional use in veterinary practice of such antiputrescents as preparations of tar and turpentine, sulphate of copper and corrosive sublimate, and the tinctures of aloes, benzoin, and myrrh. But the fact that healing of the wounds of animals can be safely relied upon in the open air is not consistent with the doctrine which, assuming the maleficent potency of ubiquitous atmospheric germs, gives elaborate directions for their destruction.

The treatment of wounds by exposure to the air, which is favourable to drying and scabbing, and the treatment by irrigation, which opposes putrefaction in proportion as it favours drainage and reduces local heat, however different at first sight are alike antiseptic methods, acting on such well-established antiputrescent agencies as drainage and drying. The same remark applies to the combination of rest, position, and pressure, with absorbent and infrequent dressing. In a wounded limb accurately adjusted, compressed, dried, immobilised, and suspended, muscular, nervous, and vascular activity are reduced to the minimum consistent with bare life and physiological repair; while pathological change is prevented by removal of existing and possible causes of irritation, and by interception of putrescible material. Scientific explanation apart, experience proves that the tendency of wounds to heal is naturally very strong; and that great success may be obtained in assisting that natural disposition by a wide variety of plans, provided they be carried out with technical accuracy and thoroughness, conformably to sound physical and physiological principles.

SAMPSON GAMGEE.

WRIST-JOINT, Amputation at the.—This is an operation now seldom performed, having obtained, in the writer's opinion, a somewhat ill-deserved disrepute. It may be done by—(1) the circular, (2) the elliptical, (3) the antero-posterior, (4) the single lateral-flap methods. These are generally known as the operations respectively of Velpeau, Guérin, Lisfranc, and Dubrueil.

The position of the joint can be determined, according to Malgaigne, by either

strongly bending back the hand, when at the summit of the angle formed by it and the forearm the articulation will be found; or again, by drawing a line between the styloid processes, two and half lines above this imaginary line corresponding to the joint. In performing this operation, great care should be taken, during the disarticulation, not to open the radio-ulnar joint, as a wound of it may ultimately lead to impairment in, or loss of, the movements of pronation and supination of the forearm. When the radio-carpal joint is opened, therefore, the point of the instrument should be directed towards the carpus, and not in the direction of the articular surfaces of the radius and ulna. By doing this, the chances of wounding the radio-ulnar joint and triangular fibro-cartilage are minimised.

In performing the *circular operation*, an assistant should retract the skin, and an incision on a level with the bases of the metacarpal bones should then be made. In this incision the skin only should be involved. It should be dissected back as far as the radio-carpal-joint—the position of which has previously been determined with accuracy—the tendons should then be divided, and the joint opened either from before backwards, or from side to side. The radial, ulnar, and occasionally the interosseous arteries are, as a rule, the only vessels requiring ligation. Drainage is in this operation most desirable, as, in the event of suppuration, there is a danger arising from purulent collections forming within the tendinous sheaths. It has been advised to divide these to 'the extent of one or two inches' to prevent these purulent collections. This procedure is, however, in the writer's opinion, quite unnecessary.

Flap amputations at the wrist-joint cannot conveniently be made by transfixion, owing to the convexity of the carpus posteriorly and to the bony prominences and concavity in front. The flaps, therefore, had better be made by division of the parts from without inwards.

The *elliptical method of Guérin* consists in dissecting a full-sized flap from the palmar aspect of the joint. In order to get a more accurate adaptation of the edges of the wound, a dorsal incision, with its convexity looking upwards, should be made; and, on the disarticulation being made, the single palmar flap is then brought over the articular surfaces of the radius and ulna. Care should be taken to commence the incisions well below the styloid processes, as otherwise there is a danger of protrusion of these processes through the wound.

The *antero-posterior flap method of Lisfranc* consists in making an anterior or palmar flap by transfixion, a narrow, double-edged knife being used for the purpose, and a dorsal flap equal in length is then made by dissection. The hand is kept in the position of pronation during the formation of both these flaps. The joint is then opened at the styloid process of the radius, and disarticulation thus effected.

Another method of amputation at the wrist is one of which the writer has had experience, and entertains a favourable opinion. Mention is made of the procedure by Bell, and it is described by M. Dubrueil as follows:—'Commencing just below the level of the articulation, while the hand is pronated, the surgeon makes a convex incision, beginning at the junction of the outer and middle thirds of the arm behind, reaching at its summit the middle of the dorsal surface of the first metacarpal, and terminating in front, just below the palmar surface of the joint, at the junction of the outer and middle thirds of the breadth of the arm. The flap being raised, the wrist is disarticulated, beginning at the radial side. A circular incision finishes the cutting of the skin.'

The cases in which amputation at the wrist is mainly indicated are extensive compound comminuted fractures of the carpus and metacarpus, resulting usually from gunshot injuries, crushing from machine accidents, caries of the carpus and metacarpus too extensive to justify resection, burns, and gangrene. WILLIAM STOKES.

WRIST-JOINT, Diseases of the.—Acute inflammation of the wrist-joint is usually traumatic, rheumatic, or pyæmic. The intercarpal joints are frequently involved in the same process which attacks the radio-carpal joint; so also are the sheaths of the adjacent tendons.

Chronic disease of these joints is most often of scrofulous origin, but is also not uncommonly the result of the degeneration of inflammatory products in old or ill-nourished persons, after the subsidence of a more acute traumatic inflammation. It is also met with in the form of osteo-arthritis.

Acute inflammation of the wrist and carpal joints gives rise to pain, heat, and swelling. The pain is often severe, and greatly aggravated by the least movement. The swelling is most obvious over the back of the joint.

For *treatment*, rest must be ensured to the joint by applying a splint to the palmar surface of the forearm and hand, which

should reach only to the junction of the palm with the fingers. The most comfortable form of splint is one with a broad surface for the palm and a separate hollow for the thumb. The forearm should then be slung, or placed on a pillow with the hand well raised. Leeches, cold, or soothing lotions can then be applied, and, after the subsidence of the acuter symptoms, blisters, or pressure by strapping or bandaging over a layer of cotton-wool.

If suppuration occurs, the joint must be opened and drained.

Chronic Synovitis usually affects both wrist and carpal joints, and leads to pulpy thickening of the synovial membrane, and often to similar changes in the synovial sheaths of the adjacent tendons. When progressive, much inflammatory thickening of the tissues outside and around the joint occurs; indolent suppuration ensues, and the bone-surfaces become carious, or perhaps some of the carpal bones completely necrosed.

The early stages of the disease should be *treated* by long-continued rest (best ensured by well-moulded leather splints) and careful attention to the general health. The occasional use of the actual cautery, lightly applied, is often most beneficial.

When suppuration has occurred, the abscess must be opened or sinuses slit up, and the diseased tissue scraped away. Sometimes, one or two of the carpal bones may be found necrosed and their removal be followed by repair; but the result of these cases is often unsatisfactory, especially in persons after middle life. At the best, there is generally much stiffness both of the wrist and of the tendons, which a long course of passive movements only partially overcomes. In young persons, especially if scrofulous, long perseverance in treatment, both local and constitutional, is desirable before proceeding to operative interference. When, however, the joint seems hopelessly disorganised, excision may be performed. But, in the elderly, the surgeon will usually be reluctantly driven to amputate.

J. Warrington Haward.

WRIST, Dislocations of the.—Under this heading will be described the dislocations of the wrist-joint proper and those of the lower radio-ulnar joint.

Wrist-joint or Radio-carpal Dislocations are very rare, and must not be confounded with fractures of the lower end of the radius, which somewhat resemble them. There are three forms—viz. *backwards*, *forwards*, and by *rotation backwards*, given in the order of their relative frequency.

Dislocation backwards of the carpus was believed to be a common accident until Colles and Dupuytren, at the beginning of this century, pointed out that the injury which usually gave rise to the deformity attributed to dislocation was a fracture of the lower end of the radius, now known as Colles's fracture. The signs of dislocation backwards are a projection on the back of the wrist, stretching from side to side, convex superiorly, and about eight lines in height. Anteriorly, there is a projection ending abruptly below, on the margins of which may be felt the styloid processes of the radius and ulna. The first row of phalanges is semiflexed on the metacarpus, and the terminal nearly straight. The forearm, measured from the tip of the olecranon to the head of the middle metacarpal bone, will be found shortened.

Dislocation forwards of the carpus gives rise to a sharp prominence behind (caused by the radius and ulna), which ends abruptly below, and is there concave. In front, the carpus forms a rounded projection. The posterior aspect of the hand appears shortened, and measurement from the olecranon to the head of the third metacarpal bone is abnormally short.

Dislocation by rotation backwards resembles what the writer has termed dislocation by rotation backwards at the metacarpo-phalangeal joint of the thumb, and he believes it has never yet been described. The case on which he founds his description was that of a plumber, aged thirty-one, who came into Guy's Hospital one evening in May, 1884, without hat or coat. He stated he had been fighting with another man, and, being surprised by the police, had run away to escape being taken into custody. In running, he slipped and fell on his left hand, which remained immovably fixed in a state of over-extension. The hand was found forced back, so that the metacarpus formed as nearly as possible a right angle with the dorsal surface of the forearm. The first phalanges were flexed at a right angle with the metacarpus, and the middle and terminal phalanges slightly flexed. The carpus pressed forward the tendons in front of the wrist, but beyond this there was no deformity. The carpus had become over-extended on the radius and ulna without rupture of the lateral ligaments, and the dorsal surfaces of the first row lay in contact with the articular surface of the radius and the inter-articular cartilage. The man was semi-intoxicated, and absolutely refused to take an anæsthetic or morphia. Extension by the aid of assistants,

over-extension and then flexion, flexion by the aid of assistants and by bending across the knee, were all tried without success. The joint was absolutely locked. He was left for the night, in the hope that when his head was clearer in the morning he would submit to an anæsthetic, but on this being again pressed upon him, he left the hospital unrelieved.

The *treatment* of dislocation forwards or backwards is to extend the hand by grasping the palm, and, as the lateral ligaments have been ruptured, little difficulty has been found in reducing the bones. An anterior splint, reaching from the bend of the elbow to the middle of the palm, should afterwards be worn for three weeks.

Radio-ulnar Dislocations at the Wrist are those in which the hand, together with the radius and triangular fibro-cartilage, become displaced from the ulna. They are described by some authors as luxations of the lower extremity of the ulna, owing to the prominence assumed by this bone when the hand is displaced from it.

As a complication of fracture of the radius, displacement at the lower radio-ulnar joint, either partial or complete, is frequent. In the majority of Colles's fractures, the lower end of the ulna is unduly movable and prominent, owing to partial dislocation of this joint, and the cases in which the ulna protrudes through the skin are almost invariably associated with fracture of the radius. There are, however, some uncomplicated cases on record. The hand and radius may be displaced either *forwards* or *backwards* from the ulna, without fracture, but when displaced *outwards* it appears always to have been associated with fracture of the radius.

Dislocation forwards is usually caused by forced pronation. It has been produced in children by lifting them by the hands when pronated. The hand is found in a state of semi-pronation and adduction, whilst the lower end of the ulna makes a very distinct prominence on the back of the wrist, escaping externally to the extensor carpi ulnaris, and riding on the back of the radius, so that the wrist is narrowed. In front there is a depression, which the flexor carpi ulnaris is seen to cross.

To reduce the dislocation, pressure should be made on the projecting ulna at the same time that the hand is supinated. Should there be a tendency to reluxation, an anterior splint should be applied, and a pad to keep down the ulna.

Dislocation backwards is rather less frequent than dislocation forwards. It has been caused by forcing the hand strongly into a state of supination. The hand and radius are thrown backwards, and the lower end of the ulna forms a projection in front near the middle of the wrist. On the back of the wrist the deformity is characteristic, for in the position of the lower end of the ulna there exists a well-marked depression. The hand is supinated, and the patient lacks the power of pronating it.

To reduce it, the hand should be abducted and pronated, at the same time that pressure is made on the lower end of the ulna.

Complicated Radio-ulnar Dislocations.—It has been before remarked that, with a fracture of the radius, there may be a great displacement at the radio-ulnar joint, the lower end of the ulna sometimes passing through the skin. In 1882, a dissipated old woman, running to escape from a vehicle, fell on both palms, and was brought to Guy's Hospital with a simple Colles's fracture of one wrist and a compound fracture of the other radius, complicated with protrusion of the lower end of the ulna through the skin, just externally to the flexor carpi ulnaris. There was no difficulty in reduction, and she was at first treated as an out-patient, but phlegmonous erysipelas followed, and she was admitted under the writer's care. Much sloughing took place, necessitating amputation, and she died from exhaustion and degenerate organs. Somewhat similar cases in which the ulna projected through the skin, in one case at the back of the carpus, and in another on the inner side, are described by Cooper. Godlee brought before the Clinical Society, in 1883, a case of compound fracture of the radius, complicated with projection of the lower end of the ulna in front of the flexor carpi ulnaris tendon, which he found impossible to reduce until he had cut down upon, and had sawn off, the articulating surface of the bone. Commenting on his case, he remarked that little deformity or impairment in usefulness resulted from excision of the lower end of the ulna—an observation previously made by the writer of this article before the same society in 1877, when exhibiting a case in which the bone had been excised for tumour.

R. Clement Lucas.

WRIST-JOINT, Excision of the. *See* Joints, Excision of.

WRYNECK. *See* Torticollis.

X

XANTHOMA (*Synon.* Xanthelasma). *Definition.*—A rare affection involving the integument, and subsequently the areolo-fibrous structure, due to the presence of a peculiar yellow-coloured growth, or deposit composed of cells and connective tissue.

Etiology.— Additional information is much needed concerning the conditions of the body which predispose to and determine this rare affection. They are, however, to be associated with defective vital power involving the nutrition and growth of certain tissues. It has been considered probable that some functional disorders of the liver, if not actual structural disease, may stand in causal relationship to xanthoma, not only because jaundice has frequently been associated with it, but also for the reason that organic disease of the liver has frequently been demonstrated *post mortem* to have co-existed with it.

In a report upon twenty-eight cases of xanthoma multiplex in adults, published in 1882, jaundice was present in twenty-three instances, while diabetes mellitus existed in one only of the remaining five. In eight cases of the same disease occurring congenitally, or commencing under puberty, jaundice was reported to be entirely absent. One case is on record in which many organs of the body were simultaneously diseased.

It is obvious, therefore, that as yet no one morbid condition has been found the constant accompaniment of the malady—indeed, in some persons no disorder of the general health has been noticed. Instances have been recorded of xanthoma present at birth or developing in early infancy. Heredity has been proved to be an occasional factor in the disease.

Among the conclusions derivable from the study of the above-mentioned cases of xanthoma multiplex, it may be noted that, etiologically, the cases occurring before puberty differ from those in adult life in having no traceable connection with jaundice or hepatic disease, they are probably to an extent hereditary and may be congenital, moreover they do not affect the eyelids, but involve other regions of the trunk and extremities. It may also be observed that, in four-fifths of the cases of xanthoma multiplex commencing after puberty, chronic jaundice from obstruction of bile-ducts existed, while in several of the remainder there had been no disorder of health. Lastly, in these the eyelids were almost constantly involved, and were generally the starting-point of the disease.

Spontaneous disappearance has been noted. The sexes would seem to be about equally affected. A case has recently been reported exhibiting the plane, tubercular, and tuberose varieties of the disease with perfect symmetry, except for a corymbose band on the right side of the trunk in the trajectory of some cutaneous nerves, and possibly determined by a zona. The patient was a man forty-four years of age, and had an enlarged liver with jaundice of twelve years' standing, which had greatly darkened the skin and was attended with pruritus. The xanthoma had developed in four years, and commenced in the gluteal region. A trace of sugar, but no albumen, was found in the urine.

Anatomical Characters.—Xanthoma is a benign growth or deposit in the cutaneous, mucous, and serous structures, and occasionally, as aforesaid, in the subjacent areolo-fibrous tissue. On microscopical examination, it is evident that the opaque yellow colour is produced by masses of a substance composed of cells of irregular form and size, round, oval, triangular, or rod-shaped, which later may undergo degeneration, and give rise to a crystalline appearance in their midst, or to a fatty metamorphosis with cholesterine plates. These cells are contained in an areolar network of connective tissue.

Description.—Xanthoma presents itself: (1) as isolated tubercles or nodules—X. tuberosum; (2) as smooth laminæ or plates—X. planum.

In the tuberous variety the tubercles are of a yellow colour, isolated or grouped, smooth, and conveying a soft or somewhat elastic sensation to the touch. The planar variety occurs in the form of defined yellow patches or plâques. Upon the palm, a linear arrangement may be present, corresponding to the natural markings or creases.

When it occurs in both its forms, the term X. multiplex is applied. Xanthoma upon the eyelids (X. palpebrarum) is known

by the presence of more or less elevated, rounded, or oblong spots of yellow colour, solitary or multiple. It has a remarkable predilection for the inner angle of the upper eyelid, where it generally commences, is often symmetrical, and later attacks the inner angle of the lower lid.

Occasionally, in severe cases, the whole palpebral aperture may be surrounded by a series of these patches more or less closely arranged. The presence of granules occasionally upon the surface with punctated apertures, corresponding to enclosed follicles, has given rise to the term X. granulosum as descriptive of this variety. Unirritated, they are painless.

Inflammatory symptoms are absent, and the surrounding skin has a brownish or pigmented appearance. While the disease was originally observed upon the eyelids, recorded instances have proved its existence on the palms, soles, knuckles, ears, elbows, face, back, abdomen and penis, &c. The mucous membrane of the lips, palate, tongue, also the trachea, bile-ducts, sub-peritoneal tissue of abdomen, and some abdominal organs, have been implicated.

Diagnosis.—The position and arrangement, colour, structure and general characters as described will suffice to determine the affection, no other cutaneous disease having any approximate resemblance to it. The course it pursues is essentially chronic.

Prognosis.—The growth is comparatively unimportant except for its appearance. Internal remedies have no effect upon it. Spontaneous disappearance has occurred.

Treatment.—The general health and requirements of the patient should be attended to, and disordered functions regulated, &c. However, local measures, and of these the use of caustics and removal with the knife, alone can effectually dispose of the disease, should it be deemed expedient to interfere. Much caution should be exercised about the eyelids if surgical means be adopted, on account of possible after-contraction.

J. Herbert Stowers.

XERODERMA, or ATROPHODERMA PIGMENTOSUM.—*Definition.* A disease of congenital origin characterised by a pigmented atrophy of the skin, and the development of papillomatous tumours which may become cancerous.

Etiology.—Nearly all the cases recorded, less than forty in number, have commenced in the second year of life; both sexes are equally liable, but generally when several members of the same family are attacked, as often happens, it selects either the girls or the boys, but not both. Although there is evidently some congenital predisposition, the disease does not develop for some time after birth. It cannot be ascribed to heredity or defects in hygiene, but exposure to the sun has been thought to be an exciting influence. Its real cause, however, is unknown.

Symptoms.— The children are born healthy, and no defect is noticed until the second year, when freckle-like pigmentation of all shades of light and dark brown occurs, sometimes preceded by erythematous papules, and limited to the exposed parts of the body.

Telangiectases develop between the freckles, and subsequently undergo obliteration and leave the skin white and atrophic, like a thin scar. The pigment-spots enlarge and get a deeper tint, and warts develop on them like those of the aged, and from these papillomatous tumours arise, which fungate, and may form masses as large as an orange; or less raised ulcerated patches occur, covered with blood-crusts. These tumours and ulcers may become epitheliomatous, and lead to the death of the patient. The eyes are often affected with conjunctivitis and pannus, and the constant discharge causes some of the ulcers, owing to the pus becoming inoculable. The general health is quite good unless the discharge becomes profuse or cancer develops. Death has occurred about puberty in many instances, but others have reached adult life.

Diagnosis.— If all the symptoms be taken into account, and the history of their development is known, no difficulty can occur, as it is only in some features that it can resemble lupus or atrophic scleroderma, while the rest are very different.

Treatment.—Nothing can be done in the way of cure, but the progress can be delayed by careful attention to the eyes, protecting them and bathing them frequently with boracic acid lotion. The ulcers should be scraped with a sharp spoon if fungating, and healed by the usual means for ulcers, and the tumours removed; fresh ulcers can usually be healed by removing the crust, and dressing them with an ointment of ammoniated mercury, gr. x. to the ounce of lard, or sometimes boracic acid ointment, gr. x. to the ounce, is preferable. No internal medication has any direct effect, but tonics and cod-liver oil may be required.

H. Radcliffe Crocker.

XEROSIS or XEROPHTHALMOS. *Causes and Pathology.*—Granular ophthalmia; diphtheritic ophthalmia; improper use of caustic applications. Conjunctival xerosis may also occur as a primary disease, especially in young children, and then leads to total destruction of the eye by ulceration of the cornea, &c., while the patients die of general malnutrition. In a case of this kind the presence of micro-organisms has been demonstrated in the conjunctiva, and similar bodies were found in the pelves of the kidneys. A remarkable, and as yet unexplained, association of night-blindness with conjunctival xerosis is sometimes seen sporadically or epidemically, the latter chiefly in foreign barracks and prisons. In this form of the affection, similar bacilli have been found in the conjunctiva.

Symptoms and Diagnosis.—This is a dry, lustreless condition of the conjunctiva. Whitish-grey epithelial scales come away from the mucous membrane, which is contracted in extent. This contraction may be ascertained by drawing down the lower lid, when the inferior fornix will be found to have almost disappeared, and the degenerated conjunctiva to stretch across from the margin of the lower lid to the margin of the cornea. The cornea takes part in the process, its epithelium losing its lustre, with consequent defect of vision.

Treatment.—There is no cure for this condition. Palliation of the distressing symptoms alone can be attempted. Collyria of milk and glycerine, to which may be added some bicarbonate of soda, are the most useful applications, and the eyes should be carefully protected from all irritating influences. H. R. Swanzy.

Z

ZONA. *See* Herpes Zoster. ZYGOMA. *See* Face, Fracture of Bones of the.

INDEX OF AUTHORS

GIVING THE CONTRIBUTIONS OF EACH WRITER.

ALEXANDER, WILLIAM, M.D., *Visiting Surgeon to the Liverpool Workhouse Hospital.*

Ligature of the Vertebral Artery.

ANDERSON, WILLIAM, *Assistant Surgeon to, and Lecturer on Anatomy at, St. Thomas's Hospital.*

Cirsoid Aneurism; Iliac Aneurism; Diseases of the Palate; Psoriasis Buccalis; Ranula; Salivary Calculi; Stomatitis; Diseases of the Tonsils and Uvula.

BAKER, HENRY F., *Assistant Surgeon to the Royal Orthopædic Hospital; Surgeon to the Cripples' Nursery.*

Club-foot; Tenotomy.

BAKER, WILLIAM MORRANT, *Surgeon to St. Bartholomew's Hospital; Consulting Surgeon to the Evelina Hospital for Sick Children.*

Diseases of the Tongue; Operations for Removal of the Tongue; Diseases of the Nails; Division and Stretching of the Gustatory Nerve; Mole; joint author with Mr. Bowlby of Articles on Carcinoma, Sarcoma, and Malignant Tumours.

BALLANCE, CHARLES A., M.S., *Assistant Surgeon to the West London Hospital; Demonstrator of Anatomy, St. Thomas's Hospital.*

Meningocele; Injuries and Diseases of the Scalp; Sebaceous Cysts.

BARKER, ARTHUR E. J., *Surgeon to University College Hospital; Assistant Professor of Clinical Surgery and Teacher of Practical Surgery at University College, London.*

Surgery of the Kidney; Injuries of the Kidney; Diseases of the Kidney; Special Articles on Nephritis, Pyelitis, and other Diseases of the Kidney; Nephrectomy; Nephrotomy; Nephro-lithotomy; Nephrography; Operations on the Pylorus; Suppression of Urine; Uræmia.

BARLOW, THOMAS, M.D., B.S., *Physician to, and Assistant Professor of Clinical Medicine at, University College Hospital; Physician to the Hospital for Sick Children, Great Ormond Street; and Physician to the London Fever Hospital.*

Craniotabes.

BARWELL, RICHARD, *Surgeon to, and Lecturer on Surgery at, Charing Cross Hospital.*

Hectic Fever; Scrofula; Tubercle.

BECK, MARCUS, M.S., *Professor of Surgery in University College, London, and Surgeon to University College Hospital.*

Diseases of the Breast; Diagnosis of Tumours of the Breast; Diseases of the Nipple and Areola; Galactocele; Perityphlitic Abscess.

BELLAMY, EDWARD, *Surgeon to, and Lecturer on Anatomy at, Charing Cross Hospital.*

Axilla; Axillary Artery; Diseases of the Scapula; Excision of the Scapula.

BENNETT, WILLIAM HENRY, *Assistant Surgeon to, and Lecturer on Anatomy at, St. George's Hospital.*

Diagnosis of Injuries and Affections of the Arm and Forearm; Arteriotomy, Venesection, and other methods of Blood-letting; Musculo-spiral Paralysis.

BERRY, G. ANDREAS, M.B., C.M., *Ophthalmic Surgeon to the Edinburgh Royal Infirmary and New Town Dispensary, Edinburgh; Lecturer on Ophthalmology to the Royal College of Surgeons, Edinburgh.*

Accommodation of the Eye; Disorders of Accommodation; Ophthalmoscopy; Perimetry; Presbyopia; Visual Acuity.

BOND, THOMAS, M.B., B.S., *Assistant Surgeon to, and Lecturer on Forensic Medicine at, the Westminster Hospital.*

Railway Injuries.

BOWLBY, ANTHONY A., *Surgical Registrar to, and Demonstrator of Surgical Pathology at, St. Bartholomew's Hospital.*

Collapse; Reaction; Injuries of Nerves; Neuralgia; Neuroma; Neurotomy and Neurectomy; joint author with Mr. Morrant

Baker of Articles on Carcinoma, Sarcoma, and Malignant Tumours.

BOYD, STANLEY, M.B., B.S., *Assistant Surgeon to Charing Cross Hospital.*

Affections of Bursæ; Hospitalism and Hospital Mortality; Local Anæsthesia; Ether-spray; Temperature.

BRAILEY, WILLIAM ARTHUR, M.A., M.D., *Assistant Ophthalmic Surgeon to Guy's Hospital; Ophthalmic Surgeon to the Evelina Hospital for Sick Children.*

Colour-blindness; Glaucoma; Diseases of the Vitreous.

BROWNE, GEORGE BUCKSTON.

Diseases of the Prostate; Prostatic Hypertrophy; Stone in the Male Bladder; Foreign Bodies in the Bladder and Urethra; Puncture of the Bladder; Incontinence of Urine; Retention of Urine.

CADGE, WILLIAM, *Surgeon to the Norfolk and Norwich Hospital.*

Lithotomy; Lithotrity.

CANTLIE, JAMES, M.A., M.B., C.M., *Assistant Surgeon to, and Demonstrator of Anatomy at, Charing Cross Hospital.*

Ambulance; Management of the Sick-room; Injuries of the Cranial Nerves; Articles on the Surgical Anatomy and Methods of Ligation of the Carotid, Iliac, Femoral, and other Arteries.

CARTER, ROBERT BRUDENELL, *Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, St. George's Hospital.*

General Examination of the Eye; Injuries of the Eyeball; Excision of the Eyeball; Diseases and Injuries of the Choroid; Diseases of the Iris; Iridectomy.

CAVAFY, JOHN, M.D., *Physician to St. George's Hospital.*

Chloasma; Lentigo; Leucoderma; Pemphigus; Urticaria.

CHARNLEY, WILLIAM, M.A., M.D., M.C., *Surgeon to the Central London Ophthalmic Hospital.*

Errors of Refraction; Retinoscopy.

CHAVASSE, THOMAS FREDERICK, M.D., C.M., *Surgeon to the Birmingham General Hospital.*

Injuries of the Abdomen; Rupture of the Liver and Spleen.

CHEYNE, WILLIAM WATSON, M.B., C.M., *Assistant Surgeon to, and Demonstrator of Surgery at, King's College Hospital.*

Inflammation; Antiseptic Surgery; Antiseptics.

CLARKE, W. BRUCE, M.A., M.B., *Assistant Surgeon to, and Demonstrator of Operative Surgery at, St. Bartholomew's Hospital; Surgeon to the West London Hospital.*

Cysticercus Cellulosæ; Pediculi.

CLUTTON, HENRY HUGH, M.A., M.B., *Assistant Surgeon to, and Lecturer on Forensic Medicine at, St. Thomas's Hospital.*

Diagnosis of Diseases of Bones; Caries; Necrosis; Ostitis; Osteomyelitis, and other Special Articles on Diseases of the Osseous System; Subperiosteal Resection; Tumours of Bone.

COLES, OAKLEY, *Dental Surgeon to the Hospital for Diseases of the Throat.*

Mechanical Treatment of Cleft Palate.

COWELL, GEORGE, *Surgeon to, and Lecturer on Surgery at, the Westminster Hospital; Surgeon to the Royal Westminster Ophthalmic Hospital, and to the Victoria Hospital for Children.*

Congenital Dislocations; Intra-uterine Fractures.

CRIPPS, WILLIAM HARRISON, *Assistant Surgeon to St. Bartholomew's Hospital.*

Bruises; Wounds of Arteries; Hæmorrhage; Transfusion.

CROCKER, HENRY RADCLIFFE, M.D., B.S., *Physician to the Skin Department, University College Hospital; Physician to the East London Hospital for Children.*

Elephantiasis Græcorum; Fungous Disease of India; Erythema; Filaria Medinensis; Ichthyosis; Molluscum Fibrosum; Purpura; Sclerema Neonatorum; Scleroderma; Striæ et Maculæ Atrophicæ; Xeroderma.

CROSSE, THOMAS WILLIAM, *Surgeon to the Norfolk and Norwich Hospital.*

Urinary Calculi; Stone in the Female Bladder; Stone in the Urethra.

CRUISE, FRANCIS R., M.D., *Consulting Physician to the Mater Misericordiæ Hospital, Dublin.*

Endoscope.

CUMBERBATCH, A. ELKIN, M.B., *Aural Surgeon to St. Bartholomew's Hospital, and to the Great Northern Hospital.*

Diseases of the External and Middle Ear.

DAVIES-COLLEY, J. NEVILLE C., M.A., M.C., *Surgeon to, and Lecturer on Anatomy at, Guy's Hospital.*

Boils; Cadaveric Warts; Carbuncle; Malignant Pustule; Glanders; Gonorrhœal Rheumatism; Diagnosis of Swellings and

Tumours of the Neck; Wounds of Jugular Vein and other Special Articles on Injuries of the Neck and Throat; Injuries and Diseases of the Œsophagus; Œsophagotomy; Scalds of the Larynx; Sinus.

DENT, CLINTON THOMAS, *Assistant Surgeon to, and Lecturer on Practical Surgery at, St. George's Hospital; Surgeon to the Belgrave Hospital for Children.*

Ankylosis; Ligatures; Junks; Diphtheria of Wounds; Vomiting.

DORAN, ALBAN HENRY GRIFFITHS, *Assistant Surgeon to the Samaritan Free Hospital.*

Amputation of the Cervix Uteri; Stenosis of the Cervix Uteri; Emmet's Operation; Extra-uterine Fœtation; Pelvic Abscess in the Female; Pelvic Cellulitis; Pelvic Hæmatocele.

DUCKWORTH, DYCE, M.D., *Physician to, and Lecturer on Clinical Medicine at, St. Bartholomew's Hospital.*

Charcot's Disease; Chronic Rheumatic Arthritis.

DUNCAN, JOHN, LL.D., M.A., M.D., *Surgeon to the Edinburgh Royal Infirmary.*

Electrolysis.

EVE, FREDERICK S., *Pathological Curator of the Museum, Royal College of Surgeons; Assistant Surgeon to the London Hospital.*

Polypi.

FENWICK, E. HURRY, *Assistant Surgeon to the London Hospital.*

Hæmaturia.

FIELD, GEORGE P., *Aural Surgeon to, and Lecturer on Aural Surgery at, St. Mary's Hospital.*

Aural Exostosis.

FITZ-GERALD, THOMAS NAGHTEN, *Surgeon to the Melbourne Hospital, Victoria.*

Hydatids.

GAMGEE, JOSEPH SAMPSON, *Consulting Surgeon to the Queen's Hospital, Birmingham.*

Wounds; Adhesion; Cold; Drainage; Immobility; Rest; Irrigation, and other Special Articles on the Treatment of Wounds.

GODLEE, RICKMAN JOHN, B.A., M.S., *Surgeon to University College Hospital; Teacher of Operative Surgery and Assistant Professor of Clinical Surgery in University College, London; Surgeon to the Hospital for Consumption, Brompton.*

Abscess; Empyema; Facial Palsy; Facial Spasm; Paracentesis.

GOLDING-BIRD, CUTHBERT H., B.A., M.B., *Assistant Surgeon to, and Lecturer on Physiology at, Guy's Hospital.*

Caries of the Spine; Lumbar Abscess; Psoas Abscess; Retro-pharyngeal Abscess.

GOULD, ALFRED PEARCE, M.S., *Assistant Surgeon to the Middlesex Hospital; Surgeon to the Royal Hospital for Diseases of the Chest.*

Diseases of the Testis; Hæmatocele; Hydrocele; Hernia Testis; Castration; Diseases of the Spermatic Cord; Diagnosis of Affections of the Popliteal Space; Wounds of the Popliteal Artery; Popliteal Aneurism; Arterio-venous Aneurism; Contraction of Hamstring Tendons; Varicocele; Varicose Veins; Diseases of the Vesiculæ Seminales.

GOWERS, WILLIAM RICHARD, M.D., *Assistant Professor of Clinical Medicine in University College, and Physician to University College Hospital; Physician for Out-patients to the National Hospital for the Paralysed and Epileptic.*

Pseudo-Hypertrophic Muscular Paralysis.

GUNN, ROBERT MARCUS, M.A., M.B., C.M., *Assistant Surgeon to the Royal London Ophthalmic Hospital, Moorfields; Ophthalmic Surgeon to the Hospital for Sick Children, Great Ormond Street.*

Affections and Injuries of the Optic Nerve; Affections of the Retina.

HAWARD, J. WARRINGTON, *Surgeon to, and Lecturer on Clinical Surgery at, St. George's Hospital.*

Anæsthetics; Diseases of Joints; Excision of Joints; Excision of Os Calcis; Parotid Tumour; Salivary Fistula; Osteo-Arthritis; Synovitis.

HEATH, CHRISTOPHER, *Holme Professor of Clinical Surgery in University College, London, and Surgeon to University College Hospital.*

Abdominal Surgery; Aneurism; Aortic Aneurism; Innominate Aneurism; Diseases of the Jaws; Operations on the Jaws; Affections of the Gums; Dentigerous Cysts, and other Special Articles on Diseases of the Jaws; Fracture of the Alveolus.

HILL, M. BERKELEY, M.B., *Professor of Clinical Surgery in University College, London, and Surgeon to University College Hospital; Surgeon to the Lock Hospital.*

Diseases of the Bladder; Stricture of the Urethra; Extravasation of Urine; Strangury; Perineal Abscess; Bougies; Catheters; La Boutonnière Operation; Diseases and Injuries of the Urethra; Urethrotomy; Urethroplasty; Urinary Fistula.

HOOD, WHARTON P., M.D.
Bone-setting.

HORSLEY, VICTOR ALEXANDER H., M.B., B.S., *Assistant Surgeon to University College Hospital, and Assistant Professor of Pathological Anatomy, University College, London; Superintendent of the Brown Institution.*
Albuminoid Degeneration; Bacillus; Bacterium; Fatty Degeneration; Hypodermic Injection; Micrococcus; Nerve-Avulsion; Nerve-Stretching; Neurotic Fever; Poisoned Wounds; Rigor; Sapræmia; Schizomycetes; Sepsin; Septicæmia; Septic Diseases; Shock; Surgical Fever; Traumatic Fever; Urea; Urethral Fever; Urinary Deposits; Urine; Vibrio.

HOWSE, HENRY GREENWAY, M.S., *Surgeon to, and Lecturer on Anatomy at, Guy's Hospital · Surgeon to the Evelina Hospital for Sick Children, and to the National Truss Society.*
Injuries of the Chest; Rupture and Wound of Heart; Wounds of Lung; Hæmoptysis from Injury; Hæmothorax; Pneumothorax, and other Special Articles on Injuries to the Chest; Femoral Aneurism; Gastrostomy; Gastric Fistula.

HUTCHINSON, JONATHAN, F.R.S., *Consulting Surgeon to the London Hospital; Consulting Surgeon to the Royal London Ophthalmic Hospital; and Surgeon to the Hospital for Diseases of the Skin.*
Syphilis; Congenital Syphilis; Chancre; Finger-chancre; Bubo; Gumma; Vaccination-Syphilis.

JACOBSON, WALTER HAMILTON ACLAND, B.A., M.B., *Assistant Surgeon to Guy's Hospital; Surgeon to the Royal Hospital for Women and Children.*
Diagnosis of Injuries and Diseases of the Foot and Ankle; Bunion; Chilblains, and other Special Articles on Wounds and Affections of the Foot; Perforating Ulcer; Diagnosis of Scrotal Swellings; Injuries and Diseases of the Scrotum; Caries of the Tarsal Bones.

KEETLEY, CHARLES R. B., *Surgeon to the West London Hospital; Surgeon to the Surgical Aid Society.*
Artificial Limbs.

KIDD, PERCY, M.A., M.D., *Assistant Physician to the Hospital for Consumption, Brompton.*
Hæmophilia.

LANGTON, JOHN, *Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; Surgeon to the City of London Truss Society.*
Reducible Hernia; Irreducible Hernia; Taxis; Trusses.

LAWSON, GEORGE, *Surgeon to the Royal London Ophthalmic Hospital and to the Middlesex Hospital.*
Diseases of the Orbit; Injuries of the Orbit; Tumours of the Orbit; Diseases of the Frontal Sinuses; Sympathetic Ophthalmitis.

LIVEING, ROBERT, M.A., M.D., *Physician to the Skin Department and Lecturer on Dermatology at the Middlesex Hospital.*
Skin Diseases; Diseases of the Hair; Achorion Schönleinii; Acne; Acne Rosacea; Acrochordon; Alopecia Areata; Bullæ; Ecthyma; Eczema; Horns; Impetigo; Lichen; Pityriasis; Psoriasis; Tinea Tonsurans; Warts.

LUCAS, R. CLEMENT, M.B., B.S., *Assistant Surgeon to, and Demonstrator of Operative and Practical Surgery at, Guy's Hospital; Surgeon to the Evelina Hospital for Sick Children.*
Dislocations; Special Articles on Dislocations of the Hip, of the Shoulder, and other Joints; Diagnosis of Injuries and Diseases about the Hip, and of Injuries and Diseases about the Shoulder; Wounds of Joints.

McCARTHY, JEREMIAH, M.A., M.B., *Surgeon to, and Lecturer on Physiology at, the London Hospital.*
Injuries and Diseases of the Rectum; Hæmorrhoids; Fistula in Ano; Fissure of the Anus; Prolapsus Ani; Atresia Ani; Recto-vesical Fistula, and other Articles on Diseases of the Anus and Rectum; Injuries of the Pelvis; Hydrophobia; Hypochondriasis; Impotence; Sterility in the Male; Tetanus; Vesico-intestinal Fistula.

MACCORMAC, SIR WILLIAM, M.A., *Surgeon to, and Lecturer on Surgery at, St. Thomas's Hospital.*
Gun-shot Wounds; Sabre and Bayonet Wounds.

MACEWEN, WILLIAM, M.D., C.M., *Surgeon to, and Lecturer on Surgery at, the Royal Infirmary, Glasgow.*
Diagnosis of Head Injuries; Fracture of the Skull; Encephalitis, Meningitis, and Abscess of the Brain; Compression of the Brain; Concussion of the Brain; Hernia of the Brain; Osteotomy; Grafting; Tracheal Catheterism.

MACKENZIE, STEPHEN, M.D., *Physician to, and Lecturer on Medicine at, the London Hospital; Physician to the Royal London Ophthalmic Hospital.*
Chyluria; Filaria Sanguinis Hominis.

McLEOD, KENNETH, A.M., M.D., *Fellow of the University of Calcutta; Professor of*

Surgery, Calcutta Medical College; First Surgeon, College Hospital.

Delhi Boil; Scrotal Elephantiasis.

MAKINS, GEORGE HENRY, *Surgical Registrar to St. Thomas's Hospital; Surgeon to Outpatients at the Great Northern Hospital, and the Evelina Hospital for Sick Children.*

Surgical Tuberculosis; Phlebitis; Embolism; Fat-Embolism; Thrombosis.

MARSH, F. HOWARD, *Assistant Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; Surgeon to the Hospital for Sick Children, Great Ormond Street.*

Fractures; Articles on Fractures of the Femur, of the Humerus, of the Patella, and other Special Fractures; Hip-Disease.

MASON, FRANCIS, *Surgeon to, and Lecturer on Practical Surgery at, St. Thomas's Hospital.*

Nævus.

MEREDITH, WILLIAM APPLETON, M.B., C.M., *Surgeon to the Samaritan Free Hospital for Women and Children.*

Cholecystotomy; Rupture of Perineum; Female Catheter; Affections of the Female Urethra; Vaginal Fistulæ; Affections of the Vagina and Vulva.

MILLER, A. G., M.D., *Surgeon to, and Lecturer on Surgery at, the Edinburgh Royal Infirmary.*

Injuries and Diseases of Muscles; Rider's Bone; Sprain; Affections of Tendons.

MILLES, W. J.

Diseases of the Ciliary Body.

MORGAN, JOHN HAMMOND, M.A., *Assistant Surgeon to Charing Cross Hospital, and to the Hospital for Sick Children, Great Ormond Street.*

Hydrocele of the Neck; Fissure of the Cheek; Macroglossia; Surgery of the Hand; Ganglion; Dupuytren's Contraction; Congenital Deformities of Fingers; Wound of Palmar Arch; Contraction of Plantar Fascia; Umbilicus and Umbilical Fistula; Webbed Fingers; Whitlow.

MORRIS, MALCOLM ALEXANDER, *Surgeon to the Skin Department of, and Lecturer on Dermatology at, St. Mary's Hospital.*

Acarus; Comedo; Elephantiasis Arabum; Favus; Lupus Erythematosus; Lupus Vulgaris; Milium; Pityriasis Versicolor; Scabies; Tylosis.

MOULLIN, C. W. MANSELL, M.D., M.A., *Assistant Surgeon to the London Hospital.*

Albuminuria; Diabetes; Pyæmia; Foreign Bodies in the Air-passages; Scalds of the Glottis.

MURPHY, SHIRLEY, F., *Assistant Director, Animal Vaccination Establishment of Local Government Board.*

Vaccination.

MURRAY, WILLIAM, M.D., *Consulting Physician to the Newcastle-on-Tyne Hospital for Sick Children.*

Aneurism of the Abdominal Aorta.

OWEN, EDMUND, M.B., *Surgeon to, and Lecturer on Anatomy at, St. Mary's Hospital; Surgeon to the Hospital for Sick Children, Great Ormond Street.*

Bow-leg; Genu Extrorsum; Genu Valgum; Hare-lip; Torticollis.

PAGE, HERBERT WILLIAM, M.A., M.C., *Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital.*

Injuries of the Back and Spine; Disorders of Vision from Injuries of Head and Spine.

PAGET, SIR JAMES, Bart., D.C.L., LL.D., F.R.S., *Sergeant Surgeon to H.M. the Queen; Surgeon-in-Ordinary to H.R.H. the Prince of Wales; Consulting Surgeon to St. Bartholomew's Hospital.*

Old Age.

PAGET, STEPHEN, B.A., *Honorary Surgeon to the Western General Dispensary.*

Cancrum Oris; Dysphagia; Sex.

PARKER, ROBERT WILLIAM, *Surgeon to the East London Hospital for Children.*

Surgical Affections of Childhood; Rickets; Affections of the Epiphyses; Separation of the Epiphyses; Laryngotomy; Laryngectomy Spina Bifida; Thyrotomy; Tracheotomy.

PARKER, RUSHTON, M.B., B.S., *Assistant Surgeon to the Liverpool Royal Infirmary; Professor of Surgery in University College, Liverpool.*

Diseases of the Nose; Epistaxis; Nasal Polypus; Nasal Douche; Peritonitis.

PEPPER, AUGUSTUS J., M.S., *Surgeon to, and Teacher of Practical and Operative Surgery at, St. Mary's Hospital; Surgeon to the London Fever Hospital.*

Diseases of Arteries; Diseases of the Lips; Plastic Surgery; Diagnosis of Affections of the Groin; Hypertrophy; Atrophy; Induration; Œdema; Metastasis; Calcification; Suppuration; Suppurative Fever.

PHILLIPS, CHARLES DOUGLAS F., M.D.

Caustics.

PICK, THOMAS PICKERING, *Surgeon to, and Lecturer on Surgery at, St. George's Hospital.*

Erysipelas; Cellulitis; Gangrene; Hospital Gangrene; Phagedæna; Spermatorrhœa; Subclavian Aneurism.

PITTS, BERNARD, M.A., M.C., *Assistant Surgeon to St. Thomas's Hospital; Assistant Surgeon to the Children's Hospital, Great Ormond Street.*

Aspiration; Aspirator; Affections of Stumps; Diagnosis of Affections of Thigh and Leg.

POLLARD, BILTON, M.D., B.S., *Surgical Registrar, University College Hospital.*

Bandages; Immovable Bandages; Bedsores; Esmarch's Bloodless Method; Needles; Specula; Articles on Splints and Surgical Appliances; Styptics; Sutures.

POORE, GEORGE VIVIAN, M.D., *Professor of Medical Jurisprudence in University College, London; Physician to University College Hospital.*

Swallowing of Acids; Swallowing of Alkalies; Pulse; Suspended Animation.

POWER, D'ARCY, M.A., M.B., *Curator of the Museum of St. Bartholomew's Hospital.*

Villous Tumours.

POWER, HENRY, M.B., *Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, St. Bartholomew's Hospital; Surgeon to the Royal Westminster Ophthalmic Hospital.*

Amaurosis; Amblyopia; Asthenopia; Blindness; Diseases of the Lacrymal Apparatus; Feigned Disorders of Vision.

PURVES, WILLIAM LAIDLAW, M.D., *Aural Surgeon to Guy's Hospital.*

Diagnosis of Deafness; Diseases of the Internal Ear.

PUZEY, CHAUNCEY, *Surgeon to the Liverpool Northern Hospital.*

Acupuncture; Surgical Uses of Ergotin; Surgical Uses of Iodoform.

RIVINGTON, WALTER, B.A., M.S., *Surgeon to, and Lecturer on Surgery at, the London Hospital.*

Rupture of the Bladder; Orbital Aneurism.

ROBERTS, FREDERICK THOMAS, M.D., *Professor of Materia Medica and Therapeutics in University College, London, and Physician to University College Hospital; Physician to the Hospital for Consumption, Brompton.*

Delirium Tremens.

ROTH, BERNARD.

Antero-posterior Spinal Curvature; Lateral Spinal Curvature; Flat-foot; Pigeon-breast; Massage; Medical Gymnastics.

SANGSTER, ALFRED, B.A., M.B., *Physician to the Skin Department, and Lecturer on Skin Diseases at, Charing Cross Hospital.*

Bromidrosis; Herpes; Hyperidrosis; Molluscum Contagiosum; Prurigo; Seborrhœa; Medicinal Eruptions; Sycosis.

SEMON, FELIX, M.D., *Assistant Physician for Diseases of the Throat to St. Thomas's Hospital.*

Laryngitis; Neuroses of the Larynx; Syphilis of the Larynx; Tuberculosis of the Larynx; Growths in the Larynx; Laryngoscopy; Aphonia; Dyspnœa; Rhinoscopy; Injuries and Diseases of the Thyroid Gland.

SMITH, PRIESTLEY, *Ophthalmic Surgeon to the Queen's Hospital, Birmingham; Consulting Ophthalmic Surgeon to the Birmingham Skin and Lock Hospital.*

Cataract; Cataract Glasses; Crystalline Lens; Nystagmus; Affections of the Ocular Muscles; Strabismus.

SMITH, THOMAS, *Surgeon to, and Lecturer on Clinical Surgery at, St. Bartholomew's Hospital; Consulting Surgeon to the Children's Hospital, Great Ormond Street.*

Surgical Treatment of Cleft Palate.

SMITH, W. JOHNSON, *Surgeon to the Seamen's Hospital, Greenwich.*

Burns; Accidents from Lightning; Frostbite; Pathological Conditions of Cicatrices; Aneurism of the Carotid Arteries; Gonorrhœa; Gleet; Mucous Patches; Cheiloplasty; Rhinoplasty; Scurvy.

STOKES, WILLIAM, M.D., M.Ch., *Professor of Surgery at the Royal College of Surgeons of Ireland; Surgeon to the Richmond Surgical Hospital, Dublin.*

Amputations; Amputation at the Ankle; Amputation of the Arm, and other Articles on the Special Amputations through Limbs and at Joints.

STOWERS, HERBERT, M.D., *Physician to the Department for Skin Diseases, North-West London Hospital.*

Xanthoma.

SWAIN, PAUL, *Surgeon to the South Devon and East Cornwall Hospital.*

Diseases of the Penis; Phimosis; Paraphimosis, and other Articles on Affections of the Male Genital Organs; Circumcision.

SWANZY, HENRY R., M.A., M.B., *Surgeon to the National Eye and Ear Infirmary, Dublin; Ophthalmic Surgeon to the Adelaide Hospital, Dublin.*

Diseases of the Conjunctiva; Injuries of the Conjunctiva; Pterygium; Pinguecula.

SYMONDS, CHARTERS JAMES, M.D., M.S., *Assistant Surgeon to Guy's Hospital; Assistant Surgeon to the Evelina Hospital for Sick Children.*

Cautery; Ecraseur; Stings of Insects; Bites of Venomous Serpents; Torsion of Arteries.

THOMPSON, SIR HENRY, *Surgeon Extraordinary to the King of the Belgians; Emeritus Professor of Clinical Surgery in University College, London; Consulting Surgeon to University College Hospital.*

Tumours of the Bladder.

THORNTON, JOHN KNOWSLEY, M.B., C.M., *Surgeon to the Samaritan Free Hospital for Women and Children.*

Abdominal Tumours; Diseases of the Broad Ligaments; Cæsarean Section; Diseases of the Fallopian Tubes; Laparo-Elytrotomy; Oöphorectomy; Ovarian Tumours; Ovariotomy; Porro's Operation; Diseases of the Spleen; Symphysiotomy; Uterine Tumours; Extirpation of the Uterus and Uterine Appendages.

TOMES, CHARLES SISSMORE, M.A., F.R.S.

Caries of the Teeth; Dentition; Extraction of Teeth; Gumboil; Teeth as a Test of Age; Toothache.

TREVES, FREDERICK, *Surgeon to, and Lecturer on Anatomy at, the London Hospital.*

Air in Veins; Artificial Anus; Intestinal Obstruction; Laparotomy for Intestinal Obstruction; Colectomy; Colotomy; Fæcal Abscess and Fæcal Fistula; Enterectomy; Enterotomy; Inflamed Hernia; Obstructed or Incarcerated Hernia; Strangulated Hernia; Articles on Femoral, Inguinal, and other Varieties of Hernia; Lymphadenitis; Lymphadenoma; Lymphangeiectasis; Lymphangitis; Lymphorrhœa; Injuries and Diseases of the Thoracic Duct.

TURNER, GEORGE ROBERTSON, *Visiting Surgeon to the Seamen's Hospital, Greenwich; Lecturer on Practical Surgery at St. George's Hospital.*

Gluteal Aneurism; Affections of the Gluteal Region; Ununited Fracture.

TWEEDY, JOHN, *Professor of Ophthalmic Medicine and Surgery at University College, and Assistant Ophthalmic Surgeon to University College Hospital; Surgeon to the Royal London Ophthalmic Hospital, Moorfields.*

Examination of the Cornea; Inflammation of the Cornea; Ulceration of the Cornea; Variations of Curvature in the Cornea; Injuries of the Cornea; Ectropion; Entropion; Diseases of the Eyelids; Injuries of the Eyelids; Hemeralopia; Herpes Frontalis; Diseases and Injuries of the Sclerotic.

WALSHAM, WILLIAM JOHNSON, C.M., *Assistant Surgeon to, and Demonstrator of Practical and Orthopædic Surgery at, St. Bartholomew's Hospital; Surgeon to the Metropolitan Free Hospital.*

Diseases of the Pharynx; Injuries of the Pharynx; Tumours of the Pharynx; Extirpation of the Pharynx; Pharyngeal Stenosis; Naso-pharyngeal Growths; Retro-nasal Catarrh; Affections of the Septum Narium; Rouge's Operation; Ulceration and Ulcers.

WILLETT, ALFRED, *Surgeon to St. Bartholomew's Hospital, and to St. Luke's Hospital.*

Tumours; Cystic Tumours; Erectile Tumours; Fibrous Tumours; Adenoma; Enchondroma, and other Special Articles on Varieties of Non-malignant Tumour.

WOOD, JOHN, F.R.S., *Professor of Clinical Surgery in King's College, London, and Surgeon to King's College Hospital.*

Ectopia Vesicæ and Epispadias; Hypospadias; Radical Cure of Hernia.

INDEX OF SUBJECTS.

ABDOMEN, Injuries of the, i. 1
contusions, i. 1
emphysema, i. 1
gunshot wounds, i. 645
protrusion of intestine, i. 4
protrusion of omentum, i. 3
rupture of intestine without wound of parietes, i. 2
wounds of hollow viscera with and without protrusion, i. 5
ABDOMINAL ANEURISM, i. 5
Abdominal aorta, ligature of, for iliac aneurism, i. 776
Abdominal extirpation of uterus, ii. 752
Abdominal gestation, i. 495
ABDOMINAL HERNIA, i. 9
Abdominal section.
See *Cæsarean Section*, i. 212
Laparotomy for Intestinal Obstruction, i. 883
Ovariotomy, ii. 153.
Uterus, Extirpation of, ii. 752
in extra-uterine fœtation, i. 497
ABDOMINAL SURGERY, i. 9
ABDOMINAL TUMOURS, Diagnosis of, i. 10
Abernethy's operation for ligation of external iliac artery, i. 778
Aberrant goître, ii. 616
Abnormal descent of testis, ii. 595
Abortive treatment of chancre, i. 272
of gonorrhœa, i. 612
ABSCESS, i. 13
causes, i. 13
contents, i. 15
diagnosis from aneurism, i. 57
treatment, i. 15
antiseptic, i. 77
by aspiration, i. 107
Abscess, acute, i. 14
chronic, i. 14
fæcal, i. 515
pyæmic, ii. 278
residual, i. 963
serous, i. 15
urinary, ii. 189
Abscess, alveolar, i. 34
axillary, i. 118
of bone, i. 17; ii. 145
of the brain, i. 461
of the breast, i. 180
Abscess of the buttock, i. 608
of the cornea, i. 370
of the eyelids, i. 509
of the groin, i. 622
in hip-disease, i. 724
ischio-rectal, i. 546
of the neck, ii. 42
of the orbit, ii. 113
pelvic, in the female, ii. 172
perineal, ii. 189
perinephritic, ii. 190
perityphlitic, ii. 201
peri-urethral, ii. 716
prostatic, ii. 248
psoas, ii. 263
rectal, i. 546
retro-pharyngeal, ii. 345
of the scalp, ii. 380
of the spleen, ii. 472
urethral, ii. 716
ABSCESS KNIFE, i. 17
ABSORBENT SYSTEM, Diseases of the.
See *Lymphadenitis*, i. 962
Lymphadenoma, i. 965
Lymphangioma, i. 967
Lymphangitis, i. 968
Lymphorrhœa, i. 969
Acantholysis, ii. 180
Acarus folliculorum, i. 18
scabiei, i. 18
Accidents from lightning, i. 929
ACCOMMODATION OF THE EYE, i. 19; ii. 318
DISORDERS OF, i. 20; ii. 316
Acephalocyst, i. 748
Acetabulum, fractures of the, ii. 178
ACHORION SCHÖNLEINII, i. 21, 521
Achromatopsia. See *Colour-Blindness*, i. 331
ACIDS, SWALLOWING OF, i. 21
ACNE, i. 22; ii. 450
artificialis, i. 23
disseminata, i. 22
indurata, i. 22
lupus, i. 960
punctata, i. 22
rosacea, i. 23; ii. 451
simplex, i. 22
varioliformis, i. 23; ii. 21
vulgaris, i. 22
Aconite, in treatment of erysipelas, i. 463
Acquired warts, ii. 811

Acrochordon, i. 24 ; ii. 452
Acromion, fracture of the, ii. 386
Actual cautery, i. 265
in treatment of hæmorrhoids, i. 670
of nævus, ii. 32
Acuity of vision, determination of, ii. 318, 801
Acupuncture, i. 24
in treatment of aneurism, i. 25, 82
of hydrocele, i. 754
of muscular disability, i. 25 ; ii. 26
of sciatica, i. 25
Acute bedsore of Charcot, i. 141
necrosis, ii. 194
rickets, ii. 360
traumatic arthritis, i. 859
malignancy, i. 165
vaginal hydrocele, i. 751
Adams's Operation, i. 26 ; ii. 142
Addison's disease, bronzing in, i. 283
Adenia, i. 965
Adenitis, i. 962
Adenoid carcinoma, i. 226
Adenoma, i. 26
Adenomatous polypi, ii. 230
Adhesion, i. 27
Adhesions from iritis, i. 825
in joints, i. 67
Adipocere, i. 518
After-cataract, i. 260
Agalactea, i. 176
Age, in cases of albuminoid degeneration, i. 29
of cancer of breast, i. 184
of caries of spine, i. 228
of prostatic enlargement, ii. 251
for operative treatment of cleft palate, i. 317
of hare-lip, i. 680
influence of, on nature of malignant disease, ii. 8
on process of fever, ii. 523
on sympathetic ophthalmia, ii. 536
See *Old Age*, ii. 96
Ainhum, i. 27
Air in Veins, i. 27
pathology, i. 27
symptoms, i. 28
treatment, i. 28
Air-passages, foreign bodies in the, i. 558
Ala nasi, restoration of, ii. 348
Albinism, i. 29
Albugo, i. 29
Albumin, form and sources of, in albuminuria, i. 31 ; ii. 740
Albuminoid Degeneration, i. 29
Albuminuria, i. 31 ; ii. 740
surgical importance of, when due to organic renal disease, i. 32
influence of, on results of surgical operations, i. 32
peculiarity of, in albuminoid degeneration of kidneys, i. 32
Alcoholic amblyopia, i. 41
coma associated with head injury, i. 688
Aleppo evil, i. 395
Alkalies, Swallowing of, i. 32
Alkaline caustics, i. 262
Allarton's operation, i. 33. See *Median Lithotomy*, i. 940
Allingham's rectal speculum, ii. 461
Allyl alcohol as an antiseptic, i. 78
Alopecia Areata, i. 33 ; ii. 451
Alphos. See *Psoriasis*, ii. 265
Alternating calculus, i. 215
Alumina, acetate of, as an antiseptic, i. 74
Alveolar Abscess, i. 34
Alveolar sarcoma, ii. 370
Alveolus, Fracture of, i. 34
Amaurosis, i. 34
alcoholic and tobacco, see *Amblyopia*, i. 40, 41
a sequela of eruptive fever and diphtheria, i. 35
a symptom of Bright's disease, i. 35
reflex, i. 35
simulated, ii. 798
Amazia, i. 37
Amblyopia, i. 37
cerebral, i. 38
crossed, i. 39
diabetic, i. 42
malarial, i. 42
reflex, i. 38 ; ii. 793
simulated, ii. 800
spinal, i. 40
tabetic, i. 40
toxic, i. 40
from cardiac disease, i. 43
disuse, i. 37
exposure to bright light, i. 38
in hysteria, i. 43
pregnancy, i. 42
Ambulance, i. 43
Ametropia, ii. 317
Ammonia, action of, on air-passages, i. 33
Ammonio-magnesian calculus, i. 215
Amplitude of accommodation, i. 21
Amputation, i. 46
circular method, i. 46
classification, i. 46
flap method, i. 47
general considerations, i. 46
historical eras, i. 46
mortality of, in hospital and private practice, i. 740
performance of an, i. 51
rectangular (Teale's), i. 47
treatment of stump, i. 51 ; ii. 508
in cases of burns, i. 208
of compound dislocation of ankle, i. 64
of compound fracture, i. 571
of gangrene, i. 589
of gangrene from aneurism, i. 58
of gunshot injury, i. 651
of hip-joint disease, i. 730
of ruptured artery, i. 93
of tetanus, ii. 599
Amputations, Special: at the ankle-joint, i. 65
of the arm, i. 84
of the breast, i. 192
of the cervix uteri, i. 268

Amputations, Special: at the elbow, i. 435
of the fingers, i. 541
in the foot, i. 550
of the forearm, i. 556
in the hand, i. 342
at the hip-joint, i. 730
at the knee-joint, i. 872
of the leg, i. 918
of the metacarpal bones, i. 543
of the metatarsal bones, i. 550
of the penis, ii. 182
at the shoulder-joint, ii. 439
of the thigh, ii. 600
of the thumb, i. 543
of the toes, i. 550
at the wrist-joint, ii. 819
Amussat's operation, i. 330
Amygdaloid bubo, i. 197
Amyloid disease. See *Albuminoid Degeneration*, i. 29
in hip-disease, i. 725
degeneration of conjunctiva, i. 357
Anæsthesia, i. 51
general, i. 52
local, i. 51, 952
treatment of, by nerve-stretching, ii. 61
of larynx, i. 904
of optic nerves, i. 38
Anæsthetics, i. 51
use of, in cataract operations, i. 251
in treating wounds, ii. 815, 818
in operations for hæmorrhoids, i. 670
Analgesia, i. 56
Anchylosis. See *Ankylosis*, i. 67
Aneurism, i. 56
causes, i. 56, 90
diagnosis, i. 57
mode of cure, i. 58
prognosis, i. 58
rupture, i. 57
spontaneous cure, i. 58
symptoms, i. 56
treatment by acupuncture, i. 61
by flexion, i. 59
by galvano-puncture, i. 440
general, i. 58
by injection of coagulating fluids, i. 61
by injection of ergotin, i. 474
by ligature, i. 59
by manipulation, i. 61
by pressure, digital, i. 59; local, i. 59; rapid, i. 59
Aneurism, Forms of: arterio-venous, i. 97
cirsoid, i. 309
diffuse traumatic, i. 61
dissecting, i. 56
false and true, i. 56
fusiform, i. 56
sacculated, i. 56
traumatic, i. 61
varicose, i. 98
Aneurismal varix, i. 98
Aneurisms, Special: of abdominal aorta, i. 5
of arch of aorta, i. 81
of axillary artery, i. 122
Aneurisms, Special: of brachial artery, i. 86
of carotid arteries, i. 235
of femoral artery, i. 521
of gluteal artery, i. 607
of iliac arteries, i. 774
of innominate artery, i. 801
orbital, ii. 125
of popliteal artery, ii. 231
of subclavian artery, ii. 511
Angeioleucitis, i. 968
Angeioma. See *Nævus*, ii. 30
Anger's urethroplastic operation, ii. 726
Angina, syphilitic, ii. 159
Angular curvature of spine. See *Caries of Spine*, i. 228
Animal ligatures, i. 863, 928
Animal poisons.
See *Glanders*, i. 593
Hydrophobia, i. 761
Malignant Pustule, ii. 2
Poisoned Wounds, ii. 224
Animal vaccination, ii. 763
Anisometropia, ii. 329
Ankle, diagnosis of diseases and injuries of, i. 554
Ankle-joint, Amputation at, i. 65
disease of, i. 66; ii. 567
dislocations of, i. 62
excision of, i. 854; ii. 567
gunshot wounds of, i. 653
Ankyloblepharon, i. 511
Ankylosis, i. 67
bony, i. 69
soft or fibrous, i. 67
symptoms and treatment, i. 68
of temporo-maxillary articulation, i. 832; ii. 574
See *Bone-setting*, i. 167
Jaws, Closure of, i. 832
Osteotomy, ii. 140
Anorchism, ii. 593
Anorexia, i. 69
Anosmia, i. 69
Anterior fossa of base of skull, fracture of, ii. 456
Antero-posterior Spinal Curvature, i. 69
Anthrax. See *Carbuncle*, i. 219
Antiseptic dressings, Esmarch on, i. 51
Antiseptic Surgery, i. 70
aims of, i. 70
contradistinction of, to aseptic method, i. 71
definition of, i. 71
influence on healing of wounds, i. 72
Antiseptic treatment of abscess, i. 77
of compound fracture, i. 571
of skull, ii. 458
Antiseptics, i. 77
acetate of alumina, i. 74
bichloride of mercury, i. 74
boracic acid, i. 74
carbolic acid, i. 72
chloride of zinc, i. 74
eucalyptus oil, i. 74
salicylic acid, i. 73

Antrum, Diseases of the, i. 79
cysts, i. 80
empyema, i. 79
epithelioma, i. 80
Anuria. See *Suppression of Urine*, ii. 518
Anus, artificial, i. 101
atresia of, i. 112
cancer of, ii. 315
fissure of, i. 544
prolapse of, ii. 244
pruritus of, ii. 260
Aorta, Abdominal, Aneurism of, i. 5
Aortic Aneurism, i. 81; ii. 651
diagnosis, i. 81
treatment by distal ligature, i. 81
electrolysis, i. 82
introduction of foreign bodies, i. 82
Aortic tourniquet, Lister's, i. 82; ii. 651
Davy's, i. 393
Aphakia, i. 261
Aphonia, i. 83
spastica, i. 902
Aphthæ, ii. 634
Aphthous stomatitis, ii. 479, 634
Apnœa, ii. 524
Appendages, Uterine, Removal of the, ii. 745
Aqueous humour, examination of, i. 501
Arachnoid, traumatic inflammation of, i. 460
Arcus senilis, i. 114, 375
Areola of the breast, diseases of, ii. 74
Argyll-Robertson symptom, i. 36
Arm, Amputation of, i. 84
antero-posterior flaps, i. 84
circular method, i. 84
lateral flaps, i. 85
rectangular (Teale's), i. 84
Syme's modified circular, i. 84
fractures of. See *Fractures of Humerus*, i. 744
Arm and Forearm, Diagnosis of Injuries and Diseases of, i. 85
Arnold's Splint, i. 87
Arsenic as a caustic, i. 263
Arterial bleeding from wounds, i. 93
treatment of, i. 94
embolism and thrombosis, i. 91
tumours, i. 92
Arteries, Diseases of, i. 87
arteritis, acute and chronic, i. 88
atrophy, i. 91
calcification, i. 91
endarteritis, i. 88
fatty degeneration, i. 91
hypertrophy, i. 91
periarteritis, i. 90
syphilitic arteritis, i. 90; ii. 555
Arteries, ligation of. See *Surgical Anatomy and Ligation of Arteries*.
Arteries, Rupture of, i. 92
subcutaneous, without fracture, i. 93
Arteries, Wounds of, i. 93
axillary, i. 120
brachial, i. 86
branches of external carotid, i. 238
femoral, i. 524
Arteries, Wounds of, gluteal, i. 607
occipital, i. 135
palmar arch, ii. 160
plantar arteries, ii. 218
popliteal, ii. 235
posterior auricular, i. 135
princeps cervicis, i. 135
pulmonary, ii. 268
tibial, ii. 624
vertebral, i. 135
Arteriotomy, i. 97
Arterio-venous Aneurism, i. 97
causes, i. 97
diagnosis, i. 98
pathology, i. 98
symptoms, i. 98
treatment, i. 99
in arm, 86
in orbit, ii. 133
Arterio-venous communication between internal carotid artery and cavernous sinus, ii. 127
Arteritis, i. 87
syphilitic, i. 90; ii. 555
Artery Forceps, i. 100
Arthritis, acute, of infants, i. 471
chronic rheumatic, i. 293
gouty, i. 850
traumatic, i. 859
Arthropathy, tabetic, i. 851. See *Charcot's Disease*, i. 272
Articular Cartilage, Diseases of, i. 100, 846; ii. 673
Artificial Anus, i. 101
drum, i. 423
leech, i. 289
limbs, i. 104
pupil, i. 817, 827
in operations for cataract, i. 251
respiration, ii. 525
Duchenne on faradisation in, ii. 526
Howard's method, ii. 525
Sylvester's method, ii. 525
velum palati, i. 315
Ascites, diagnosis of, ii. 150
Aseptic operation, details of an, i. 74
Aspermatism, ii. 476
Asphyxia, i. 524
Aspiration, i. 107
in empyema, i. 455
in ovarian disease, ii. 151
in pericardial effusion, i. 107
in retention of urine, i. 150
in strangulated hernia, i. 108
in tympanitis, i. 107
Aspirator, i. 108
Assalini's forceps, i. 100
Assistants in amputation, i. 51
Asthenopia, i. 108
accommodative, i. 108
muscular, i. 109
nervous, i. 110
from railway injury, ii. 793
Astigmatism, i. 110; ii. 328
Astragalus, caries of the, ii. 567
dislocations of the, i. 110

Astragalus, proper dislocations of the, i. 110
excision of the, ii. 567
fracture of the, i. 553
Asylums for the blind, i. 162
Athelia, ii. 74
Atheroma, i. 88
Atheromatous ulcer, i. 89
Atlanto-axial disease, i. 230
Atlas, fracture and dislocation of, i. 131
Atonic relaxation of uvula, ii. 755
Atony of bladder, i. 142
of rectum, ii. 310
Atresia Ani, i. 112
vaginæ, ii. 769
Atrophoderma pigmentosum, ii. 824
Atrophy, i. 114
of arteries, i. 91
of articular ends of long bones, i. 115
of muscle, i. 115 ; ii. 28
of optic nerve, ii. 110
of tongue, ii. 631
Atropia in treatment of iritis, i. 822
'Attacks of the stone,' ii. 483
Auditory nerve, injuries of, i. 183
Auditory meatus, eczema of the, i. 434
foreign bodies in the, i. 418
inflammation of the, i. 417
Auditory vertigo, i. 419
Aural catarrh, i. 421
exostoses, i. 116
Avulsion of toe-nail, i. 798
of tonsil, ii. 646
Axilla, i. 117
abscess in the, i. 118
cellulitis of the, i. 118
tumours in the, i. 119
wounds of the, i. 120
Axillary Artery, Surgical Anatomy of the, i. 121
aneurism of, i. 122
wounds of, i. 120
Axis, fracture and dislocation of, i. 131
Azoospermism, ii. 476

Bacilli of leprosy, i. 447
of lupus, i. 959
Bacillus, i. 123
Bacillus anthracis, i. 124 ; ii. 3, 421, 422
action of different antiseptics on, i. 78
tuberculosis, ii. 666, 668
Back and Spine, Injuries of the, i. 124
concussion of spinal cord, i. 134 ; ii. 296
fractures and dislocations of spine, i. 130
intraspinal hæmorrhage, i. 128
laceration of membranes and traumatic meningitis, i. 129
punctured wounds, i. 134
railway injuries, i. 126 ; ii. 296
sprains, i. 125
Bacteria, influence of, on wounds, i. 71
Bacterium, i. 135
Baker, Morrant, operation for removal of tongue, ii. 640
tracheotomy tube, ii. 659
Balanitis, i. 136
Balano-posthitis, i. 136
Baldness, i. 672. See *Alopecia Areata*, i. 33
Bandages, i. 137
compound, i. 140
immovable, i. 779
simple, i. 137
triangular (Esmarch's), i. 140
Barbadoes leg, i. 441
Barnes's crescent vaginal speculum, ii. 461
Barwell's indications for distal ligature in aortic aneurism, i. 82
Base of skull, fracture of, ii. 455
Basedow's disease, ii. 613
Bath, calomel vapour, i. 216
continuous warm, in treatment of burns, i. 208
in treatment of phagedæna, ii. 206, 546
Battey's operation. See *Oöphorectomy*, ii. 99
Bavarian splint, i. 780
Bayonet wounds, ii. 364
Beard, ringworm of the, ii. 534
Bedsores, i. 141, 582
in fracture of the spine, i. 134
Bees, stings of, ii. 478
Belladonna, eruption from, ii. 16
in the treatment of spermatorrhœa, ii. 467
Bellocq's Sound, i. 141
Bertrandi, suture of, or fold suture, ii. 529
Biceps cubiti muscle, contraction of the, i. 85
rupture of the, i. 86
Bigelow on dislocation at the hip, i. 733
'Bistournage,' Chauveau's experiments on, i. 794
Bistoury, i, 142
Bites of insects and reptiles.
See *Bites of Venomous Serpents*, ii. 783
Stings of Insects, ii. 478
Bivalve specula, ii. 461
Black cataract, i. 248
Black eye, i. 686 ; ii. 456
tongue, ii. 635
Bladder, Atony of the, i. 142
cancer of the, i. 155
catarrh of the, i. 145
extroversion of the, i. 425
fistulous opening into the.
See *Recto-vesical Fistula*, ii. 308
Vaginal Fistulæ, ii. 773
foreign bodies in the, i. 563
gunshot wounds of the, i. 647
hæmorrhage from the, i. 658
imperfect evacuation of the, i. 143
inflammation of the, acute and chronic, i. 145
neuralgia of the, i. 149
paralysis of the, in injury to the spine, i. 133
puncture of the, i. 150
rupture of the, i. 151
sacculation of the, ii. 253
tumours of the, i. 154
Blebs. See *Bullæ*, i. 199
Bleeding in head injuries, i. 687 ; ii. 456
Blennorrhagia. See *Gonorrhœa*, i. 610
Blennorrhœa neonatorum, i. 352

Blepharitis, i. 507
Blepharoplasty, i. 430, 470
Blepharospasm, i. 509
Blind, suitable occupations for the, i. 162
asylums for the, i. 162
Blind-boil, i. 164
Blindness, i. 157
distribution of, i. 157
etiology of, i. 159
preventibility of, i. 161
Blisters, i. 162
Blood, morbid conditions of: in chyluria, i. 300
in erysipelas, i. 477
in hæmophilia, i. 659
in inflammation, i. 788
in purpura, ii. 273
in pyæmia, ii. 278
sources of, in hæmaturia, i. 658
Blood-cysts, electrolysis in treatment of, i. 440
Blood-ferment poisoning, ii. 367
Bloodless method of operating, i. 489
Blood-letting, i. 162
See *Arteriotomy*, i. 97
Cupping, i. 389
Leeches, i. 918
Venesection, ii. 782
Blue pus, ii. 521
Boils, i. 163
in diabetes, i. 401
from poisoned wounds, ii. 226
Bone-disease, Diagnosis of, i. 165
Bone-grafting, i. 617
Bone-setting, i. 167
Bone, tumours of, ii. 683
Bones, Diseases of: abscess, i. 17; ii. 145
carcinoma, ii. 693
caries, i. 226
cystic tumours, ii. 692. See also *Diseases of the Jaws*, i. 835
enchondroma, i. 465; ii. 683
exostosis, i. 491
fragilitas ossium, i. 572
hydatids, ii. 692
leontiasis ossea, i. 924
necrosis, ii. 43
osteo-aneurism, ii. 134
osteoma, ii. 135
osteomalacia, ii. 136
osteomyelitis, ii. 138
osteoporosis, ii. 140
ostitis, ii. 144
ostitis deformans, ii. 146
periostitis, ii. 193
pulsating tumours, ii. 134, 689, 693
sarcoma, ii. 685
scrofulous affections, ii. 398
tubercular disease, ii. 670
Bones, gunshot wounds of, i. 634
morbid changes in: in chronic rheumatic arthritis, i. 296
in rickets, ii. 356
Bougie, use of, in stricture of the œsophagus, ii. 99
Bougies, i. 169
Boutonnière, The Operation of, i. 170; ii. 258
Bow-leg, i. 171
Bowman's operation for lacrymal obstruction, i. 880
Bozeman's Operation, i. 172
Brachial Artery, Surgical Anatomy and Ligation of the, i. 173
wound of the, i. 86
Brachial plexus, seat of election for exposure of the, ii. 73
Brain, Abscess of the, i. 461
Compression of the, i. 172
Concussion of the, i. 174
gunshot wounds of the, i. 639
Hernia of the, i. 175
traumatic inflammation of the, i. 459
Brain-substance, escape of, in head injury, i. 688
Brasdor's operation for aneurism, i. 60, 176
Breast, Tumours of the, Diagnosis of, i. 191
Breast, Female, Diseases of the, i. 176
abnormalities of secretion, i. 176
abscess, i. 177
cancer, i. 184
hypertrophy, i. 177
inflammatory affections, i. 177
neuralgia, i. 177
syphilitic disease, i. 181
tumours (non-cancerous), i. 181
Breast, male, diseases of the, i. 191
Breast, excision of the, i. 192
Bridle stricture, ii. 498
Broad Ligaments, Diseases of the, i. 194
Bromidrosis, i. 195
Bromine, as a caustic, i, 263
eruption from, ii. 15
Bronchi, foreign bodies in the, i. 560
Bronchocele, ii. 613
Bronchotomy.
See *Laryngotomy*, i. 890
Tracheotomy, ii. 654
Bronzing of Addison's disease, i. 283
Bruises, i. 195
Bruit in aneurism, i. 57, 61
Brush-Burn, i. 196
Bryant's Splint, i. 197
ilio-femoral triangle, i. 529, 720
rectal speculum, ii. 461
tracheotomy tube, ii. 659
Bubo, i. 197, 962; ii. 543
Bubon d'Emblée, i. 198
Bubonocele, i. 198, 799
Buchanan's cheiloplastic operation, i. 273
Rectangular Staff, i. 198
Buffer accidents, ii. 294
Bullæ, i. 199
Bullet bubo, ii. 543
Bullet wounds, i. 626
Bunion, i. 199
Burns, i. 200
amputation in, i. 208
cicatricial deformities from, i. 208, 303
classifications of, i. 200
duodenal ulcer in, i. 205
modes of death from, i. 204
prognosis of, i. 203

Burns, treatment of, i. 206
visceral congestion from, i. 204
of cornea, i. 379
Bursa, subgluteal, enlargement and suppuration of the, i. 609
Bursæ, Affections of, i. 208
tuberculosis, ii. 677
Butcher's Saw, i. 211
Button Suture, i. 76, 211; ii. 529

Cachexia in cancer, ii. 7
Cachexia strumipriva, ii. 611
Cacolet, i. 45
Cadaveric Warts, i. 212; ii. 226
Cæsarean Section, i. 212
Calabar bean in tetanus, ii. 599
Calcaneo-astragaloid joint, dislocation of foot at the, i. 553
Calcaneum, causes of, ii. 565
fracture of, i. 1, 554
Calcareous degeneration of arteries, i. 91
of thrombi. See *Phlebolith*, ii. 216
Calcification, i. 213
of arteries, i. 91, 213
of cataract, i. 244
of new-growths, i. 214
of veins, i. 213
Calculous deposits, i. 216; ii. 732
Calculus, intestinal, i. 808
prostatic, ii. 250
renal, ii. 52
salivary, ii. 336
urethral, ii.
Calculus, Urinary, i. 215
alternating, i. 215
carbonate of lime, i. 215
cystic oxide, i. 215
fusible, i. 215
mulberry, i. 215
phosphate of lime, i. 215
triple phosphate, i. 215
uric acid, i. 215
xanthic oxide, i. 215
Calculus, vesical.
See *Stone in the Female Bladder*, ii. 482
Stone in the Male Bladder, ii. 482
Callaway's test in dislocation of the shoulder, ii. 442
Callus, i. 571
Calomel Vapour Bath, i. 216; ii. 563
Canaliculi, obstruction of the, i. 877
probing of the, i. 880
slitting of the, i. 880
Canalisation of Clot, i. 216
Canalisation of the Prostate, i. 216
Cancer.
See *Carcinoma*, i. 220
Malignant Tumours, ii. 5
Sarcoma, ii. 369
diagnosis of, from aneurism, i. 57
'en cuirasse,' i. 189; ii. 391
in old age, ii. 98
of scar-tissue, i. 306
Cancer of the axilla, i. 119
of the bladder, i. 155
Cancer of bone, ii. 685, 693
of the breast, i. 184
of the eye, ii. 112, 122, 341
of the jaws, i. 836
of the larynx, i. 895
of the lips, i. 932
of lymphatic glands, i. 966
of the nose, ii. 77
of the œsophagus, ii. 94
of the penis, ii. 183
of the pharynx, ii. 212
of the prostate, ii. 250
of the rectum, ii. 314
of the scrotum, ii. 405
of the skin. See *Rodent Ulcer* under *Carcinoma*, i. 222
of the testis, ii. 589
of the tongue, ii. 638
of the tonsil, ii. 647
of the uterus, ii. 751
Cancrum Oris, i. 217
Canities, i. 673
Canquoin's paste, i. 263
Canthoplasty, i. 470
Capelline bandage, i. 138
Capillaries, changes in, during inflammation, i. 789
Carbolic acid, as an antiseptic, i. 72, 78
eruption from local application of, ii. 16
Carbolised catgut, i. 73
gauze, i. 73
silk, i. 73
Carbonate of lime calculus, i. 215
Carbuncle, i. 219
facial, i. 220
Carcinoma, i. 220
adeno-carcinoma, i. 226
colloid, i. 225
cylindrical-celled, i. 226
encephaloid, i. 225
epithelioma, i. 221; ii. 701
rodent ulcer, i. 222; ii. 700
scirrhus, i. 225
spheroidal-celled, i. 221
dissemination of,
glandular affection of,
interference of, with general health,
local recurrence of, after excision,
mode of growth of,
} See *Malignant Tumours*, ii. 5
Carden's amputation at knee-joint, i. 872
Caries, i. 226
necrotica, i. 227
sicca, i. 227
Caries of metatarsal bones, ii. 569
of tarsal bones, ii. 565
of teeth, i. 234
Caries of the Spine, i. 228
diagnosis of, i. 231
pathology of, i. 229
treatment of, i. 232
hammock method, i. 233
Sayre's plaster jacket, i. 232
Walker's recumbent method, i. 233

Carotid Arteries, Aneurism of the, i. 235
common carotid, i. 235
external carotid, i. 236
internal carotid, i. 236
Surgical Anatomy and Ligation of the common carotid, i. 237, 238
external carotid, i. 237
Carotid artery, the common, ligature of, for hæmorrhage, i. 238
for orbital aneurism, ii. 131
for punctured wound in neck, i. 135
Carotid Artery, the External, wounds of branches of the, i. 238
Carpal Bones, Dislocations of the, i. 239
fractures of the, i. 676
Carpus, dislocation of the, ii. 821
diagnosis of, i. 679
Carr's Splint, i. 240
Carriage of wounded, by hand, i. 43
by railway, i. 45
by stretcher, i. 44
by waggon, i. 45
Carron oil, i. 207
Carte's compressor, ii. 652
Cartilages, Articular, Diseases of, i. 100
changes of, in osteo-arthritis, ii. 134
Cartilages, laryngeal, changes of, in syphilis, ii. 905
in tuberculosis, ii. 909
fractures of, i. 884
Cartilages, loose, in joints, i. 953
Cartilages, costal, fractures of, i. 381
Cartilaginous tumours.
See *Enchondroma*, i. 465
Parotid Tumour, ii. 165
Castration, i. 240
for chronic swelling of testis, ii. 585, 587
for neuralgia of testis, ii. 589
of retained testis, ii. 595
Cataract, i. 241
anterior-polar, i. 243
black, i. 248
diabetic, i. 247
hard, i. 250, 254
lamellar, i. 248
nuclear, i. 251
primary, i. 241
secondary, i. 243
senile, i. 246
soft, i. 250
traumatic, i. 243
causes and pathology of, i. 241
Cataract, Treatment of, i. 250
operative treatment: accidents, complications, and difficulties of, i. 258
extraction by flap operation, i. 255
by linear operation, i. 253
by needle operation, i. 252
by peripheral linear (Von Græfe's) operation, i. 256
by solution, i. 252
by suction, i. 254
iridectomy in operation for cataract, i. 251
iridodesis in operation for cataract, i. 252
iridotomy in operation for cataract, i. 252
Cataract, Treatment of: palliative, i. 250
therapeutic, i. 250
Cataract-Glasses, i. 261
Catarrh of bladder, i. 143, 145
of ear, i. 421
laryngeal, i. 884
Catarrhal conjunctivitis, i. 348
pharyngitis, ii. 209
stomatitis, ii. 479
tonsillitis, ii. 644
Catgut ligatures, i. 73, 928
Catheter, i. 261
female, i. 521
Catheter fever, ii. 723
Catheterism, i. 262
of Eustachian tube, i. 416
forcible, of prostate, i. 216
of lacrymal passages, i. 880
in prostatic hypertrophy, ii. 253
Catlin, i. 262
Caustics, i. 262
use and mode of application of, i. 264
in treatment of abscess, i. 264
of cirsoid aneurism, i. 311
'Caustique Filhos,' i. 262
Cautery, i. 265
actual, i. 265
galvanic, i. 266
Paquelin's, i. 267
Cavernous angeioma, i. 967
Cellulitis, i. 267
from poisoned wound, ii. 225
Centipedes, bites of, ii. 478
Cephalhæmatoma, ii. 18, 379
Cerebral abscess, i. 461
after gun-shot injury, i. 640
Cerebral aneurism, ii. 126
Cerebral disease in syphilis, ii. 555
Cerebro-spinal fluid, escape of, in head injury, i. 687; ii. 456, 457
Cerebrum, areas, motor and non-motor, of, i. 684
Cervical aneurism and tumours, diagnosis of, ii. 41
Cervical vertebræ, disease of. See *Caries of the Spine*, i. 228; ii. 345
dislocations and fractures of, i. 131
Cervix uteri, amputation of the, i. 268
laceration of the, i. 451
stenosis of the, i. 269
Chair-back palsy, ii. 28
Chalazion, i. 506
Chancre, i. 270; ii. 543
of finger, i. 541
of lip, i. 932
of nipple, ii. 75
of vulva, ii. 809
Charbon. See *Malignant Pustule*, ii. 2
Charcot's acute bed-sore, i. 141
Charcot's Disease, i. 272, 851
of hip, i. 720
relation between, and chronic rheumatic arthritis, i. 274
Charcot's views on influence of locality on results of cerebral lesion, i. 684

Cheek, Fissure of the, i. 275
gangrene of the. See *Cancrum Oris*, i. 220
Cheek-compressor, i. 672
Cheiloplasty, i. 276
Cheloid. See *Keloid*, i. 305
Chest, Injuries of the, General Diagnosis of, i. 278
See *Emphysema*, i. 453.
Fracture of Ribs, ii. 351
Hæmoptysis from Injury, i. 661
Hæmothorax, i. 670.
Rupture and Wound of Heart, i. 279, 689
Wounds of Lung, i. 955
Wounds of Pericardium, ii. 186
Pneumocele, ii. 221
Pneumo-hæmothorax, i. 671
Traumatic Pneumonia, ii. 222
Pneumothorax, i. 279, 956; ii. 223
Wounds of Pulmonary Artery, ii. 268
gun-shot wounds of the, i. 643
paracentesis of the, ii. 163
Chigoe, i. 280
Chilblains, i. 280
Childhood, Surgical Affections of, i. 280
Chimney-sweep's cancer, ii. 405
Chloasma, i. 283; ii. 451
Chloral, eruption from, ii. 16
use of, in operations for cataract, i. 251
Chloroform, i. 54
Choked disc, ii. 108
Cholecystectomy, i. 285
Cholecystotomy, i. 284
Cholin, ii. 416
Chondro-sarcoma, ii. 371
of testis, ii. 589
Chopart's amputation of the foot, i. 551; ii. 568
operation for cheiloplasty, i. 277
Chordee, i. 285, 610
Choroid, Diseases of the, i. 286
hæmorrhages, i. 291
inflammation, i. 257
injuries of the, i. 293
tumours, i. 292
Choroid, ophthalmoscopy of the, i. 286
Choroidal hyperæmia, i. 292
Chronic Rheumatic Arthritis, i. 293
prominent characteristics of, compared with those of Charcot's disease, i. 275
Chronic vaginal hydrocele, i. 752
Chylous fluid, effusion of, into pleura after wound of thoracic duct, ii. 606
Chylous urine, i. 301
Chyluria, i. 298; ii. 741
cause of, i. 298
geographical distribution of, i. 298
pathology of, i. 298
symptoms of, i. 300
treatment of, i. 302
Cicatrices, Pathological Conditions of, i. 303
deformed scars, i. 303
painful scars, i. 305
tumours of scars, i. 305
ulcerated scars, i. 305
Cicatricial deformities, i. 303
Cicatricial deformities after burns, i. 203
Ciliary Body, Diseases of the, i. 307
atrophy, i. 308
inflammation, i. 306
tumours, i. 308
Ciliary body, injuries of the, i. 308
Ciliary follicles, affections of the, i. 507
Ciliary muscle, paralysis of the, i. 308
Circular bandage, i. 137
Circular method of amputation, i. 48
Circumcision, i. 308
Cirsoid Aneurism, i. 309
electrolysis in treatment of, i. 440
of orbit, ii. 129
Clavicle, Dislocations of the, i. 312
acromial end. See *Dislocations of the Scapula*, ii. 383
sternal end, i. 312
both ends simultaneously, i. 313
Clavicle, Fracture of the, i. 313
Cleft Palate, Mechanical Treatment of, i. 315
Surgical Treatment of, i. 316
suitable age for, i. 317
Clergyman's sore-throat, ii. 209
Cline's Splints, i. 320
Clitoris, hypertrophy of the, ii. 807
Clove-hitch, i. 320
Club-hand, i. 677
Club-foot, i. 320
Talipes calcaneo-varus, i. 325
calcaneus, i. 321
equino-valgus, i. 325
equino-varus, i. 323
equinus, i. 320
valgus, i. 322
varus, i. 322
Cnidosis. See *Urticaria*, ii. 742
Coagulating fluids, injection of, in treatment of aneurism, i. 61
Cocaine, muriate of, use of as a local anæsthetic, i. 52, 251, 953
in laryngoscopy, i. 890, 895
in operations on the palate, ii. 160
Coccydynia, i. 325
Coccyx, Dislocations of the, i. 326
fracture of the, ii. 178
Cock's operation, i. 170
Cohnheim's 'inclusion' theory of origin of malignant growths, ii. 7
Cold as a therapeutic agent, i. 326
application of, in cases of head injury, i. 463
in inflammation, i. 796
Colectomy, i. 327
Collapse, i. 327
influence of mental impression in cases of, i. 328
in intestinal obstruction, i. 809
in swallowing of sulphuric acid, i. 21
Colles's fracture, ii. 292
Collodion, i. 329
Colloid cancer, i. 225
Coloboma, of choroid, i. 293
of iris, i. 820
of optic nerve-sheath, ii. 106

Colotomy, i. 330
inguinal (Littre's operation), i. 331
lumbar (Amussat's operation), i. 330
Colour as a test of syphilitic eruptions, ii. 549
Colour-blindness, i. 331
acquired, i. 334
detection of, i. 332
prevalence of, i. 334
Coma, differential diagnosis of forms of, i. 688
Comedo, i. 22, 335
Compound dislocation, i. 404, 406
fracture, i. 570
Compression. See *Pressure*, ii. 242
Compression of the brain, i. 172
in gun-shot wounds of head, i. 639
Concussion of the brain, i. 174
of the spinal cord, i. 134; ii. 296
Condyloma, ii. 548
Congenital cysts, i. 392
Congenital Deformities and Malformations.
See *Atresia Ani*, i. 112
Cheek, Fissure of the, i. 275
Cleft-palate, i. 316
Club-foot, i. 320
Ectopia Vesicæ and Epispadias, i. 425
Fingers, Congenital Deformities of, i. 544
Hare-lip, i. 680
Hypertrophy of the Gums under *Gums, Affections of the*, i. 624
Hypospadias, i. 769
Macroglossia, ii. 1
Meningocele, ii. 16
Nose, Diseases of the, ii. 76
Phimosis, ii. 213
Spina Bifida, ii. 467
Vagina, Congenital Malformations of the, ii. 769
Vulva, Congenital Malformations of the, ii. 807
Webbed Fingers, ii. 812
Congenital Dislocations, i. 325
fractures. See *Intra-uterine Fractures*, i. 814
hernia, i. 799
hydrocele, i. 756
hypertrophy of toes. See *Pes Gigas*, ii. 205
Congenital Syphilis, i. 339
diagnosis of, i. 345
evolution of, i. 342
modes of inheritance of, i. 339
tumours of orbit, ii. 121
Conical cornea, i. 375
stump, ii. 510
Conjugate paralysis of ocular muscles, ii. 87
Conjunctiva, Diseases of the, i. 347
examination of the, i. 500
injuries of the, i. 357
transplantation of, i. 617
Conjunctivitis, i. 348
catarrhal, i. 348
croupous, i. 355
diphtheritic, i. 355
follicular, i. 349
Conjunctivitis, granular, i. 350
phlyctenular, i. 356
Consolidated popliteal aneurism, diagnosis of, ii. 604
Constipation, causes of, in strangulated hernia, i. 704
Continuous sutures, ii. 529
Contracted cicatrices, i. 303
Contraction of Ham-string Tendons, i. 674
Contractures, treatment of, by nerve-stretching, ii. 61
Contre-coup, fracture of skull by, ii. 456
Contusion of bones of skull, ii. 459
of scalp, resemblance of, to depressed cranial fracture, ii. 455
Contusions, i. 195
Convergence, paralysis of, ii. 87
Convulsions from injury to the brain, i. 685
Cooper's, Sir A., method of reducing dislocation of shoulder, ii. 444
operation for ligature of external iliac artery, i. 788
Copaiba Rash, i. 358; ii. 16, 550
Coracoid Process, Fracture of the, i. 358
Corelysis, i. 825
Cornea, Changes of Curvature in the, i. 375
examination of the, i. 359, 501
inflammation of the, i. 360
injuries of the, i. 378
new-growths of the, i. 378
ulceration of the, i. 370
Corneal changes (secondary) in purulent ophthalmia, i. 353
opacities, i. 374
Corneitis punctata, ii. 537
Corns, i. 379
Cornua, i. 738
Coronoid process of ulna, fracture of the, ii. 702
Corpuscles of Gluge, ii. 521
Corrigan's pulse, ii. 271
Corrosive sublimate as an antiseptic, i. 74, 78
Coryza, ii. 78
from iodide of potassium, ii. 563
Costal Cartilages, Fractures of the, i. 381
Coster's paste, i. 263
Counter-extension in treatment of dislocation, i. 407
Counter-irritation in treatment of inflammation, i. 796
Counter-opening, i. 16, 381
Coxalgia, i. 721
Cracked lip, i. 931
Cracked nipple, ii. 74
Cradles, i. 381
Cranial bosses, i. 383
Cranial changes in rickets, ii. 356
Cranial Nerves, Injuries of the, i. 381
Cranial sinuses, obstruction of the, ii. 128
Craniotabes, i. 383
origin, whether syphilitic or rachitic, i. 385
Cranium, injuries of the.
See *Head Injuries, Diagnosis of*, i. 683
Skull, Fracture of the, ii. 452
Crepitus, i. 566

Cripps's Long Splint, i. 386
Croft's plaster of Paris splints, i. 781
Cross-legged progression, i. 720
Croupous conjunctivitis, i. 355
Crushing, treatment of hæmorrhoids by, i. 670
Crutch-paralysis, i. 118; ii. 28
Cryptorchism, ii. 593
Crystalline Lens, i. 386
  dislocations of the, i. 387
  examination of the, i. 502
Cubebs, eruption from, ii. 16
Cuboid bone, caries of the, ii. 569
  dislocation of the, i. 552
Cuneiform bone, dislocation of the, i. 552
Cupping, i. 389
Curvature of the spine, angular. See *Caries of the Spine*, i. 228
  antero-posterior, i. 69
  lateral, i. 910
Cusco's vaginal speculum, ii. 461
Cut throat, ii. 607
Cyclitis, i. 306, 828
  traumatic, i. 308
Cyclo-iritis, i. 307
Cylindrical-celled carcinoma, i. 226
Cylindroma, ii. 370
Cyphosis, i. 69
Cystic goitre, ii. 614
'Cystic sarcoma' of the lower jaw, i. 836
Cystic Tumours, i. 391
  of bone, ii. 692
  of the breast, i. 183
  of the testis, ii. 589, 590
Cysticercus Cellulosæ, i. 390
Cystine or cystic oxide calculus, i. 215
Cystitis, i. 144
Cystocele, ii. 772
Cystoplasty, i. 427
Cysto-sarcoma of testis, ii. 590
Cysts, i. 392
  of the antrum, i. 80
  of the broad ligament, i. 194
  dentigerous, i. 400
  of the iris, i. 820
  of the larynx, i. 892
  of the lower jaw, i. 835
  of the neck. See *Hydrocele of the Neck*, i. 758
  of the orbit, ii. 120
  ovarian, ii. 148
  sublingual. See *Ranula*, ii. 306
Cysts, hydatid. See *Hydatids*, i. 747
  dermoid, ii. 148, 381, 408
  sebaceous, ii. 408
Czerny-Lembert suture, i. 924; ii. 530

Dacryocautery, i. 881
Dacryocystitis, i. 877
Dactylitis, i. 393
Daltonism. See *Colour-blindness*, i. 331
Dandriff, ii. 410
Davy's Lever, i. 393, 731
Deaf-mutism, i. 420
Deafness, Diagnosis of, i. 393, 419
Deafness in diseases of internal ear, i. 419
  in syphilis, ii. 553
Death, causes of, in burns, i. 204
  in empyema, i. 459
Decalcified bone-tubes, i. 411
Decubitus. See *Bedsores*, i. 141
Deformities. See Articles given in Index under *Congenital* and *Non-congenital Deformities*.
Degeneration, albuminoid, i. 29
  of arteries, i. 91
  fatty, i. 518
  of muscle, ii. 28
Delayed descent of testis, ii. 593
Delhi Boil, i. 395
Delirium Tremens, i. 398
Demarcation, line of, in gangrene, i. 586
De Morgan's splint, i. 399
Denonvillier's operation for closing artificial anus, i. 104
Dentigerous Cysts, i. 400
Dentist's drilling machine, use of, in perforation of aural exostoses, i. 116
Dentition, i. 400
Depressed fracture of skull, ii. 454
  treatment of, ii. 458
Depressed nose, operation for, ii. 349
Depression of cranial vault, without fracture, in children, ii. 455
Dermatolytic tumours, ii. 23
Dermoid tumours of the orbit, ii. 121
  of the ovary, ii. 148
  of the scalp, ii. 381, 408
    diagnosis of, from meningocele, ii. 18
  of the testis, ii. 589, 590
Desault's long splint, i. 401
Desormeaux on granular urethritis, i. 606
Detection of colour-blindness, i. 332
Deviation of the eye, ii. 83
  of the puncta, i. 877
Diabetes, i. 401
  retinal changes in, ii. 338
Diabetic amblyopia, i. 42
  cataract, i. 247
Diagnosis, Surgical, Abdominal tumours, i. 10
  Arm and Forearm, injuries and diseases of the, i. 85
  Axilla, diseases and injuries of the, i. 117
  Bones, diseases of the, i. 164
  Breast, tumours of the, i. 176
  Chest, injuries of the, i. 278
  Deafness, varieties of, i. 393
  Eye, general examination of, i. 499
  Foot and ankle, injuries and diseases of the, i. 554
  Gluteal region, diseases of the, i. 608
  Groin, diseases of the, i. 619
  Hand, injuries and diseases of the, i. 676
  Head-injuries, i. 683
  Hip, injuries and diseases about the, i. 719
  Neck, swellings and tumours of the, ii. 41
  Popliteal space, affections of the, ii. 236
  Scrotal swellings, ii. 402

Diagnosis, Surgical, Shoulder, injuries and diseases about the, ii. 437
Skin, diseases of the, ii. 449
Spermatic cord, swelling of the, ii. 463
Thigh and Leg, affections of the, ii. 601
Diagnosis, differential, of sources of blood in hæmaturia, i. 657
Diaphragmatic Hernia, i. 401
Dickinson on cause of albuminoid degeneration, i. 29
Dicrotous pulse, ii. 271
Diet in treatment of albuminoid degeneration, i. 31
of aneurism, i. 58
of bow-leg, i. 171
of chronic cystitis, i. 148
of eczema, i. 433
of erysipelas, i. 483
of peritonitis, ii. 200
Dieulafoy's aspirator, i. 108
Diffuse cellular inflammation, i. 267
hydrocele of the cord, i. 758
traumatic aneurism, i. 61
Digital compression in aneurism, i. 59
in aortic aneurism, i. 9
in axillary aneurism, i. 123
in carotid aneurism, i. 236
in orbital aneurism, ii. 130
Digital dilatation of pylorus, ii. 287
Dilatation of female urethra, ii. 482
of stricture, ii. 501
Dilating vaginal specula, ii. 461
Dioptre, ii. 317
Diphtheria of Wounds, i. 402
Diphtheritic conjunctivitis, i. 355
Diplopia, ii. 83
Direct inguinal hernia, i. 800
Directors, i. 403
Discharge of watery fluid from nostril, i. 80
Dislocation, extension and counter-extension in the treatment of, i. 406
predisposing causes of, i. 404
symptoms of, i. 404
treatment of, i. 405
resection in the treatment in the compound forms of, i. 406
of tendons, ii. 575
of the crystalline lens, i. 386
of the spleen, ii. 471
Dislocations, i. 403
complicated, i. 406, 569
compound, i. 406
congenital. See *Congenital Dislocations*, i. 335
consecutive, i. 403
incomplete, i. 403
pathological, i. 403
simple, i. 404
spontaneous, i. 403
traumatic, i. 403
unreduced, i. 407
Dislocations, Special, of the ankle, i. 62
of the astragalus, i. 110
of the atlas, i. 131
of the carpal bones, i. 239
Dislocations, Special, of the clavicle, i. 312
of the coccyx, i. 326
of the elbow, i. 437
of the bones of the foot, i. 552
of the bones of the hand, i. 674
of the hip, i. 721, 733
of the lower jaw, i. 830
of the knee, i. 871
of the patella, ii. 166
of the radius, ii. 290
of the shoulder, ii. 442
of the sternum, ii. 477
subastragaloid of foot, i. 553
of vertebræ, i. 131
Displaced septum narium, ii. 426
Displacement of the scapula, ii. 383
Dissecting aneurism, i. 56
Dissection wounds. See *Poisoned Wounds*, ii. 224
Disseminated ringworm, ii. 630
Distal ligature, in treatment of aneurism, i. 60
aortic aneurism, i. 81
carotid aneurism, i. 236
innominate aneurism, i. 801
Distichiasis, i. 508
Distribution of disease with regard to sex, ii. 429
Divergence, paralysis of, ii. 86
Donders's discs for detection of colour-blindness, i. 333
Dorsalis Pedis Artery, Surgical Anatomy and Ligation of the, i. 409
Double vision, ii. 83
Dracunculus, i. 535
Drainage, i. 409 ; ii. 815
in antiseptic surgery, i. 75
in treatment of empyema, i. 457
of hydatid cyst, i. 750
Drainage-tubes, i. 410
Drop-wrist, ii. 28
Dropsy of antrum, i. 80
of Fallopian tube, i. 516
ovarian. See *Ovarian Tumours*, ii. 147
Drugs used in hypodermic injection, i. 768
Dry cupping, i. 390
gangrene, i. 587
Duchenne's paralysis, ii. 260
Dugas's test, i. 411
Duodenum, ulcer of, in cases of burn, i. 205
Duodenostomy, ii. 288
Duplay's nasal speculum, ii. 462
Dupuytren's Contraction, i. 411
operation for closing artificial anus, i. 104
Splint, i. 412
Durham's tracheotomy canula, ii. 659
Dysphagia, i. 412
from disease of pharynx and œsophagus, i. 413
from disease of surrounding parts, i. 413
from paralysis or spasm, i. 412
Dysphonia, i. 83
Dyspnœa, i. 414
Dysuria, ii. 252, 500, 737

Ear, bleeding from the, in head injury, i. 687
gun-shot injury of the, i. 642
methods of examining the, i. 415
Ear, External, Diseases of the, i. 415
eczema, i. 416
foreign bodies in the, i. 418
hæmatoma auris, i. 417
inflammation, i. 417
injuries to the, i. 418
obstruction of the, i. 418
otomycosis, i. 417
Ear, Internal, Diseases of the, i. 419
Menière's disease, i. 420
Ear, Middle, Diseases of the, i. 421
acute and chronic catarrh, i. 421
acute purulent catarrh, i. 422
chronic purulent catarrh, i. 423
complications of purulent catarrh, i. 423
mastoid disease, i. 424
Eburnation in chronic rheumatic arthritis, i. 296
Ecchymosis, subconjunctival, ii. 516
Echinococcus. See *Hydatids*, i. 747
Ecraseur, i. 424
Ectasia corneæ, i. 375
Ecthyma, i. 425
Ectopia cruralis, ii. 596
perinealis, ii. 596
Ectopia Vesicæ, i. 425
Ectropion, i. 430
Eczema, i. 431 ; ii. 450
causes, general and local, of, i. 431
differential diagnosis of, i. 432
subjective sensations present in, i. 431
supposed risks of cure of, i. 432
Eczema, Acute, i. 432
subacute or chronic, i. 433
Local forms
of the auditory meatus, i. 416, 434
of the hand and foot, i. 434
of the face, i. 434
of the leg, i. 434
of the nails, ii. 35
of the nipple, i. 435 ; ii. 75
of the scalp, i. 433
of stumps, ii. 509
Elastic bandage in treatment of elephantiasis scroti, i. 443
Elastic pressure in arrest of hæmorrhage, i. 731
Elbow, diagnosis of injuries and diseases of the. See *Arm and Forearm*, i. 85
stiffness of the, i. 86
Elbow-joint, Amputation at the, i. 435
by antero-posterior flap, i. 435
by circular method, i. 435
by lateral flaps, i. 436
Diseases of the, i. 436
Dislocations of the, i. 436
backwards, i. 437
inwards, i. 439
outwards, i. 438
excision of the, i. 855
gun-shot wounds of the, treatment of, i. 438
Electricity in the diagnosis of amblyopia, ii. 801
of railway injuries, ii. 303
in the treatment of elephantiasis Arabum, i. 443
of extra-uterine fœtation, i. 497
of sequelæ of injuries to muscle, ii. 26
Electrolysis, i. 439
in the treatment of cirsoid aneurism, i. 311, 440
of nævus, ii. 33
Elephantiasis Arabum, i. 441
scroti, i. 442
Elephantiasis Græcorum, i. 444
mixed tuberculated lepra, i. 446
non-tuberculated lepra, i. 445
tuberculated lepra, i. 444
Elephantoid fever, i. 441
Ellis's Splint, i. 448
Elongation of uvula, ii. 755
Elsberg's nasal speculum, ii. 462
Emboli, origin and nature of, i. 448
Embolism, i. 448
results of, general, i. 450
local, i. 449
a result of chronic endarteritis, i. 90
Embolism of central artery of retina, ii. 339
defect of field of vision in, ii. 188
Emmert's suture, ii. 531
Emmet's Operation, i. 451
Emmetropia, i. 452 ; ii. 317
Emphysema, i. 452
of the abdominal wall, i. 2
of eyelids, i. 509
from injury to the chest, i. 279, 452
from decomposition, i. 452
Emprosthotonos, ii. 597
Empyema, i. 453
from perforation, i. 454
inflammatory, i. 453
traumatic, i. 453
treatment of, by aspiration, i. 455
by drainage, i. 457
by free incision, i. 456
by removal of a portion of a rib, i. 457
Empyema of antrum, i. 79
Encephalitis, i. 459
Encephalocele, ii. 16
Encephaloid cancer of the breast, diagnosis of, i. 177
carcinoma, i. 225
Enchondroma, i. 465
in old age, ii. 95
of bones, ii. 683
of orbit, ii. 119
of testis, ii. 589
Encysted calculus, i. 937
hæmatocele, i. 656
hernia, i. 799
hydrocele, i. 757
Endemic goître, ii. 613
Endogenous tumours, i. 391
Endoscope, i. 466
Endoscopic appearances in gleet, i. 606
in gonorrhœa, i. 611
Enterectomy, i. 467

Enterectomy, direct union of the ends of the divided bowel, i. 468
formation of an artificial anus, i. 468
Enterolith, i. 808
Enterotome, i. 104
Enterotomy, i. 469
Entropion, i. 469
Enucleation of eyeball, i. 504
of nævus, ii. 34
Enuresis, i. 785
Eperon, i. 103
Ephelis, i. 924
Epidermic growths of scars, i. 305
Epididymitis, ii. 404, 579
gonorrhœal, i. 611; ii. 19
Epiphora, i. 877
Epilepsy, treatment of, by nerve-stretching, ii. 61
Epileptiform neuralgia, ii. 68
Epiphyses, Affections of, i. 470
Separation of, ii. 411
at the ankle-joint, ii. 414
at the elbow-joint, i. 746; ii. 413
at the hip-joint, ii. 414
at the knee-joint, i. 534; ii. 414
at the shoulder-joint, ii. 413
at the wrist-joint, ii. 414
Epiphysitis, i. 470
Episcleritis, ii. 393
Epispadias, i. 425
operative treatment of, i. 429
Epistaxis, i. 472
use of ergotin in, i. 474
Epithelioma. See *Carcinoma*, i. 221
of the antrum, i. 80
of the anus, ii. 315
of the bladder, i. 155
of the gums, i. 625
of the jaw, i. 837
of the larynx, i. 895
of the lip, i. 932
of the nose, ii. 77
of the penis, ii. 183
of the scrotum, ii. 405
of the tongue, ii. 638
of the tonsils, ii. 647
of the uterus, ii. 741
of the vulva, ii. 811
Epithelioma molluscum, ii. 21
Epulis, i. 625
Equinia, i. 593
Erectile Tumours, i. 473
Ergot of rye, gangrene from, i. 584
Ergotin, Surgical Uses of, i. 473
Ergotinin, i. 474
Erosion of vertebræ in abdominal aneurism, i. 6
Errors of refraction, ii. 316
Eruptions of skin in secondary stage of syphilis, ii. 549
after vaccination, ii. 759
Erysipelas, i. 474
constitutional predisposition to, i. 477
cutaneous, i. 479
micrococci of, i. 478; ii. 20, 418
phlegmonous, i. 481
Erysipelas, cellular or diffuse cellulitis. See *Cellulitis*, i. 267
Erysipelas neonatorum, i. 482
of the scalp, ii. 380
Erythema, i. 484
Groups:
exudativum, i. 486
hyperæmicum, i. 484
Sub-groups:
bullosum, i. 487
fugax, i. 486
intertrigo, i. 485
iris, i. 487
læve, i. 485
marginatum, i. 487
multiforme, i. 486
nodosum, i. 488
diagnosis of, ii. 605
papulatum, i. 487
paratrimma, i. 485
pernio, i. 485
roseola, i. 485
scarlatiniforme, i. 486
simplex, i. 485
Esmarch's Bloodless Method, i. 489
alleged defects of, i. 49
use of, in treatment of abscess of bone, i. 18
of aneurism, i. 59
of traumatic aneurism, i. 61
Esmarch's Interrupted Splint, i. 490
operation for closure of the jaws, i. 833
rules of antiseptic dressing, i. 51
triangular bandage, i. 140
Ether as an anæsthetic, i. 52
Ether, anhydrous, as a local anæsthetic, i. 490, 952
Ether Spray, i. 490
Ethics, professional, in cases of railway injury, ii. 300
Ethylenediamine, ii. 416
Eucalyptus oil as an anæsthetic, i. 74
Eustachian Catheter, i. 491
Eustachian tube, catheterism of, i. 416
Examination of external ear, i. 415
of eye, i. 499
of shoulder, ii. 441
Examination, method of, in case of abdominal tumour, i. 10
of supposed hip-disease, i. 723
of lateral spinal curvature, i. 912
of ovarian disease, ii. 150
of railway injury, ii. 298
Exanthematous necrosis, i. 833
Excessive sweating, i. 764
Excision of breast, i. 192
indications and contra-indications in cases of cancer, i. 192
method of operating, i. 192
results, i. 193
Excision of the astragalus, ii. 567
of bronchocele, ii. 620
of cirsoid aneurism, i. 312
of the eyeball, i. 504
of the jaws, i. 838, 839
of joints. See *Joints, Excision of*, i. 852

Excision of joints, subperiosteal, i. 853 ; ii. 515
of the os calcis, ii. 133, 566
of parotid tumour, ii. 165
of the pylorus, ii. 284
of the rectum, ii. 316
of rib in empyema, i. 457
of the scapula, ii. 384
Exfoliation, ii. 44
Exomphalos. See *Umbilical Hernia*, ii. 704
Exophthalmic goître, ii. 613, 614, 616
Exostosis, i. 491
ivory, of ear, i. 116
of orbit, ii. 119
subungual, ii. 517
Extension in dislocation, i. 406
by weights, in hip-disease, i. 725
Extirpation of the lacrymal gland, i. 876
of the larynx, i. 897
of the pharynx, ii. 212
of the uterus, ii. 237, 752
Extraction of cataract, flap, i. 255
linear, i. 253
peripheral linear, i. 256
Extraction of Teeth, i. 493
Extra-Uterine Fœtation, i. 494
Extravasation of Urine, i. 498
Extroversion of bladder, i. 425
Exudation as a result of inflammation, i. 791
Exudation cysts, i. 392
Eye, affections of the, in diabetes, i. 401
General Examination of the, i. 999
gun-shot injuries of the, i. 642
Eyeball, Excision of the, i. 504
Injuries of the, i. 504
tension of the, i. 503
Eyelids, Diseases of the, i. 505
ecchymosis of the, in head injury, i. 686
examination of the, i. 500
Injuries of the, i. 511

Face, Fracture of Bones of the, i. 512
gun-shot injuries of the, i. 642
sebaceous cysts of the, ii. 409
Facial Artery, Surgical Anatomy and Ligation of the, i. 513
Facial carbuncle, i. 220
Facial nerve, exposure of the, in neurotomy, ii. 73
injuries of the, i. 382
stretching of the, i. 514
Facial pain in head-injury, cause of, ii. 453
Facial Palsy, i. 513
Facial Spasm, i. 514
Fæcal Abscess, i. 515
Fæcal accumulation, i. 808
Fæcal Fistula, i. 515
Fallopian Tubes, Diseases of the, i. 516
False aneurism, i. 56
joint, ii. 708
passage, ii. 499, 503
Faradisation in suspended animation, ii. 526
Farcy. See *Glanders*, i. 593
Fascia, palmar, contraction of the, i. 411
plantar, contraction of the, i. 324 ; ii. 219
Fat-Embolism, i. 517 ; ii. 742
Fatty Degeneration, i. 518
of arteries, i. 91
of toes (ainhum), i. 27
infiltration, i. 518
tumour. See *Lipoma*, i. 930
Favus, i. 520 ; ii. 451
fungus of (Achorion Schönleinii), i. 21
Fell's paste, i. 264
Female bladder, stone in the, ii. 482
Female Catheter, i. 521
Femoral Aneurism, i. 521
Artery, secondary hæmorrhage from the, i. 525
Surgical anatomy and ligation of the, i. 523
common femoral, i. 523
superficial femoral, i. 523
wound of the, i. 524
Femoral epiphyses, separation of the, i. 534, ii. 414
Femoral Hernia, i. 527
Femur, dislocation of the. See *Hip-joint*, Dislocation of the, i. 733
Femur, Fractures of the, i. 528
of the lower end, i. 533
of the neck, i. 528
of the shaft, i. 531
gun-shot wounds of the, i. 650
Femur, head of the, congenital dislocation of the, i. 337, 608
displacement of the, in hip-disease, i. 722
excision of the, i. 729
Femur, neck of the, division for the relief of ankylosis, i. 26 ; ii. 142
Fergusson, Sir W., on amputation of upper extremity in cases of subclavian aneurism, i. 61 ; ii. 514
extending arm-splint of, i. 534
on manipulation in treatment of aneurism, i. 61 ; ii. 514
rhinoplastic operation of, ii. 349
Ferment-poisoning, ii. 368
Fever, process of, ii. 522
catheter, ii. 723
filarial, i. 301
hectic, i. 689
inflammatory, i. 794
neurotic, ii. 71
sapræmic, ii. 368
suppurative, ii, 521
traumatic, ii. 660
urethral, ii. 722
Fibro-cystoma of uterus, ii. 750
Fibroma. See *Fibrous Tumours*, i. 535
of the breast, diagnosis of, i. 177
of the jaws, i. 835
of the larynx, i. 892
in old age, ii. 98
of the orbit, ii. 120
of scars, i. 306
of the testis, ii. 590
Fibro-myoma of uterus, ii. 748
Fibro-myomatous polypi, ii. 230
Fibro-sarcoma, ii. 371

Fibrous Tumours, i. 535
polypi, ii. 230
of uterus, ii. 750
Fibula, fracture of the, i. 921
Field of vision, defects of the, ii. 188
Field stations in war, i. 45
Fifth nerve, injuries of the, i. 382
exposure of branches of the, in neurotomy, ii. 73
Figure-of-8 bandage, i. 138
suture, ii. 529
Filaria Medinensis, i. 535
Sanguinis Hominis, i. 536
in elephantiasis Arabum, i. 443
Filarial fever, i. 301
infection, i. 537
periodicity, i. 538
Finger Chancre, i. 541
Fingers, Amputations of the, i. 541
Congenital Deformities of the, i. 544
contraction of the, i. 411, 679
dislocations of the, i. 675, 679
fractures of the, i. 676
webbed, ii. 812
Fissure of the anus, i. 544
of the cheek, i. 275
of the nipple, ii. 74
of the vulva, ii. 808
Fissured fracture of skull, ii. 453
Fistula in Ano, 543
Fistula, biliary, i. 285
fæcal, i. 515
lacrymal, i. 882
penile, ii. 725
perineal, ii. 734
recto-vaginal, ii. 774
recto-vesical, ii. 308
salivary, ii. 366
sterco-purulent, i. 516
urinary, ii. 734
vesico-vaginal, ii. 773
Flap extraction of cataract, i. 255
method of amputation, special advantages of the, i. 49
Flat-Foot, i. 548
Floating kidney. See *Movable Kidney*, ii. 24
Fluids resembling pus, ii. 521
Fluttering stroke of bladder, ii. 486
Focal illumination, i. 245
of cornea, i. 360
Fœtal cretinism, ii. 361
Fold suture, ii. 529
Follicular conjunctivitis, i. 349
pharyngitis, ii. 209
stomatitis, ii. 479
tonsillitis, ii. 644
Fomentations, i. 549
Foot, Amputations in the, i. 550
medio-tarsal (Chopart's), i. 551
tarso-metatarsal, i. 551
of toes, i. 550
dislocation of the, i. 62
subastragaloid, i. 553
Bones of the, Dislocations of, i. 552
cuneiform bones, i. 552
Foot, Bones of the, metatarso-phalangeal dislocations, i. 553
scaphoid dislocation, i. 552
Smith's dislocation, i. 552
tarso-metatarsal dislocations, i. 552
Fractures of the, i. 553
astragalus, i. 553
calcaneum, i. 554
Foot and Ankle, Diagnosis of Diseases and Injuries of the, i. 554
Forcible catheterism of prostate, i. 216
extension in dislocation, evil results of, i. 408
Forcipressure forceps, i. 100
Forearm, Amputations of the, i. 556
antero-posterior flaps, i. 557
circular, i. 557
rectangular (Teale's), i. 557
diagnosis of diseases and injuries of, i. 85
Foreign Bodies in the Air-passages, i. 558
in the Bladder, i. 563
in the cornea, i. 378
in the meatus auditorius, i. 418
in the nostrils, ii. 77
in the œsophagus, ii. 91
in the orbit, ii. 116
in the pharynx, ii. 208
in the rectum, ii. 309
in the urethra, ii. 716, 721
in the vagina, ii. 771
Four-tailed bandage, i. 120
Fourth cranial nerve, paralysis of the, i. 382; ii. 86
Fracture-boards, i. 566
Fractures, i. 566
causes of, i. 566
complicated, i. 568
compound, i. 570
amputation in, i. 571
consequences of, i. 572
impacted, i. 567
incomplete (greenstick), i. 566
intra-uterine, i. 814
latent, of spine, i. 131
mode of union after, i. 571
multiple, i. 566
simple, i. 566
spontaneous, i. 114
symptoms, circumstantial and direct, i. 566
treatment of, i. 568
union of, in old people, i. 574
ununited, ii. 707
with dislocation, i. 569
with much laceration of soft parts, i. 568
with rupture of the main artery, i. 568
Fractures, Special. Bones:
of the acetabulum, ii. 178
of the acromion, ii. 385
of alveolus, i. 34
at the ankle-joint, i. 62
of the astragalus, i. 553
of the calcaneum, i. 554
of the clavicle, i. 313
of the coccyx, ii. 178
of the coracoid process, i. 358

Fractures, Special. Bones:
of the coronoid process, ii. 702
at the elbow-joint, i. 85
of the ethmoidal and frontal cells, i. 576
of the bones of the face, i. 512
of the femur, i. 528
of the fibula, i. 62, 921
of the bones of the foot, i. 553
of the humerus, i. 744
of the hyoid bone, i. 764
of the malar bone, i. 513
of the superior maxilla, i. 512
of the inferior maxilla, i. 830
of the metacarpal bones, i. 676
of the metatarsal bones, i. 554
of the nasal bones, i. 512; ii. 77
of the olecranon, i. 85; ii. 702
of the bones of the orbit, ii. 115, 455
of the os innominatum, ii. 178
of the patella, ii. 167
of the pelvis, ii. 177
of the phalanges of the hand, i. 676
of the radius, ii. 291
of the ribs, ii. 351
of the sacrum, ii. 178
of the scapula, ii. 385
of the bones of the skull, ii. 452
of the sternum, ii. 477
of the tibia, i. 920
of the ulna, ii. 702
of the vertebræ, i. 130
of the zygoma, i. 513
Fractures of Cartilages:
of costal cartilages, i. 381
of laryngeal cartilages, i. 884
Fractures, splints used in treatment of. See under *Splints and Surgical Appliances.*
Fragilitas Ossium, i. 572
of old people, i. 114
Fränkel's nasal speculum, ii. 462
Freckles, i. 924
Free incision in treatment of empyema, i. 456
Freund's operation for extirpation of the uterus, ii. 752
Friction, ii. 11
Frontal Sinuses, Diseases of the, i. 574
tumours, i. 576
Frostbite, i. 576
Fuller's tracheotomy canula, ii. 655
Fulminating urethral fever, ii. 723
Fumigation, i. 216
Fungous Disease of India, i. 577
Fungus of the brain, i. 175
of the testis, i. 715
Fungus hæmatodes of testis, ii. 590, 591
Furunculus, i. 163
Fusible calculus, i. 215

Gait, in cases of amaurosis, i. 36
of pseudo-hypertrophic muscular paralysis, ii. 262
of congenital dislocation of the head of the femur, i. 337
Galactocele, i. 579
Galactorrhœa, i. 179
Gall-bladder, distension of the, i. 284
Gall-stone, extraction of, i. 284
impaction of, a cause of intestinal obstruction, i. 807
Galvanic cautery, i. 266
Galvano-puncture, i. 439
in treatment of aortic aneurism, i. 440
of cirsoid aneurism, i. 311
of iliac aneurism, i. 776
of nævus, ii. 33
of orbital aneurism, ii. 131
Ganglion, i. 579
Gangrene, i. 550
causes of, i. 580
constitutional, i. 582
local, i. 580
specific, i. 584
pathology of, i. 585
symptoms of, 586
treatment of, i. 587
varieties of:
dry, i. 587
moist, i. 586
senile, i. 582
spontaneous, i. 583
spreading traumatic, i. 584; ii. 419
Gangrene from special causes:
from aneurism, i. 58
in diabetes, i. 401, 584
from ergot of rye, i. 584
from gunshot injury, i. 632
Gangrene, specific forms of.
See *Boils*, i. 163
Cancrum Oris, i. 217
Carbuncle, i. 219
Glanders, i. 593
Hospital Gangrene, i. 739
Malignant Pustule, ii. 2, 421
Phagedæna, ii. 205
Gangrène foudroyante, ii. 419
symétrique of Raynaud, i. 584
Gangrenous stomatitis, i. 217
Garson on elevation of the bladder by fluid distension of the rectum, i. 940
Gastric Fistula, i. 589
Gastro-enterostomy, ii. 287
Gastrostomy, i. 590; ii. 95
Gastrotomy, i. 883
Gauze dressing, i. 73
Gély's suture, ii. 531
Genital organs, gunshot wounds of the, i. 648
Genu Extrorsum, i. 591
Genu Valgum, i. 592
treatment of by osteotomy, ii. 143
Geographical distribution of Delhi boil, i. 395
of elephantiasis arabum, i. 441
of elephantiasis græcorum, i. 444
of goître, ii. 613
Gerdy's suspensory ligament, part played by in axillary abscess, i. 117
Gerontoxon (arcus senilis), i. 375
Giant-celled sarcoma, ii. 370
Gibson's Splint for Fractured Thigh, i. 593
Gingivitis, i. 625

Glanders, i. 593
a variety of pyæmia, ii. 419
Glands, lymphatic, affections of.
See *Bubo*, i. 197
Lymphadenitis, i. 962
Lymphadenoma, i. 965
Lymphoma, i. 965
Glandular affections in cases of malignant tumour, ii. 6
Glass drainage-tubes, i. 411
Glaucoma, i. 594
defect of field of vision in, ii. 188
treatment of, i. 601
Gleet, i. 605
Glioma, ii. 370
of the retina, ii. 124, 341
Glossitis, ii. 632
Glottis, scalds of the, i. 904; ii. 377
Glue bandages, i. 781
Gluteal Aneurism, i. 607
Gluteal artery, wounds of the, i. 608
Gluteal muscles, wasting of the, i. 608
Gluteal Region, Diagnosis of affections of the, i. 608
Glycosuria, as a sequela of injuries, i. 401
Goitre. See *Diseases of the Thyroid Gland*, ii. 613
Goitre asthma, ii. 615
geographical distribution of, ii. 613
miasma, ii. 613
plongeant, ii. 615
Gonorrhœa, i. 610
complications of, i. 611
treatment of, i. 612
urethral hæmorrhage in, i. 611
Gonorrhœal epididymitis, ii. 578
ophthalmia, i. 352
rheumatism, i. 614
Gooch's Splint, i. 615
Gordon's method of reducing dislocation of shoulder, ii. 444
splints for Colles's fracture, i. 615
for fractured clavicle, i. 615
Gouty arthritis, i. 850
Gowland's rectal speculum, ii. 461
Gradual interrupted dilatation in treatment of stricture, ii. 501
Grafting, i. 616
of bone, i. 617
of medulla, i. 618
of periosteum, i. 618
of skin, i. 616
of sponge, i. 618
Granular laryngitis, i. 887
ophthalmia, i. 350
pharyngitis, ii. 209
urethritis, i. 606
Graves's Disease, ii. 613
Greenstick fracture, i. 566
of arm and forearm, i. 85
Gritti's amputation at the knee-joint, i. 873
Groin, Diagnosis of affections of the, i. 619
Guinea-worm, i. 535
Gum-and-chalk bandages, i. 781
Gum-Boil, i. 622
Gumma, i. 623
of the larynx, i. 905
of muscle, ii. 28
of the testis, ii. 554
of the tongue, ii. 637
Gums, Affections of the, i. 624
hypertrophy, i. 624
inflammation, i. 625
scorbutic swelling, i. 625; ii. 407
tumours, i. 625
Gunshot Wounds, i. 626
complications of, i. 631
shock in, i. 629
symptoms of, i. 629
treatment of, i. 637
general, i. 632
primary in field, i. 632
Gunshot Wounds, Special.
of the abdomen, i. 645
of arteries, i. 649
of the bladder, i. 647
of bones, i. 634
of the ear, i. 642
of the eye, i. 642
of the face, i. 642
of the genital organs, i. 648
of the head, i. 638
of joints, i. 636
of the neck, i. 643
of nerves, i. 642
of the spine, i. 641
of the thorax, i. 643
of veins, i. 649
Gussenbauer's suture, ii. 530
Gustatory Nerve, division and stretching of the, i. 653
Gutta-percha splints, ii. 473

Hæmatocele, i. 654
of the pelvis. See *Pelvic Hæmatocele*, ii. 175
of the spermatic cord, i. 656
of the testicle, i. 656
of the tunica vaginalis, i. 654
Hæmato-chyluria. See *Chyluria*, i. 298
Hæmato-salpinx, i. 516
Hæmatoma, i. 196
of the ear, i. 417
of the scalp, i. 686; ii. 379
Hæmaturia, i. 657, 864
differential diagnosis of sources of bleeding in, i. 658
fallacies of, i. 657
tests of, i. 657
treatment of, i. 659
in injuries to the spine, i. 126
in prostatic hypertrophy, ii. 258
Hæmophilia, i. 659
joint-affection of, i. 660
order of hereditary transmission of, i. 659
Hæmoptysis from Injury, i. 661
Hæmorrhage, i. 662
classification of, i. 662
constitutional symptoms of, i. 663

Hæmorrhage, difference between arterial and venous bleeding, i. 663
natural means of arrest, i. 664
treatment of arterial bleeding, i. 94
of capillary bleeding, i. 666
of venous bleeding, i. 666
dangers of in old age, ii. 96
Hæmorrhage, arterial, i. 93
from bladder, i. 658
from extraction of teeth, i. 493
in gonorrhœa, i. 611
from gunshot wounds, i. 649
from hæmorrhoids, i. 668
in head-injury, i. 687; ii. 456, 457
intracranial, i. 173; ii. 456
from the kidney, i. 658, 863
after lithotomy, i. 938
from the nose, i. 472
after removal of tonsils, ii. 646
in spinal injury, i. 126, 128
in scurvy, ii. 408
from the urethra, i. 658
in wounds of the chest, i. 661, 670
Hæmorrhagic diathesis. See *Hæmophilia*, i. 659
sarcoma, ii. 370
Hæmorrhoids, i. 667
Hæmothorax, i. 670
Hagedorn's needles, ii. 46
Hainsby's Truss, i. 672
Hair, Diseases of the, i. 672
alopecia areata, i. 33
atrophy of the, i. 672
baldness, i. 672
loss of, from lightning, i. 929
in syphilis, ii. 533
Halter bandage, i. 138
Hamilton's splint for fracture of the femur, i. 673
of the lower jaw, i. 831
test in dislocation of the shoulder, ii. 442
Hammer-toes, i. 673
Hammock-method of treating spinal caries, i. 233
Hammond's Splint for fracture of the lower jaw, i. 674
Hamstring Tendons, Contraction of the, i. 674
Hand, Amputations of the, ii. 819
atrophy of the, i. 677
bursal swellings about the, i. 209
deformities of the, i. 411, 544, 679; ii. 812
dislocation of the, ii. 821
dislocation of the bones of the, i. 676
fracture of the bones of the, i. 677
ganglions of the, i. 579
hæmorrhage from wounds of the, ii. 160
hypertrophy of the, i. 677
inflammation of the, i. 678
tumours of the, i. 680
warts of the, ii. 811
wounds of the, i. 677; ii. 160
Hand, Surgery of the, i. 676
Handkerchief bandage, i. 140
Hare-Lip, i. 680
age for operation in, i. 680
operative treatment of, i. 681
Head, gunshot wounds of the, i. 638
relations of surface of, to cerebral convolutions and sulci, i. 686
tapping of the, ii. 164
tumours of the—
See *Exostosis*, i. 491
Meningocele, ii. 16
Diseases of the Scalp, ii. 381
Sebaceous Cysts, ii. 400
Head-Injuries, Diagnosis of, i. 683
Hearing, acuteness of, mode of testing, i. 393
impaired, in diseases of internal ear, i. 419
Heart, Rupture and Wounds of the, i. 639
Hebra's prurigo, ii. 259
Hectic Fever, i. 689
Hemeralopia, i. 691
in scurvy, ii. 407
Hemianopsia, i. 39, 691; ii. 188
defect of field of vision in, ii. 188
Hemiplegia in head-injury, i. 685
in railway injuries, ii. 296
Hereditary syphilitic physiognomy, i. 346
transmission of hæmophilia, i. 659
of malignant disease, ii. 7
of mammary cancer, i. 186
Heredity in diseases of childhood, i. 281
in hypospadias, i. 770
in leprosy, i 444
in scrofula, ii. 396
Hernia, conditions of
Incarcerated, i. 693
Inflamed, i. 691
Irreducible, i. 692
Obstructed, i. 693
Reducible, i. 702
Strangulated, i. 702
analysis of symptoms of strangulation, i. 704
aspiration in treatment of strangulation, i. 708
cause of constipation in strangulation, i. 704
cause of diminished secretion of urine in strangulation, i. 705
cause of pain in strangulation, i. 704
diagnosis of strangulated hernia, i. 707
herniotomy *versus* taxis in, i. 709
methods of strangulation, i. 702
reduction of *en masse*, i. 711
treatment of, i. 709
Hernia, kinds of; acquired, i. 799
congenital, i. 799
infantile, i. 799
Littre's, i. 707
Hernia, radical cure of, i. 693
methods of Annandale, Banks, and Stokes, i. 694
Spanton's operation, i. 694
Wood's method, in crural hernia, i. 699
in inguinal hernia, i. 696
in umbilical hernia, i. 700
after herniotomy for strangulated inguinal hernia, i. 699
results of treatment, i. 695
selection of cases, i. 695

HERNIA, special forms of—
abdominal, i. 9
diaphragmatic, i. 401
femoral, i. 527
inguinal, i. 798
external, oblique or indirect, i. 798
internal or direct, i. 800
lumbar, i. 955
obturator, ii. 81
perineal, ii. 190
pudendal, ii. 268, 810
rectal, ii. 245
sciatic, i. 609
scrotal, ii. 402
of tunica vaginalis, i. 799
umbilical, ii. 704
vaginal, ii. 775
ventral. See *Abdominal Hernia*, i. 9
Hernia of bladder, i. 392
of brain, i. 175
after gun-shot wound, i. 640
of lung, ii. 221
after gunshot wound, i. 645
of muscle, ii. 227
of testis, i. 715; ii. 586, 587
Hernial sac, contents of the,
in reducible hernia, i. 701
in strangulated hernia, i. 708
hydrocele of the, i. 758
morbid anatomy of the, in strangulation, i. 708
removal of, in radical cure of hernia, i. 697
in herniotomy, i. 714
Herniotomy, i. 712
comparison of, with taxis, i. 709
how to deal with bowel, i. 713
with omentum, i. 713
with sac, i. 712, 714
sequelæ of operation, i. 714
in femoral hernia, i. 527
in inguinal hernia, i. 801
in obturator hernia, ii. 81
in umbilical hernia, ii.
HERPES, i. 716; ii. 450
FRONTALIS, i. 718
iris, i. 487, 717; ii. 450
of the penis, i. 136; ii. 185, 544
of the pharynx, ii. 212
zoster, i. 717; ii. 450
in association with syphilis, ii. 544
Hey's amputation, i. 551
Hidebound disease (scleroderma), ii. 388
Hilton's rectal speculum, ii. 461
HIP, diagnosis of diseases and injuries about the, i. 719
HIP-DISEASE, i. 721
age of patients in, i. 721
amyloid degeneration or complication of, i. 725
causes of, i. 721
complications of, i. 724
diagnosis of, i. 719, 722
examination of patient in, i. 723
pathology of, i. 722
symptoms of, i. 722
HIP-DISEASE, symptoms of altered position of limb, i. 722
lameness, i. 722
loss of movement in joint, i. 723
muscular wasting, i. 723
pain, i. 722
swelling, i. 723
treatment of, i. 725
by amputation, i. 730
by excision, i. 728
by extension, i. 727
by rest, i. 725
tubercular meningitis in cases of, i. 725
HIP-JOINT, Amputations at the, i. 730
arrest of hæmorrhage during, i. 731
antero-posterior or double flap method, i. 732
circular method, i. 732
modified circular (Furneaux Jordan's method), i. 733
mortality of, in military surgery, i. 638
oval method, i. 732
ankylosed, osteotomy for relief of, ii. 142
Dislocations of the, i. 733
Sir Astley Cooper's classification of, i. 733
Bigelow on the importance of the ilio-femoral ligament in, i. 733
irregular or anomalous, i. 737
into the perineum, i. 738
regular – superiliac (upwards and backwards on to dorsum ilii), i. 734
superpubic (upwards and forwards on to pubes), i. 736
supersciatic (upwards and backwards into sciatic notch), i. 735
superthyroid (downwards, or downwards and forwards), i. 735
dislocations, congenital, of the, i. 337
pathological, of the, i. 721
excision of the, i. 728
Hoarseness, i. 83
HODGEN'S SPLINT, i. 738
Hodgkin's Disease, i. 738, 965
Hogan's speculum, ii. 462
Holmgren's coloured wools for detection of colour-blindness, i. 333
Hordeolum, i. 505
Horns, i. 738
Horsehair drains, i. 411
Horseshoe fistula, i. 546
HOSPITAL GANGRENE, i. 739; ii. 419, 545
after gun-shot injury, i. 632
HOSPITALISM AND HOSPITAL MORTALITY, i. 740
prevention of, i. 743
statistics of, i. 741
Housemaid's knee, i. 210
Howard's method of artificial respiration, ii. 525
HOWSE'S SPLINT, i. 744
Humerus, disarticulation of the, ii. 439
for axillary aneurism, i. 123
for subclavian aneurism, i. 61
dislocations of the, ii. 442
congenital of the, i. 336

HUMERUS, FRACTURES of the, i. 744
HUMERUS, FRACTURES
of the anatomical neck, i. 744
of the greater tuberosity, i. 744
of the lower end, i. 747
of the shaft, i. 745
of the surgical neck, i. 745
separation of epiphyses of the,
the upper, i. 744; ii. 413
the lower, i. 746; ii. 413
tumours of (malignant) of the, ii. 688, 691
Hunterian operation for aneurism, i. 59
Hyalitis, ii. 803
Hydatid cysts of bone, ii. 692
of the orbit, ii. 120
of the spleen, ii. 472
Hydatid rash, i. 749
HYDATIDS, i. 747
operative treatment of, i. 750
HYDRARTHROSIS, i. 750
Hydrencephalocele, ii. 16
Hydroa. See *Herpes Iris*, under *Erythema*, i. 487
HYDROCELE, i. 751
acute vaginal, i. 751
chronic vaginal, i. 752
congenital, i. 756
diffuse, of the cord, i. 758
encysted, of the cord, i. 757
of the testis, i. 757
of a hernial sac, i. 758
infantile, i. 756
inguinal, i. 758
diagnosis of, ii. 403
treatment of
by acupuncture, i. 754
by incision, i. 755
by injection, i. 755
by tapping, i. 754
Hydrocele, chronic vaginal, diagnosis of from hernia, i. 753
of the canal of Nuck, ii. 810
HYDROCELE OF THE NECK, i. 758
Hydrocephalus, ii. 17
Hydro-hæmatocele, i. 750
HYDRONEPHROSIS, i. 759
HYDROPHOBIA, i. 761
causes of, i. 761
diagnosis of, i. 764
pathology of, i. 763
prognosis of, i. 763
treatment of, i. 763
Hydrops articuli, ii. 541
Hydro-salpinx, i. 516
Hydrosarcocele, ii. 582, 583
Hygroma, i. 758
Hymen, imperforate, ii. 769
HYOID BONE, fracture of the, i. 764
Hyperæmia of conjunctiva, i. 347
Hyperæsthesia, of the larynx, i. 904
of mucous membrane of urethra, a cause of spermatorrhœa, ii. 465
treatment of, by nerve-stretching, ii. 61
HYPERIDROSIS, i. 764; ii. 450
Hypermetropia, i. 765. See *Errors of Refraction*, ii. 316
Hyperostosis of the lower jaw, i. 834
Hyperpyrexia, ii. 533
HYPERTROPHY, i. 765
compensatory, i. 767
irritative, i. 767
physiological, i. 766
of bones. See *Leontiasis Ossea*, i. 924; *Ostitis Deformans*, ii. 146
of the breast, i. 179
of the clitoris, ii. 807
of the gums, i. 624
of muscle, ii. 28
of the nails, ii. 35
of the prostate, ii. 251
of the scrotum, ii. 399
of the spleen, ii. 471
of the thyroid gland. See *Goitre*, ii. 613
of the toes. See *Pes Gigas*, ii. 205
of the tongue, ii. 631. See *Macroglossia*, ii. 1
of the tonsils, ii. 645
HYPOCHONDRIASIS, i. 767
HYPODERMIC INJECTION, i. 767
accidents attending, i. 769
drugs employed in, i. 768
use of in checking growth of tumours, i. 769
spread of acute specific disease, i. 769
of ergotin, i. 474.
of mercury in syphilis, ii. 563
Hypoglossal nerve, paralysis of the, i. 383
Hypopyon, i. 769
Hypospadias, i. 769
hereditary transmission of, i. 770
treatment of, i. 771
Hyposphagma, ii. 516
Hysterectomy. See *Porro's Operation*, ii. 237; *Extirpation of the Uterus*, ii. 752
Hysteria after railway injury, ii. 298
Hysterical dysphagia, i. 413
joint-affections, i. 851
laryngeal affections, i. 898

ICHTHYOSIS, i. 772
association with, of asthma and mental weakness, i. 773
hystrix, i. 773
simplex, i. 772
treatment of, i. 774
xeroderma, i. 772
Iliac abscess, i. 622
ILIAC ANEURISM, i. 774
treatment of, i. 775
by amputation at the hip-joint, i. 777
by compression, i. 775
by galvano-puncture, i. 776
by injection of perchloride of iron, i. 776
by ligature, distal, i. 776
proximal of abdominal aorta, i. 776
of common iliac, i. 776
of external iliac, i. 775
ILIAC ARTERIES, Surgical Anatomy and Ligation of the, i. 777
common iliac, i. 777, 779

Iliac Arteries, Surgical Anatomy and Ligation of the, external iliac, i. 777, 778
internal iliac, i. 778, 779
Ilio-femoral ligament, part played by in dislocation of the hip, i. 733
Ilio-femoral triangle of Bryant, i. 720
Immobility, i. 779
Immovable Bandages, i. 779
Impacted calculus, ii. 488
fracture, i. 566
of the neck of the femur, i. 528
Imperforate anus, i. 112
hymen, ii. 769
Impetigo, i. 782
differential diagnosis of, and eczema, i. 782
Impotence, i. 783
Incarcerated hernia, i. 693
Inclined Planes, i. 785
Incomplete dislocation, i. 403
Incontinence of Urine, i. 785
juvenile, i. 786
Incubation-period of septicæmia, ii. 424
Indian plastic operations, ii. 220, 347
Indolent bubo, i. 197
Indolent ulcer, ii. 698
Indurated chancre, minute structure of, ii. 548
Induration, i. 787
Infantile hernia, i. 779
scurvy, ii. 361
syphilis. See *Congenital Syphilis*, i. 339
Infants, erysipelas in, i. 482
hernia in, i. 282
predisposition of to sarcoma, i. 282
shock in, ii. 433
surgery of. See *Surgical Affections of Childhood*, i. 280
susceptibility to action of drugs, i. 282
temperature of, i. 281
tetanus in, ii. 598
Infarction, i. 480, ii. 278
Infarcts, i. 450
Infective cellulitis, i. 419
Inferior dental nerve, exposure of, in neurotomy, ii. 73
Infiltration-keratitis, i. 363
Inflammation, Acute, i. 788
causes of, i. 792
early phenomena of, i. 788
exudation, i. 791
resolution, i. 791
retrogression, i. 791
suppuration, i. 792
treatment of, i. 795
chronic, i. 795
in old age, ii. 97
Inflammatory adhesion as a therapeutic resource, i. 27
fever, i. 794
stricture, ii. 497
Inflation in treatment of intussusception, i. 811
Inflation of tympanum, i. 416
by Politzer's method, i. 416
by Valsalva's method, i. 416
Infra-orbital nerve, exposure of, in neurotomy, ii. 73
Infra-patellar bursa, enlargement of the, ii. 604
Ingrowing Toe-nail, i. 797, ii. 35
Inguinal aneurism. See *Iliac Aneurism*, i. 774
colotomy, i. 331
Inguinal Hernia, i. 798
external or oblique, i. 798
acquired, i. 799
congenital, i. 799
internal or direct, i. 800
operation of herniotomy in, i. 801
Injury an exciting cause of malignant growth, ii. 8
Injuries of cranial nerves, i. 381
Innominate Aneurism, i. 801
Innominate Artery, Surgical Anatomy and Ligation of the, i. 801, 802
Inoculation treatment of granular ophthalmia, i. 352
Insects, stings of, ii. 478
Intemperance a cause of aneurism, i. 56
Intermaxillary bone in hare-lip, i. 680
Intermediate hæmorrhoids, i. 668
Internal hæmorrhoids, i. 668
urethrotomy, ii. 727
Interrupted sutures, ii. 528
Interstitial keratitis, i. 367
in congenital syphilis, i. 343
treatment of, ii. 564
Intertrigo, i. 485
Intestinal Obstruction, i. 802
Acute—
acute intussusception, i. 805
acute obstruction by gall-stones, i. 808
internal strangulation, i. 802
volvulus of the sigmoid flexure, i. 804
Chronic—
chronic intussusception, i, 814
fæcal accumulation, i. 808
stricture and stenosis of the intestine, i. 806
cicatricial stricture, i. 806
cancerous stricture, i. 807
differential diagnosis of, i. 810, 812, 813
symptoms of, i. 809
treatment of, i. 810
acute obstruction, i. 810
chronic obtruction, i. 814
Intestine, conditions of, in inflamed hernia, i. 691
in obstructed hernia, i. 693
in strangulated hernia, i. 708, 713
gun-shot wounds of, i. 646
management of, in different conditions of strangulation, i. 713
perforation of, in strangulated hernia, i. 713
protrusion of, in injuries of the abdomen, i. 4
resection of.
See *Colectomy*, i. 327
Enterectomy, i. 461
Pylorus, operations on the, ii. 283
rupture of, in injuries of the abdomen, i. 4

For articles on diseases, injuries, and malformations of Intestinal Tract
See *Injuries of the Abdomen*, i. 1
Abdominal Hernia, i. 9
Artificial Anus, i. 101
Atresia Ani, i. 112
Colectomy, i. 327
Colotomy, i. 330
Diaphragmatic Hernia, i. 401
Enterectomy, i. 467
Enterotomy, i. 469
Fæcal Abscess and *Fæcal Fistula*, i. 915
Inflamed Hernia, i. 691
Reducible Hernia, i. 701
Strangulated Hernia, i. 702
Intestinal Obstruction, i. 802
Recto-Vesical Fistula, ii. 308
Injuries and Diseases of the Rectum, ii. 309
Umbilical Fistula, ii. 704
Intra-capsular fracture of neck of femur, i. 528
Intra-cranial abscess, i. 461
aneurism, ii. 126
hæmorrhage, i. 173
Intra-orbital aneurism, ii. 125
Intra-spinal hæmorrhage, i. 128
Intra-thoracic aneurism, i. 801
Intra-uterine Fractures, i. 814
Intussusception, i. 805
Inunction of Mercury, i. 816, ii. 562
Invagination treatment of hernia.
See *Hernia, Radical Cure of*, i. 693
Inversion of testis, ii. 593
Involution cysts of breast, i. 183
Iodic roseola, ii. 15
Iodide of potassium, in treatment of syphilis, ii. 558, 563
coryza from, ii. 563
eruption from, ii. 15, 563
Iodide of sodium, in treatment of syphilis, ii. 563
Iodine, injection of, in bronchocele, ii. 617
in hydrocele, i. 755
in spina bifida, ii. 470
Iodoform, Surgical uses of, i. 816
as an antiseptic, i. 817
in local treatment of tertiary syphilis, ii. 561
Iridectomy, i. 817, 826
in cataract, i. 251, 258
in glaucoma, i. 602
in iritis, i. 826
Irido-choroiditis, i. 307
Irido-cyclitis, i. 307
Iridodesis, i. 252
Iridotomy, i. 252
Iris, Diseases of the, i. 820
coloboma, i. 820
cysts and tumours, i. 820
inflammation, i. 821
examination of the, i. 502
Iritis, plastic, i. 821
serous, i. 828
syphilitic, ii. 551
Iritis, syphilitic, treatment of, ii. 552, 564
Iron, perchloride of, in treatment of erysipelas, i. 483
of nævus, ii. 33
Irreducible hernia, i. 692
Irrigation, i. 828
Irritable bladder.
See *Neuralgia of the bladder*, i. 149
Strangury, ii. 495
testis, ii. 588
Issues, i. 829
Itch. See *Scabies*, ii. 375
Ivory exostosis, i. 491
of external ear, i. 116
of frontal sinus, i. 576

Jaw, Lower, Congenital dislocation of the, i. 335
dislocations of the, i. 830
bilateral, i. 830
unilateral, i. 830
subluxation, i. 831
Fracture of the, i. 831
removal of the, i. 839
Jaw, Upper, fracture of the, i. 512
removal of the, i. 538
Jaws, Closure of the, i. 832
diseases of the, i. 833
See *Antrum, Diseases of the*, i. 79
Gums, Affections of the, i. 624
Odontoma, ii. 88
cysts, i. 835
dentigerous cysts, i. 400
exanthematous necrosis, i. 833
hyperostosis, i. 834
necrosis, i. 833
periostitis, i. 833
phosphorus-necrosis, i. 834
tumours, i. 835
gunshot wounds of the, i. 642
operations on the, i. 837
Jejunostomy, ii. 288
Jobert's suture, ii. 530
Joints, Amputations at the
ankle, i. 65
elbow, i. 435
hip, i. 730
knee, i. 872
shoulder, ii. 439
wrist, ii. 819
Joints, Diseases of the, i. 840
of articular cartilage, i. 846
of articular ends of bones, i. 846
chronic articular ostitis, i. 847
of ligaments, i. 840
of synovial membrane, i. 840; ii. 540
Special forms of:—chronic rheumatic arthritis, i. 296
gouty disease, i. 850
affections of joints in hæmophilia, i. 660
hysterical affections, i. 851
affections after nerve-section, ii. 53
osteo-arthritis, ii. 134

Joints, Diseases of the, Special forms of:—
pyæmic affections, i. 849; ii. 279
rheumatic affections, i. 849
scrofulous affections, i. 850; ii. 398
syphilitic affections, i. 850
tabetic arthropathy, i. 272, 851
tubercular disease, ii. 673
Joints, Excision of, i. 852
of the ankle, i. 854
of the elbow, i. 855
of the hip, i. 729
of the knee, i. 856
of the shoulder, i. 857
of the wrist, i. 858
subperiosteal excision, i. 853
Joints, Injuries of.
in complicated fracture, i. 569
in compound dislocation, i. 404
gunshot wounds, i. 636
sprains, i. 475
Wounds, i. 859
Joints, loose cartilages in, i. 953
stiffness of. See *Ankylosis*, i. 67
Jordan on shock during amputation, ii. 433
Jordan's amputation at hip, i. 730, 732
Jugular vein, blood-letting from the, ii. 782
wounds of the, i. 861
Junks, i. 862

Kangaroo-tendon Ligature, i. 863
Keloid, i. 305; ii. 452
Kelotomy (herniotomy), i. 712
Keratitis, i. 360
circumscribed interstitial, i. 367
neuropathic, i. 365
phlyctenular, i. 364
suppurative, i. 369
trachomatous, i. 363
traumatic, i. 363
in congenital syphilis, i. 346
Kerato-globus (globular cornea), i. 375
Keratoconus (conical cornea), i. 375
Keratoscopy, ii. 341
Keratosis pilaris, i. 927
Kidney, degeneration of in ectopia vesicæ, i. 425
Kidney, Diseases of the:—
hæmorrhage, from the, i. 658, 863, 868
hydronephrosis, i. 759
movable kidney, ii. 24, 55
nephralgia, ii. 46
nephritis, ii. 50
nephrolithiasis, ii. 52
perinephritic abscess, ii. 190
pyelitis, ii. 281
pyelonephritis, ii. 282
pyonephrosis, ii. 288
suppression of urine, ii. 518
surgical kidney. See *Pyelonephritis*, ii. 282
tumours, i. 870
Injuries of the, i. 863
non-penetrating, i. 863
penetrating, i. 865
gunshot wounds, i. 646
Kidney, Operations on the—
nephrectomy, ii. 47
nephro-lithotomy, ii. 54
nephroraphy, ii. 55
nephrotomy, ii. 56
Surgery of the, i. 867
Knee-Joint, Amputations at the, i. 872
Carden's operation, i. 872
Gritti's operation, i. 873
supra-condyloid amputation, i. 873
Syme's operation, i. 872
ankylosis of the, osteotomy for, ii. 142
congenital dislocation of the, i. 336
diseases of the, i. 873
Dislocations of the, i. 871
backwards, i. 872
forwards, i. 872
partial inwards, i. 872
partial outwards, i. 871
by rotation outwards, i. 872
excision of the, i. 856
gunshot wounds of the, i. 638
injuries of the, diagnosis of, ii. 603
Knock-knee, i. 592
Knotted bandage, i. 138
Koch's test of value of antiseptic agents, i. 78
Kocher's operation for removal of goître, ii. 620
for removal of the tongue, ii. 643
plan of reducing dislocation at shoulder-joint, ii. 445
Kyphosis, i. 69

Labial chancre, i. 932
Labyrinth, changes in the, in disease of the internal ear, i. 420
Lacerated wounds, ii. 817
Lacrymal Apparatus, Diseases of the, i. 876
Lacrymal fistula, i. 882
Lacrymal gland, extirpation of the, i. 876
inflammation of the, i. 876
Lacrymal sac, acute inflammation of the, i. 881
chronic inflammation of the, i. 877
treatment of, i. 879
Lactation, disorders of, i. 179
Lamellar cataract, i. 248
Lameness in hip-disease, i. 722
Langenbeck's rhinoplastic operation, ii. 348
Langenbuch's method of nephrectomy, ii. 49
Laparo-elytrotomy, i. 882
Laparotomy.
See references under *Abdominal Section*.
Laparotomy for Intestinal Obstruction, i. 883
Lardacein, i. 30
Lardaceous disease. See *Albuminoid Degeneration*, i. 29
Laryngeal Cartilages, Fracture of the, i. 884
Laryngeal phthisis, i. 908
syphilis, i. 905
Laryngectomy, i. 891
Laryngismus stridulus, i. 902
Laryngitis, i. 884
Laryngoscope, i. 888

Laryngoscopy, i. 888
in cases of laryngeal paralysis, i. 899
of laryngeal phthisis, i. 908
of laryngeal syphilis, i. 906
of laryngeal tumour, i. 893, 896
Laryngotomy, i. 890
Larynx, Diseases of the, i. 884
Growths, i. 892
malignant, i. 895
non-malignant, i. 892
inflammation (laryngitis), i. 884
acute, i. 884
acute œdematous, ii. 89
chronic, i. 886
Neuroses, i. 898
paralysis, i. 898
of sensation, i. 904
spasms, i. 901
troubles of co-ordination, i. 903
Syphilis, i. 905
Tuberculosis, i. 908
Extirpation of the, i. 891, 897
foreign body in the, i. 559
Scalds of the, i. 904; ii. 377
wounds of the, ii. 607
'Latent' fracture of the spine, i. 131
squint, ii. 490
Lateral Spinal Curvature, i. 910
Lead-poisoning, amblyopia from, i. 41
musculo-spiral paralysis from, ii. 28
Leech, Artificial, i. 289, 918
Leeching, i. 918
Leg, Amputations of the, 918
circular method, i. 919
flap method, i. 918
Lister's method, i. 919
Teale's rectangular method, i. 918
diagnosis of affections of the, ii. 601
Fractures of the, i. 920
of both bones, i. 921
of fibula, i. 921
of tibia, i. 920
compound fracture, i. 923
Leiter's Tubes, i. 923
Lembert's Suture, i. 924; ii. 530
Lentigo, i. 924
Leontiasis Ossea, i. 924
Lepra. See *Psoriasis*, ii. 265
Leprosy. See *Elephantiasis Græcorum*, i. 444
Leucasmus. See *Leucoderma*, i. 925
Leucocytes, part played by in inflammatory changes, i. 790
Leucoderma, i. 925
Leucoma (of cornea), i. 374
Leucoplakia, ii. 633. See *Psoriasis Buccalis*, ii. 267
Leukæmic lymphadenoma, i. 966
Levis's Apparatus, i. 925
Lice, ii. 170
Lichen, i. 926
syphilitic, ii. 550
Ligaments, Diseases of, in joint-disease i. 848
rupture of, ii. 475
Ligamentum patellæ, rupture of, ii. 575
Ligation of arteries.
See references under heading of *Surgical Anatomy of and Ligation of Arteries.*
Ligature, distal, i. 60
proximal, i. 59
temporary, i. 60
in treatment of aneurism, i. 59
of cirsoid aneurism, i. 311
of nævus, ii. 33
of abdominal aorta for iliac aneurism, i. 776
of the axillary artery, for aneurism, i. 123
for rupture of vessel, in reduction of dislocation, i. 121
for wound, i. 120
of the brachial artery, for wound of the palmar arch, ii. 161
of the carotid artery, for aneurism of the common trunk, i. 236
for aneurism of the external and internal carotids, i. 236
for cirsoid aneurism of the scalp, i. 311
for orbital aneurism, ii. 131
distal, of, in aortic aneurism, i. 81
distal, of, in innominate aneurism, i. 801
of femoral artery:
for elephantiasis arabum, i. 443
for popliteal aneurism, ii. 234
for punctured wound of vessel, i. 525
for secondary hæmorrhage, i. 526
for wounds of plantar arteries, ii. 219
of gluteal artery, for aneurism of vessel, i. 607
for wound, i. 608
of common iliac artery, for iliac aneurism, i. 776
of external iliac artery, for iliac aneurism, i. 775
for recurrent popliteal aneurism, ii. 234
of internal iliac artery, for gluteal aneurism, i. 607
of jugular vein, i. 862
of lingual artery, in removal of tongue, ii. 643
of popliteal artery, for wound of vessel, ii. 235
of subclavian artery, for axillary aneurism, i. 123
for wound of axillary artery, i. 120
for subclavian aneurism, ii. 513
distal ligature for aortic aneurism, i. 81
for innominate aneurism, i. 801
for subclavian aneurism, ii. 514
of vertebral artery, ii. 785
Ligature, elastic, in treatment of fistula in ano, i. 547
Ligatures, i. 928
catgut, i. 75, 928
kangaroo-tendon, i. 863
Lightning, Accidents from, i. 929
Lightning pains, treatment of, by nerve-stretching, ii. 61
Limbs, artificial, i. 104

Linear extraction of cataract, i. 253
Lingual Artery, Surgical Anatomy and Ligation of the, i. 930
Linseed-meal poultice, ii. 240
Lipoma, i. 930
nasi, ii. 77
in old age, ii. 98
'Lipome herniaire,' i. 708
Lips, Diseases of the, i. 931
adenoma, i. 933
cysts, i. 933
epithelioma, i. 932
ulcers, i. 931
plastic operations on the. See *Cheiloplasty*, i. 276
Liquid glass bandages, i. 781
Lisfranc's amputation in the foot, i. 551
Lister's, Sir Joseph, abdominal clamp, i. 731
bloodless method, i. 490
modification of Teale's amputation, i. 48
needle, ii. 46
operation for excision of wrist, i. 858
splint for use after excision of wrist, i. 933
treatment of fractured patella, ii. 169
Listerism. See *Antiseptic Surgery*, i. 70
in abdominal surgery, i. 10
in hip-disease, i. 728
Liston's artery-forceps, i. 100
long splint, i. 933
Litholapaxy, i. 943
Lithophone, ii. 486
Lithotomy, i. 934
lateral operation in the adult, i. 934
causes of death after, i. 939
dangers of, i. 938
obstacles met with in, i. 937
median operation, i. 940
advantages and disadvantages of, i. 940
suprapubic operation, i. 940
in children, i. 939
in women, i. 941
mortality after, i. 942
recurrence of stone after, i. 943
Lithotrite, use of in removing foreign body from bladder, i. 565
Lithotrity, i. 943
the new method (litholapaxy), i. 949
the old method, i. 946
dangers of, i. 948
fatal complications of, i. 946
obstacles met with in, 947
results of, i. 949
Lithotrity, or lithotomy, choice of operation, ii. 486
Littre's operation, i. 330
in treatment of imperforate anus, i. 113
Littre's hernia, i. 707
Liver, albuminoid degeneration of, i. 30
in hip-disease, i. 725
gunshot wounds of the, i. 646
hydatids of the, i. 748
Rupture of the, i. 951
Local Anæsthesia, i. 952
See *Ether-spray*, i. 490
Localisation of cerebral lesions, i. 464
Locality, influence of, on nature of malignan disease, ii. 8
Lock-jaw, ii. 598
London paste, i. 262
Loose Cartilage, i. 953
in the knee, i. 875
Lordosis, i. 69
Lumbar Abscess, i. 954
colotomy, i. 330
Hernia, i. 955
Lung, bleeding from, due to injury. See *Hæmoptysis from injury*, i. 661; *Hæmothorax*, i. 670
collapse of, from injury, i. 222
emphysema from wound of, i. 452
gunshot wound of, i. 279, 643
hernia of. See *Pneumocele*, ii. 221
inflammation of from injury. See *Traumatic Pneumonia*, i. 279; ii. 222
rupture of, i. 956
wounds of, i. 279, 955
Lupoid ulcerations in syphilis, treatment of, ii. 565
Lupus Erythematosus, i. 957
exedens or exulcerans, i. 959
exfoliativus, i. 959
hypertrophicus, i. 959
serpiginosus, i. 959
tuberculatus, i. 959
verrucosus, i. 959
Vulgaris
of the cheeks, i. 960
of the ear, i. 961
of the extremities and trunk, i. 961
of the mucous membranes, i. 961
of the nose, i. 960; ii. 78
relation of, to tuberculosis, i. 959
symptoms of, i. 959
treatment of, i. 961
by actual cautery, i. 961
by injection of iodine, i. 962
by local application of strong acids, i. 962
by scarification, i. 961
by scraping, i. 961
Luxatio erecta of shoulder, ii. 442, 443
Lymphadenitis, i. 962
from poisoned wound, ii. 227
Lymphadenoma, i. 965
leukæmic, i. 966
non-leukæmic, i. 965
sarcomatous, i. 966
Lymphangiectasis, i. 967
Lymphangioma, i. 967
Lymphangitis, i. 968
from poisoned wound, ii. 227
Lymphatic glands—
affections of, in glanders (farcy-buds), i. 593
in cases of malignant tumour, ii. 5
cancerous disease of, i. 966
hypertrophy of. See *Lymphadenoma*, i. 965
inflammation of. See *Lymphadenitis*, i. 962

Lymphatic glands—
scrofulous affections of, ii. 398
suppuration of, i. 963
syphilitic enlargement of, i. 197; ii. 543
tumours of, i. 965
venereal affections of. See *Bubo*, i. 197
Lymphatics—
discharge of lymph from open. See *Lymphorrhœa*, i. 969
inflammation of. See *Lymphangitis*, i. 968
varix of. See *Lymphangiectasis*, i. 967
Lymphoma, i. 965
Lymphorrhagia, i. 969
Lymphorrhœa, i. 969
Lympho-sarcoma, ii. 370
Lymph-scrotum, i. 442

Macewen's operation for genu valgum, ii. 143
McIntyre's Splint, ii. 14
Mackenzie's amputation at the ankle-joint, i. 66
Macroglossia, ii. 1
Macropodia, ii. 205
Macrostoma congenitum, i. 266
Madura foot, i. 577
Malar bone, fracture of the, i. 513
Malaria, amaurosis from, i. 42
Male, greater liability of the, to suffer from aneurism, i. 56
Malformations, Congenital, of anus, i. 112
of the bladder, i. 425
of the cheek, i. 275
of the lip, i. 680
of the palate, i. 316
of the spine, ii. 467
of the vagina, ii. 769
of the vulva, ii. 807
Malgaigne's hooks in fracture of patella, ii. 169
Malignant disease, in cicatrices, i. 306
in stumps, ii. 509
Malignant lymphoma, i. 965
Malignant œdema, ii. 3
Malignant Pustule, ii. 2
presence of bacillus anthracis in cases of, ii. 3
relation to woolsorters' disease, ii. 3
treatment of, ii. 4
Malignant stricture of œsophagus, ii. 94
of rectum, ii. 314
Malignant Tumours, ii. 5
affections of general health in cases of, ii. 7
etiology of, ii. 7
glandular affections, ii. 5
influence of age, sex, and locality on, ii. 8
mode of dissemination, ii. 6
mode of growth, ii. 5
See *Carcinoma*, i. 220.
Sarcoma, ii. 369
Malleoli, fractures of the, i. 62, 63
Malum coxæ senile, i. 296
Mamma, excision of, 192
Mammary abscess, i. 177
cancer, i. 184
tumours, i. 181
differential diagnosis of, i. 191
'Manifest' squint, ii. 490
Manipulation in treatment of aneurism, i. 61
Marriage, question of, after an attack of syphilis, ii. 565
in cases of retained testes, ii. 595
Marshall's osteotrite, ii. 144.
space in spontaneous rupture of empyema, i. 456
Martin's Bandages, ii. 7
in treatment of elephantiasis Arabum i. 443
in treatment of indolent ulcer, ii. 698
Massage, ii. 11
Mastitis, i. 177
neonatorum, i. 179
Mastodynia, i. 177
Mastoid disease, i. 423
Masturbation, ii. 13
amblyopia from, i. 38
Maturity of cataract, i. 249
Meatus auditorius, foreign bodies in the, i. 418
inflammation of the, i. 417
injuries to the, i. 418
Mechanical treatment of cleft palate, i. 315
Mechanism of accommodation, i. 21
Meckel's diverticulum, internal strangulation by, i. 803
Meckel's ganglion, extirpation of, ii. 57, 73
Median lithotomy, i. 940
Median nerve, exposure of, for neurotomy, ii. 74
Medical Gymnastics, ii. 14
Medicinal Eruptions, ii. 15
Medicinal treatment of aneurism, i. 58
Medullary cancer, i. 224
Meibomian glands, affections of the, i. 506
Melancholia. See *Hypochondriasis*, i. 767
Melanosis, ii. 6
Melanotic carcinoma, ii. 226
sarcoma, ii. 370
of choroid, ii. 122
Melasma, i. 283
Melon-seed bodies, i. 579, ii. 576
Membrana tympani, puncture of the, i. 421
rupture of the, i. 422
Menière's disease, i. 420
in syphilis, ii. 553
Meningitis, cranial, i. 459
spinal, i. 129
Meningocele, ii. 16
Mentagra. See *Sycosis*, ii. 532
Mental condition, in head-injury, i. 688
in railway injury, ii. 295
in hydrophobia, ii. 762
in hypochondriasis, i. 767
influence of, on shock, ii. 434
in spermatorrhœa, ii. 465
Mercurial necrosis of jaws, i. 834

Mercury in syphilis, ii. 559
bichloride of, as an antiseptic, i. 74, 78
Metacarpal bones, amputation of the, i. 543
dislocations of the, i. 674
fractures of the, i. 676
Metacarpo-phalangeal joints, amputation at the, i. 342
Metamorphosis of septic diseases, ii. 420
Metastatic erysipelas, i. 480
orchitis, ii. 20
Metatarso-phalangeal joints, amputations at the, i. 550
Metatarsus, ii. 19
amputations of the, i. 551, ii. 569
caries of the, ii. 569
dislocations of the, i. 552
fracture of the, i. 554
Methylene, bichloride of, as an anæsthetic, i. 55
Metrostaxis after oöphorectomy, ii. 100
after ovariotomy, ii. 159
Micrococcus, ii. 20
Micro-organisms, action of antiseptics on, i. 78
influence of, on wounds, i. 71, 72
presence of, in erysipelas, i. 475
in elephantiasis Græcorum, i. 447
in lupus vulgaris, i. 959
in malignant pustule, ii. 3
Microscopic changes in mesentery of frogs in inflammation, i. 788
Microsporon furfur, ii. 218
Micturition, Disorders of
See *Incontinence of Urine*, i. 785
Prostatic Hypertrophy, ii. 251
Retention of Urine, ii. 332
Strangury, ii. 495
Stricture of Urethra, ii. 496
Milium, ii. 20
Milk, excessive secretion of, i. 177
total absence of, i. 176
Milk abscess, i. 177
cyst, i. 299, 579
Milky fluid in hydrocele, i. 752
Mineral caustics, i. 263
'Miner's elbow,' i. 87
Mixed-celled sarcoma, ii. 370
Moist corns, i. 380
gangrene, i. 586
Mole, ii. 21
Mollities ossium. See *Osteomalacia*, ii. 136
Molluscum Contagiosum, ii. 21
Fibrosum, ii. 22
Morphœa, ii. 390
Mortality after amputation, i. 740
after amputation of thigh, ii. 601
in military surgery, i. 651
gunshot wounds of the abdomen, i. 647
the head, i. 639
joints, i. 637
the spine, i. 642
the thorax, i. 644
after resection of joints in military surgery, i. 652
after lithotomy, i. 942
after lithotrity, i. 949
Mortification. See *Gangrene*, i. 580
Morton's injection in treatment of spina bifida, ii. 470
Mother's mark. See *Nævus*, ii. 30
Mouth, Diseases of the.
See *Cancrum Oris*, i. 217
Palate, Diseases of the, ii. 159
Ranula, ii. 306
Stomatitis, ii. 479
bleeding from, in head-injury, i. 686, ii. 457
Movable Kidney, ii. 24
Moxa, i. 829
Mucocele, i. 877
Mucous membranes, erysipelas of, i. 482
scrofulous affections of, ii. 398
syphilis of, ii. 552
tuberculosis of, ii. 678
Mucous Patches, ii. 25, 552
Mucous polypi, ii. 230
Mulberry calculus, i. 215
Multilocular cysts of the lower jaw, i. 835
Multiple lipoma, i. 930
Mummification in gangrene, i. 587
Murray's needle, ii. 46
Muscæ volitantes, ii. 805
after railway injuries, ii. 793
Muscle, electrical reaction of, after nerve-section, ii. 62
Muscles, Diseases and Injuries of, ii. 25
atrophy, ii. 28
contraction, ii. 27
contusion, ii. 25
degeneration, ii. 28
hernia, ii. 27
hypertrophy, i. 766; ii. 28, 260
inflammation, ii. 27
ossification, ii. 28
rupture, ii. 26
strain, ii. 26
syphilis, ii. 28, 557
trichinosis, ii. 28
tumours, ii. 28
wounds, ii. 27
Muscular action, dislocation through, i. 403
fracture through, i. 566
Muscular affections of eyelids, i. 509
Muscular asthenopia, i. 109
Muscular atrophy in joint-disease, i. 115
after nerve-section, ii. 62
Muscular rheumatism, ii. 27
Muscular spasm in ulceration of cartilage, i. 101
Muscular wasting in hip-disease, i. 723
Musculo-cutaneous nerve, exposure of, ii. 74
Musculo-spiral nerve, exposure of, ii. 74
Musculo-Spiral Paralysis, ii. 28
Myalgia, ii. 27
Mycetoma, i. 517
Mycosis, ii. 420
Mycosis intestinalis. See *Malignant Pustule*, ii. 2
Mydriasis, i. 822
Myeloid sarcoma, ii. 370
of jaws, i. 836

Myeloid tumour of gums, i. 625
Myoma, ii. 29
in old age, ii. 28
Myopia, ii. 319
Myositis, ii. 27
Myotomy, ii. 27
Myxœdema, ii. 90, 611
Myxoma, ii. 30
Myxo-sarcoma, ii. 371

Nævoid lipoma, ii. 32
Nævus, ii. 30
structure of, ii. 31
treatment of, ii. 32
by actual cautery, ii. 32
by enucleation, ii. 34
by ethylate of sodium, ii. 32
by injections, ii. 33
by ligature, ii. 33
by nitric acid, ii. 32
by setons, ii. 33
by vaccination, ii. 32
Nævus needle, ii. 46
Nævus pigmentosus, ii. 21
pilosus, ii. 21
Nails, Diseases of the, ii. 35
eczema and psoriasis, ii. 36
hypertrophy, ii. 35
ingrowing nail, i. 797 ; ii. 35
onychia, ii. 35
parasitic diseases, ii. 36
Nasal bones, fractures of the, i. 512
catarrh, ii. 78
Douche, ii. 36
duct, probing of the, i. 879
Polypus, ii. 37
Naso-pharyngeal catarrh, i. 421
Naso-pharyngeal Growths, ii. 39
fibro-mucous polypi, ii. 40
fibrous polypi, ii. 40
malignant polypi, ii. 41
vegetations, ii. 39
Nebulæ of cornea, i. 374
Neck, Diagnosis of Swellings and Tumours of the, ii. 41
gun-shot wounds of the, i. 643
hydrocele of the, i. 758 ; ii. 41
inflammatory affections of the, ii. 42
Necrosis, ii. 43
acute, ii. 194
micrococcus of, ii. 20
exanthematous, i. 833
Necrosis of the lower jaw, i. 833
from alveolar abscess, i. 34
from phosphorus, i. 834
of the scapula, ii. 383
Needle operation for cataract, i. 253
Needles, ii. 45
in acupuncture, i. 253
Nélaton's dislocation at ankle, i. 64
line in the diagnosis of injuries to the hip, i. 529, 720
operation for epispadias, i. 427
rhinoplastic operation, ii. 348
Nephralgia, ii. 46
Nephrectomy, ii. 47
advantages and disadvantages of each of the three methods of, ii. 48
lateral abdominal section, ii. 49
lumbar section, ii. 48
median abdominal section, ii. 50
for hydronephrosis, i. 761
for injury to the kidney, i. 866, 867
for movable kidney, ii. 24
for nephro-lithiasis, ii. 54
for pyo-nephrosis, ii. 289
for wound of ureter, i. 865
Nephritic colic. See *Renal Colic*, ii. 330
Nephritis, ii. 50
presence of a contra-indication to operations on the urinary organs, ii. 52
Nephro-lithiasis, ii. 52
choice of operations in treatment of, ii. 54
Nephro-lithotomy, ii. 54
distinction between, and incision of renal abscess, ii. 54
Nephrorraphy, ii. 55
Nephrotomy, ii. 56
for hydronephrosis, i. 761
for nephro-lithiasis, ii. 54
for pyelo-nephritis, ii. 283
for pyo-nephritis, ii. 289
Nerve, changes in, after division, ii. 61
Nerve-Avulsion, ii. 57
of the inferior dental nerve, ii. 57
of the infra-orbital nerve, ii. 57
of Meckel's ganglion, ii. 57
Nerve-injuries in dislocations, ii. 66
in fractures, ii. 66
Nerve section, diagnosis of, ii. 64
Nerve-Stretching, ii. 58
local anatomical changes produced by, ii. 59
physiological effects of, ii. 59
value of, in the treatment of anæsthesia, ii. 61
of contracture, ii. 60
of hyperæsthesia, ii. 61
of lightning pains of tabes, ii. 61
of neuralgia, ii. 61, 69
of paralysis, ii. 61
of reflex epilepsy, ii. 61
of spasm, ii. 60
of tetanus, ii. 60
Nerve, union of, after section, ii. 62
Nerves, compression of, ii. 66
contusions of, ii. 67
in dislocation, ii. 66
in fracture, ii. 66
gunshot wounds of, i. 642
injuries of, ii. 61
punctured wounds of, ii. 67
section of, complete, ii. 61
partial, ii. 65
Nerves, operations for exposure of, for neurectomy or neurotomy, ii. 73
anterior tibial nerve, ii. 74
brachial plexus, ii. 73
facial nerve, ii. 73

Nerves, operations for exposure of great sciatic nerve, ii. 74
inferior dental nerve, ii. 73
infra-orbital nerve, ii. 73
Meckel's ganglion, ii. 73
median nerve, ii. 74
musculo-cutaneous nerve, ii. 74
musculo-spiral nerve, ii. 74
popliteal nerves, ii. 74
posterior tibial nerve, ii. 74
radial nerve, ii. 74
spinal accessory nerve, ii. 73
supra-orbital nerve, ii. 73
ulnar nerve, ii. 74
Nettle-rash. See *Urticaria*, ii. 742
Neuralgia, ii. 67
operative treatment of, ii. 69
of the bladder, i. 149
of the breast, i. 180
epileptiform, ii. 68
of the rectum, ii. 310
of scars, i. 305
of the testis, ii. 588
of the tongue, ii. 635
of the urethra, ii. 714
Neurasthenia in railway spinal injuries, i. 127
Neurectomy, ii. 72
Neuritis, i. 67
Neuroma, ii. 69
Neuromimesis, i. 851
Neuromimetic contraction of the sterno-mastoid, ii. 650
Neurotic Fever, ii. 71
Neurotomy and Neurectomy, ii. 72
New-formation cysts, i. 392
Nicotine, in tetanus, ii. 599
Nictitation, i. 509
Night-blindness, i. 38
Nigrities, i. 283
Nipple and Areola, Diseases of the, ii. 74
Nipple, chancre of the, ii. 75
eczema of the, ii. 75
fissure of the, ii. 74
Nitric acid, as a caustic, i. 262
poisoning by, i. 22
in treatment of nævus, ii. 32
Nitrous oxide gas, as an anæsthetic, i. 55
Nocturnal incontinence, i. 786
Nodes, i. 196; ii. 557
Nodular rheumatism, i. 295
Noma, i. 217; ii. 76
Non-Congenital Deformities
Ankylosis, i. 67
Cicatricial Deformities, i. 303
Contraction of Hamstring Tendons, i. 674
Dupuytren's Contraction, i. 411
Genu Extrorsum, i. 591
Genu Valgum, i. 592
Lateral Spinal Curvature, i. 910
Non-Congenital Talipes, i. 320
Rickets, ii. 353
Torticollis, ii. 649
Normal temperature of the body, ii. 572
Nose, Diseases of the, ii. 76
acquired and congenital deformities, ii. 76
Nose, Diseases of the: chronic coryza, ii. 78
discharges, ii. 78
epithelioma, ii. 77
lipoma nasi, ii. 77
lupus, i. 959; ii. 78
necrosis of bones, ii. 79
ozæna, ii. 78
foreign bodies in the, ii. 77
injuries of the, i. 512; ii. 76
inspection of the. See *Rhinoscopy*, ii. 349
plastic operations on the. See *Rhinoplasty*, ii. 346
For other articles on the surgery of the nose
See *Epistaxis*, i. 472
Nasal Douche, ii. 36
Nasal Polypus, ii. 37
Naso-pharyngeal Growths, ii. 39
Nostrils, plugging the, i. 472
Nyctalopia, i. 38
Nystagmus, ii. 79

Oblique bandage, i. 137
inguinal hernia, i. 798
Obstruction, intestinal, i. 802
Obturator Artery, ii. 80
Hernia, ii. 81
Obturators in cleft palate, i. 315
Occlusion of arteries, i. 90
Occupations suited for the blind, i. 162
Ocular Muscles, Affections of the, ii. 81
deviation of the eye, ii. 83. See *Strabismus*, ii. 489
diplopia, ii. 83
paralysis of the ocular muscles, ii. 84
fourth nerve, ii. 86
sixth nerve, ii. 86
third nerve, ii. 86
conjugate paralysis, ii. 87
paralysis of convergence, ii. 87
Oculo-pupillary symptoms after spinal injury, ii. 797
Odontoma, ii. 88
Œdema, ii. 88
of the larynx, i. 887
in erysipelas, i. 482
in scalds, i. 904; ii. 377
of the scrotum, ii. 405
of the septum narium, ii. 427
Œdematous laryngitis, i. 884
Œsophagostomy, ii. 91, 95
Œsophagotomy, ii. 90, 95
Œsophagus, Diseases and Injuries of the, ii. 91
foreign bodies in the, ii. 91
injuries from swallowing acids or alkalies, ii. 92
stricture, malignant, ii. 99
simple, ii. 93
spasmodic, ii. 93
wounds of the, ii. 93
Ogston's operation for genu valgum, ii. 143
Old Age, ii. 96
hæmorrhage in, ii. 96
inflammation in, ii. 97

Old Age, morbid growths in, ii. 97
repair of injuries in, ii. 96
risks of shock in, ii. 96
in relation to sex, ii. 431
Olecranon, fracture of the, i. 85; ii. 702
Olfactory nerve, injury of the, i. 381
Ollier's experiments on regeneration of bone, ii. 515
rhinoplastic operation, ii. 348
Omental hernia, i. 702
'Omental cord,' internal strangulation by an, i. 803
Omentum, condition of, in strangulated hernia, i. 709
management of, in strangulated hernia, i. 713
protrusion of, in wounds of abdomen, i. 3
Onychia, i. 679; ii. 35
maligna, ii. 35
Onyx, i. 370, 769; ii. 99
Oöphorectomy, ii. 99
Opacities of aqueous and vitreous humours, ii. 102
of cornea, i. 374
Operation, an aseptic, i, 74
Operations, in collapse, i. 329; ii. 435
for gun-shot injury, i. 650
prognosis of, as affected by albuminuria, i. 32
by old age, ii. 96
Ophthalmia, i. 348
gonorrhœal, i. 352
granular, i. 350
neonatorum, i. 352
purulent, i. 352
Sympathetic, ii. 534; i. 828
Ophthalmic artery, aneurism of the, ii. 128
rupture of the, ii. 128
Ophthalmoplegia externa, ii. 88
Ophthalmoscope, ii. 101
use of, in cataract, i. 246
in determining nature and extent of anomalies of refraction. See *Retinoscopy*, ii. 341
Ophthalmoscopic appearances in albuminoid retinitis, ii. 337
in amaurosis, i. 36
in atrophy of the choroid, ii. 104
in atrophy of the optic nerve, ii. 103, 111
in cataract, i. 246
in choroidal hæmorrhage, i. 292
in choroiditis, i. 288
in coloboma of the choroid, i. 293
in detachment of the retina, ii. 340
in diabetic retinitis, ii. 338
in displacement of the crystalline lens, i. 388
in embolism of the central artery of retina, ii. 104, 339
in glaucoma, i. 595, 596, 599
in glioma of the retina, ii. 341
in hæmorrhagic retinitis, ii. 337
in hyalitis, ii. 804
in opacities of the transparent media, ii. 102
Ophthalmoscopic appearances in optic neuritis, ii. 107
in physiological excavation of the papilla, ii. 103
in retinal sclerosis, ii. 105
in retinitis, ii. 337
in retinitis pigmentosa, ii. 338
in rupture of the choroid, ii. 106
in syphilitic retinitis, ii. 338
in tabetic amblyopia, i. 40
in tobacco amblyopia, i. 41
in tumours of the choroid, i. 292
Ophthalmoscopy, ii. 100
direct examination, ii. 101
indirect examination, ii. 101
examination of the choroid, i. 286; ii. 103
of the media, ii. 102
of the optic disc, ii. 102
of the retina, ii. 105
of the vessels at the fundus, ii. 103
Opisthotonos, ii. 597
Optic atrophy, condition of field of vision in, ii. 188
Optic Nerve, Diseases and Injuries of the, ii. 106
atrophy, ii. 110
congenital abnormalities, ii. 106
grey degeneration, ii. 110
inflammation, ii. 107
injuries, ii. 112
tumours, ii. 112
Orbit, bleeding into, in fracture of skull, ii. 456
Orbit, Diseases of the, ii. 113
acute abscess, ii. 113
aneurism, ii. 125
caries, ii. 115
chronic abscess, ii. 113
congenital tumours, ii. 121
dermoid cysts, ii. 121
enchondroma, ii. 119
exostosis, ii. 119
fibroma, ii. 120
foreign bodies, ii. 116
fracture, ii. 115
hydatid cyst, ii. 120
Injuries of the, ii. 115
necrosis, ii. 115
periostitis, ii. 114
pulsating sarcoma, ii. 129
sarcoma, ii. 117
scirrhus, ii. 119
serous cysts, ii. 120
vascular tumours, ii. 128
Orbital Aneurism, ii. 125
differential diagnosis of pulsating swellings in the orbit, ii. 126
treatment of, by digital compression of the carotid, ii. 130
by instrumental compression of the carotid, ii. 130
by local compression, ii. 130
by galvano-puncture, ii. 131
by injection (into the sac) of a coagulating fluid, ii. 131
by injection (subcutaneously) of ergotin, ii. 131

Orbital Aneurism, treatment of, by ligature of aneurismal ophthalmic vein, ii. 133
by ligature of common carotid artery, ii. 131
Orchitis, acute, ii. 579
chronic, ii. 581
metastatic, ii. 20
syphilitic, ii. 554, 581
Orthotonos, ii. 597
Os Calcis, Caries of the, i. 565; ii. 565
excision of the, ii. 133, 566
fracture of the, i. 554
Os innominatum, fracture of the, ii. 178
Os magnum, dislocation of the, i. 239
Osseous ankylosis, ii. 69
Ossification of muscle, ii. 28
Osteo-Aneurism, ii. 134
Osteo-Arthritis, ii. 134
of knee, i. 875
Osteoclasts, ii. 145
Osteoma, ii. 135. See also *Exostosis*, i. 491
of ear, i. 116
of lower jaw, i. 836
Osteomalacia, ii. 136
Osteomyelitis, ii. 138
micrococcus of, ii. 20
Osteophytes, ii. 196
Osteo-plastic periostitis, ii. 196
resection, ii. 516
Osteoporosis, ii. 140
Osteo-sarcoma, ii. 371
Osteo-sclerosis, ii. 145
Osteotome, ii. 140
Osteotomy, ii. 140
for ankylosis of hip, ii. 142
knee, ii. 142
for genu valgum, ii. 143
Osteotrite, ii. 144
Ostitis, ii. 144
condensing, ii. 145
rarefying, ii. 144
Ostitis Deformans, ii. 146
Otomycosis, i. 417
Otorrhœa, ii. 421
Ovarian gestation, i. 495
Ovarian Tumours, ii. 147
diagnosis of, ii. 149
pathology of, ii. 148
treatment: aspiration or tapping, ii. 151
Ovariotomy, ii. 151
method of operation, ii. 153
preparation of patient, ii. 152
room, instruments, &c., ii. 152
time to operate, ii. 158
Ovary, cystic tumours of the, i. 391
removal of. See *Oöphorectomy*, ii. 99
Oxalate of lime calculus, i. 215
Oxaluria, ii. 732
Ozæna, ii. 78
diagnosis of, from suppuration of the antrum, i. 79

Pachydermatous tumour of scalp, ii. 381
Pachymeningitis, i. 459
Paget, Sir J., on classification of sebaceous cysts, ii. 408
on discharge of watery fluid from the nose, i. 80
on disease of nipple, i. 157, 435
on hereditary tendency to cancer of the breast, i. 186
on local causation of cancer of breast, i. 187
on ostitis deformans, ii. 146
Pain, in abdominal aneurism, i. 6
in abdominal injury, i. 1
in aneurism, i. 57
in cases of burn, i. 203
in epileptiform neuralgia, ii. 68
in hip-disease, i. 722
in intestinal obstruction, i. 809
in spinal injuries, i. 127
in strangulated hernia, i. 704
in suppuration of the antrum, i. 79
relief of, by acupuncture, i. 25
cold applications, i. 326
nerve-stretching, ii. 61
Painful scar, i. 304
stump, ii. 509
subcutaneous tubercle, ii. 70
ulcer, ii. 697
Palate, Diseases of the, ii. 159
fissure of the. See *Cleft Palate*, i. 315, 316
syphilitic ulceration of the, ii. 159
tumours of the, ii. 160
Palmar Arch, wounds of the, ii. 160
Palmar fascia, contraction of the, i. 411
division of the, ii. 578
Pannus, i. 363
treatment of, i. 364, 351
Panophthalmitis, i. 503; ii. 803
Papilla optica, physiological excavation of the, ii. 103
Papillary growths in syphilis, ii. 552
polypi, ii. 230
of the rectum, ii. 310
tumours. See *Papilloma*, ii. 161
in old age, ii. 98
Papillitis, ii. 107
Papilloma, ii. 161
of the bladder, i. 154
of the larynx, i. 892
of the rectum, ii. 310
Paquelin's thermo-cautery, i. 267
Paracentesis, ii. 162
of abdomen, ii. 163
in ovarian disease, ii. 151
of head, ii. 164
of pericardium, ii. 164
of thorax, ii. 163
in empyema, i. 455
Paraffin bandages, i. 781
Paralysis of accommodation, i. 19
of the bladder, i. 142
from compression of brain, i. 173
of the facial nerve, i. 513
from head injury, i. 685
from intra-cranial suppuration, i. 462
of larynx, i. 898
musculo-spiral, ii. 28

Paralysis of ocular muscles, ii. 84
pseudo-hypertrophic muscular, ii. 260
from spinal disease, i. 132
from spinal injury, i. 230
from syphilis, ii. 555
treatment of, by nerve-stretching, ii. 61
Parametritis. See *Pelvic Cellulitis*, ii. 174
Paraphimosis, ii. 164
Paraplegia from caries of the spine, i. 230
from injury to the spine, i. 132
Parasites causing disease in man :
acarus scabiei (scabies), i. 18 ; ii. 375
aspergillus (otomycosis), i. 417
achorion Schönleinii (favus), i. 21
bacillus anthracis (malignant pustule, woolsorters' disease), i. 124 ; ii. 3
chigoe, i. 280
cysticercus cellulosæ, i. 390
echinococcus hominis (hydatids), i. 747
filaria medinensis (Guinea-worm), i. 535
filaria sanguinis hominis, i. 536
microsporon furfur (pityriasis versicolor), ii. 218
oïdium albicans (thrush), ii. 480
pediculi (phthiriasis), ii. 170
trichina spiralis (trichinosis), ii. 28
tricophyton tonsurans (sycosis parasitica), ii. 534, 627
See *Bacillus*, i. 123
Bacterium, i. 135
Micrococcus, ii. 20
Schizomycetes, ii. 386
Vibrio, ii. 788
Parasitic Affections. Blood : filarial infection, i. 537
elephantiasis Græcorum, i. 447
erysipelas, i. 475
Connective Tissue : malignant pustule, ii. 2
External Ear : otomycosis, i. 417
Eye : cysticercus cellulosæ, i. 390
Muscles : trichinosis, ii. 28
Mouth : thrush, ii. 480
Nails, ii. 36
Skin and Hair : favus, i. 520
phthiriasis, i. 170
pityriasis versicolor, ii. 218
scabies, ii. 375
sycosis parasitica, ii. 534
tinea tonsurans, ii. 627
See *Classification and Etiology of Septic Diseases*, ii. 417
Paronychia. See *Whitlow*, ii. 812
Parotid Tumour, ii. 165
Parrot, on syphilitic origin of craniotabes, i. 385
Patella, Dislocations of the, ii. 166
by complete version, ii. 167
inwards, ii. 166
outwards, ii. 166
by semi-rotation, ii. 166
upwards, ii. 166
dislocation, congenital, of the, i. 336
Patella, fracture of the, ii. 167
Péan's operation for excision of pylorus, ii. 284
Pearl tumour, ii. 370
Pedicle, management of, in ovariotomy, ii. 154
Pediculi, ii. 170
Peliosis, ii. 274
Pelvic Abscess in the Female, ii. 172
Pelvic bones, fractures of the, ii. 178, 179
Pelvic Cellulitis, ii. 174
Pelvic Hæmatocele, ii. 175
Pelvis, deformities of, in rickets, ii. 357
Pelvis, Injuries of the, ii. 177
contusion, ii. 178
fracture, of acetabulum, ii. 178
of coccyx, ii. 178
of os innominatum, ii. 178
of pelvic girdle, ii. 179
of sacrum, ii. 178
Pelvis of kidney, wounds of, i. 864
Pemphigus, ii. 179
foliaceus, ii. 181
vulgaris, ii. 180
Penetrating wounds of the abdomen, i. 3
from gunshot wound, i. 645
of the chest, i. 279
from gun-shot injury, i. 643
of the joints, i. 859
of the kidney, i. 865
Penis, Amputation of the, ii. 182
congenital malformations of the.
See *Epispadias*, i. 425
Hypospadias, i. 769
Phimosis, ii. 213
Diseases of the, ii. 183
cancer, ii. 183
gangrene, ii. 185
herpes, i. 136 ; ii. 185, 544
inflammation of the corpora cavernosa, ii. 184
tumours, ii. 184
Perforating Ulcer, ii. 185
Perforation of membrana tympani, i. 422
of vermiform appendix, ii. 203
Periarteritis, ii. 90
Pericardial effusion, aspiration in, i. 107
Pericardium, paracentesis of the, ii. 164
wounds of the, ii. 186
Perimeter, ii. 187
Perimetry, ii. 186
Perineal Abscess, ii. 189
Band, ii. 190
fistula. See *Urinary Fistula*, ii. 734
Hernia, ii. 190
Perinephritic Abscess, ii. 190
Perineum, Rupture of the, ii. 191
treatment of, by immediate operation, ii. 191
by remote operation, ii. 192
Periosteal flaps in amputation, i. 50
sarcoma of femur, ii. 603
Periostitis, ii. 193
acute diffuse, ii. 194
chronic, ii. 196
simple acute, ii. 193
of lower jaw, i. 833
in congenital syphilis, i. 345
in secondary syphilis, ii. 553
in tertiary syphilis, ii. 557

Peripheral linear extraction of cataract (Von Graefe's operation), i. 256
Periproctitis, ii. 197
Peritoneal effusion, aspiration in, i. 107
false ligament, internal strangulation by, i. 802
Peritonitis, ii. 198
acute, ii. 198
circumscribed, ii. 203
hernial, i. 705
after herniotomy, i. 714
malignant, ii. 199
Perityphlitic Abscess, ii. 201
extra-peritoneal, ii. 201
intra-peritoneal, ii. 203
Peri-urethral abscess, ii. 716
Peroneal tendons, division of, in tenotomy, ii. 577
Pes Gigas, ii. 205
Petersen's method of distending rectum in supra-pubic lithotomy, i. 940
Phagedæna, ii. 205
in syphilis, i. 272; ii. 544
Phagedænic chancre, i. 271
Phalangeal amputations: in fingers, i. 542
in toes, i. 550
Pharyngeal Stenosis, ii. 206
Pharyngotomy, ii. 90
Pharynx, Diseases of the, ii. 209
acute catarrhal pharyngitis, ii. 209
chronic catarrhal pharyngitis, ii. 209
follicular or granular pharyngitis, ii. 209
herpes, ii. 212
pharyngitis sicca, ii. 210
phlegmonous or suppurative pharyngitis, ii. 210
strumous ulceration, ii. 211
syphilitic ulceration, ii. 211
tubercle, ii. 211
tumours, ii. 212
extirpation of the, ii. 212
injuries of the, ii. 207
foreign bodies, ii. 208
lesions from action of corrosive liquids, ii. 208
scalds, ii. 207
wounds, ii. 207, 607
Phimosis, ii. 213
Phlebitis, ii. 214
diffuse suppurative, ii. 215
local, ii. 215
Phlebolith, ii. 216
Phlebotomy. See *Venesection*, ii. 782
Phlegmonous erysipelas, i. 481
Phlyctenular conjunctivitis, i. 356
keratitis, i. 364
Phosphatic calculi, i. 215
Phosphorus-necrosis, i. 834
Photophobia, ii. 216
Phthiriasis, i. 170; ii. 450
Pia mater, traumatic inflammation of the, i. 460
'Pied tabetique,' i. 274
Pigeon-Breast, ii. 216
Pigmentation of skin, abnormal, i. 283
Piles. See *Hæmorrhoids*, i. 667
Pinguecula, ii. 217
Pirogoff's amputation at the ankle-joint, i. 66; ii. 568
Pisiform bone, dislocation of the, i. 239
Pistol Splint, ii. 217
Pityriasis, ii. 217
rubra, ii. 217
versicolor, ii. 218
Plantar Arteries, Wounds of the, ii. 218
Fascia, contraction of the, ii. 219
division of the, ii. 578
Plantaris tendon, rupture of the, ii. 605
Plaster of Paris bandage, i. 780
Bavarian method, i. 780
Croft's method, i. 781
Plastic Surgery, ii. 219
See also *Cheiloplasty*, i. 276
Surgical Treatment of Cleft Palate, i. 316
Ectopia Vesicæ, i. 425
Hare-lip, i. 680
Hypospadias, i. 769
Pathological Conditions of Cicatrices, i. 305
Rhinoplasty, ii. 346
Ruptured Perineum, ii. 191
Urethroplasty, ii. 724
Vaginal fistulæ, ii. 773
'Platform accidents,' ii. 295
Pleura, presence of air in. See *Pneumothorax*, ii. 221
of blood in. See *Hæmothorax*, i. 670
gun-shot wounds of, i. 644
Pleural effusion, aspiration in, i. 107
paracentesis in, ii. 163
Pleurosthotonos, ii. 597
Plexiform sarcoma, ii. 370
Plugging the nostrils, i. 472
Pneumocele, ii. 221
Pneumogastric nerve, injuries of the, i. 383
Pneumo-hæmothorax, i. 671
Pneumonia, Traumatic, ii. 222
Pneumothorax, ii. 222
Poisoned Wounds, ii. 224
boils, ii. 226
cellulitis, ii. 225
inflammation of lymphatics and glands, ii. 227
of sheaths of tendons and of fasciæ, ii. 228
periphlebitis, ii. 229
pustules, ii. 225
simple local inflammation, ii. 225
warts, i. 212; ii. 225
Politzer's method of inflating the tympanum, i. 416
Polydactylism, i. 544
Polymazia, ii. 229
Polypi, ii. 229
Polypus of antrum, i. 80
of the bladder, i. 154
of the ear, i. 423
of the frontal sinus, i. 576
of the larynx, i. 892

Polypus of the naso-pharyngeal cavity, ii. 40
of the nose, ii. 37, 229
of the pharynx, ii. 212, 230
of the rectum, ii. 229, 310
of the urethra (female), ii. 721
of the uterus, ii. 230, 750
Polythelia, ii. 74
Pompholyx, ii. 179
Popliteal Aneurism, ii. 231
diagnosis of, ii. 604
Artery, Surgical Anatomy and Ligation of the, ii. 234
wounds of the, ii. 235
nerves, exposure of, for neurotomy, ii. 74
Space, Diagnosis of Affections of the, ii. 236
Porro's Operation, ii. 237
Porte-moxa, i. 829
Position, in surgical treatment, ii. 239
of limb, alteration of, in hip-disease, i. 722
Post-mortem wounds, ii. 226
Post-pharyngeal abscess, ii. 345
Potain's aspirator, i. 108
Potassium bromide and iodide, eruptions from, ii. 15
Pott's disease of the spine, i. 228
fracture of the fibula, i. 921
Poultices, ii. 240
Power of accommodation, i. 20
Pregnancy, amblyopia in, i. 42
Prepuce, elongation of the, ii. 213
hypertrophy of the, ii. 184
slitting of the, i. 309
See *Balanitis*, i. 136
Chancre, i. 270
Circumcision, i. 308
Paraphimosis, ii. 164
Phimosis, ii. 213
Presbyopia, ii. 241
Pressure, ii. 242
digital, local, and rapid, in treatment of aneurism, i. 58, 59
method of applying, in arterial hæmorrhage, i. 96
Priapism in fracture of the spine, i. 133
Price's needle, ii. 46
Primary deviation in paralysis of ocular muscles, ii. 85
Probangs, ii. 243
Proctitis, ii. 244
Prolapse of vagina, ii. 772
Prolapsus Ani et Recti, ii. 244
linguæ, ii. 1, 631
Proliferating cystoma, i. 391
Prostate, canalisation of the, i. 216
Prostate, Diseases of the, ii. 246
abscess, ii. 248
atrophy, ii. 248
cancer, ii. 250
cysts, ii. 249
hypertrophy, ii. 248, 251
inflammation, ii. 247
neuralgia, ii. 249
tubercle, ii. 249
tumours, ii. 250
Prostate, ulceration, ii. 249
Prostatic calculi, ii, 250
disease, ii. 251
hæmorrhage, ii. 258
retention, ii. 333
'stricture,' ii. 249
Prostatorrhœa, ii. 249
Prurigo, ii. 259
Pruritus Ani, ii. 260
Psammoma, i. 214; ii. 370
Pseudo-hypertrophic Muscular Paralysis, ii. 260
Psoas Abscess, ii. 263
diagnosis, ii. 602
Psoriasis, ii. 265
Buccalis, ii. 267, 633
palmaris, i. 432; ii. 266
syphilitic, ii. 554
Pterygium, ii. 267
Ptomaines, ii. 416
pathological action of, ii. 417
Ptosis, i. 381; ii. 86
Pubic dislocation of head of femur, i. 736
Pudendal Hernia, ii. 268
Puerperal fever, ii. 418
Pulex penetrans, i. 280
Pulmonary Artery, Wounds of the, ii. 268
Pulpy degeneration of synovial membrane, i. 844; ii. 540
Pulsating bronchocele, ii. 614
exophthalmos, ii. 125
hæmatoma of scalp, ii. 18, 381
sarcoma of orbit, ii. 129
tumours of bone, ii. 372, 689, 693
tumours of orbit. See *Orbital Aneurism* ii. 125
tumours of scalp, ii. 381
Pulsation in aneurism, i. 56, 57
in meningocele, ii. 17
Pulse, ii. 269
in aneurism, i. 57
in aortic aneurism, i. 81
changes of, during amputation, ii. 433
nephrectomy, ii. 49
Corrigan's, or 'water-hammer' pulse, ii. 271
in chronic nephritis, ii. 51
dicrotic pulse, ii. 272
in exophthalmic goître, ii. 270
in fever, ii. 270
indications of, as to administration of stimulants, ii. 273
in innominate aneurism, i. 801
in peritonitis, ii. 199
in poisoning by aconite, ii. 270
influence of position on, ii. 269
Pulse-respiration ratio, ii. 272
Puncta, deviation of the, i. 877
Puncture of the Bladder, i. 150
rectal, i. 151
perineal, i. 151
supra-pubic, i. 150
through symphysis pubis, i. 151
under symphysis pubis, i. 151
Punctured fracture of the skull, ii. 454

Pupil, artificial formation of, i. 817, 827
'exclusion' or closure of, i. 824
Purpura, ii. 273
hæmorrhagic, ii. 274
rheumatic, ii. 274
simple, ii. 244
urticans, ii. 742
Purulent ophthalmia, i. 352
Pus, ii. 520
Pustules from poisoned wounds, ii. 225
Putrefaction, products of, ii. 416
Pyæmia, ii. 275, 418
distinction between, and septicæmia, ii. 276
Pyæmic affection of eye (panophthalmitis), i. 503
joint-disease, i. 849
Pyelitis, ii. 281
Pyelo-nephritis, ii. 282
Pylorectomy, ii. 284
Pylorus, Operations on the, ii. 283
digital dilatation, ii. 287
duodenostomy, ii. 288
excision of the pylorus, ii. 284
gastro-enterostomy, ii. 287
jejunostomy, ii. 288
Pyonephrosis, ii. 288
Pyo-salpinx, ii. 516
Pyrexia, after aseptic operations, cause of, ii. 367
Quarter-evil, ii. 419
Quilled suture, ii. 530
Quinine, amblyopia from, i. 41
eruption from, ii. 16
Quinsy, ii. 645

Rabies, ii. 761
Radial Artery, Surgical Anatomy and Ligation of the, ii. 290
Radial nerve, exposure of the, in neurotomy, ii. 74
Radical cure of hernia, i. 693
of hydrocele, i. 755
of varicocele, ii. 778
Radius, Dislocation of the, ii. 290
backwards, ii. 291
forwards, ii. 290
outwards, ii. 291
congenital, i. 335
Fractures of the, ii. 291
Railway collisions, spinal injuries from, i. 126
Railway Injuries, ii. 294
classification, ii. 294
concussion of spine, i. 126; ii. 296
diagnosis, ii. 301
method of examination before making report, ii. 298
nervous shock, ii. 295
remote injuries, ii. 297
treatment, ii. 304
Ranula, ii. 306
Rapid pressure, treatment of abdominal aneurism by, i. 7
Raynaud's disease, i. 91, 584
Reaction, ii. 307
Rectal hernia, ii. 245
Rectangular staff, i. 198
Recti muscles of eyeball, insufficiency of, i. 109
Rectocele, ii. 772
Recto-vaginal fistula, ii. 774
Recto-vesical Fistula, ii. 308
Rectum, Diseases and Injuries of the, ii. 309
atony, ii. 310
fissure, i. 544
fistulous openings.
See *Fistula in Ano*, i. 545
Vaginal Fistula, ii. 773
Recto-vesical Fistula, ii. 308
foreign bodies, ii. 309
hæmorrhoids, i. 667
inflammation. See *Proctitis*, ii. 244
malignant disease, ii. 314
nævoid growths, ii. 309
neuralgia, ii. 310
obstruction, ii. 313
polypus, ii. 310
prolapse, ii. 246
stricture, ii. 311
syphilitic disease, ii. 311, 314
ulceration, ii. 313
wounds, ii. 309. See *Rupture of the Perineum*, ii. 191
in lithotomy, i. 938
Recurrence of malignant disease, ii. 7
after removal of breast, i. 193
Reducible hernia, i. 701
'Reduction en masse,' i. 711
Refraction, Errors of, ii. 316
astigmatism, ii. 327
hypermetropia, ii. 324
myopia, ii. 319
Regnoli's operation for removal of the tongue, ii. 643
Reid's treatment of aneurism, i. 59
Renal calculus, ii. 52
colic, ii. 330
Repair of injuries in old age, ii. 96
Resolution of inflammation, i. 791
Respiration, artificial, ii. 525
Rest, ii. 331
in treatment of aneurism, i. 58
of spinal injuries, i. 125
Retention of Urine, ii. 332
habitual, i. 143
habitual partial, in stricture of urethra, i. 142
after operation on hæmorrhoids, i. 669
Retention-cysts, i. 392
of breast, i. 183
Retina, Affections of the, ii. 335
changes in blood-vessels, ii. 335
congenital abnormality, ii. 335
detachment of the retina, ii. 340
embolism, ii. 339
glioma, ii. 341
inflammation, ii. 337
thrombosis, ii. 339
Retinal disease in diabetes, ii. 338
in leucocythæmia, ii. 338
in syphilis, ii. 338, 552

Retinitis, albuminuric, ii. 337
central, from exposure to direct sunlight, ii. 338
defect of field of vision in, ii. 188
hæmorrhagic, ii. 337
ophthalmoscopic appearances in, ii. 105, 337, 338, 339
pigmentosa, ii. 338
syphilitic, ii. 338
Retinoscopy, ii. 341
Retained testis, ii. 593
Retracted testis, ii. 596
Retro-nasal Catarrh, ii. 343
Retro-pharyngeal Abscess, ii. 345
Reversion of testis, ii. 593
Rheumatic arthritis, prominent characteristics of, compared with those of Charcot's disease, i. 275
Rheumatic synovitis, i. 849
Rheumatoid arthritis.
See *Chronic Rheumatic Arthritis*, i. 293
Osteo-Arthritis, ii. 134
Rhinoplasty, ii. 346
Rhinoscopy, ii. 349
anterior, ii. 349
posterior, ii. 350
Ribs, Fractures of the, ii. 351
partial resection in cases of empyema, i. 457, 458
Richardson's ether-spray, i. 490
Rickets, ii. 353
causes of, ii. 354
craniotabes in, ii. 356
fœtal rickets, ii. 361
late rickets, ii. 359
osseous changes in, ii. 356
pathological anatomy of, ii. 355
period of onset, ii. 354
prognosis of, ii. 359
relapsing rickets, ii. 352
treatment of, 359
Rider's Bone, ii. 363
Rigor, ii. 363
Rigor mortis in fatal gun-shot injury, i. 629
Ringworm. See *Tinea Tonsurans*, ii. 627
Risus sardonicus, ii. 598
Rodent ulcer, i. 222; ii. 700
of nose, ii. 77
Roseola, i. 485
Round-celled sarcoma, ii. 369
Rouge's Operation, ii. 364
Rupture of aneurism, i. 57
of bladder, i. 151
Rupia, ii. 550

Sabre and Bayonet Wounds, ii. 364
Sac of cyst, i. 392
of hæmatocele, i. 655
of hernia, morbid anatomy of, in strangulation, i. 708
removal of, in strangulation, i. 714
removal of, in operation for radical cure, i. 697
whether to be opened or not in herniotomy, i. 712
Sac, lacrymal. See *Diseases of the Lacrymal Apparatus*, i. 876
of meningocele, ii. 16
of spina bifida, ii. 468
Sacculated aneurism, i. 56
vesical calculus, i. 485
Sacculation of the female urethra, ii. 720
Sacro-iliac Joint, Disease of the, ii. 365
suppuration in, ii. 366
symptoms of, ii. 365
treatment of, ii. 366
Sacrum, fracture of the, ii. 178
'Sago' tongue, ii. 638
Salicylic acid, as an antiseptic, i. 73, 78
eruption from, ii. 16
in treatment of warts, i. 263
ointment, i. 73
wool, i. 73
Salivary Calculi, ii. 366
Fistula, ii. 366
Salivation, ii. 480
Salpingotomy, i. 516
Salter's swing cradle, i. 381
Sandbags, ii. 367
Sanderson, Dr. Burdon, on pyæmia and septicæmia, ii. 276
Saphenous vein, varix of the, i. 621
Sapræmia, ii. 367
etiology of, ii. 368
symptoms of, ii. 368
treatment of, ii. 369
Sapræmic fever, ii. 368
Sarcocele, cancerous, ii. 589
cystic, ii. 590
simple, ii. 582
syphilitic, ii. 554, 581
tubercular, ii. 585
differential diagnosis of forms of, ii. 591
treatment of, ii. 592
Sarcoma, ii. 369
in childhood, i. 282
classification of forms of, ii. 369
clinical characters of, ii. 372
degenerative changes in, ii. 373
differential diagnosis of the sarcomata, ii. 373
dissemination of, ii. 6
etiology of, ii. 7
glandular affections in, ii. 6
inflammatory changes in, ii. 373
local recurrence of, ii. 7
localities of, ii. 372
treatment of, ii. 10
Varieties of: alveolar sarcoma, ii. 370
chondro-sarcoma, ii. 371
fibro-sarcoma, ii. 371
giant-celled sarcoma, ii. 370
hæmorrhagic sarcoma, ii. 370
lympho-sarcoma, ii. 370
melanotic sarcoma, ii. 370
mixed-celled sarcoma, ii. 370
myeloid sarcoma, ii. 370
myxo-sarcoma, ii. 371
osteo-sarcoma, ii. 371, 686
plexiform sarcoma, ii. 370

Sarcoma, Varieties of: round-celled sarcoma, ii. 369, 686
spindle-celled sarcoma, ii. 369, 686
Sarcoma of the axilla, i. 119
of the bladder, i. 155
of bone, ii. 373, 685
of the breast, i. 177, 186
of the choroid, i. 292; ii. 122
of the dura mater, ii. 381
of the gums, i. 625
of the iris, i. 821
of the jaws, i. 836
of the kidney, i. 871
of the larynx, i. 895
of lymphatic glands, i. 966
of the naso-pharyngeal region, ii. 41
of the ovary, ii. 148
of the palate, ii. 160
of the pharynx, ii. 41, 212
of the prostate, ii. 250
of the retina, ii. 124, 341
of the scapula, ii. 382
of the spermatic cord, ii. 463
of the testis, ii. 589
of the thyroid gland, ii. 621
of the tonsils, ii. 646
of the uterus, ii. 751
Sarcomatous polypi, ii. 230
Sayre's jury-mast apparatus in disease of the cervical vertebræ, i. 234
plaster-of-Paris jacket in caries of the spine, i. 232
splint for hip-joint disease, i. 727; ii. 375
treatment of fractured clavicle, i. 314
Scabies, ii. 375
Scalds. See *Burns*, i. 200
of the Glottis, i. 904; ii. 377
Scalp, Diseases and Injuries of the, ii. 379
abscess, ii. 380
cancer, ii. 381
cysts, ii. 381
erysipelas, ii. 380
parasitic affections of.
See *Favus*, i. 520
Pediculi, ii. 170
Tinea Tonsurans, ii. 627
pulsating tumour, ii. 381
wounds, i. 686; ii. 379
Scalpels, ii. 382
Scaphoid bone, disease of the, ii. 567
dislocation of the, i. 552
Scapula, Diseases of the, ii. 382
Dislocations of the, ii. 383
Excision of the, ii. 384
Fractures of the, ii. 385
Scarification, ii. 386
of larynx, i. 886
Scarlet fever of surgical patients, ii. 419
Scar, deformity of, i. 303
discoloration of, i. 303
neuralgia of, i. 305
ulceration of, i. 305
Schizomycetes, ii. 386
Schrœder's operation for extirpation of the uterus, ii. 753
Sciatic aneurism, i. 607
hernia, ii. 387
diagnosis of, i. 609
nerve, seat of election for exposure of, ii. 74
Sciatica, treatment of, by nerve-stretching, ii. 61
Scirrhus, structure of, i. 225
of the bladder, i. 155
of the breast, i. 187
of the œsophagus, ii. 94
of the orbit, ii. 119
of the prostate, ii. 250
of the pylorus, ii. 283
of the rectum, ii. 314
of the testis, ii. 589
of the uterus, ii. 751
Scleral puncture in glaucoma, i. 604
Sclerema Neonatorum, ii. 387
Scleroderma, ii. 388
circumscribed, ii. 390
diffuse symmetrical, ii. 389
Sclerosis. See *Induration*, i. 787
Sclerotic, Diseases of the, ii. 391
hyperæmia, ii. 392
inflammation (episcleritis), ii. 393
new growths, ii. 394
staphyloma, ii. 394
Injuries of the, ii. 395
Sclerotomy, i. 604
Scorbutic indurations, ii. 407
Scorpions, stings of, ii. 478
Scotomata, i. 334; ii. 188
Scrofula, ii. 396
Scrofulous affections of the skin, ii. 398
Scrotal Elephantiasis, ii. 399
indications and contra-indications for operative treatment, ii. 399
hernia, i. 799
Scrotal Swellings, Diagnosis of, ii. 402
Scrotum, Diseases and Injuries of the, ii. 404
'Sculler's sprain,' i. 86
Scurvy, ii. 406
in combination with rickets, ii. 361
Sebaceous Cysts, ii. 408
of scalp, ii. 381
'Seats of election' for exposure of nerves, ii. 73
Seborrhœa, ii. 410
Secondary cancer in bone, ii. 693
deviation in paralysis of ocular muscles, ii. 85
hæmorrhage, i. 662
syphilis. See *Syphilis*, ii. 542
Sediments in urine, i. 216
Semilunar bone, dislocation of the, i. 239
Seminal flux, ii. 465
Senile cataract, i. 246
gangrene, i. 582
Sensation, loss of, after nerve-section, ii. 63
Separation, line of, in gangrene, i. 586
Separation of Epiphyses, ii. 411
at the ankle-joint, ii. 414
at the elbow-joint, i. 746; ii. 413
at the hip-joint, ii. 414
at the knee-joint, i. 534; ii. 414

Separation of Epiphyses at the shoulder-joint, ii. 413
at the wrist, ii. 414
Sepsin, ii. 416
Septate vagina, ii. 769
Septic arthritis, i. 859
Septic Diseases, Classification and Etiology of, ii. 417
general, ii. 418
local, ii. 418
intoxication. See *Sapræmia*, ii. 367
organisms. See *Bacillus*, i. 123
Bacterium, i. 135
Schizomycetes, ii. 386
modes of action of, ii. 420
poisons. See *Sepsin*, ii. 416
excretion of, ii. 422
Septicæmia, ii. 423
acute, ii. 423
chronic, ii. 425
distinction of, from sapræmia, ii. 423
Septum Narium, Affections of the, ii. 426
blood-tumour of the, ii. 77
deflection of the, ii. 76, 426
œdema of the, ii. 427
perforation of the, ii. 427
tumours of the, ii. 427
Sequestrum, i. 428; ii. 44
Serous cysts of breast, i. 184
Seton-wounds from gunshot injury, i. 627
Setons, ii. 428
in treatment of bronchocele, ii. 618
of nævus, 33
Sex, ii. 428
influence of, on nature of malignant disease, ii. 8
on risks of surgical operation, ii. 431
relation of, to distribution of disease, ii. 429
to transmission of disease, ii. 428
relative frequency of, with regard to aneurism, i. 56; ii. 432
of atresia ani, ii. 429
of cancer of lip, i. 932; ii. 432
of cancer of the tongue, ii. 432
of club-foot, ii. 429
of congenital dislocation of the hip, i. 337; ii. 429
of ectopia vesicæ, i. 425; ii. 429
of elephantiasis Arabum, i. 441
of fissure of the rectum, i. 545
of goître, ii. 613
of hæmophilia, i. 659
of hare-lip, i. 680; ii. 429
of hernia, ii. 432
of rupture of the bladder, i. 151
of spina bifida, ii. 429
of stone in the bladder, ii. 482
Shadow test of colour-blindness, i. 333
Shampooing. See *Massage*, ii. 11
Shells, injuries from, ii. 628
Shock, ii. 432. See *Collapse*, i. 327
with depression, ii. 433
with excitement, ii. 436
in gunshot wounds, i. 629
Shock, influence of anæsthetics in, ii. 435
in injuries to abdomen, i. 1
in injuries to children, i. 281
operation during, ii. 435
question of risks of, in old age, ii. 96
Shot, injuries from, ii. 628
Shoulder, Diagnosis of Diseases and Injuries about the, ii. 437
fractures of humerus near, i. 744, 745
fractures of scapula near, ii. 385, 438
Shoulder-joint, Amputations at the, ii. 439
antero-posterior flap method, ii. 440
circular method, ii. 439
oval method, ii. 439
Spence's method, ii. 440
square-shaped flap method, ii. 441
in subclavian aneurism, i. 61; ii. 514
Diseases of the, ii. 441
Dislocations of the, ii. 442
luxatio erecta, ii. 443
subclavicular, ii. 443
subcoracoid, ii. 442
subglenoid, ii. 442
subspinous, ii. 443
supracoracoid, ii. 443
Callaway's test in, ii. 442
Dugas's test in, ii. 442
Hamilton's test in, ii. 442
dislocation, congenital, of the, i. 336
excision of the, i. 857
Sick Room, Management of the, ii. 445
Sigault's operation. See *Symphysiotomy*, ii. 539
Sight, weakness of, i. 108
in injuries to head and spine, ii. 790
in railway injuries, ii. 295, 304, 790
Silvester's method of artificial respiration, ii. 525
Sinus, ii. 448
treatment of, i. 17
Sinus, Frontal, Diseases of the, i. 574
Sixth nerve, injury of the, i. 382
paralysis of the, ii. 86
Skin, affections of, in secondary syphilis, ii. 549
in tertiary syphilis, ii. 557
medicinal eruptions on, ii. 15
Skin Diseases, Classification of, ii. 449
Skin-grafting, i. 616
Skull, deformities of the.
See *Meningocele*, ii. 16
Rickets, ii. 356
Skull, diseases of bones of the.
See *Craniotabes*, i, 383
Leontiasis Ossea, i. 924
Ostitis Deformans, ii. 146
Syphilis, ii. 553
Tumours of the Frontal Sinus, under *Diseases of the Frontal Sinus*, i. 576
Skull, Fracture of the, ii. 452
of base, ii. 455
anterior fossa, ii. 456
middle fossa, ii. 457
posterior region, ii. 458
of vault, ii. 453
depressed fracture, ii. 454

Skull, Fracture of the: fissured fracture, ii. 453
punctured fracture, ii. 454
Results of.
See *Compression of the Brain*, i. 172
Encephalitis, Meningitis, and Abscess of the Brain, i. 459
Hernia of the Brain, i. 175
Diagnosis of Head Injuries, i. 683
Disorders of Vision from Injuries of the Head and Spine, ii. 790
symptoms of: bleeding from the ear, i. 687; ii. 457
bleeding into the eyelids, i. 686; ii. 456
from the mouth, i. 687
from the nose, i. 687
coma, i. 172
escape of brain-matter, i. 688
of cerebro-spinal fluid, i. 687
extravasation of blood in neck, ii. 458
mental derangement, i. 688
tenderness over mastoid process, ii. 458
treatment of, ii. 458
elevation of depressed bone, ii. 458
trephining, ii. 459
skull, gunshot wounds of the, i. 639
Slough and Sloughing, ii. 460
Sloughing phagedæna, i. 545. See *Hospital Gangrene*, i. 739
Sloughing ulcer, ii. 696
Smallpox, conjunctival complication of, i. 356
Smith's (Nathan) Anterior Splint, ii. 460
(R. W.) dislocation of foot, i. 552
(T.) needle, ii. 46
Snuffles in congenital syphilis, i. 342
Soap lees, swallowing of, i. 33
Sodium, ethylate of, in treatment of nævus, ii. 32
Sonde coudé, i. 262
Sore-throat, ii. 209, 644
Sounding for stone, ii. 484
Spanton's operation for radical cure of hernia, i. 694
Spasm of the ciliary muscle, i. 19
of the facial muscles, i. 514
functional, inspiratory, i. 903
of the glottis, i. 901
treatment of, by nerve-stretching, ii. 60
Spasmodic stricture of the œsophagus, ii. 93
of the urethra, ii. 498
Spastic aphonia, i. 903
Speaker's cramp, i. 902
Spectacles, i. 261; ii. 329. See *Errors of Refraction*, ii. 316
Specula, ii. 460
aural, ii. 462
ocular, ii. 462
nasal, ii. 462
rectal, ii. 461
urethral, ii. 462
vaginal, ii. 460
Spence's amputation of thigh, ii. 600
at shoulder-joint, ii. 440
Spermatic Cord, Swellings and Tumours of the, ii. 463. See also *Hæmatocele*, i. 654
Spermatic Cord.
See also *Hydrocele*, i. 751
Diagnosis of Scrotal Swellings, ii. 402
Varicocele, ii.
ligature of, in castration, i. 240
Spermatorrhœa, ii. 464
views of Clemens, Lallemand, and Trousseau as to cause of, ii. 465
Spermatozoa, presence of in encysted hydrocele, i. 757
Sphacelus. See *Gangrene*, i. 580
Spheroidal-celled carcinoma, i. 223
Sphincter ani, spasm of the, i. 544
vesicæ, paralysis of the, in spinal injury, i. 133
Spica bandage, i. 139
Spiders, bites of, ii. 478
Spina Bifida, ii. 467
causes of, ii. 469
diagnosis of, ii. 469
pathological anatomy of, ii. 467
symptoms of, ii. 469
treatment of, ii. 470
Spina ventosa, ii. 692
Spinal accessory nerve, injuries of the, i. 383
seat of election for exposure of the, ii. 73
Spinal cord, diseases and injuries of the.
See *Injuries of the Back and Spine*, i. 124
Railway Injuries, ii. 294
Caries of the Spine, i. 226
compression from injury, i. 128
from spinal caries, i. 230
concussion, i. 134; ii. 303
hæmorrhage, i. 128
impaired vision from injury, ii. 304
inflammation, from spinal caries, i. 230
traumatic, i. 129
laceration of membranes, i. 129
morbid histology of, in hydrophobia, i. 763
in tetanus, ii. 600
paralysis from spinal disease, i. 230
from spinal injury, i. 132; ii. 297, 303
wounds of the, i. 134
Spindle-celled sarcoma, ii. 369, 686
Spine, caries of the, i. 228
contusion of the, i. 126
curvatures of the, angular, i. 228
antero-posterior, i. 69
lateral, i. 910
dislocations of the, i. 131
erosion of, by aneurism, i. 6
fractures of the, i. 130
gunshot injuries of the, i. 641
sprains of the, i. 125
trephining of the, i. 134
Spiral bandage, i. 138
Spiral fracture of tibia, i. 922
Spiral wire drains, i. 411
Spirillum, i. 471
Obermeieri, ii. 471
Spirochæte, ii. 471

Splay-foot. See *Flat-foot*, i. 548
Spleen, Diseases of the, ii. 471
abscess, ii. 472
cystic disease, ii. 472
gunshot wound, i. 646
hydatid disease, ii. 472
injuries of the, ii. 471
leukæmic hypertrophy, ii. 471
malignant hypertrophy, ii. 472
rupture, ii. 472
simple hypertrophy, ii. 471
swelling of, in septicæmia, ii. 425
Splenectomy, ii. 472
Splenic fever, ii. 421
virus of (bacillus anthracis), i. 124; ii. 3, 421
Splints, ii. 473. See also *Immovable Bandages*, i. 780
method of applying, in antiseptic dressing, ii. 473
padding of, ii. 474
plaster-of-Paris, i. 780
plaster-of-Paris and telegraph-wire, ii. 474
Splints and Surgical Appliances—
For arm: Fergusson's Splint, i. 534
Stromeyer's Cushion, ii. 508
For cheeks: Hainsby's compressor, i. 672
For collar-bone: Ellis's Splint, i. 314, 448
Gordon's Splint, i. 615
Sayre's apparatus, i. 314
For elbow: Mason's Splint, ii. 11
For forearm and wrist: Carr's Splint, i. 240
Esmarch's Splint, i. 490
Gordon's Splint, i. 615
Lister's Splint, i. 933
Pistol Splint, ii. 217
For hip: Sayre's Splint, ii. 375
Taylor's Splint, ii. 570
Thomas's Splint, i. 727; ii. 605
For knee: Howse's Splint, i. 744
Thomas's Splint, ii. 605
Watson's Splint, ii. 812
For leg: Arnold's Splint, i. 87
Cline's Side Splints, i. 320
Dupuytren's Splint, i. 412
McIntyre's Splint, ii. 14
For lower jaw: Hamilton's splint, i. 831
Hammond's Wire Splint, i. 674, 832
For spine: Davy's hammock, i. 233
Furneaux Jordan's apparatus, i. 234
Sayre's jury-mast apparatus, i. 234
Sayre's plaster-of-Paris jacket, i. 232
Walker's modification of, i. 233
For thigh: Bryant's Splint, i. 197
Cripps's Long Splint, i. 386
De Morgan's Splint, i. 399
Desault's Long Splint, i. 401
Gibson's Splint, i. 593
Gooch's Splint, i. 615
Hamilton's Splint, i. 673
Hodgen's Splint, i. 738
Liston's Long Splint, i. 938
Smith's (N.), Splint, i. 460
Sponge-grafting, i. 618; ii. 696
Sponges, counting of, in ovariotomy, ii. 156
Spongy condition of gums, i. 625
in scurvy, ii. 407
exostosis, i. 491
Spontaneous cure of abdominal aneurism, i. 5
dislocation, i. 403
gangrene, i. 583
rupture of empyema, seat of, i. 455
Sprain, ii. 475
of back, i. 125
Spray, antiseptic, i. 75
Spray-producer, i. 73
Spreading traumatic gangrene, i. 584
'Spring' catarrh of conjunctiva, i. 349
Squint. See *Strabismus*, ii. 489
Staff, in the boutonnière operation, i. 170
in lithotomy, i. 934
Rectangular, i. 198
Staphyloma, i. 377
posticum, ii. 104
Staphyloraphy. See *The Surgical Treatment of Cleft Palate*, i. 316
Starch bandages, i. 781
Startin's needle, ii. 46
Stasis, i. 789
Steatorrhœa, ii. 410
Stenosis of the cervix uteri, i. 269
of the lacrymo-nasal passages, i. 878
of the laryngeal cavity, i. 906
of the pharynx. See *Pharyngeal Stenosis*, ii. 206
Stenositomy, i. 881
Sterco-purulent fistula, i. 516
Sterility in the Male, ii. 476
Sterno-mastoid muscle, contraction of. See *Torticollis*, ii. 648
Sternum, Fracture of the, ii. 477
Stilling's operation for mucocele, i. 881
pseudo-isochromatic tables, i. 133
Stings of Insects, ii. 478
Stitches of coaptation, i. 76
of relaxation, i. 76
Stokes's supracondyloid amputation, i. 873
Stomach, cancer of, operative treatment of. See *Operations on the Pylorus*, ii. 283
fistula into the. See *Gastric Fistula*, i. 589
fistulous opening into the, formation of. See *Gastrostomy*, i. 590
gun-shot wounds of the, i. 646
Stomatitis, ii. 479
gangrenous. See *Cancrum Oris*, i. 217
syphilitic, ii. 481, 552
Stone. See *Urinary Calculus*, i. 214
in the Female Bladder, ii. 482
in the Male Bladder, ii. 482
treatment of.
See *Lithotomy*, i. 934
Lithotrity, i. 943
recurrence of, after lithotomy, i. 943
after lithotrity, i. 950
spontaneous discharge of, in the female, ii. 482
Strabismometer, ii. 490
Strabismus, ii. 489

Strabismus, amblyopia in, i. 37
convergent (hypermetropic), ii. 489
divergent (myopic), ii. 494
Strangulated hernia, i. 702
Strangulation, internal, by bands and through apertures, i. 802
Strangury, ii. 495
Stretching of facial nerve for tic convulsif, i. 514
of nerves. See *Nerve-stretching*, ii. 58
Striæ et Maculæ Atrophicæ, ii. 496
Stricture of Fallopian tubes, i. 516
of the intestine, i. 806
cancerous, i. 807
cicatricial, i. 806
of the naso-lacrymal canal, i. 878
of the œsophagus, ii. 93
malignant, ii. 94
simple, ii. 93
spasmodic, ii. 93
of the rectum, ii. 311
of the Urethra, ii. 496
inflammatory, ii. 497
organic, ii. 498
spasmodic, ii. 498
the urethra in the female, ii. 720
Stricture-Dilators, ii. 507
Stromeyer's Cushion, ii. 508
Struma. See *Scrofula*, ii. 396
(goître). See *Diseases of the Thyroid Gland*, ii. 610
Strumous lip, i. 932
ulcers, treatment of, i. 264
Stumps, Affections of, ii. 508
conditions of a good stump, ii. 508
conical stump, ii. 510
malignant disease of, ii. 509
necrosis of, ii. 509
painful stump, ii. 509
treatment of recent, i. 51; ii. 508
Sty, i. 505
Styptics, ii. 510
Subastragaloid dislocation of foot, i. 553
Subclavian Aneurism, ii. 511
causes of, ii. 511
diagnosis of, ii. 512
symptoms of, ii. 512
treatment of, ii. 513
by amputation at the shoulder-joint, ii. 514
by direct pressure, ii. 513
by distal compression, ii. 513
by distal ligature, ii. 514
by galvano-puncture, ii. 514
by injection of ergotin, ii. 514
by manipulation, ii. 514
by proximal ligature, ii. 513
by proximal pressure, ii. 513
Subclavian artery, ligation of, in aortic aneurism, i. 81
in axillary aneurism, i. 123
in innominate aneurism, i. 801
in wound of axillary artery, i. 121
surgical anatomy and ligation of the, ii. 515
Subclavicular dislocation of the head of the humerus, ii. 443
Subconjunctival Ecchymosis, ii. 516
Subcoracoid dislocation of the head of the humerus, ii. 442
Subcutaneous injection. See *Hypodermic Injection*, i. 767
osteotomy. See *Osteotomy*, ii. 140
urethrotomy, ii. 732
Subglenoid dislocation of the head of the humerus, ii. 442
Subjective sensations in eczema, i. 431
Sublingual abscess, ii. 307
dermoid cyst, ii. 307
Subluxation of lower jaw, i. 831
Submammary abscess, i. 181
Submental excision of tongue (Kocher's and Regnoli's operations), ii. 643
Subperiosteal Resection, ii. 516
Subspinous dislocation of head of humerus, i. 443
Subungual Exostosis, ii. 517
Suction treatment of cataract, i. 254
Sulphate of copper as a caustic, i. 264
Sulphuric acid, swallowing of, i. 21
use of, in local treatment of caries, i. 228
Sulphurous acid as an antiseptic, i. 78
Sunburn, i. 283
Supernumerary Breasts, ii. 229
fingers, i. 554
nipples, ii. 74
Suppositories, ii. 518
Suppression of Urine, ii. 518
Suppuration, ii. 520. See also *Abscess*, i. 13
of antrum, i. 79
in bone, i. 17
in caries of spine, i. 229
See *Lumbar Abscess*, i. 954
Psoas Abscess, ii. 263
Retro-Pharyngeal Abscess, ii. 345
a cause of albuminoid degeneration, i. 29
intracranial, i. 461
in joints, i. 841
in middle ear, i. 423
a result of inflammation, i. 792
Suppurative Fever, ii. 521
secondary, ii. 522. See *Hectic Fever*, i. 689
Supracotyloid dislocations at hip-joint, i. 737
Supraorbital nerve, exposure of, for neurotomy, ii. 73
Superpubic aspiration of bladder, i. 150
lithotomy, i. 940
Supratrochlear nerve, exposure of, for neurotomy, ii. 73
Surgical Anatomy and Ligation of Arteries:—
Axillary, i. 121
Brachial, i. 172
Carotid, Common, i. 237
External, i. 237
Facial, i. 513
Femoral, i. 523
Iliac, i. 777
common, i. 779
external, i. 777
internal, i. 778

Surgical Anatomy and Ligation of Arteries:—
Innominate, i. 801
Lingual, i. 930
Obturator, ii. 80
Popliteal, ii. 234
Radial, ii. 290
Subclavian, ii. 515
Temporal, ii. 573
Tibial, ii. 624
anterior, ii. 625
posterior, ii. 624
Surgical diagnosis. See *Diagnosis, Surgical, in Index.*
Fever, ii. 522
kidney. See *Pyelo-nephritis*, ii. 282
scarlet fever, ii. 419
Suspended Animation, ii. 523
asphyxia, ii. 524
treatment of, by artificial respiration, ii. 525
syncope, ii. 523
Suspension in Surgical Treatment, ii. 527
Suspensory Bandages, ii. 527
Suture of divided nerve, ii. 64
Sutures, ii. 528
Sutures of skull, liability of, to be mistaken for fissured fracture, ii. 454
Swallowing of Acids, i. 21
of Alkalies, i. 32
Sweating Feet, ii. 532
Sycosis, ii. 532
non-parasitica, ii. 533
parasitica, ii. 534
Sylvius, fissure of, external localisation of, i. 686
Symblepharon, i. 511
treatment of, i. 358, 511
Syme's abscess-knife, i. 17
amputation at the ankle-joint, i. 65
operation for removal of the tongue, ii. 643
for restoration of lower lip, i. 277
of nose, ii. 348
for stricture of urethra, ii. 730
operative treatment of aneurism, i. 123, 236
treatment of indolent ulcer, ii. 698
Sympathetic Ophthalmitis, ii. 534
irritation, ii. 534
ophthalmia, ii. 535
Symphysiotomy (Sigault's Operation), ii. 539
Symphysis pubis, puncture of bladder through and under, i. 151
Synchisis scintillans, ii. 102
Syncope, ii. 523
Synovial Membrane, Pulpy Degeneration of, ii. 540
tuberculosis of, ii. 674
Synovitis, ii. 540
acute, ii. 540
chronic, ii. 541
gonorrhœal. See *Gonorrhœal Rheumatism*, i. 614
recurrent, of ankle, i. 67
subacute, ii. 542
'Syphilide pigmentaire,' i. 283
Syphilides, ii. 450, 451, 549, 554, 556
Syphilis, ii. 542
See *Bubo*, i. 197
Chancre, i. 270
Congenital Syphilis, i. 339
Finger-Chancre, i. 541
Gumma, i. 623
Mucous Patches, ii. 25
Vaccination-Syphilis, ii. 767
congenital, i. 339
hereditary. See *Congenital Syphilis*, i. 339
intermediate, ii. 554
primary, i. 270; ii. 543
secondary, ii. 546
tertiary, ii. 556
treatment of, ii. 558
See *Calomel Vapour Bath*, i. 216
Inunction of Mercury, i. 816
Syphilitic albuminuria, ii. 555
alopecia, i. 672; ii. 553
analgesia, ii. 555
angina, i. 159
arteritis, i. 90; ii. 555
caries, i. 226
choroiditis, i. 288; ii. 555
condyloma, ii. 548
coryza, i. 342
deafness, ii. 553
disease of bones, i. 166, 226; ii. 553, 557
in hereditary cases, i. 343
of the brain, ii. 555, 557
of the breast, i. 183
of hair, i. 672; ii. 553
of the internal ear, i. 419; ii. 553
of joints, i. 850
of the larynx, i. 905
of the lips, i. 932
of lymphatic glands. See *Bubo*, i. 197
of the mouth, ii. 552. See *Mucous Patches*, ii. 25
of mucous membranes, ii. 552
of muscles, ii. 28
of the nails, ii. 35
of the nose, ii. 79
of the pharynx, ii. 211
of the rectum, ii. 311, 314
of the skin, ii. 450, 451, 549, 557
in the congenital form, i. 342
of the testes, ii. 581
of the tongue, ii. 636
of the tonsils, ii. 646
erythema, ii. 554
intertrigo, i. 343, 485
iritis, ii. 551. See also *Iritis* under *Diseases of the Iris*, i. 821
keratitis, i. 343
lichen, ii. 550
lupus, i. 344
malformation of teeth, i. 346
necrosis, ii. 43
neuro-retinitis, ii. 552
ostitis, ii. 145
periostitis, ii. 190, 553

Syphilitic psoriasis, ii. 550, 554
palmaris, ii. 554
pyrexia, ii. 555
retinitis, ii. 338, 552
roseola, ii. 547
rupia, ii. 550
sarcocele, ii. 554, 581
stomatitis, ii. 481
warts, ii. 548

Tabes dorsalis from railway injury, ii. 29
Tabetic arthropathy, i. 851. See *Charcot's Disease*, i. 272
Tagliacotian operation, ii. 220, 347
Talipes. See *Club-foot*, i. 320
calcaneo-valgus, i. 325
calcaneo-varus, i. 325
calcaneus, i. 321
equino-valgus, i. 325
equino-varus, i. 323
congenital, in infancy, i. 323
after the period of infancy, i. 324
caused by paralysis, i. 325
equinus, i. 320
valgus, i. 322
varus, i. 322
Tapping. See *Paracentesis*, ii. 163
the antrum, i. 79
the bladder, i. 150
for hydatid disease, i. 749
in ovarian tumour, ii. 151
Tarsal Bones, Caries of the, ii. 565
dislocations of the, i. 552
excision of the astragalus, ii. 567
cuboid, ii. 568
os calcis, ii. 133
scaphoid, ii. 568
fractures of the, i. 553
astragalus, i. 553
os calcis, i. 554
cartilages, affections of the. See *Diseases of the Eyelids*, i. 505
Joints, Diseases of the, ii. 569
Tarsal tumour, i. 506
Tarso-metatarsal dislocations, i. 552
Taxis, i. 710; ii. 569
fallacies of, i. 710
versus herniotomy, i. 709
Taylor's Splint, ii. 570
Teale's method of amputation, i. 48
Teeth, extraction of, i. 493
malformations of, in hereditary syphilis, i. 346
Teeth as Tests of Age, ii. 571
Teething, supposed ill-effects of, i. 400
Telangeiectasis. See *Nævus*, ii. 30
Temperature, ii. 371
alterations of, after nerve-section, ii. 64
in children, i. 281; ii. 572
diurnal variations of, ii. 572
in urethral fever, ii. 723
variations of, at different periods of life, ii. 572
in cases of fracture of the spine, i. 133
Temporal Artery, Surgical Anatomy and Ligation of the, ii. 573
Temporo-maxillary Articulation, Diseases of the, ii. 574
Tenaculum, ii. 574
Tendo Achillis, division of the, ii. 577
rupture of the, i. 555
Tendons, Affections of, ii. 574
dislocations of, ii. 575
division of. See *Tenotomy*, ii. 576
rupture of, ii. 575
spasm of, ii. 475
union of, after section or laceration, ii. 575
wounds of, ii. 574
Tendon-sheaths, inflammation of, ii. 576
tuberculosis of, ii. 677
'Tennis elbow,' i. 86
Teno-synovitis, ii. 576
Tenotomy, ii. 576
of the biceps femoris, ii. 578
of the extensor longus digitorum, ii. 578
of the external rectus, i. 493
of the internal rectus, i. 491
of the peroneus longus et brevis, ii. 577
of the semi-membranosus, ii. 578
of the semi-tendinosus, ii. 578
of the sterno-mastoid, ii. 578
of the tendo Achillis, ii. 577
of the tibialis anticus, ii. 577
of the tibialis posticus, ii. 577
in the treatment of ankylosis, i. 69
in the treatment of club-foot, i. 323
Tension of eyeball, i. 503
Tertiary syphilis, ii. 556
Testis, Affections of the, ii. 578
abnormal descent of, ii. 595
abscess of, ii. 579, 580
absence of, ii. 593
atrophy of, ii. 580, 592
carcinoma of, ii. 589
contusion of, ii. 592
cystic disease of, ii. 590
delayed descent of, ii. 593
dermoid tumours of, ii. 589
enchondroma of, i. 465; ii. 589
hæmatocele, i. 656
encysted, i. 656
parenchymatous, i. 657
hernia of, i. 715; ii. 582
hydrocele of, i. 757
incomplete descent of, ii. 593
inflammation of, acute, ii. 578
chronic, ii. 581
Injuries of the, ii. 592
inversion of, ii. 593
irritability of, ii. 588
Malpositions of, ii. 593
neuralgia of, ii. 588
removal of. See *Castration*, i. 240
retention of, ii. 593
retraction of, ii. 596
reversion of, ii. 593
sarcoma of, ii. 589
syphilitic disease of, ii. 554, 591
tubercular disease of, ii. 558, 669

Testis, Wounds of, ii. 592
Tests of vision in French army and navy, i. 37
Tetanus, ii. 597
after gun-shot injuries, i. 631
treatment of, by nerve-stretching, ii. 60
Thecal abscess, ii. 229
Thecitis, ii. 576
Thigh, abscess in the, ii. 602
Amputation of the, ii. 600
flap method, ii. 600
advantages of, compared with those of the circular method, ii. 600, 601
mortality of, as influenced by antiseptic surgery, ii. 601
aneurism in the. See *Femoral Aneurism*, i. 521
gun-shot injuries of the, i. 650
tumours of the, ii. 603, 689
wounds of the vessels of the, i. 525
Thigh and Leg, Diagnosis of Affections of the, ii. 601
the knee, ii. 603
the leg, ii. 604
the thigh, ii. 601
Third cranial nerve, injuries of the, i. 381
paralysis of the, ii. 86
Thomas's Hip Splint, ii. 605; i. 727
Knee Splint, ii. 605
Thoracentesis, i. 455; ii. 163
Thoracic Duct, Injuries and Diseases of the, ii. 606
Thorax, deformities of the.
See *Caries of the Spine*, i. 230
Pigeon-breast, ii. 216
Rickets, ii. 357
gun-shot wounds of the, i. 643
injuries of the. See *Injuries of the Chest*, i. 278
Throat, Injuries of the, ii. 606
Thrombi, ii. 609
changes in, degenerative, ii. 610
of organisation, ii. 610
structure of, ii. 610
Thrombosis, ii. 609
of central artery of retina, ii. 339
in pyæmia, ii. 279
a result of chronic endarteritis, i. 90
Thrush, ii. 634
Thumb, amputation of the, i. 543
dislocation of the, i. 675
malformation of the, i. 544
Thyroid Gland, Diseases of the, ii. 610
goître, ii. 613
cystic, ii. 614
endemic, ii. 613
epidemic, ii. 613
exophthalmic, ii. 613
fibroid, ii. 614
parenchymatous, ii. 614
treatment of, by external application of biniodide of mercury, ii. 617
by external application of cold, ii. 617
by external application of iodine, ii. 617
Thyroid Gland, Diseases of the, Treatment of, by incision of the sac, ii. 619
by injection of iodine, ii. 617
by injection of perchloride of iron, ii. 618
by internal use of hydrofluoric acid, ii. 617
by internal use of iodine, ii. 617
by the removal of the diseased gland, ii. 620
by resection of the isthmus, ii. 620
hydatid disease of the, ii. 614
inflammation of the, ii. 612
Malignant Disease of the, ii. 621
removal of the (Kocher's operation), ii. 620
indications for, ii. 619
results of, ii. 611
Wounds of the, ii. 621
in cut-throat, ii. 608
Thyrotomy, ii. 623
indications for, ii. 623
for removal of foreign body from larynx, i. 562
versus intralaryngeal removal, in cases of growths in the larynx, i. 894
Tibia, dislocations of the. See *Dislocations of the Knee*, i. 871
fractures of the, i. 920
and fibula, fractures of the, i. 921
sarcoma of the, ii. 690
operative treatment of, ii. 690
Tibial Arteries, Surgical Anatomy and Ligation of the, ii. 624
anterior tibial, ii. 625
posterior tibial, ii. 624
Wounds of the, ii. 625
Tibial nerves, exposure of, for neurotomy, ii. 74
'Tic convulsif,' i. 514
Tinea barbæ. See *Sycosis Parasitica*, ii. 534
favosa. See *Favus*, i. 520
tarsi. See *Blepharitis Ciliaris*, i. 507
Tonsurans, ii. 627
versicolor. See *Pityriasis Versicolor*, ii. 218
Tinnitus, i. 419, 420
Tobacco amaurosis, i. 40
Todd's stricture dilator, ii. 508
Toenail, avulsion of, i. 798
hypertrophy of, ii. 35
ingrowing, i. 797; ii. 35
Toes, amputations of, i. 550
dislocations of, i. 553
hypertrophy of. See *Pes Gigas*, ii. 205
Tongue, Diseases of the, ii. 631
aphthous stomatitis, ii. 634
atrophy, ii. 631
black tongue, ii. 635
cancer, ii. 638
cirsoid aneurism, ii. 638
congenital absence, ii. 631
hypertrophy, ii. 631. See *Macroglossia*, ii. 1
inflammation, ii. 632
acute glossitis, ii. 632

Tongue, Diseases of the, chronic glossitis, ii. 632
leucoplakia, ii. 633
lupus, ii. 636
nævus, ii. 637
neuralgia, ii. 635
non-malignant tumours, ii. 637
pigmentary affections, ii. 635
sago tongue, ii. 638
syphilitic affections, ii. 636. See *Mucous Patches*, ii. 25; *Syphilis*, ii. 553
thrush, ii. 634
tongue-tie, ii. 632
tuberculosis, ii. 636
tylosis, ii. 633, 693
wandering rash, ii. 635
warty tongue, ii. 638
xanthelasma, ii. 635
Tongue, Operations for Removal of the, ii. 640
Morrant Baker's operation, ii. 640
Kocher's operation, ii. 643
Regnoli's operation, ii. 643
Syme's operation, ii. 643
Whitehead's operation, ii. 642
Tongue-tie, ii. 632
Tonsil, enlarged, ii. 645
avulsion of (Borelli's operation), ii. 646
removal of, ii. 646
dangers of, ii. 646
Tonsil-guillotine, ii. 646
Tonsillar calculus, ii. 646
Tonsillitis, ii. 644
erythematous (catarrhal), ii. 644
phlegmonous (quinsy), ii. 645
Tonsils, Diseases of the, ii. 644
encephaloid cancer, ii. 647
epithelioma, ii. 647
hypertrophy, ii. 645
sarcoma, ii. 646
syphilitic lesions, ii. 646
tuberculosis, ii. 646
tumours, ii. 646
Toothache, ii. 647
Tooth-tumour. See *Odontoma*, ii. 88
Torsion, ii. 648
Torsion-forceps, i. 100
Torticollis, ii. 648
Tourniquets, ii. 650
aortic, i. 82
Davy's, i. 393
Lister's, i. 82; ii. 651
Carte's, ii. 652
Esmarch's, i. 489; ii. 650
Higginbottom's, ii. 652
Petit's, ii. 651
Signoroni's, ii. 651
Skey's, ii. 651
Tuffnell's, ii. 652
weight-compressors, ii. 652
Toynbee's artificial drum, i. 423
Trachea, compression of, by aortic aneurism, i. 81
by goître, ii. 615
foreign bodies in, i. 560
gunshot wounds of, i. 643
Trachea, surgical anatomy of, ii. 654
wounds of, ii. 607
Tracheal Catheterism, ii. 652
Tracheal tube. See *Tracheotomy Tubes*, ii. 658
Trachelorrhaphy. See *Emmet's Operation*, i. 451
Tracheotomy, ii. 654
after-treatment, ii. 656
complications, ii. 657
indications, ii. 654
methods of operating, ii. 655
performance of, for foreign bodies in air-passages, i. 562
for malignant growth of the larynx, i. 897
for paralysis of the larynx, i. 901
for scald of the larynx, i. 905; ii. 378
for syphilis of the larynx, i. 907
for tuberculosis of the larynx, i. 910
for wounds of throat, ii. 608
Tracheotomy Tubes, ii. 656, 658
Transfusion, ii. 659
Traumatic aneurism, i. 61
arthritis, i. 859
cataract, i. 248
cerebral abscess, i. 461
delirium, diagnosis of, from delirium tremens, i. 399
empyema, i. 453
encephalitis, i. 460
Fever, ii. 660
gangrene, i. 584
malignancy, i. 165
peritonitis. See *Peritonitis*, ii. 198
Pneumonia, ii. 222
pneumothorax. See *Pneumothorax*, ii. 222
Traumatism in causation of chronic rheumatic arthritis, i. 294
of cirsoid aneurism, i. 310
of tuberculosis, ii. 669
Traversing gunshot wounds, i. 627
Trendelenburg's Trachea Tampon, ii. 662
Trephining of the cranium, in abscess of brain, i. 464
in fracture of skull, ii. 459
in gunshot injury of head, i. 639
of the sclerotic in glaucoma, i. 605
of the spine, i. 134
Trichiasis, i. 508
Trichinosis, ii. 28
Trichorexis nodosa, i. 672
Tricophyton tonsurans, ii. 627
Triple incision in amputation, i. 47
Triple phosphatic calculus, i. 215
Trismus, ii. 597
Trocars, ii. 662
Trochanter, great, fracture through, i, 530
position of, determination of, in cases of injury to hip, i. 529
Trophic changes after nerve-section, ii. 63
Trusses, ii. 663
Tubal gestation, i. 494
tubo-ovarian, i. 495
tubo-uterine, i. 494
Tubercle, ii. 666

Tubercular disease of bone, ii. 670. See *Caries*, i. 226
of the breast, i. 183
of the conjunctiva, i. 357
of joints, i. 850; ii. 673
of the larynx, i. 908
of lymphatic glands, ii. 679
of mucous membrane, ii. 678
of the pharynx, ii. 211
of the prostate, ii. 249
of the skin, ii. 678. See *Lupus Vulgaris*, i. 958
of the testis, ii. 585
of the tongue, ii. 636
of the tonsils, ii. 646
of the urethra, ii. 714
of wounds, ii. 677
Tubercular ulceration, ii. 678
Tuberculosis, Surgical, ii. 669
Tumours: of the antrum, i. 80
in the arm and forearm, i. 87
in the axilla, i. 119
of the bladder, i. 154
of Bone, ii. 683
See *Enchondroma*, i. 465
Exostosis, i. 491
Osteo-aneurism, ii. 134
Osteoma, ii. 135
Sarcoma, ii. 369
of the breast, i. 183
diagnosis of the, i. 177
of the choroid, ii. 122
of the eyelids, i. 506
of the groin, diagnosis of, i. 621
of the gums, i. 625
of the iris, i. 820
of the jaws, i. 835
of the kidneys, i. 870
of the labia, ii. 810
of the larynx, i. 892
of the lips, i. 932
of muscle, ii. 28
of the naso-pharyngeal space. See *Naso-pharyngeal Growths*, i. 39
of the neck, ii. 41. See *Hydrocele of the Neck*, i. 758
of nerves. See *Neuroma*, ii. 69
of the nose, ii. 77
of the optic nerve, ii. 112
of the orbit, ii. 117
of the ovaries. See *Ovarian Tumours*, ii. 147
of the palate, ii. 160
of the parotid gland. See *Parotid Tumour*, ii. 165
of the penis, ii. 184
of the pharynx, ii. 212
in the popliteal space, diagnosis of the, ii. 237
of the prostate, ii. 250
of the rectum, ii. 310, 314
of the retina, ii. 124, 341
of the scalp, ii. 381. See *Sebaceous Cysts*, ii. 408
of the scrotum, ii. 405
Tumours of the scrotum, diagnosis of the. See *Diagnosis of Scrotal Swellings*, ii. 402
of the skin, ii. 451
of the spermatic cord, ii. 463
of the testis, ii. 589
of the thyroid gland, ii. 614, 621
of the tongue, ii. 637, 638
of the tonsils, ii. 646
of the female urethra, ii. 721
of the uterus, ii. 748
of the vagina, ii. 772
of the vulva, ii. 810
Tumours, Malignant, ii. 5
See *Carcinoma*, i. 220
Sarcoma, ii. 369
Tumours, Non-Malignant, 680
See *Adenoma*, i. 26
Cystic Tumours, i. 391
Enchondroma, i. 465
Erectile Tumours, i. 473
Exostosis, i. 491
Fibrous Tumours, i. 535
Hydrocele of the Neck, i. 758
Lipoma (*Fatty Tumour*), i. 930
Myoma, ii. 29
Myxoma, ii. 30
Neuroma, ii. 69
Odontoma, ii. 88
Osteoma, ii. 135
Papilloma, ii. 161
Sebaceous Cysts, ii. 408
Villous Tumours, ii. 789
Tunica vaginalis, hæmatocele of the, i. 654
hernia into the, i. 799
hydrocele of the, i. 751
Tuning-fork, use of, in diagnosis of deafness, i. 394
Tunnelling the prostate. See *Canalisation of the Prostate*, i. 216
Tylosis, ii. 633, 693
Twisted suture, ii. 529
Tympanic membrane, catarrh of the, i. 421
injuries of the, i. 419
perforation of the, i. 421
polypus of the, i. 423
Tympanum, affections of the. See *Diseases of the Middle Ear*, i. 421
inflation of the, i. 416

Ulceration, ii. 693
of the anus. See *Fissure of the Anus*, i. 544
of arteries, i. 88
of articular cartilage, i. 100
of the bladder, i. 145
of bone. See *Caries*, i. 226
of the cornea, i. 370
of the duodenum in burns, i. 205
of the eyelids, i. 507
of the lips, i. 931
of the nipple, ii. 74
phagedænic, ii. 206, 544, 697
of the rectum, ii. 313
of scars, i. 305

Ulceration, serpiginous, ii. 549
strumous, ii. 699
syphilitic, ii. 549, 699
of the tongue, ii. 639
of the tonsils, ii. 646
of the umbilicus, ii. 706
Ulcers, ii. 695
atheromatous, i. 89
chronic, ii. 698
eczematous, ii. 698
epitheliomatous, i. 221; ii. 701
gouty, ii. 698
inflammatory, ii. 696
irritable, ii. 697
lupoid, i. 959; ii. 700
œdematous, ii. 696
phagedænic, ii. 206, 544, 697
rodent, i. 223; ii. 701
scorbutic, ii. 408, 699
simple, ii. 695
sloughing, ii. 696
strumous, ii. 699
syphilitic, ii. 549, 699
varicose, ii. 698
venereal. See *Chancre*, i. 270
Ulna, Dislocation of the, i. 85; ii. 702
Fractures of the, i. 85; ii. 702
sarcoma of the, ii. 691
Ulnar Artery, Surgical Anatomy and Ligation of the, ii. 703
nerve, exposure of, for neurotomy, ii. 74
Umbilical Fistula, ii. 704, 706
Umbilical Hernia, ii. 704
adult form, ii. 705, 707
congenital form, ii. 704
infantile form, ii. 705, 706
radical cure of, i. 700
strangulation of, ii. 705
Umbilical vein, pyæmia from inflammation of the, ii. 706
Umbilicus, ii. 706
Unreduced dislocations, i. 407
Ununited Fracture, ii. 707
causes, ii. 707
forms, ii. 708
treatment, ii. 708
Urachus, non-closure of the, ii. 704
Uræmia, ii. 710
Uræmic convulsions, ii. 711
Uranoplasty. See *Surgical Treatment of Cleft Palate*, i. 316
Urates, deposits of, in urine, i. 216; ii. 733
Urea, ii. 711
Ureter, obstruction of the. See *Hydronephrosis*, i. 759
wounds of the, i. 864
Urethra, Diseases of the (in the female), ii. 720
fistula, ii. 721
inflammation, ii. 720
malformations, ii. 720
stricture, ii. 720
tumours, ii. 721
Urethra, Diseases of the (in the male), ii. 713
inflammation, ii. 713. See *Gleet*, i. 605
Gonorrhœa, i. 610
Urethra, Diseases of the (in the male):—
neuralgia, ii. 714
peri-urethral abscess, ii. 716
stricture of the, ii. 496
warts, ii. 715
endoscopic examination of the. See *Endoscope*, i. 466
Foreign Bodies in the, i. 564; ii. 716, 719
in the female, ii. 721
hæmorrhage from the, i. 658; ii. 718
in gonorrhœa, i. 611
injuries of the, ii. 718
in injuries of the pelvis, ii. 179
plastic operations on the. See *Urethroplasty*, ii. 724
pressure on the, in dislocation of hip, i. 738
stone in the, ii. 487, 719
Urethral caruncle, ii. 811
fever, ii. 722
lithotomy, i. 942; ii. 482
Urethritis, in the female, ii. 721
in the male, ii. 713.
See *Gleet*, i. 605
Gonorrhœa, i. 660
eczematous, ii. 713
gouty, ii. 713
traumatic, ii. 713
tubercular, ii. 714
Urethrocele, ii. 720
Urethroplasty, ii. 724
Urethro-rectal fistula after lithotomy, i. 938
Urethrotomes, ii. 727
Urethrotomy, ii. 727
external, ii. 730
internal, ii. 727
perineal section, ii. 731
subcutaneous, ii. 732
See also *The 'Boutonnière' Operation*, i. 170
Urethro-vaginal fistula, ii. 773
Uric acid calculus, i. 215
deposits in urine, i. 216; ii. 732
Urinary abscess. See *Perineal Abscess*, ii. 189
calculus, i. 214
Deposits, ii. 732
Fistula, ii. 248, 734
parasites, ii. 734
Urine, diminished secretion of, in intestinal obstruction, i. 810
in strangulated hernia, i. 705
extravasation of, i. 498
incontinence of, i. 785
Morbid Conditions of, in relation to surgery, ii. 736
in albuminuria, i. 31: ii. 740
in chronic cystitis, i. 216
in chyluria, i. 301; ii. 741
in glycosuria, ii. 741
in hæmaturia, i. 657; ii. 738
in malignant disease of the bladder, i. 155
in malignant disease of the kidney, i. 871

Urine, Morbid Conditions of, in osteomalacia, ii. 137
in nephritis, ii. 51
in pyelitis, ii. 282
in pyelo-nephritis, ii. 283
in pyonephrosis, ii. 288
in scurvy, ii. 407
in vesical calculus, i. 216
retention of, ii. 332
suppression of, ii. 518
after lithotrity, i. 946
Urticaria, ii. 742
acute, ii. 743
chronic, ii. 743
papulosa, i. 927; ii. 743
pigmentosa, ii. 744
Uteri, Cervix, Amputation of the, i. 268
Stenosis of the, i. 269
Uterine Appendages, Removal of the, ii. 745
extra-peritoneal method, ii. 746
intra-peritoneal method, ii. 747
See also *Oöphorectomy*, ii. 99
Ovariotomy, ii. 151
Tumours of the, ii. 748
carcinoma, ii. 751
fibro-cystoma, ii. 750
fibro-myoma, ii. 748
myxoma, ii. 751
polypi, ii. 750
sarcoma, ii. 751
Utero, fractures *in*, i. 814
Uterus, Extirpation of the, ii. 752
abdominal operation (Freund's), ii. 752
partial operations, ii. 754
vaginal operation (Schrœder's), ii. 753
Uvula, Diseases of the, ii, 754
atonic relaxation, ii. 755
chronic inflammation (hypertrophy), ii. 755

Vaccination, ii. 756
animal vaccination, ii. 765
from the human subject, ii. 766
revaccination, ii. 763
in the treatment of nævus, ii. 32
Vaccination-Syphilis, ii. 767
Vagina, Affections of the, ii. 769
acquired malformations, ii. 769
congenital malformations, ii. 769
foreign bodies, ii. 771
imperforate hymen, ii. 769
inflammation, ii. 771
malignant disease, ii. 772
prolapse, ii. 772
tumours, ii. 772
wounds, ii. 771
Vaginal Fistulæ, ii. 773
recto-vaginal, ii. 774
vesico-vaginal, ii. 773
Hernia, ii. 775
lithotomy, i. 942; ii. 482
operation for extirpation of uterus, ii. 753
specula, ii. 460
Vaginismus, ii. 775
Valsalva's method of inflating the tympanum, i. 416
Varicocele, ii. 775
diagnosis of, i. 404; ii. 777
Varicose aneurism, i. 98
ulcer, ii. 698
Veins, ii. 778
Varix, aneurismal, i. 98
of lymphatics. See *Lymphangiectasis*, i. 967
of saphenous vein, diagnosis of, from femoral hernia, i. 621
Vascular growths.
See *Cirsoid Aneurism*, i. 309
Erectile Tumours, i. 473
Nævus, ii. 30
of meatus urinarius in women, ii. 811
Vegetations, adenoid, of naso-pharyngeal region, ii. 39
syphilitic, ii. 548
Vein, axillary, wound of, i. 120, 121
jugular, wound of, i. 861; ii. 607
Veins, air in, i. 27
canalisation of. See *Canalisation of Clot*, i. 216
diseases of.
See *Phlebitis*, ii. 214
Thrombosis, ii. 608
Varicose Veins, ii. 778
gunshot wounds of, i. 649
Venereal disease.
See *Chancre*, i. 270
Gonorrhœa, i. 610
Syphilis, ii. 543
Venesection, ii. 782
Venomous Serpents, Bites of, ii. 783
Venous hæmorrhage, i. 662
difference between, and arterial hæmorrhage, i. 663
treatment of, i. 666
Ventral hernia, See *Abdominal Hernia*, i. 9
Vermiform appendix, perforation of the, ii. 203
Verruca.
See *Warts*, ii. 811
Acrochordon, i. 24
necrogenica, ii. 226. See *Cadaveric Warts*, i. 212
senilis, ii. 811
venereal, of vulva, ii. 809
vulgaris, ii. 811
Vertebræ, caries of. See *Caries of the Spine*, i. 228
dislocations of, i. 130
erosion of, in abdominal aneurism, i. 6
fractures of, i. 130
gunshot wounds of, i. 641
spongioid condition of, in rickets, ii. 358
Vertebral Artery, Ligature of the, ii. 785
Vesical catarrh, i. 145
Vesico-intestinal Fistula, ii. 786
Vesico-vaginal fistula, ii. 773
Vesiculæ Seminales, Diseases of the, ii. 788
Vessels, changes in structure of, in albuminoid degeneration, i. 30
Vibrio, ii. 788
Vienna paste, i. 262
Villous cancer of the breast, i. 191

Villous Tumours, ii. 789
of the bladder, i. 155; ii. 789
of the rectum, ii. 311
Visceral congestion in burns, i. 204
Vision, Disorders of, from Injuries of the Head and Spine, ii. 790
from railway injuries, ii. 304, 793
Feigned diseases of, ii. 798
simulated bilateral amaurosis, ii. 798
unilateral amaurosis, ii. 799
amblyopia, ii. 800
loss of, in orbital aneurism, ii. 132
Visual Acuity, ii. 801
Vitiligo, i. 925
Vitreous, Diseases of the, ii. 803
cysticercus, ii. 804
hæmorrhage, ii. 804
inflammation, ii. 803
muscæ volitantes, ii. 805
opacities, ii. 804
Volvulus, i. 804
of ascending colon, i. 804
of sigmoid flexure, i. 804
of small intestine, i. 805
Vomiting, as a Symptom in Injuries and Surgical Diseases, ii. 806
in abdominal injuries, i. 2; ii. 806
in head injuries, ii. 806
in intestinal obstruction, i. 809; ii. 806
in peritonitis, ii. 199, 807
in strangulated hernia, i. 704; ii. 807
Vulva, Affections of the, ii. 807
acquired malformations, ii. 807
chancres, ii. 809
congenital malformations, ii. 807
eruptions, ii. 809
fissure, ii. 808
hæmatoma, ii. 808
inflammation, ii. 808
malignant disease, ii. 811
noma, ii. 808
tumours, ii. 809
vascular growth, ii. 811
venereal warts, ii. 809

Wakley's stricture dilator, ii. 507
'Wandering rash' of tongue, ii. 635
Wardrop's operation for aneurism, i. 60
Warts, ii. 811
cadaveric, i. 212; ii. 226
of hands, i. 679
of penis, ii. 185
syphilitic, of tongue, ii. 548. See *Mucous Patches*, ii. 25
treatment of, by salicylic acid, i. 263
venereal, of vulva, ii. 809
Warty growths of scars, i. 305
tongue, ii. 638
Wasps, stings of, ii. 478
Watson's operation for removal of carious tarsal bones, ii. 568
Plaster of Paris Swing Splint, ii. 812
Weak ulcer, ii. 696
Webbed Fingers, i. 544; ii. 812
Wells's, Sir Spencer, forcipressure forceps, i. 100
needle, ii. 46
Wet cupping, i. 389
Wheelhouse's operation for stricture, i. 170; ii. 731
Whitehead's operation for removal of the tongue, ii. 642
Whitlow, ii. 812
Wisdom teeth, eruption of the, ii. 571
Women as surgical patients, ii. 431
Wood's operation for ectopia vesicæ and epispadias. See *Ectopia Vesicæ* and *Epispadias*, i. 425
for radical cure of hernia. See *Radical Cure of Hernia*, i. 693
rhinoplastic operation, ii. 348
Woolsorters' disease, ii. 3, 419
Wounds, contused, ii. 817
gunshot. See *Gun-shot Wounds*, ii. 626
incised, ii. 817
lacerated, ii. 814
poisoned. See *Poisoned Wounds*, ii. 224
punctured. See *Sabre and Bayonet Wounds*, ii. 364
Treatment of, ii. 813
absorbent dressings, ii. 816
antiseptic dressings, i. 76; ii. 816
arrest of hæmorrhage, i. 93, 666; ii. 814
drainage, i. 75, 409; ii. 815
immobility, i. 779; ii. 815
pressure, i. 295; ii. 815
sutures, i. 73; ii. 528, 815
wound-apposition, ii. 815
wound-cleansing, ii. 814
Wounds of the abdomen, i. 2
of the arch of aorta, ii. 268
of arteries, i. 93
of the axilla, i. 120
of the bladder, ii. 179. See *Rupture of the Bladder*, i. 151
of the chest. See *Injuries of the Chest*, i. 278
of the ciliary body, i. 308
of the conjunctiva, i. 358
of the cornea, i. 379
of the cranial nerves, i. 381
of the external ear, i. 418
of the eyeball, i. 504
of the femoral artery, i. 524
of the gluteal artery, i. 607
of the heart, i. 689
of intestine, i. 4
of joints, i. 859
of the jugular veins, i. 861
of the kidney, i. 863
of the lacrymal sac, i. 882
of the larynx, ii. 607
of the liver, i. 951
of the lung, i. 953
of muscles, ii. 27
of nerves, ii. 61
of the œsophagus, ii. 93
of the optic nerve, ii. 112
of the orbit, ii. 115

Wounds of the palmar arch, ii. 160
of the pelvis (renal), i. 864
of the pericardium, ii. 186
of the pharynx, ii. 207
of the pulmonary artery, ii. 268
of the rectum, ii. 309
of the scalp, i. 686; ii. 379
of the sclerotic, ii. 395
of the scrotum, ii. 404
of the spinal cord, i. 134
of the spleen, ii. 471
of the throat, ii. 606
of the trachea, ii. 607
of the ureter, i. 864
of the urethra, ii. 718
of the vagina, ii. 771
of the vulva, ii. 808
Wrenches of spine, i. 125
Wrist-joint, Amputation at the, ii. 819
antero-posterior flap method (Lisfranc's), i. 820
circular method (Velpeau's), ii. 820
elliptical method (Guérin's), ii. 820
Wrist-joint, single lateral flap method (Dubrueil's), ii. 820
Diseases of the, ii. 820
Dislocations of the, ii. 821
radio-carpal, ii. 821
radio-ulnar, ii. 822
dislocations, congenital, of the, i. 336
excision of the, i. 858
Wryneck. See *Torticollis*, ii. 648

Xanthelasma. See *Xanthoma*, ii. 823
of tongue, ii. 635
Xanthic oxide calculus, i. 215
Xanthoma, ii. 823
Xeroderma, ii. 824
Xerophthalmos, ii. 825
Xerosis, ii. 825

Zona. See *Herpes Zoster*, under *Herpes*, i. 717
Zone of ciliary injection, ii. 392
Zooglœa, ii. 387
Zygoma, fracture of the, i. 513

THE END.

ALPHABETICAL LIST

OF

Medical and Surgical Works.

AGNEW. The Principles and Practice of Surgery. By D. HAYES AGNEW, M.D., LL.D. Illustrated. 3 vols. 8vo. (See page 4.) Cloth, $22.50; Sheep, $25.50.

———**Hand-Book of Practical Anatomy.** By D. HAYES AGNEW, M.D., LL.D. With Illustrations. Second Edition. 12mo. Cloth, $2.00.

AITKEN. Outlines of the Science and Practice of Medicine. By WILLIAM AITKEN, M.D. (Edin.), F.R.S., Professor of Pathology in the Army Medical School; Corresponding Member of the Imperial Society of Physicians of Vienna, etc. 8vo. Cloth, $2.50.

"The book cannot fail to become a popular one, and we cordially recommend it to the notice of teachers and students."—*London Lancet.*

"It is, we believe, destined to as great a popularity as the larger works of the same author. It is well digested, clear, well written, and the work of a man who is conversant with every detail of his subject, and a thorough master of the art of teaching."—*British Medical Journal.*

ALLEN. Outlines of Comparative Anatomy and Medical Zoology. By HARRISON ALLEN, M.D. Second Edition. 8vo. Cloth, $2.00.

———**Studies in the Facial Region.** By HARRISON ALLEN, M.D. Illustrated. 8vo. Cloth, $2.00.

ANSTIE. Notes on Epidemics. For the Use of the Public. By FRANCIS E. ANSTIE, M.D. Edited, with American Notes, by WILLIAM A. HAMMOND, M.D. 12mo. Cloth, 75 cents.

ARTHUR. Treatment and Prevention of Decay of the Teeth. By ROBERT ARTHUR, M.D., D.D.S. Illustrated. New Edition, Revised. 16mo. Cloth, $1.25.

ASHHURST. On Injuries of the Spine. Their Pathology and Treatment. By JOHN ASHHURST, JR., A.M., M.D. 12mo. Cloth, $1.50.

ATLEE. General and Differential Diagnosis of Ovarian Tumors, with Special Reference to the Operation of Ovariotomy. By WASHINGTON L. ATLEE, M.D. Illustrated. 8vo. Cloth, $5.00.

"As regards matter, from title-page to colophon, we have hardly turned a leaf without finding something new, something interesting, something of value."—*Philadelphia Medical Times.*

BANTING. A Lecture on Corpulence. Addressed to the Public. By WILLIAM BANTING. Eighth Edition. 18mo. Paper, 25 cents.

BARTHOLOW. A Manual of Hypodermatic Medication. By ROBERTS BARTHOLOW, A.M., M.D. Fourth Edition, Revised and Enlarged. Illustrated. 12mo. (See page 18.) Cloth, $2.00.

BENNETT. Text-Book of Physiology, General, Special, and Practical. By JOHN HUGHES BENNETT, M.D., F.R.S.E., Professor of the Institutes of Medicine or Physiology, and Senior Professor of Clinical Medicine in the University of Edinburgh. Illustrated. Crown 8vo. Cloth, $3.00.

"It is undoubtedly a work of great value, and will be highly appreciated by all students."—*Pacific Medical and Surgical Journal.*

"For a compact, highly scientific, and complete text-book of physiology, we have met no superior to this work of Prof. Bennett's. His experience of nigh thirty-five years as a teacher and practical worker in the department renders him a master of instruction."—*Philadelphia Medical and Surgical Reporter.*

BLACK. The Ten Laws of Health; or, How Diseases are Produced and Prevented; and Family Guide to Protection Against Epidemic Diseases and Other Dangerous Infections. By J. R. BLACK, M.D. Crown 8vo. Extra Cloth, $2.00.

"The results of scientific research are exhibited in a popular form, unembarrassed by technical details, and in a style impressive by its excellent practical sense, and attractive by its neatness and simplicity. It is no commonplace performance; on the contrary, it is a production showing a sound and mature judgment, a refined sense of propriety, and a thorough knowledge of the conditions which underlie the material welfare of the race."—*New York Tribune.*

"I consider it a legacy of great value to the world."—F. H. HAMILTON, M.D., LL.D., *Professor of Surgery and Hygiene, Bellevue Medical College.*

"A book which contains much useful information. It is written in plain language, easily understood, but containing nothing offensive. It is intended as a family guide to protection against epidemic and infectious diseases, and should be read by somebody in authority in every family."—*Philadelphia Inquirer.*

BUCKHAM. Insanity Considered in its Medico-Legal Relations. A Treatise on the Subject of Insanity as Affected by Legal Decisions, Especially in the Criminal Courts, Exposing the Errors and Dangers of the Present System, and Indicating the Reforms that are Necessary. By T. R. BUCKHAM, A.M., M.D. Crown 8vo.
Extra Cloth, $2.00; Library Sheep, $2.50.

"The fact that this work is dedicated to Judge Cooley, of Michigan, who, the author says in his dedication, rendered important aid in the preparation of the legal sections, is of itself a recommendation. . . . The whole subject is treated in a very logical and conclusive manner, and the book can be read with profit by members of both the legal and the medical professions."—*Baltimore Day.*

CALKINS. Opium and the Opium-Appetite. With Notes on Alcoholic Beverages, Cannabis Indica, Tobacco and Cocoa, and Tea and Coffee, in their Hygienic Aspects and Pathological Relations. By ALONZO CALKINS, M.D. 12mo. Cloth, $1.50.

CAMPBELL. Essays on the Secretory and the Excito-Secretory System of Nerves, in their Relation to Physiology and Pathology. By HENRY FRASER CAMPBELL, A.M., M.D. 8vo. Cloth, $1.50.

CHAPMAN. Diarrhœa and Cholera. Their Origin, Proximate Cause, and Cure through the Agency of the Nervous System by Means of Ice. By JOHN CHAPMAN, M.D., etc. 16mo. Paper, 25 cents.

CUTTER. Comprehensive Anatomy, Physiology, and Hygiene. Adapted for Schools, Academies, Colleges, and Families. Containing Brief Directions for Illustrative Dissections of Mammals, for Elementary Work with the Microscope, for Physiological Demonstrations on the Human Body, and for the Management of Emergent Cases. By Prof. JOHN C. CUTTER, B.S., M.D. With 140 Illustrations. 12mo.
Half Roan, $1.25.

CHAVASSE (P.H., M.D.). Advice to a Wife, and Advice to a Mother. Advice to a Wife on the Management of Her Own Health, and on the Treatment of Some of the Complaints Incident to Pregnancy, Labor, and Suckling. Advice to a Mother on the Management of her Children, and on the Treatment of Some of their More Pressing Illnesses and Accidents. Counsel to a Mother: being a Continuation and the Completion of "Advice to a Mother." New Edition. 3 volumes in one. Large 12mo. Extra Cloth, $2.00.

DA COSTA. Medical Diagnosis, with Special Reference to Practical Medicine. Illustrated. Sixth Edition. 8vo. (See page 8.) Cloth, $6.00; Sheep, $7.00; Half Russia, $7.50.

———**Harvey and His Discovery.** By J. M. DA COSTA, M.D., Professor of Practice of Medicine in Jefferson College. 12mo. Extra Cloth, 75 cents.

DAMON. The Neuroses of the Skin. Their Pathology and Treatment. By HOWARD F. DAMON, A.M., M.D. 8vo. Cloth, $2.00.

———**The Structural Lesions of the Skin.** Their Pathology and Treatment. Illustrated. By HOWARD F. DAMON, A.M., M.D. Cloth, $3.00.

DAVIS. Practical Microscopy. By GEORGE E. DAVIS, F.R.M.S., etc. Illustrated with 258 Wood-cuts and a Colored Frontispiece. Second Edition. 8vo. Extra Cloth, $2.50.

A popular treatise upon the practical use of the microscope and its accessories, giving plain directions as to the selection, care, and handling of this and kindred instruments, the choice of objectives, the collection, preparation, and mounting of objects, etc., and embodying the latest information upon these subjects.

DESCRIPTIVE ATLAS OF ANATOMY (THE). A Representation of the Anatomy of the Human Body. In 92 Royal 4to Plates, containing 550 Figures. Bound in Cloth, $7.50.

DUHRING. Diseases of the Skin. A Practical Treatise on Diseases of the Skin. By LOUIS A. DUHRING, M.D. A New and Thoroughly Revised Edition. Illustrated. 8vo. (See page 9.) Extra Cloth, $6.00.

———**Atlas of Skin Diseases.** By LOUIS A. DUHRING, M.D. Royal 4to. (See page 10.) Half Morocco, $25.00.

DUTCHER. Pulmonary Tuberculosis. Its Pathology, Nature, Symptoms, Diagnosis, Prognosis, Causes, Hygiene, and Medical Treatment. By ADDISON P. DUTCHER, M.D. Illustrated. Crown 8vo. Extra Cloth, $3.00.

"Few men in our country have given the subject under consideration more thought than Dr. Dutcher, and his experience has been ample. While we object to portions of the treatment recommended in the book, we are bound to give the author credit for furnishing the profession with one of the best, if not the very best, works extant on this subject."—*St. Louis American Medical Journal.*

EBERLE AND MITCHELL. A Treatise on the Diseases and Physical Education of Children. By JOHN EBERLE, M.D., late Professor of the Theory and Practice of Medicine in Transylvania University. Fourth Edition. With Notes and Large Additions. By THOMAS D. MITCHELL, A.M., M.D. 8vo. Sheep, $3.50.

ENCYCLOPÆDIA OF CHEMISTRY. By WRITERS OF EMINENCE. Illustrated. 2 vols. Imperial 8vo. (See page 14.) Cloth, $24.00; Library Sheep, $27.00; Half Russia, $30.00.

EVE. A Collection of Remarkable Cases in Surgery. By PAUL F. EVE, M.D. Sheep, $5.00.

EYRE. The Stomach and its Difficulties. By SIR JAMES EYRE, M.D. Sixth Edition. 16mo. Cloth, 50 cents.

FARABEUF. Ligation of Arteries. An Operative Manual. By Dr. L. H. FARABEUF. With 43 fine Engravings. Translated by JOHN D. JACKSON, M.D. 12mo. Cloth limp, red edges, $1.75.

"The translator has done a good service in placing this useful little work before the profession in excellent English. As a manual or hand-book of the ligation of arteries the work admirably fulfils the purpose of its author. The descriptions of the various operations are so clear and full as to render the manual one of much practical value."—*New York Medical Journal.*

GARRETSON. A System of Oral Surgery. By JAMES E. GARRETSON, M.D., D.D.S., etc. Fourth Edition, Thoroughly Revised, and with Important Additions. Illustrated. 8vo. (See page 11.)
Extra Cloth, $8.00; Sheep, $9.00; Half Russia, $9.50.

GERHARD. The Diagnosis, Pathology, and Treatment of the Diseases of the Chest. By W. W. GERHARD, M.D. Fourth Edition, Revised and Enlarged. 8vo. Sheep, $4.00.

GETCHELL. The Maternal Management of Infancy. For the Use of Parents. By F. H. GETCHELL, M.D. 18mo. Cloth, 75 cents.

GORTON. Mental Hygiene. An Essay on the Principles of Mental Hygiene. By D. A. GORTON, M.D. 12mo. Cloth, $1.75.

GROSS. A Manual of Military Surgery; or, Hints on the Emergencies of Field, Camp, and Hospital Practice. Illustrated with wood-cuts. By S. D. GROSS, M.D. 18mo. Cloth, 63 cents.

HAMMOND. Lectures on Venereal Diseases. By WILLIAM A. HAMMOND, M.D. 8vo. Cloth, $3.00.

———**Physiological Memoirs.** By WILLIAM A. HAMMOND, M.D. 8vo. Cloth, $2.00.

———**Sleep and its Derangements.** By WILLIAM A. HAMMOND, M.D. Second Edition, Revised. 12mo. Cloth, $1.50.

"When the original monograph appeared, it received our careful attention and commendation; and now we have only to repeat our good words, and express our gratification that the work has undergone such careful revision."—*Cincinnati Lancet and Observer.*

HAND-BOOK OF NURSING. For Family and General Use. Published under the Auspices of the CONNECTICUT TRAINING-SCHOOL FOR NURSES, State Hospital, New Haven, Connecticut. 12mo. (See page 17.)
Extra Cloth, $1.25; School Edition, Abridged, $1.00.

HARTSHORNE. Cholera. Facts and Conclusions as to its Nature, Prevention, and Treatment. By HENRY HARTSHORNE, A.M., M.D. 18mo. Paper Cover, 25 cents.

———**The Family Adviser and Guide to the Medicine Chest.** A Concise Hand-book of Domestic Medicine. By HENRY HARTSHORNE, A.M., M.D. Revised and Enlarged. 18mo. Cloth, 75 cents.

———**Glycerin and its Uses.** A Monograph. By HENRY HARTSHORNE, A.M., M.D. 18mo. Cloth, 60 cents.

HEATH. A Dictionary of Practical Surgery. By Various British Hospital Surgeons. Edited by CHRISTOPHER HEATH, F.R.C.S. Over 2000 pages. 8vo. (See page 13.) Cloth, $7.50; Sheep, $8.50.

HOPKINS. The Roller Bandage. By WILLIAM BARTON HOPKINS, M.D. With 73 Designs fully Illustrating the Process of Bandaging. 12mo. (See page 19.) Extra Cloth, Flexible, $1.25.

HOPPE. On Percussion and Auscultation as Diagnostic Aids. A Manual for Students and Practitioners of Medicine. By Dr. CARL HOPPE. Translated by L. C. LANE, M.D. 12mo. Cloth, 50 cents.

"This little book of 152 pages, as the translator remarks, is a model of conciseness and completeness; for it will be found, on examination, to contain in a compendious form every point of importance bearing upon this branch of medicine. . . . The medical student will find this one of the best text-books in the English language."—*Pacific Medical Journal.*

HORNER. The United States Dissector. Lessons in Practical Anatomy. By WILLIAM E. HORNER, M.D. Illustrated with 177 Wood Engravings. Fifth Edition, Carefully Revised and Entirely Remodelled. By HENRY H. SMITH, M.D. 12mo. Sheep, $2.00.

KEEN. Early History of Practical Anatomy. Being the Introductory Address to the Course of Lectures on Anatomy at the Philadelphia School of Anatomy. By WILLIAM W. KEEN, M.D.
Cloth limp, 50 cents; Paper Cover, 25 cents.

KIRKBRIDE. Hospitals for the Insane. The Construction, Organization, and General Arrangements; with some Remarks on Insanity and its Treatment. By THOMAS KIRKBRIDE, M.D., LL.D., Physician-in-Chief and Superintendent of the Pennsylvania Hospital for the Insane at Philadelphia, etc. Second Edition, with Revisions, Additions, and New Illustrations. 8vo. Extra Cloth, $3.00.

This book is the result of the ripest experience and most mature reflections of the oldest and ablest superintendent of a hospital for the insane in the United States, and can be commended in the heartiest manner to the careful study and candid examination of all who are interested in the care and treatment of the insane, whether as officers of hospitals for that class or those in the community at large who wish to be correctly informed in regard to the true principles of construction of such institutions and their proper management after they have been erected.

"The best and most nearly perfect work of the kind ever produced."—*American Journal of the Medical Sciences.*

KÖLLIKER. A Manual of Human Microscopical Anatomy. By A. KÖLLIKER, Professor of Anatomy and Physiology in Würzburg. Translated by GEORGE BUSK, F.R.S., and THOMAS HUXLEY, F.R.S. Edited, with Notes and Additions, by J. M. DA COSTA, M.D., and Illustrated with over 300 Wood Engravings. 8vo. Sheep, $3.50.

"The reputation of Professor Kölliker will be enhanced by this text-book, for such it is destined to be pre-eminently. We commend it to the profession, and to students especially, as worthy of their patronage."—*New York Medical Gazette.*

LEE. The Correct Principles of Treatment for Angular Curvature of the Spine. By BENJAMIN LEE, A.M., M.D. Illustrated. Second Edition. 12mo. Cloth, $1.00.

LEIDY. Treatise on Human Anatomy. By JOSEPH LEIDY, M.D. Second Edition, Rewritten and Enlarged, with Numerous Illustrations. (See page 19.) *In press.*

MACLAREN. Atlas of Venereal Diseases. By H. P. MACLAREN, M.D., F.R.C.S.E. To be Complete in 10 Parts. Published Monthly. Sold by Subscription only. Parts I. to V. now Ready. Royal 4to. (See page 18.) Paper, $2.00 per Part.

MALGAIGNE. A Treatise on Fractures. With 106 Illustrations. By J. F. MALGAIGNE, Membre de l'Académie Royale de Médecine. Translated from the French, with Notes and Additions, by JOHN H. PACKARD, M.D. 8vo. Sheep, $2.50.

McCLELLAN. The Principles and Practice of Surgery. By the late GEORGE McCLELLAN, M.D., and JOHN H. B. McCLELLAN, M.D. With Illustrations. Demi 8vo. Sheep, $2.00.

"The work is worthy of strong commendation."—*New York New Remedies.*
"Contains much valuable information."—*Pacific Medical and Surgical Journal.*
"The very best work for practitioners before the profession."—*Georgia Medical Companion.*

MEDICAL TIMES. A Bi-Weekly Journal of Medical and Surgical Science. Vols. I. to XIV. Imperial 8vo. (See page 2.) Fine Cloth, each $4.00. Annual Subscription, beginning Vol. XV., October, 1884, $2.00. Single Number, 10 cents.

MEREDITH. The Teeth, and How to Save Them. By L. P. MEREDITH, M.D., D.D.S. Illustrated. 16mo. Cloth, $1.25.

MITCHELL. Five Essays on the Cryptogamous Origin of Malarious and Epidemic Fevers; Animal Magnetism, or Vital Induction; The Penetrativeness of Fluids; The Penetrativeness of Gases; and a New Practice in Acute and Chronic Rheumatism. By JOHN KEARSLEY MITCHELL, M.D., late Professor of the Practice of Medicine in Jefferson Medical College of Philadelphia. 12mo. Cloth, $1.25.

MITCHELL. Injuries of the Nerves, and their Consequences. By S. WEIR MITCHELL, M.D. 8vo. (See page 19.) Cloth, $3.00.

———**Fat and Blood.** An Essay on the Treatment of Certain Forms of Neurasthenia and Hysteria. Third Edition, Revised, with Additions. 12mo. (See page 19.) Extra Cloth, $1.50.

———**Wear and Tear;** or, Hints for the Overworked. 16mo. (See page 19.) Paper, 30 cents; Cloth, 50 cents.

———**Nurse and Patient, and Camp Cure.** Two Essays. 18mo. (See page 19.) Cloth limp, 50 cents.

MITCHELL. Materia Medica and Therapeutics. With ample Illustrations of Practice in all the Departments of Medical Science, and Copious Notices of Toxicology. The whole Adapted to the wants of Medical Pupils and Practitioners. By THOMAS D. MITCHELL, M.D. New Edition. Revised and Corrected. 8vo. Sheep, $4.00.

MORRIS. A Practical Treatise on Shock after Surgical Operations and Injuries. With Special Reference to Shock Caused by Railway Accidents. By EDWIN MORRIS, M.D., F.R.S.C. 12mo. Cloth, $1.25.

NELIGAN. A Treatise on Materia Medica. By J. M. NELIGAN. 12mo. Cloth, $2.00.

PACKARD. Hand-Book of Operative Surgery. By JOHN H. PACKARD, M.D. Secretary of the College of Physicians of Philadelphia, etc. With 54 Steel Plates and numerous Illustrations on Wood. 8vo. Extra Cloth, $5.00; Sheep, $5.75.

"Its distinguishing feature is abundant illustration, and in this respect is unequalled by any hand-book with which we are acquainted. . . . To students and practitioners who have not the frequent opportunity of witnessing practical surgery the volume before us will prove of unquestionable value."—*New York Medical Record.*

REEVES. A Practical Treatise on Enteric Fever. Its Diagnosis and Treatment. Being an Analysis of One Hundred and Thirty Consecutive Cases Derived from Private Practice, and Embracing a Partial History of the Disease in Virginia. By JAMES E. REEVES, M.D. 12mo. Cloth, $1.00.

REMINGTON. A Practice of Pharmacy. By JOSEPH P. REMINGTON, Ph.G. With over 900 Pages, and nearly 500 Illustrations. 8vo. (See page 6.) Cloth Extra, $5.00; Sheep, $6.00.

REYNOLDS. A System of Medicine. Edited by J. RUSSELL REYNOLDS, M.D., F.R.C.P., London, and contributed to by the Most Eminent Physicians in England. New Edition, Thoroughly Revised and Enlarged. Five volumes now ready. 8vo.

Price per volume: Cloth, $9.00; Sheep, $10.00.
Vols. IV. and V., Cloth, $6.00; Sheep, $7.00.

RICHARDSON. Elements of Human Anatomy. General, Descriptive, and Practical. By T. G. RICHARDSON, M.D., Professor of Anatomy in the Medical Department of the University of Louisiana. Second Edition. Carefully Revised, and Illustrated with nearly 300 Engravings. 8vo. Cloth, $5.00; Sheep, $6.00.

RILEY. A Compend of Materia Medica and Therapeutics. For the Use of Students. By JOHN C. RILEY, A.M., M.D., Professor of Materia Medica and Therapeutics in the National Medical College, etc. 8vo. Cloth, $3.00.

"Prof. Riley has done his work very well. . . . The descriptions of the various articles of the Materia Medica are very concise and remarkably accurate."—*New York Medical Journal.*

SAYRE. Spinal Disease and Spinal Curvature. Their Treatment by Suspension and the Use of the Plaster of Paris Bandage. By LEWIS A. SAYRE, M.D. Handsomely Illustrated with Photographs from Nature. 12mo. Extra Cloth, $4.00.

SCHECH. Diseases of the Mouth, Throat, and Nose. Including Rhinoscopy and Methods of Local Treatment, for Practitioners and Students. By Dr. PHILIP SCHECH, Munich. Translated by R. H. BLAIKIE, M.D., F.R.C.S.E. Illustrated. 8vo. (See page 16.) Cloth, $3.00.

SCHWEIGGER. Hand-Book of Ophthalmology. By Prof. C. SCHWEIGGER, of the University of Berlin. Translated from the Third German Edition by PORTER FARLEY, M.D. With Diagrams and other Illustrations. 8vo. Extra Cloth, $4.50.

"For the general practitioner it is also an excellent book. The author is remarkably accurate in his descriptions. Not only does he make practical original suggestions in regard to diagnosis and treatment, but he likewise shows familiarity with the writings of others, to whom he accords credit. The work, in short, seems to be well up to the times, and is heartily commended. The translation has been admirably done, and the book has been nicely issued by the publishers."—*Virginia Medical Monthly.*

SEATON. A Hand-Book of Vaccination. Adapted to the American Profession. By EDWARD C. SEATON, M.D., Medical Inspector to the Privy Council, London. Illustrated. Cloth, $1.25.

"Dr. Seaton's 'Hand-Book of Vaccination' may be regarded as a boon not only to the medical profession, but to the public at large."—*Saturday Review.*

SIMPSON. The Obstetrical Memoirs and Contributions of James Y. Simpson, M.D., F.R.S.E., Professor of Midwifery in the University of Edinburgh, etc. Edited by W. O. PRIESTLEY, M.D., and HORATIO R. STORER, M.D. With Illustrations. Two vols. 8vo. Cloth, $7.50; Sheep, $9.00.

SMITH. The Common Nature of Epidemics, and their Relation to Climate and Civilization. Also, Remarks on Contagion and Quarantine. By SOUTHWOOD SMITH, M.D., Physician to the London Fever Hospital. Edited by J. BAKER, Esq., Author of "Laws Relating to Public Health, Sanitary, Medical, and Protective." 12mo. Cloth, $1.50.

STEWART. Diseases of the Nervous System. By Prof. THOMAS GRAINGER STEWART, M.D., F.R.C.P.E., F.R.S.E. Profusely Illustrated. 8vo. (See page 16.) Extra Cloth, $4.00.

STILLÉ. Epidemic or Malignant Cholera. By ALFRED STILLÉ, M.D., Professor of the Theory and Practice of Medicine in the University of Pennsylvania. 16mo. Paper Cover, 30 cents.

STIRLING. Practical Histology. A Text-Book of Practical Histology, with Outline Plates. By WILLIAM STIRLING, M.D., Sc.D., F.R.S.E., Regius Professor of the Institutes of Medicine in the University of Aberdeen. With 30 Outline Plates, 1 Colored Plate, and 27 Wood Engravings. Quarto. Extra Cloth, $4.50.

"The author has endeavored to give a faithful account of the methods which he has found to be the most useful for the preparation of each of the tissues and organs of the body for microscopic purposes. No method is introduced which he has not found from repeated trials to be successful. The methods described are those which, after nine years' experience in the teaching of practical histology, he has found to be really reliable."—*Preface.*

STROMEYER and ESMARCH. Gunshot Fractures and Resection in Gunshot Injuries. By Dr. LOUIS STROMEYER and Dr. FRIEDRICH ESMARCH. Translated by S. F. STATHAM. 12mo. Cloth, 75 cents.

SURGERY IN THE PENNSYLVANIA HOSPITAL. Being an Epitome of the Practice of the Hospital since 1756. Including Collations from the Surgical Notes, and an Account of the More Interesting Cases from 1873 to 1878. With Statistical Tables. By WILLIAM HUNT, M.D., and T. G. MORTON, M.D. With Papers by J. B. ROBERTS, M.D., and F. WOODBURY, M.D. 8vo. Extra Cloth, $4.00.

SYME. The Principles of Surgery. By JAMES SYME, F.R.S.E., Surgeon in Ordinary to Queen Victoria, in Scotland. To which are appended Treatises on the Diseases of the Rectum; Stricture of the Urethra and Fistula in Perineo; The Excision of Diseased Joints; and numerous Additional Contributions to the Pathology and Practice of Surgery. Edited by DONALD MACLEAN, M.D., L.R.C.S.E. 8vo. Cloth, $5.00.

TAYLOR. Infantile Paralysis, and its Attendant Deformities. By CHARLES FAYETTE TAYLOR, M.D., Resident Surgeon New York Orthopedic Dispensary. Illustrated with numerous Engravings. 12mo. Paper Cover, 75 cents; Cloth, $1.00.

THOMAS. A Comprehensive Pronouncing Medical Dictionary. Containing the Etymology and Signification of Terms made use of in Medicine and the Kindred Sciences. By J. THOMAS, M.D. Imperial 8vo. (See page 5.) Cloth, $5.00; Sheep, $6.00.

TURNBULL. A Clinical Manual of Diseases of the Ear, including the Anatomy, Physiology, Pathology, and Treatment. By LAURENCE TURNBULL, M.D., Ph.G., Physician to the Department of the Eye and Ear, Howard Hospital; Aural Surgeon to the Jefferson Medical College Hospital, Philadelphia; Fellow of the American Association for the

Advancement of Science; and Member of the American Medical Association, etc. 8vo. 500 pages. 106 Illustrations.

Extra Cloth, $5.00.

"It might almost be called an aural encyclopædia."—*American Journal of the Medical Sciences.*

"Sound, clear, and eminently practical in all its parts."—*Boston Medical and Surgical Journal.*

"Dr. Turnbull proves himself thoroughly acquainted with the literature of the subject, and employs it very promptly."—*Monatsschrift für Ohrenheilkunde, Berlin*, May, 1873.

TURNBULL. Imperfect Hearing and the Hygiene of the Ear. Including Nervous Symptoms, Tinnitus Aurium (or Noises in the Ear), Aural Vertigo (or Dizziness), Diseases of the Nose, Throat, Middle Ear, and Mastoid Region. With the Mode of Instructing the Deaf Mute at Home. By LAURENCE TURNBULL, M.D., Ph.G., Aural Surgeon to the Jefferson Medical Hospital and Howard Hospital, Philadelphia. Third Edition. With Illustrations. 147 Pages. Large 8vo. Extra Cloth, $2.50.

"That this book has reached a third edition is good testimony of its value and general excellence. We recommend it cordially to all those who are interested in the subject of which it treats."—*Glasgow Medical Journal.*

"On all the subjects treated Dr. Turnbull has much to say that would interest the specialist as well as the general practitioner."—*American Journal of the Medical Sciences.*

"The pages of this book are stores filled with valuable treasures, for the topics under discussion are of the highest interest, scientifically and practically, that no intelligent physician can afford to be ignorant of them."—*Chicago Medical Journal and Examiner.*

"To those who are interested in watching the progress of otology, and in studying the improvements which have been made for correcting imperfect hearing, the book will possess more than ordinary value."—*Maryland Medical Journal.*

UNITED STATES DISPENSATORY. *New Edition.* Edited by Dr. H. C. WOOD, and Profs. JOSEPH P. REMINGTON and SAMUEL P. SADTLER. Fifteenth Edition, Thoroughly Revised, Enlarged, and Corrected. Illustrated. 8vo. (See page 3.)

Cloth, $7.00; Library Sheep, $8.00; Half Russia, $9.00.

WILSON. Clinical Charts. Designed for the Convenient, Accurate, and Permanent Daily Recording of Cases in Hospital and Private Practice. By JAMES C. WILSON, M.D. 50 Charts, in Tablet Form. Size, 8½ x 11 inches. (See page 15.) Price, 50 cents per Block of 50 Charts.

———**A Manual of Physical Diagnosis.** With Special Reference to Diseases of the Heart, Lungs, and Great Vessels. By JAMES C. WILSON, A.M., M.D. *In Press.*

WOOD. A Treatise on the Practice of Medicine. By GEORGE B. WOOD, M.D., LL.D. Sixth Edition. 2 vols. Thick 8vo.

Cloth, $5.00; Sheep, $6.50.

———**A Treatise on Therapeutics and Pharmacology, or Materia Medica.** By GEORGE B. WOOD, M.D., LL.D. Third Edition. 8vo.

Cloth, $9.00; Sheep, $10.00.

———**Introductory Lectures and Addresses on Medical Subjects.** Delivered chiefly before the Medical Classes of the University of Pennsylvania. By GEORGE B. WOOD, M.D., LL.D. Second Edition. 8vo.

Cloth, $3.00.

WOOD. Treatise on Therapeutics. Comprising Materia Medica and Toxicology, with Especial Reference to the Application of the Physiological Action of Drugs to Clinical Medicine. By H. C. WOOD, A.M., M.D. Fifth Edition, Revised, with Important Additions, and Adapted to the New Pharmacopœia. 8vo. (See page 7.)

Cloth, $6.00; Sheep, $6.50.

WOOD. Fever. A Study in Morbid and Normal Physiology. By H. C. Wood, A.M., M.D. Large 8vo. Extra Cloth, $2.50.

———**Thermic Fever or Sunstroke.** By H. C. Wood, A.M., M.D. Awarded the Boyleston Prize of Harvard University. 12mo. Cloth, $1.25.

"We know of no work which gives so full an exposition of this affection. The profession are under many obligations to Dr. Wood for his excellent monograph."—*Buffalo Medical and Surgical Journal.*

———**Vade-Mecum and Physician's Visiting List.** 16mo. Bound in Leather, Pocket-Book form, $1.25.

WOODHULL. Studies, chiefly Clinical, in the Non-Emetic Use of Ipecacuanha. With a Contribution to the Therapeusis of Cholera. By Alfred A. Woodhull, M.D., Assistant-Surgeon and Brevet Lieutenant-Colonel U.S.A. 8vo. Cloth, $2.00.

WOODWARD. Outlines of the Chief Camp Diseases in the United States Armies, as observed during the War. A Practical Contribution to Military Medicine. By Joseph Janvier Woodward, M.D., Member of the Academy of Natural Sciences of Philadelphia. 8vo. Cloth, $2.50.

WORMLEY. Micro-Chemistry of Poisons. Including their Physiological, Pathological, and Legal Relations. By Theodore G. Wormley, M.D., Ph.D., LL.D. A New, Revised, and Enlarged Edition. Illustrated. Large 8vo. (See page 12.) Extra Cloth, $7.50; Sheep, $8.50.

WÜRTZ. Elements of Modern Chemistry. By Adolphe Würtz. Second American Edition. Translated and Edited by Wm. H. Greene, M.D. Thoroughly Revised and Enlarged. Illustrated. 12mo. (See page 17.) Extra Cloth, $2.50; Sheep, $3.00.

The works on this list are for sale by Booksellers generally, or will be sent, free of charge, upon receipt of the price by

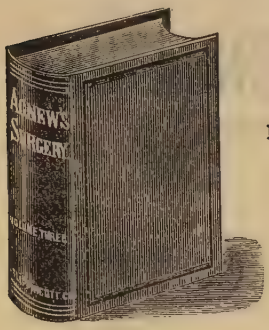
J. B. LIPPINCOTT COMPANY,

PUBLISHERS, BOOKSELLERS, AND IMPORTERS,

715 and 717 Market Street,

PHILADELPHIA.

AGNEW'S SURGERY.



The Principles and Practice of Surgery.

BEING A TREATISE ON SURGICAL DISEASES AND INJURIES.

—BY—

D. HAYES AGNEW, M.D., LL.D.,

Professor of Surgery in the Medical Department of the University of Pennsylvania.

Volume I. contains 1072 Pages, with 901 Illustrations, embracing Surgical Diagnosis, Inflammation, Wounds, Injuries of the Head, Injuries of the Chest and Abdomen, Wounds of the Extremities, Diseases of the Abdomen, Diseases and Injuries of the Blood-Vessels, Ligation of Arteries, Surgical Dressings, Injuries and Diseases of the Osseous System.

Volume II. contains 1070 Pages, with 791 Illustrations, embracing Dislocations, Diseases of the Joints, Excision of Joints and Bones, Consideration of Subjects connected with Minor Surgery, On the Use of the Knife, Venesection, General Considerations with Regard to Operations, Anæsthetics, Amputation, Shock, Traumatic Fever, Furunculus, Phlegmon or Boil, Injuries and Diseases of the Genito-Urinary Organs, Surgical Diseases of Women, Surgical Affections of the Spinal or Dorsal Region, Malformation of the Head from Effusion, Surgical Diseases of the Mouth.

Volume III. contains 900 Pages, with 475 Illustrations, embracing Surgical Diseases of the Larynx and Trachea, Diseases and Injuries of the Nose, the Naso-Pharyngeal Region and the Associate Parts, Diseases and Injuries of the Eye and its Appendages, Diseases and Injuries of the Ear, Malformations and Deformities, Tenotomy in the Treatment of Orthopædia, Affections of the Muscles, Tendons, Bursæ, and Aponeuroses, Surgical Affections of the Nerves, Surgical Affections of the Lymphatic System, Skin, and Subcutaneous Connective Tissue, Syphilis, Tumors, Diseases of the Mammary Glands, Electro-Therapeutics as Applied to Surgery, Massage.

"It is wonderful, and yet it is never verbose, but always concise; never rambling, but always practical. The matter is good,—all good,—and the complete work will be not only a monument of personal patience and literary effort, but, all things considered, the best standard text-book on surgery in the English language."—*New York Medical Journal.*

"We find the book throughout to be a clearly detailed statement of the surgical principles and procedures which have enabled the author to achieve deserved success, honor, and reputation. In addition to the author's own views, we have, side by side, those of other eminent surgeons, which, of course, largely increases the value of the book for reference."—*Ohio Medical Observer.*

"A work which is not only an exponent of the theories of surgical diseases as maintained by most eminent observers, but is also a treasure-house from which may be drawn all those valuable points of practice which have been slowly accumulated by the wisdom and experience of the ages. It is a true storehouse, to which one may go who desires to study exhaustively surgical subjects."—*New York Medical Gazette.*

"The book bears full and searching criticism, and will not be compared unfavorably with the best surgical text-books, while it cannot fail to extend Prof. Agnew's reputation not only on his own, but on our side of the Atlantic also."—*London Medical Times and Gazette.*

"Can we say more than that, in our opinion, the author has succeeded in giving the surgeon a reliable guide to practice, and one which is a credit to his reputation as a teacher and practitioner, and a work which is a monument of the surgery of the present day."—*Hospital Gazette.*

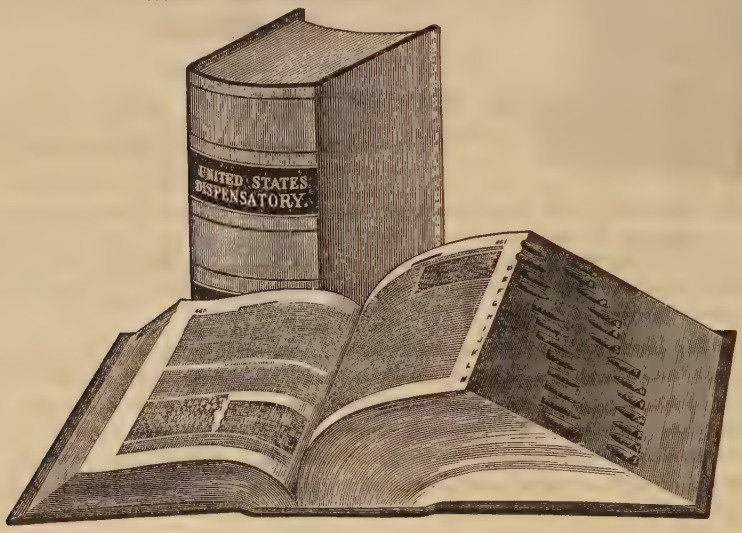
Three Volumes. 8vo. Price per Volume: Extra Cloth, $7.50; Sheep, $8.50; Half Russia, $9.00.

"Indispensable to every Druggist and Physician."

THE

UNITED STATES DISPENSATORY.

(WITH DENISON'S PATENT INDEX.)



FIFTEENTH EDITION. ILLUSTRATED.

CAREFULLY REVISED AND REWRITTEN BY

HORATIO C. WOOD, M.D., LL.D., J. P. REMINGTON, Ph.G.,
AND
S. P. SADTLER, Ph.D., F.C.S.

Handsomely Bound in One Volume, Royal 8vo, containing 1928 pages.
Price, in Cloth Extra, $7.00; Best Leather, Raised Bands, $8.00; Half Russia, Raised Bands, $9.00.

For Facility of Reference, Denison's Patent Index will be Inserted for $1.00 Additional to above Prices. (See Illustration.)

"We commend this work as a most valuable addition not only to pharmaceutical literature, but to the medical profession as almost invaluable. Its literature, its chemistry, and its pharmacy are fully up to any similar work here or abroad of its kind, and the high standard of excellence in the past is only enhanced by the thoroughly reliable and trustworthy work of the present fifteenth edition."—*Pharmaceutical Record.*

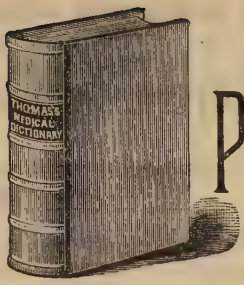
"It has been the *vade-mecum* of every practitioner, more valued than, perhaps, any other book in the library. Every edition has been an improvement upon the one preceding it, and the volume has grown in value and scope as it has grown in bulk and popularity."—*Gaillard's Medical Journal.*

"As a work of reference it has few equals and no superiors in our language, and it does great credit to American pharmacy and therapeutics."—*Edinburgh Medical Journal.*

"The present edition sustains the high reputation of former editions."—*London Practitioner.*

"It forms a valuable work of reference as well for the practitioner as for the pharmacist."—*Dublin Journal of Medicine.*

"The book as a whole is one that is most worthy to hold a place in the pharmacist's select library."—*London Pharmaceutical Journal.*

A Complete  Pronouncing

MEDICAL DICTIONARY:

Embracing the Terminology of Medicine and the Kindred Sciences,

WITH THEIR

SIGNIFICATION, ETYMOLOGY, AND PRONUNCIATION.

With an Appendix,

Comprising an Explanation of the Latin Terms and Phrases Occurring in Medicine, Anatomy, Pharmacy, etc.;
Together with the Necessary Directions for Writing Latin Prescriptions, etc., etc.

By JOSEPH THOMAS, M.D., LL.D.,

Author of the System of Pronunciation in Lippincott's "Pronouncing Gazetteer of the World," and "Pronouncing Dictionary of Biography and Mythology."

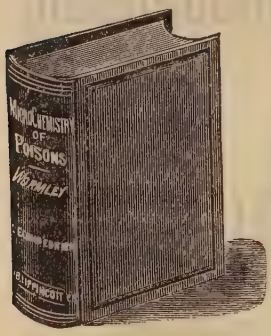
On the Basis of Thomas's "Comprehensive Pronouncing Medical Dictionary."

THE aim in the preparation of this work has been not only to embrace within a convenient compass a definition of all terms in medicine and the allied sciences with which the practitioner or medical student should be familiar, but also to combine therewith much other information not usually found in similar works, but yet necessary to a perfect dictionary for the profession. Thus, coupled with the definitions of the terms, are given, whenever practicable, the Latin and Greek words from which the terms are derived, by this means adding greatly to the clearness of the definitions. Another marked peculiarity of the volume is the pronunciation of the terms, a feature hitherto unattempted in any work of the kind (except in a smaller volume by the same author), and one which cannot but be of great importance to students, especially to those not well versed in the dead languages. Embraced in the volume will also be found, in the form of an *Appendix*, an "Explanation of Latin Terms, Phrases," etc.; remarks "On Writing Prescriptions;" a complete "Table of Doses;" a table of "Chemical Symbols;" a "Table of the Orders and Families of the Living Mammalia;" a table of "Metric Weights and Measures," etc.,—all of which, it is believed, will add much to the practical value of the work.

Imperial 8vo. 844 Pages.
Extra Cloth, $5.00; Sheep, $6.00.

A VALUABLE WORK FOR EVERY PHYSICIAN.

Wormley's Micro-Chemistry of Poisons,



Including their Physiological, Pathological, and Legal Relations.

WITH AN APPENDIX ON THE DETECTION AND MICROSCOPIC DISCRIMINATION OF THE BLOOD.

Adapted to the Use of the Medical Jurist, Physician, and General Chemist.

By THEODORE G. WORMLEY, M.D., Ph.D., LL.D.,

Professor of Chemistry and Toxicology in the Medical Department of the University of Pennsylvania.

A NEW, REVISED, AND ENLARGED EDITION. WITH NEW ILLUSTRATIONS.

"These plates, considered as products of art, surpass anything we have had the opportunity of meeting with in European works, and if anything could convince us of the value of microscopic tests as applicable to medico-legal research, such exquisite representation of various crystals would be certain to do so. In any case, these plates are a great ornament of the work before us, and their perusal has given us, as it will be sure to give to all readers, the very greatest pleasure. . . . To sum up our impression concerning Dr. Wormley's work, we think it a very valuable manual; while in parts it is a little *doctrinaire*, it has the greatest practical value by the incorporation with it of American experience, and we have, therefore, great pleasure in recommending it to the careful attention of all students and readers."—*London Medical Press.*

"The second edition of this admirable work will be received with great pleasure by those whose toxicological studies have already been aided by its perusal. The present volume contains an entirely new chapter upon blood, another on gelsemium, and additional sections on ptomaines and on arsenic. Two new plates will be observed, one of which belongs to the final chapter. The revision has been most thorough and conscientious."—*New York Medical Journal.*

"The chemical tests are admirably arranged, and the illustrations on steel, nearly one hundred in number, are marvels of accurate work. On the whole, it is a good book, and will be found of great value in medico-legal investigations."—*London Lancet.*

"Commending it as the best as well as the only exhaustive work on the subject, and advising its purchase by any who have occasion to examine the subject of toxicology, either as student, teacher, or on the legal side of the matter."—*New York Pharmaceutical Record.*

"It would be difficult, if not impossible, to speak in terms of too high praise of this beautiful work. The arrangement is systematic, the author's style clear, and the whole subject is minutely and thoroughly treated. The plates, sixteen in number, all from steel engravings, are, without exception, admirably executed, and constitute a most important feature in a work which, even without them, would have made its mark."—*Medical Times and Gazette*, London.

"It is certainly the best and most complete work on the subject ever produced in this as well as in any other country, and is highly creditable both to the author and publishers."—*American Chemical Review*, Chicago.

"The book is invaluable to all who are interested in the application of the microscope in chemistry and toxicology."—*American Monthly Microscopical Journal*, Washington, D. C.

"The reputation for correctness and accuracy which Professor Wormley has so justly attained, and the faithful manner in which these scientific attributes have been carried out in the original work and the revision of it, places the present production beyond the pale of adverse criticism."—*Physician and Surgeon*, Ann Arbor.

"The second edition of Dr. Wormley's work, just issued, is a superb contribution to this interesting subject, and the additions made are of great importance in their relation to medical jurisprudence."—*New York Medico-Legal Journal.*

"This edition has been thoroughly revised and much enlarged in matter, especially by the addition of illustrative cases, largely American, and by new tests and methods of recovering poisons from organic mixtures. The chemical nomenclature of the first edition has been entirely revised and made to conform with the most recent views of chemists upon this subject. Two new steel plates have also been added, including twelve illustrations of microscopic crystals. We consider this the most valuable work of its kind."—*N. E. Medical Monthly.*

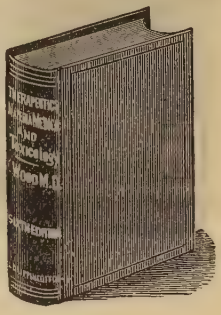
Large 8vo. Extra Cloth, $7.50; Sheep, $8.50.

TREATISE ON THERAPEUTICS.

COMPRISING

MATERIA MEDICA AND TOXICOLOGY.

WITH ESPECIAL REFERENCE TO
THE APPLICATION OF THE PHYSIOLOGICAL ACTION OF
DRUGS TO CLINICAL MEDICINE.



By H. C. WOOD, A.M., M.D.,

Late Professor of Botany, and now Professor of Materia Medica and Therapeutics, and Clinical Professor of Diseases of the Nervous System in the University of Pennsylvania.

Sixth Edition, Revised, with Important Additions, and Adapted to the New Pharmacopœia.

THE plan of the present work has been to make the physiological action of remedies the principal point in discussion. A thoroughly scientific treatise would in each article simply show what the drug does when put into a healthy man, and afterwards point out to what diseases or morbid processes such action is able to afford relief. Unfortunately, in the great majority of cases our knowledge is not complete enough for this, and the clinical method has to be used to supplement the scientific plan.

COMPARATIVELY few persons have a full conception of the rapid advancement of therapeutic science or the amount of labor involved in keeping up with such advance. Although only two years have elapsed since the last edition of this treatise, yet nearly four hundred papers have been studied in preparing the present one. An article upon cocaine has been added, the chapter upon disinfectants entirely rewritten, old literature restudied, and every endeavor made to have the book represent even more thoroughly than before the best therapeutic thoughts of the day.

PRESS NOTICES.

"To get fully at its great merits demands a careful perusal of every page. It should be in the library of every medical man. We cheerfully recommend it to the profession."—*Cincinnati Lancet and Clinic.*

"In its especial field it is unequalled in any language, and no library is complete without it."—*Buffalo Medical and Surgical Journal.*

"This standard work still retains the first place among all our treatises on this subject."—*Boston Medical and Surgical Journal.*

"This is, undoubtedly, the most popular text-book on therapeutics by an American author. In its present form there is no work better fitted to teach a student the essentials of materia medica and therapeutics."—*New York New Remedies.*

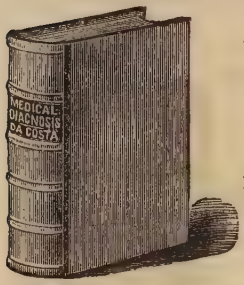
" . . . Altogether, this work stands by itself as the only complete treatise on the physiological action of drugs in the English language, and no student of scientific therapeutics should be without it."—*London Practitioner.*

8vo. Cloth, $6.00; Sheep, $6.50.

MEDICAL DIAGNOSIS,

WITH

SPECIAL REFERENCE TO PRACTICAL MEDICINE.



A GUIDE TO THE KNOWLEDGE AND DISCRIMINATION OF DISEASES.

—BY—

J. M. DA COSTA, M.D.,

Lecturer on Clinical Medicine, and Physician to the Pennsylvania Hospital; Fellow of the College of Physicians of Philadelphia, etc., etc.

SIXTH EDITION.

ILLUSTRATED WITH NUMEROUS ENGRAVINGS.

THE author's chief aim in writing this work has been to furnish advanced students and young graduates of medicine with a guide that might be of service to them in their endeavors to discriminate disease. He has sought to offer to those members of the profession who are about to enter on its practical duties a book on diagnosis of an essentially practical character, one neither so meagre in detail as to be next to useless when they encounter the manifold and varying features of disease, nor so overladen with unnecessary detail as to be unwieldy and lacking in precise and readily-applicable knowledge. In connection with this, however, he has endeavored to take cognizance of the prognosis of individual affections, and occasionally the record of cases has been introduced by way of elucidation.

In the sixth edition, a number of wood-cuts have been added, new matter has been introduced into many of the chapters, and all have been revised.

"As the work of a clear thinker and acute observer it must always be a favorite book of reference with the thinking and reading portion of the medical community. We know of no book in medical literature which is more helpful than this one to a young practitioner."—*New York Medical Journal.*

"A very excellent treatise upon the subject is presented, than which no better exists in the language."—*Cincinnati Medical News.*

"It is a book which every practitioner needs as an assistant in the discrimination of diseases, and for a reference in such cases as are constantly arising, wherein there is doubt as to their positive diagnosis. To be a good diagnostician is more than half the battle in the treatment of disease; and a thorough knowledge of the topics treated of in this work is certain to add to the success of him who gains it. It is a treatise as necessary to the physician as his anatomy or materia medica, and none should be without it."—*New Orleans Medical and Surgical Journal.*

"Da Costa's work is well known and highly and justly esteemed in England as in America. It is too firmly established, and its value too thoroughly recognized, to need a word *pro* or *con*."—*London Medical Times and Gazette.*

"The book before us is the work of the first diagnostician in America. It is the best book on diagnosis extant."—*The American Practitioner.*

"It has been prepared with careful research among books, at the bedside, and in the autopsy; and it is made available by a good arrangement, and a style of unusual ease, clearness, and finish. To digest and memorize the matter of all its pages will well repay the labor it costs."—*American Journal of the Medical Sciences.*

"It is sufficient to say that we believe it the best and safest authority which can be selected for the guidance of the student or young practitioner, and cordially commend it to them as such."—*Philadelphia Medical Times.*

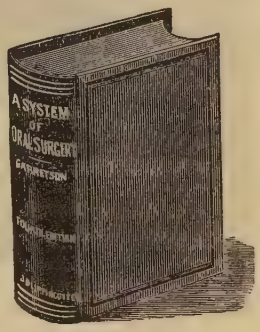
8vo. Cloth, $6.00; Sheep, $7.00; Half Russia, $7.50.

"A VALUABLE AND INDISPENSABLE WORK FOR DENTISTS, SURGEONS, AND PHYSICIANS."

GARRETSON'S ORAL SURGERY.

A SYSTEM OF ORAL SURGERY.

Being a Treatise on the Diseases and Surgery of the Mouth, Jaws, Face, Teeth, and Associate Parts.



BY JAMES E. GARRETSON, M.D.,

Surgeon in charge of the Philadelphia Hospital of Oral Surgery, Dean of the Philadelphia Dental College, etc.

ILLUSTRATED WITH STEEL PLATES AND NUMEROUS WOOD-CUTS.

THE scope of the volume is indicated in the title, and it would indeed be a rare pathological condition of the parts named, which does not find discussion in this work. It is, in fact, of itself a dental library, embracing almost every subject connected, directly or indirectly, with the practice of oral surgery. It is a volume of 1002 pages, splendidly printed and bound, profusely illustrated by excellent steel plates and wood-cuts, nine of the former and six hundred and sixteen of the latter.

The present edition (fourth) is enlarged by the addition of several chapters on subjects not heretofore treated, while some seventy-five new cuts have been added with a view to improvement in illustration.

Practitioners or students of medicine, surgery, or dentistry will find it invaluable.

"When compared with former editions, the evident expenditure of time and care in rewriting, the extensive additions of new matter, the many new and original illustrations, almost entitle the fourth edition to be classed as a new production. The degree to which the author has been able to condense the text of his chapters, conveying his information in the fewest words possible, is something remarkable, and, so far as we know, without a parallel in medical and dental text-books. The reader is not obliged to wade through pages of *words* to catch a few *ideas*, nearly every sentence conveying a thought, clearly and tersely. So comprehensive are the subjects presented, and so minutely and thoroughly considered, we have no hesitation in saying that could the dental profession have but *one* of the text-books now in existence, Garretson's 'System of Oral Surgery' would be, *par excellence*, *the* book. It is a credit to the author, to the publishers, and to the dental profession."—*Dental Practitioner.*

"For accurate description, skilful arrangement, and thoroughness of detail, it has no equal. As a text-book for the mechanical and surgical dentist, it is invaluable."—*New York Medical Record.*

"The work is a monument of profound learning and ripe experience. It needs no words of commendation. No dentist or oral surgeon could afford to lack this practical treatise."—*Philadelphia Press.*

"The work is well written, full and complete both in description and illustration. The author has spared neither labor nor expense to render the work a complete and comprehensive exponent of oral surgery. It is supplied with a copious index. We heartily commend it to the attention of the profession."—*The Canada Lancet.*

"Immediately upon the appearance of the first edition of this work it assumed the leading place as a text-book, to which its merit and the distinguished position of its author as a surgeon and writer entitled it. The estimation in which it is held is evidenced by the demand for repeated editions, until now its fourth has been placed before the public. So much of new matter has been introduced as to make it obligatory upon every dentist, who desires to keep abreast of the advance of thought, to add the latest edition of this standard work to his library. Altogether, to say that the whole work is satisfactory is but feebly to express the sentiments with which every intelligent dental surgeon will receive it."—*New York Independent Practitioner.*

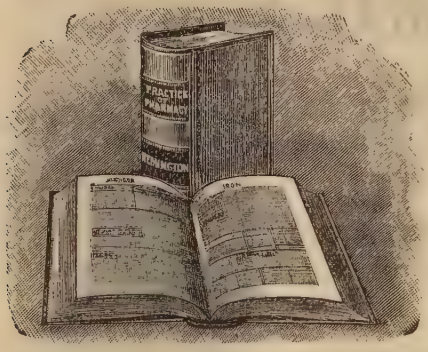
"It is in the main eminently practical, and, as an encyclopædic presentation of the higher as well as of the ordinary aspects of dentistry, has no rival."—*The Dental Cosmos.*

"The work has come into common use in all dental colleges. All interested in the surgery of the mouth, jaws, teeth, and face will be sure to place this work on their study tables, and its contents within their brains. In fact, there is no other book which contains so exhaustive and withal briefly stated an account of the organs in question."—*Detroit Lancet.*

Fourth Edition, Thoroughly Revised, with Important Additions.

8vo. Extra Cloth, $8.00; Sheep, $9.00; Half Russia, $9.50.

PRACTICE OF PHARMACY.



With over 900 Pages and Nearly 500 Illustrations.

A TREATISE ON THE

Modes of Making and Dispensing Officinal, Unofficinal, and Extemporaneous Preparations, With Descriptions of their Properties, Uses, and Doses.

INTENDED AS A HAND-BOOK FOR PHARMACISTS AND PHYSICIANS AND A TEXT-BOOK FOR STUDENTS.

By JOSEPH P. REMINGTON, Ph.G.,

Professor of Theory and Practice of Pharmacy and Director of the Pharmaceutical Laboratory in the Philadelphia College of Pharmacy; Pharmaceutical Editor of the United States Dispensatory, etc., etc.

DESCRIPTION OF CONTENTS.

PART I., embracing the first 200 pages, is devoted to *detailed descriptions* of Modern Pharmaceutical Processes and Apparatus. This part is profusely illustrated, mostly with original outline drawings.

PART II. treats of Officinal Preparations. These are classed upon a progressive plan, according to the character of the operations involved; the simplest first, the more complex last. The formulas are not only expressed in parts by weight, but the equivalent quantities of each ingredient are also displayed in AVOIRDUPOIS WEIGHT and APOTHECARIES' MEASURE in *bold type, near the margin, in tabular form.*

PART III. treats of Inorganic Chemical Substances. Sharp distinctions are here made between the officinal and unofficinal preparations. The descriptions, solubilities, and tests for identity and impurities of each substance are systematically tabulated under the head of each title. This novel feature in a text-book will be appreciated by all who have heretofore been compelled to construct these tables personally.

Each chemical operation is accompanied by equations which are expressed symbolically, whilst the reaction is, in addition, explained in words.

In **PART IV.** the Carbon Compounds are considered. These are naturally grouped according to the physical and medical properties of their principal constituents, beginning with simple bodies like gum, and progressing to the most highly organized alkaloids, etc.

Condensed charts accompany both Parts III. and IV. These aid the student in reviewing these parts, giving the outlines of the previously detailed facts.

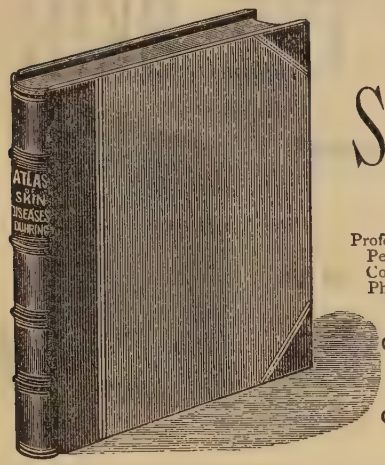
PART V. is devoted to Extemporaneous Pharmacy, and is thoroughly illustrated with clearly executed cuts, most of which have been drawn from *photographs of new apparatus* or from manual operations represented in actual life. Fac-simile prescriptions, showing difficulties in compounding, or obscure penmanship, also form a portion of the illustrations in this part.

The most approved methods of making pills, plasters, ointments, suppositories, capsules, emulsions, etc., are carefully explained.

PART VI. contains a Formulary of Pharmaceutical Preparations that have not been recognized by the Pharmacopœia. The recipes are selected, and are mostly those which have been heretofore rather difficult of access to most pharmacists. *Avoirdupois weight* and *apothecaries' measure* are also used for these, and they are arranged so as to facilitate *quick* and *accurate* reading.

8vo. Cloth Extra, $5.00; Sheep, $6.00.

"THE MOST VALUABLE WORK OF ITS KIND EVER PUBLISHED."



AN ATLAS
—OF—
SKIN DISEASES.

By LOUIS A. DUHRING, M.D.,

Professor of Skin Diseases in the Hospital of the University of Pennsylvania; Dermatologist to the Philadelphia Hospital; Consulting Physician to the Dispensary for Skin Diseases, Philadelphia; Author of "Diseases of the Skin," etc.,

WITH TABLE OF CONTENTS, AND CLASSIFICATION OF DISEASES TREATED IN THE ENTIRE WORK.

ROYAL QUARTO.

CONTAINS THIRTY-SIX FULL-PAGE PLATES, AND EXPLANATORY TEXT OF THE CASE REPRESENTED.

THE ATLAS consists of a series of ORIGINAL, nearly life-size, chromo-lithographic illustrations, painted from life, representing the MOST IMPORTANT DISEASES MET WITH IN THE UNITED STATES. For the portraits of the cases, the Publishers are pleased to state that they are indebted to the skill of the well-known artist, Mr. HERMANN FABER. The drawings are reproduced in the very highest style of the chromo-lithographic art, under the immediate supervision of Mr. F. MORAS, whose name in association with chromo-lithography is a sufficient guarantee for artistic productions of the highest order.

"The work is certainly of great value, for with it the physician and student can study skin diseases as if he had cases of each affection before him. It is all that can be wished for in the way of plates,—far more than could be reasonably expected. No portrayals of dermatology heretofore have been as accurate as these."—*Cincinnati Medical News.*

"The work constitutes the most practical treatise upon skin diseases yet offered to the profession."—*Buffalo Medical and Surgical Journal.*

"The high expectations raised by the earlier parts of this Atlas continue to be abundantly satisfied, and there is certainly no falling off either in the care with which the subjects have been selected, or in the beautiful execution of the chromo-lithography. Dr. Duhring's efforts in this Atlas have been crowned with great success, and he is giving us portrayals of skin diseases by far the most truthful that have yet appeared."—*London Lancet.*

"We have nothing but praise to give in noticing it; the plates are excellent in every way. We have seen none to equal them as truthful representations of typical cases of skin diseases. The text is clear and concise."—*Toronto Journal of Medical Science.*

"The plates are of great artistic excellence, and are faithful copies of diseased appearances."—*London Practitioner.*

"The Atlas is a credit to the author as a dermatologist, to the artists who have worked so faithfully upon it, and to the publishers for the excellence of its general appearance, and deserves the most liberal support from the profession."—*American Journal of the Medical Sciences.*

"We need only mention the appearance of these accurate and excellent chromo-lithographs. Dr. Duhring's authority in the field of dermatology is undisputed. Those who have the means to supply themselves with the series cannot spend the money to better advantage."—*Cincinnati Clinic.*

"Every American physician ought to feel proud of this splendid work, for, indeed, it is not surpassed in excellence by any European book on the subject."—*West Virginia Medical Student.*

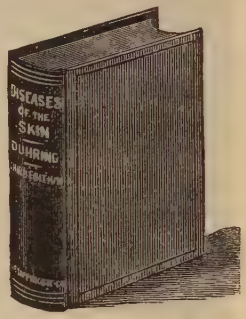
"The Atlas, in its completed form, is the best and cheapest atlas of skin diseases with which we are acquainted, and reflects the utmost credit upon its author and its publishers."—*Dublin Journal of Medical Science.*

In One Volume. Large 4to. Half Morocco.
Price, $25.00.

"The Best Book on the Subject in the English Language."

DISEASES OF THE SKIN.

A Practical Treatise on Diseases of the Skin.



BY LOUIS A. DUHRING, M.D.,

AUTHOR OF

"Atlas of Skin Diseases."

THIS work is essentially practical, being presented to the reader in a condensed, though thoroughly simple and intelligent form. While the author has given due prominence to the methods most approved of by dermatologists at large, he has carefully avoided all questions of theory and points of discussion, and has brought forward more particularly the remedies and modes of treatment which have proved of the greatest benefit in his own personal experience. The new edition has undergone careful revision, and many new and important additions have been made.

"We regard it as the most complete and satisfactory work on dermatology in the English language, and most heartily commend it to the practitioner and the student."—*Boston Medical and Surgical Journal.*

"At last we have a practical treatise, so full and systematic, so sound and sensible, and so scientifically exact, that we unhesitatingly recommend it as the text-book in dermatology for students and practitioners in America."—*Philadelphia Medical Times.*

"It is seldom our good fortune to meet with so satisfactory a book as the present one. In its clearness of description, its terseness and comprehensiveness, it is certainly exceptional, and it will for years take high rank as a hand-book for diseases of the skin."—*New York Medical Record.*

"It is the best work on the topic, in our opinion, in the language, and to the American physician deserves to supersede all others."—*Medical and Surgical Reporter.*

"A work which will at once take its place in English-speaking countries as a standard book. . . . We know of no work which the busy practitioner who has to treat this troublesome class of diseases can consult with more advantage, and we cordially recommend it."—*The British Medical Journal.*

"Dr. Duhring gives the plainest evidence that he is a large-minded, well-read, and accomplished dermatologist. He may fairly be congratulated on having produced a most readable and trustworthy text-book."—*The London Medical Record.*

"Those who want a reliable book which gives them the main descriptive, etiological, diagnostic, and therapeutic facts of dermatology, will find it in the work before us. . . . Not the least important consideration is the fact that it is written in a thoroughly scientific spirit."—*London Lancet.*

Third Edition. Thoroughly Revised and Improved. 8vo. Illustrated.

Extra Cloth, $6.00; Sheep, $7.00.